

**DEVELOPMENT OF AN ELECTRONIC PERFORMANCE SUPPORT
SYSTEM FOR TRAINING PEOPLE ON RADIO LABORATORY
EQUIPMENT**

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by

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EQUIPMENT**

**A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
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NİMET CEREN ALPARSLAN**

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ABSTRACT

DEVELOPMENT OF AN ELECTRONIC PERFORMANCE SUPPORT SYSTEM FOR TRAINING PEOPLE ON RADIO LABORATORY EQUIPMENT

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Remote Laboratories are now technologies providing several benefits for the educators. They support distance education and they provide alternative educational environments. However, it is hard for the learners to interact with the devices, which they have no experience on before. This thesis aims to develop a solution for the learners with which they can experience and get help for the usage of specific devices. The proposed system is tested in a case study for a remote laboratory environment. Results of this study show that the objective has been accomplished and Electronic Performance Support System (EPSS) presents several potential advantages for the higher education institutions by reducing the necessity of the physical interaction between the users and the real equipments.

Keywords: Electronic Performance Support System, EPSS, Remote Radio Laboratory, e-learning, distance education.

ÖZ

KİŞİLERİN RADYO LABORATUVARLARININ EKİPMANLARI ÜZERİNE EĞİTİMLERİNİ SAĞLAMAK İÇİN ELEKTRONİK PERFORMANS DESTEKLEME SİSTEMİNİN GELİŞTİRİLMESİ

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Uzaktan erişimli laboratuvarlar, günümüzde eğitimcilere birçok fayda sağlamakta olan teknolojilerdir. Bu laboratuvarlar, uzaktan erişimli eğitimi destekledikleri gibi alternatif eğitim çevreleri de sağlamaktadırlar. Bunun yanı sıra öğrenciler için daha önce hiç deneyimleri olmayan bir aleti kullanmak veya etkileşime geçmek oldukça zordur. Bu tez, kullanıcıların üzerinde deneyim kazanabileceği ve özel bir takım aletlerin kullanımı hakkında bilgi ve yardım edinebilecekleri bir çözüm üretmeyi ve geliştirmeyi amaçlamaktadır. Önerilen sistem bir uzaktan erişim laboratuvar çerçevesinde, örnek olay olarak test edilmiştir. Bu örnek çalışmanın test sonuçları yapılan ara yüzlerin amacına ulaştığını ve geliştirilen Elektronik Performans Destekleme Sistemleri'nin kullanıcıların laboratuvar aletlerini gerçek ortamda kullanmalarını engelleyerek, yüksek eğitim kurumlarına çok büyük potansiyel avantajlar sağladığını göstermiştir.

Anahtar Kelimeler: Elektronik Performans Destekleme Sistemi, EPDS, uzaktan erişimli radyo laboratuvarı, e-öğretim, uzaktan erişimli eğitim.

To My Parents
&
My lovely husband

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LIST OF ABBREVIATIONS

ERRL	-	European Remote Radio Laboratory
EPSS	-	Electronic Performance Support System
GST	-	General Systems Theory
CBT	-	Computer Based Training
ICT	-	Information and Communication Technologies
LMS	-	Learning Management System
WBSS	-	Workbench Server Software
DBMS	-	Database Management System
PHP	-	Hypertext Preprocessor
HTML	-	Hyper Text Markup Language
XML	-	Extensible Markup Language
VNA	-	Vector Network Analyzer
SA	-	Spectrum Analyzer
OSC	-	Oscilloscope
RF	-	Radio Frequency
WFG	-	Waveform Generator

CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, the rapid development of the technology, especially computer technology, is influencing every part of our lives. One of the most important influenced parts of life is educational area. Education is a very important area and it also becomes an electronic manner with the help of Internet. Internet is a very big library to find relevant information anywhere and anytime. Accordingly, different alternatives for distance education and e-learning are becoming more popular.

As the technology is growing, learners prefer to get some information via Internet [38]. People are ready to learn something while they are at their home, while they are working at office or studying with their friends [1]. With these opportunities, the requirements and expectations in educational area, job requirements in business and industry are also changing [1]. As information grows too rapidly, people (e.g. employees, educators and students) have to deal with a wide range of information, analyze it according to the job requirements and use this information to be able to perform their jobs more efficiently [1]. In the area of education, remote laboratories provide one of those alternatives for enriching the educational advantages with the help of technology.

Remote radio laboratories are supportive environments for providing good opportunity to use laboratory equipment remotely [37]. This is a beneficial structure for the educational organizations, for the learners as well as the distance learning programs [39]. In these environments: the learners in the system should know the usage of equipment before they use it for performing some experiments. According

to these needs a big project named “European Remote Radio Laboratory (ERRL)” is developed.

The basic aim of ERRL is to develop a remote access platform for a set of radio communications experiments which exploits high-tech high frequency equipments [40]. Being a pilot project under the Leonardo Da Vinci Program, its scope is to develop a remote access laboratory area that the users can reach via Internet, and which will provide radio communications training along with the theoretical supplements to students, technicians, and engineers in radio communications field of Information and Communication Technologies (ICT) [40].

The target groups of the project are; a) people who needs some experience/training in telecom/radio related topics, b) students or graduates (technicians) of vocational schools/colleges serving for the electrical, electronics, telecommunications, computers fields, or their equivalents, c) engineers, particularly the new graduates, in the fields of electrical, electronics, telecommunications or computer, and d) the students from electrical, electronics, telecommunications or related departments of engineering educational/training organizations (such as universities or institutes) [40].

The main aim of the project is to provide remote access, training and experimentation, via a remote radio laboratory, on the equipments that are highly expensive and new technology which are not available in most of the educational and training organizations in the radio communications field of ICT [40]. On the other hand, there are also side aims of the project such as [40];

- Making easier to reach the high technology equipment and training to the related groups and improving the quality of education in the targeted field.
- Enabling to reach the information anytime, anywhere and providing practical training to encourage people to learn more information without being present in the laboratory physically.
- Being a good leader to encourage other schools or institutions which have limited financial resources to establish a remote access facility that allows students or learners to develop self learning skills.
- Allowing the partner countries’ people to exchange technical materials and feedbacks about radio communications. Accordingly, establishing an international network.

- Providing remote access to the laboratory equipment and enriching many types of learners such as disabled and women who have no chance otherwise.
- Supporting the distance education programs in the specified field and providing the flexibility for the trainees to reach the laboratory experience in distance [40].

The problem in remote laboratories is that the theoretical and practical background should be provided to the learners to prepare them for using the equipment in the practical studies and experiments [37]. Generally, these laboratories serve for a wide range of groups. Their background and expectations from the system differs. For some learners, such as teachers and employees, only a specific feature of equipment might be important since they have already used another model of the equipment. On the other hand, for some users, such as students, whole structure could be new.

In remote laboratory environments while the users' background vary a lot, their expectations may also be different from each other. For example, some of the users may prefer to reach the system while they are working at their offices. On the other hand, the others may need to reach the system to be able to do some experiments in their classes for their courses. Thus, the required system should be accessible while the learners are performing their tasks: system must be reachable at any time, and from anywhere. The system should provide the necessary information in the form the user requests as much as the user needs to know.

The system also requires that learners are not necessarily had to follow a linear path on the instructions provided for different equipment. They shall be able to just reach the necessary information which is needed at the moment of the work. Accordingly, the required system must be self-directed and must also support non-linear instructions, besides linear instructions.

Another issue is that, technological development is very fast at present. This is a sign that the required system must be easily updatable. When new equipment is developed or a new property is added to an old system, it must be easy to continuously update the information in the training system.

In this thesis, the aim of the research is that to find out “if EPSS is an appropriate approach for training people on how to use remote or virtual laboratory equipments”.

Accordingly, in this study, based on the user requirements and the EPSS theory in the field of education, different EPSS applications are developed for each of the equipment in the ERRL laboratory. After the development process, in order to answer the research problem a study is conducted with the ERRL users. The results of this study are also discussed.

This thesis is organized as follows: Chapter 1 briefly introduces the topic and gives the statement of the problem. Chapter 2 provides background information. Chapter 3 explains the research method of the thesis. Chapter 4 gives the techniques used and structure of the developed EPSS tools. Chapter 5 shows the test results to answer the research problem of this study. Finally, in Chapter 6, conclusions are provided. The future study in this area is also discussed at the end of this chapter.

CHAPTER 2

BACKGROUND INFORMATION AND LITERATURE REVIEW

This chapter discusses firstly, e-learning and distance learning concepts. The study continues with the theoretical framework and history of EPSS approaches in the educational settings by discussing the definition, goals, characteristics, and components of EPSS.

2.1 E-Learning and Distance Education

According to the development of the technology, different types of learners prefer to reach educational experience through appropriate application of new technologies, commonly referred to as **e-learning**, which provides some flexible opportunities [30]. E-learning can be used for a number of reasons [30]:

- Encouraging learning effectiveness: This must be encouraged because the number of students are increasing day by day and the resources are becoming limited,
- Providing flexibility of place, time and learning,
- Giving detailed information about difficult concepts,
- Providing equivalent level of opportunities to learners by supporting access to the needed resources and different learning styles,
- Improving communication between teachers, learners, and course management,
- Meeting needs of workers and employers by providing learning at work.

It is clear that amount of data; knowledge and information are also becoming enormous. Thus, people are obligated to find most suitable organizational, analytical and technical tools for providing the management of these resources [30]. Nowadays, there are two different and acceptable views to solve this problem. The first one is General Systems Theory (GST) and the second one is electronic performance support techniques [30].

Practically, different techniques supported by the principles and practice of electronic performance support are one of the useful and successful approaches for handling information in electronic form [26, 27]. Thus, the way in which these EPSS techniques have been used to support knowledge management within an e-learning context tried to be reflected with Figure 2.1.

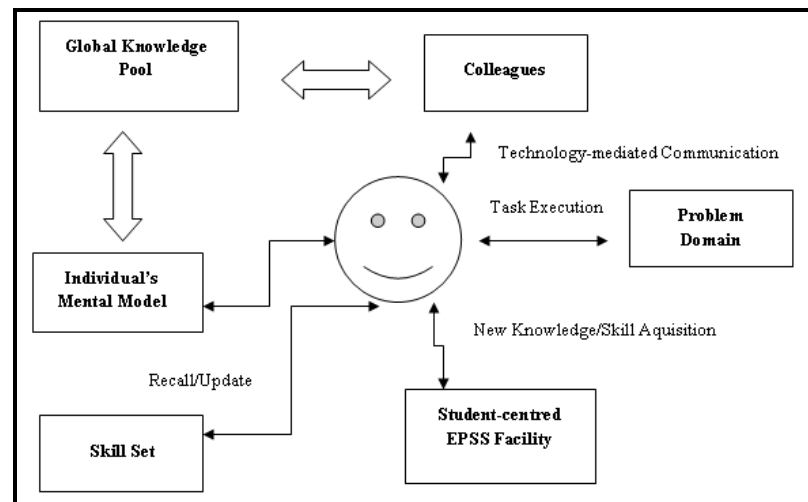


Figure2.1 Sources of Knowledge in a pro problem-solving situation [28]

According to Barker, as it can be also seen from the Figure 2.1, there are three potential sources of knowledge that a person can use to solve a particular problem. First, the persons' own knowledge that is embedded within his/her cognitive structures (e.g., mental models, rules, scripts, etc...), this is private knowledge [28]. Second, there is the knowledge that is embedded in the EPSS facility that the student is using to help him/her to solve the problem in hand. Third, there is the global pool of shared knowledge that is available to the student as a result of various knowledge-sharing processes. Thus, EPSS is related with e-learning and distance learning processes [28].

2.2 Electronic Performance Support System (EPSS)

This thesis is prepared by the belief of that Electronic Performance Support System is an appropriate approach for fitting the requirements of teaching how to use the remote or virtual laboratories. In the light of this hypothesis, EPSS background must be understood clearly.

2.2.1 What is an EPSS?

There are many definitions and many views of EPSS. For example, according to McGraw an EPSS is an integration of artificial intelligence, hypermedia and learning support (CBT) to produce an integrated system that includes intelligent user interface, embedded training, a hypertext online help system and an intelligent advisor/coaching system [3]. Barker and Banerji view an EPSS as a computer-based interactive guidance and information support facility integrated into the normal working environment of an individual or work group to facilitate and/or improve human performance, problem solving capability within some target application domain [4]. According to Barker, EPSS is a computer based environment which helps to improve the skill and knowledge on a particular work. They agree that, EPSS can be embedded with computer-based learning systems to be able to extend the efficiency and effectiveness of the learners on the skills and knowledge about the objective [5]. Also, an EPSS is, according to Raybould, “a computer-based system that improves worker productivity by providing on-the-job access to integrated information, advice, and learning experiences” [6].

From all these explanations the most popular and accepted one is Gery's explanation [39]. According to her, electronic performance support system is an integrated electronic environment that is available to and easily accessible by each learner and is structured to provide immediate, individualized on-line access to the full range of information, software, guidance, advice and assistance, data, images, tools, and assessment and monitoring systems to permit job performance with minimal support and intervention by others [7]. Electronic performance support systems are used for:

- ❖ task structuring support: help with how to do a task (procedures and processes),
- ❖ access to knowledge basis (help user find information they needed),
- ❖ alternate forms of knowledge representation (multiple representation of knowledge, e.g., video, audio, text, image, data) [8].

2.2.2 Characteristics of EPSS

An electronic performance support system can have some or all the following characteristics [8, 9, 10]:

Computer-based: EPSSs are computer-based systems. That is why we call it as “electronic”. In the near past, there were some trials of performance support systems, such as manuals, job aids and some other paper materials. However, these cannot be powerful and successful because they cannot bring the information at the time of work. It becomes powerful only when the computers take place in the performance area and when the supports became electronic.

Access during task: EPSS provides information needed to perform a task at the time the task is to be performed (done). This contains two characteristics: *access to the specific information needed to perform a task* and *access to the information at the time the task is to be done*. If one of these characteristics is missing, the characteristic cannot be a performance support characteristic. The needed information mentioned in this characteristic can be:

- ✓ data: the type of data may be textual, numeric (e.g., prices, names), visual (e.g., photographs, videos), audio (e.g., conversations, speeches, music)
- ✓ instruction: the instructions are the list of steps to follow (e.g., video showing the procedure, simulation of a task to help users to practice)
- ✓ advice: the advice may be an expert system that ask the user questions, then suggests the most appropriate step to do next.
- ✓ tools: the software tools may be spreadsheet or a statistical analysis package.

Used on the job: EPSS provides information to learners at their workstations on the job, so that the learners can reach the needed information while doing their works.

Controlled by the learner: The learner decides when and what information is needed. No teachers to teach something, they learn by themselves, non-linearly. The motivation is provided by the learner's desire to accomplish the task.

Reduce the need for prior training: The easy availability of the information needed reduces the need for prior training. Also, in prior training, learners must learn linearly all the information to pick up the necessary ones. On the other hand, in EPSS just get the related parts.

Easily updated: The updating process becomes very easy and fast because of the computerized nature of the EPSS. It is not easy to update other media such as handouts, videos and audios. The update issue is very important in terms of keeping the information fresh and up to date.

Fast access to information: The learners must reach the information needed quickly when it is needed on the job.

Irrelevant information is not included: The learners access only the specific, discrete information needed at that instant, instead of going through loads of irrelevant information to find few details needed.

Allow for different levels of knowledge: EPSS must provide minimal information for those who do not want details. The detailed information can also be provided by other links or documentation for those who want.

Allow for different learning styles: EPSS also can provide varied learning styles for more optimal learning. The same information can be presented in visual, textual, and audio formats.

Integrate information, advice and learning experiences: An EPSS can integrate information, advice and learning experiences for the user. For example, the advisory system would ask the learner some questions about what he or she needs to accomplish, then would suggest which procedure to use.

Artificial intelligence: This is an essential characteristic of EPSSs, according to Carr, but not according to Gery [11, 17]. This characteristic will become very important in the future when the researches progressed further.

All of these characteristics are not required to be included in one EPSS. However, some of them are key characteristics of an EPSS such as; computer-based system, access the information during task is performing, used on the job, is controlled by the learner and reduced the need for prior training. In our point of

view, these five characteristics are necessarily needed in order to call the system as an EPSS.

2.2.3 Theoretical Framework of EPSS

In EPSS concept, there is an important issue to be expressed. This subject is the theoretical history of the EPSS [13]. In the developing education world, there are many approaches and theories of education. These theories also deeply examine EPSS approach in their point of view. There is a need to analyze the type of frameworks for well understanding, satisfied explanations, qualified developments, and future productions of the systems [13]. For these reasons, constructed a theoretical framework is an important step for the continuance and the future of the EPSS. In this view, the aim of this review is to develop a set of theoretical construct that provide explanation of EPSS and its key characteristics and features.

Based on the literature, the theoretical framework is constructed under five interrelated domains including concepts, constructs and propositions that contribute to the body of EPSS knowledge in such context [13]. The following Figure 2.2 visualizes a pentagon model for the interrelated domains of the theoretical framework of EPSS [13].

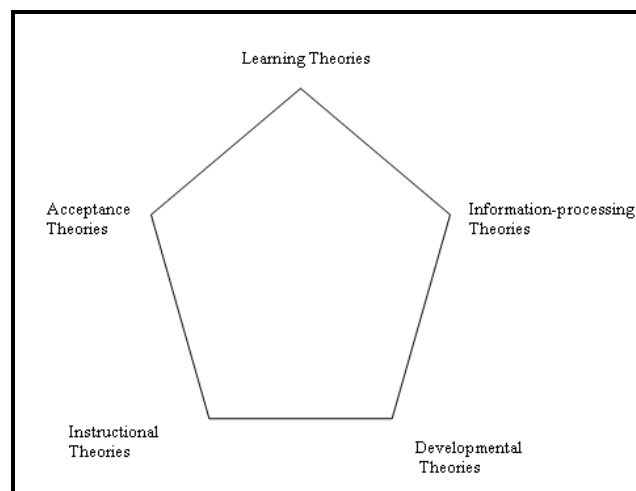


Figure 2.2 Theoretical Framework of EPSS [13]

EPSS theoretical framework contains five different basic points in educational view as seen in Figure 2.2. These are learning theories, information processing theories, developmental theories, instructional theories, and acceptance theories. This framework is explaining the descriptions about which outcomes occur under each theoretical condition [13].

Electronic Performance Support Systems (EPSS) are generally being developed for workers who already work with computer technology. So, it is possible to provide them with ready access to various forms of online help, databases, completed examples, and demonstrations, as well as system and human guidance, to assist them in completing their current task [13]. Based on the theoretical framework, the following Table 2.1 summarizes some of the theoretical concepts supporting to the EPSS related features [13].

Table 2.1 Theoretical concepts sharing and supporting EPSS features [13]

Theoretical concepts supporting to the EPSS's features
Performance Support (Performance information, support mechanism, improvement, productivity, empowering)
Problem Solving – Decision Making (Conflict- resolution, dilemma-handling, troubleshooting, alternative solutions)
Work Practice (Group work, training exercises, demonstrations, integrated unites, role playing)
Guidance – Advisory System (Online help, peer dialogue, sharing of mind, work, questioning, discussion)
Collaboration-Cooperation (Effective communication, social context, teamwork, peer dialogue, interactivity)
Learning Environment (Situating learning, anchor instructional, brainstorming, feedback, human memory, perception)
Management System (Instructional-learning environment, databases, knowledge skills, acquisition, negotiation)
Motivation (Satisfaction, self-efficiency, intrinsic motivation-enjoyment, extrinsic motivation-usefulness)
Case Studies-Examples (Modeling, role taking, alternative solutions, practicing)
User-Acceptance (Self-regulation, ease of use, user-centered, perceptions, perceived usefulness, beliefs and needs)

From Table 2.1 it is seen that, (1) learning theories, (2) information-processing theories, (3) developmental theories, (4) instructional theories, and (5)

acceptance theories and their some relevant or similar features are selected to support the aim of the idea of EPSS [13].

This framework is designed to improve the understanding of how and why empowerment can be developed in an organization [13]. From educational point of view including empowerment, interaction, collaboration and service management, the theoretical framework is a good way to describe the nature of online communication and its effectiveness, some practical skills for real-life problems, user friendly and flexible interfaces, which are guidance to increase training on the job and performance support for the users [13].

Theoretical framework has a very important place and influences on EPSS in the job training applications. This is not only about the current state of EPSSs, but also about the trends for the future cyber learning projects [13].

2.2.4 Conceptual Framework of EPSS

Environment, technology, people, guidance, and work practice are the five general interactive domains of the EPSS [34]. Figure 2.3 visualizes a basic conceptual framework showing the specific features of general domains of EPSS for training and educational implications in general.

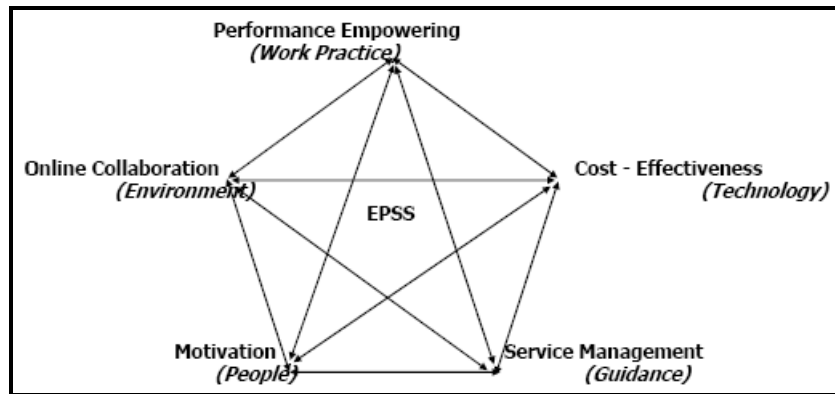


Figure 2.3 Conceptual Framework of EPSS [34]

Similar to general domains (environment, people, guidance, technology and work practice), this conceptual framework of the EPSS is also grouped as five different concepts. These concepts are related and dependent to each other [34]:

- online collaboration,
- motivation,
- service management,
- cost-effectiveness,
- performance empowering.

Table 2.2 shows how general domains are related with each conceptual framework domain [34].

Table 2.2 General Domains and Framework Domains [34]

General Domains	Features
Environment	Electronic artificial software system; Virtual training for performance support; On/in the job tool; CBT, CBI, Distance Learning Technologies; Information in the form of databases; Support achieving a performance objective
People	Any individual or group of people
Guidance	Advise system, expert systems, directions and help opportunities
Technology	Computer hardware, software and mind ware; Networking, www, database systems
Work Practice	Standardized specific tasks and actions; Performance problems and activities for specific subjects, topic and jobs; Tracking performance and recording data

2.2.5 Classification of the Range of EPSS Design

When an electronic performance support system (EPSS) is to be designed, there are some decisions that must be taken, such as defining which and how many EPSS characteristics are necessary and are displayed, how much of the design is new and how much is based on existing system[12].

The extent of the new design which means that how much of the design of the EPSS is new and how much is based on existing systems, is an important concept in classification of the range view. According to Gery, the extent of the new design can be divided into four categories [12]:

- 1) front end to existing system,
- 2) supplement to existing system,

- 3) stand-alone tool for specific tasks, and
- 4) new systems with integrated performance support.

Front end to existing system: Existing systems have usually not been designed for performance support. These systems do not permit non-linear hypertext links that is very important and that improve ease of access to information, or do not permit easy updating of information. Accordingly, the systems that are designed specifically for electronic performance support are in higher importance than the designs that use existing systems [12].

Supplement to an existing system: A supplement to an existing system means that it changes the existing system in some way. For example, if the system has hypertext links to a traditional database, we can say that this is a good example of a supplement to an existing system. Hypertext links allow users to make non-linear connections between pieces of related information. It can be said that this is a system to help users to make a decision about what to read next while they are reading one part. A supplement may also act as a patch on a system not designed for performance support, although it does make changes within the existing system itself [12].

Stand-alone tools for specific tasks: Stand-alone tools are small EPSSs which are not embedded on an existing system, but they are built for specific tasks. A tutorial on how to use a computer program is an example of a stand-alone tool, since it can be used apart from the program itself, and supports only the use of that particular program [12].

New Systems with Integrated Performance Support: New systems give a support to the wide variety of job tasks, instead of giving support to small specific tasks, as do the stand-alone tools which are mentioned above part. New EPSSs might provide the data, training and advice for all the tasks that a user or learner would need in order to do his or her job [12].

2.2.6 Ranges of Technologies Classified as EPSS

Figure 2.5, it is shown that the range of technologies named as electronic performance support, both the EPSS characteristics and the extent of the design must be taken into account [8].

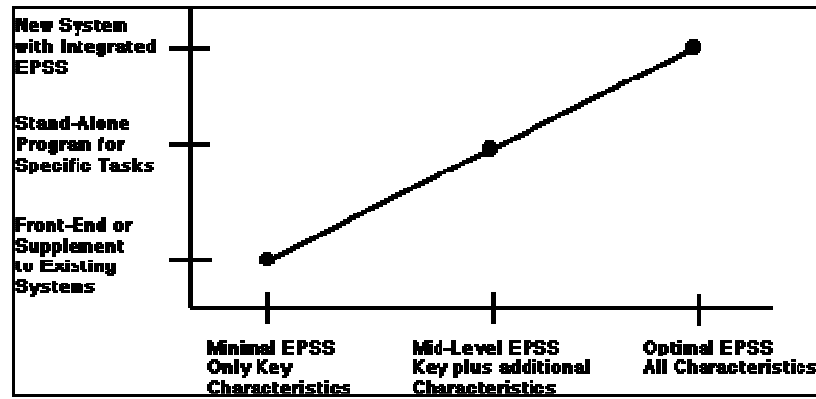


Figure 2.4 Range of EPSS as the Relationship between their Characteristics and Extend of Design [8]

A minimal EPSS must have the minimum scope of design and must present to view only the key characteristics of an EPSS. It does not matter that the needed system requires larger scope or more complex characteristics to provide the task or tasks [8].

A mid-level EPSS must have a larger scope of design and extra characteristics of EPSS besides the key characteristics. However, not necessarily all the characteristics needed have to be provided by the system to support the task or the tasks [8].

An optimal EPSS must contain the largest scope of design and all the characteristics have to support the task or tasks. All the characteristics may not be necessary for optimum support. An optimal EPSS must cover all the characteristics needed and does not cover the unnecessary ones [8].

2.2.7 Components of an EPSS

An EPSS normally has at least the following six components [14]:

An advisory system: a system that must provide support for problem solving, troubleshooting, as well as decision support, analysis and decision-making.

A data/information base: a system that provides support for accessing and searching the information needed to perform a job.

A learning/training support facility: a system that provides support for self directed learning (non-linear) experiences that are task-related and flexible.

On-line help/reference: a system that provides on-line explanations, demonstrations, advice, references and alternatives for using the software.

Productivity software: a system to provide documentation processors, flowchart drawing tools, graphing tools, so forth.

An end-user interface: a system that provides the user to navigate easily on the system, to access easily the information that is searching, to advice quickly and easily.

These components form the basis of an EPSS. However, there are some different approaches. According to Gloria Gery, there can be some additional components such as assessment system, monitoring and feedback system [7]. On the other hand, some of the researchers eliminated some of these characteristics. For example, according to Raybould, EPSS has four components such as, advisory system, information base, learning experiences or support and productivity software. Accordingly, there is no consensus in the literature about the components of an EPSS [14].

2.2.8 Differences of Other Similar Systems from the EPSS

In the following table 2.3 there are some types of different training programs and some similar characteristics of EPSS. There may be some additional of the training programs but the general characteristics are listed in the Table 2.3.

Table 2.3 Key characteristics of training programs [15]

	Traditional Classroom	Computer-Based Training	Traditional Electronic Database	Online Help
Computer-based		X	X	X
Access to information and tools when needed to perform a task			X	X
Used on the job, in simulations, or other practice		X	X	X
Controlled by the worker			X	X
Reduce the need for prior training in order to accomplish the task				X
Easily updated			X	X
Fast access to specific, task-related information				X
Irrelevant information excluded				X
Allow for different levels of user knowledge		X		X
Allow for different learning styles		X		
Integrate information, advice, and instruction	X			

EPSS and Online help are very similar to each other. However, because it does not provide access to the tools needed to do a task while doing the task, but only information, it cannot be considered as a kind of EPSS. An electronic database might be an example of EPSS only if it was designed with its key characteristics.

Table 2.4, adapted from Gery (1991), shows the difference between performance support and traditional help systems [16].

Table 2.4 EPSS vs. Help Systems [16]

EPSS	Help Systems
Support a broad range of job tasks	Supports software-related tasks
Provide "what if" type of advice	Provide passive information only.
Can support complex, interrelated tasks	Provide descriptions of procedures.
Accepts and processes user input	Presents information as a result of menu options.

There are some other types of training such as computer-based training (CBT) and traditional classroom training. These types are not even similar with EPSSs. These systems are not able to provide fast and easy access to the needed information about a specific task [15]. They are only under the designer or the instructor control. CBT is designed as to be reached from the users' work stations, but it does not provide quick access of specific details of the needed information. In addition, CBT can be a component of an EPSS which compose the tutorial part [15]. Some differences of CBT and EPSS are shown in the Table 2.5 to be able to show clearly:

Table 2.5 CBT vs. EPSS [15]

EPSS	CBT
Hypertext environment with multiple accesses.	Info-base structured within predetermined presentation sequences.
Contains a range of support mechanisms to assist user in performing a task.	Outlines procedures to be followed by the user. Does not actually help with execution.
Accepts and manipulates user input	Checks user input against model answer or calculated answer.
Available on demand and in context.	Forms an event in a larger teaching process. Available when its turn comes up.
Emphasis on user construction of individualized learning sequence based on need.	Structured according to design of the developer.
Granular	Modular

Some CBT programs contain some tools to provide how to learn the content of the CBT. Some examples of these performance supports might be a glossary, concept map, calculator and access to computer-mediated communication [15]. Such CBT programs might be considered to be EPSS, if the information provided is about the learning of the content [15].

2.2.9 Benefits and Some Limitations of EPSS

EPSS facilities become more popular in organizations, because it is known that it is improving the learner's and user's performance on the job by reducing the training time [18]. Organizations are aware of the fact that EPSS can bring many benefits in many different areas if it is well designed [19].

According to Levin and Raybould, an EPSS is able to increase the speed of on-the-job learning and improve the capacity to remember information [21]. It also helps to keep the organization's knowledge for a long time and decrease the training time and cost in an important degree. EPSSs decrease the paper documentation such as user manuals, whereas it increases the employee's abilities for solving the problems and self-sufficiency [22]. According to Levin, EPSS facilities can offer many different benefits for an organization. These benefits include [21]:

- An EPSS can influence the customer service at all levels, both internally and externally, for example a reduction in errors or a decrease in task performance times. This helps to increase the job performance of the learners.
- An EPSS prevents learners from wasting time on training about the things they already know. It decreases training time.
- An EPSS delivers information and training at the point of need without instructors. This means that the training delivery, travel and personnel costs are decreased.
- Workers have a high motivation to learn, they are in control of the learning process and their need to know the specific information is higher than in traditional training.
- Workers do not have to deal with paper manuals and updates because an EPSS decreases the paper documentation.

- Computerized searches take workers directly to appropriate information and decrease documentation reading time.
- Workers do not waste time in looking for information.

Finally, according to McGraw, there are many benefits about the new technological assistance such as troubleshooting aids, policy decisions, job-related training, problem-solving advice which are available at the moment of need [24]:

- The job is accomplished in a more limited time and completed with fewer errors.
- The organization will have a benefit from training budget and can use it in a different area.
- EPSS reduces training time and cost.
- An EPSS increases the employee's power and status in a particular situation.

In every technological development, there are some problems or limitations of the systems. So EPSS also has some limitations. This system is not the answers of all problems. These limitations are [25]:

- Learning should take place on the job in small increments.
- Social skills will be lost because people interaction becomes minimum degree.
- It is hard to justify the cost to develop traditional computer based training. So, it is also difficult to justify the cost of developing the much more complicated EPSSs.

CHAPTER 3

RESEARCH METHODOLOGY

This work is a part of a large-scale project, which is managed by one of the higher education institutions (Atılım University) of Turkey, namely European Remote Radio Laboratory (ERRL). This is a Leonardo Da Vinci project and has seven partners (Germany, France, Greece, Finland, Balıkesir University, Romania and Atılım University). The ERRL basically aims development of a remote access platform for a set of radio communications experiments which exploits high-tech high frequency equipments [40].

These users will use very important devices of a physical laboratory remotely. These devices are very expensive and can be broken easily while they are being used by the people who do not really know how to use them professionally. So, the research point of this thesis is to explore how we can train people on how to use remote / virtual laboratory equipments. People must both learn how to use these equipments before they use them and get much better performances while they are learning. After conducting literature review, it is seen that the best solution to solve this problem is an electronic performance support system. Accordingly, this study aims to develop an electronic performance support system for all of these equipments of the remote laboratory.

The following methodology has been used in this study;

In the first phase, in order to understand EPSS, the review of the existing literature relevant to the study was completed. Areas of concentration included; the theoretical framework history of EPSS in the educational view, what an EPSS is, the

main goals of EPSS, characteristics and components of an EPSS, examination of the design of EPSS and the types of EPSS. The aim of this literature review was to ensure that the most recent contributions to the relevant literature have been used in the preparation of this study.

Secondly, because this is a large-scale project, the managers decided to choose a pilot equipment and develop a pilot experiment instead of developing all the equipments at the same time. The selected equipment was Vector Network Analyzer (VNA). The documentation and the related materiel were gathered from the partners and Electrical and Engineering Department of Atılım University. The other EPSS tools for all other equipments were designed after the pilot equipment was designed and tested.

Thirdly, the most suitable EPSS type was selected and implemented according to the gathered data and documents. After the development of the pilot study, the partners tested the system. According to the test results, the system was modified and extended with respect to the needs.

Then, because this is an international system and all the seven partners' universities will use it, the language preferences were also added. The system was developed so that the user can set the desired language as the EPSS language.

3.1 Procedure

3.1.1 Software Development Methodology

The Spiral Modeling (Prototyping) is used in this study. Steps of the development methodology are summarized in Figure 3.1. Spiral development model has been evolving based on experience with various refinements of the waterfall model as applied to software projects.

This model is selected to reduce the risk early by dividing the project into smaller iterations. This allows making some test and designing developments earlier in the project, which in turn gives a chance to fix the problems in longer time as they are discovered. Using this methodology showed us that some plans cannot be applied to the project and must be changed so that it can be finished in allocated time.

Spiral Model contains four important main processes. These are determining objectives, identifying and resolving the risks, developing the software and testing

and lastly planning the next iteration. Figure 3.1 shows the steps of Spiral Development Method cycle.

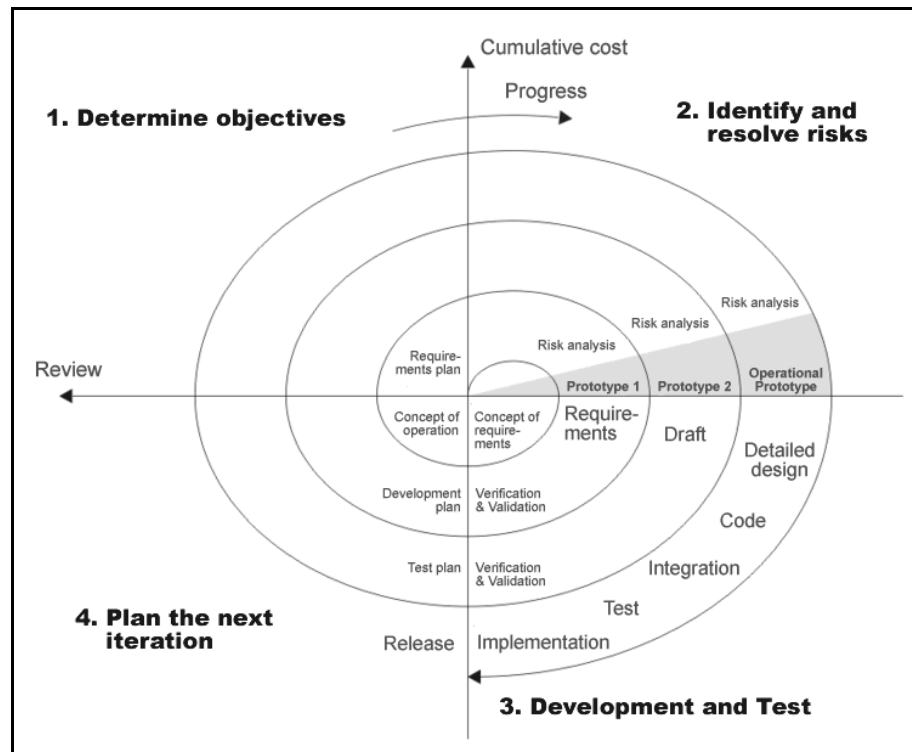


Figure 3. 1 Steps of Spiral Development Method cycle

3.1.1.1 Determine Objectives (Requirements Plan)

In order to better understand the requirements of the ERRL-EPSS we have conducted requirements analyses study on the possible users of the system. These users are engineers, students and technicians. For this reason, we have developed a questionnaire and administered it to 39 engineers, 116 students and 15 technicians. The system requirements are deeply discussed in Chapter 5.

3.1.1.2 Identify and Resolve Risks

In this phase of the cycle, we divided the development into smaller parts and started with a pilot experiment (Prototyping). According to the end user needs, the database and the tables are created. However, after the project managers decided to use the system with the Moodle integration, we analyzed the risks for database and

saw that Moodle has its own database design and it is impossible to integrate it with this new system. The risk was detected earlier and the design has changed to XML formatting than creating a database and tables. See Appendix C for XML structure.

3.1.1.3 Development and Test

According to the user requirement analysis, detailed design completed. After implementation was finished, the integration with Moodle and ERRL project is done. Finally, after the development phase was completed, feedback from the users about the use of the developed system was collected by means of a questionnaire. The main purpose of the questionnaire was to gather user responses and their scale and satisfaction about the developed systems. This questionnaire was administered to the 15 students, 2 technicians and 3 academicians. The system analysis results are deeply discussed in Chapter 5.

3.1.1.4 Planning the Next Iteration

When the system tested by the end user of the project, they gave some feedbacks to produce the new versions of the developed prototype. This phase helped to realize some missed parts and give chance to redevelop them. After testing part many participants expressed their idea at the time of usage. According to these important ideas, some parts reorganized. This cycle continued at the end of the project deadline.

3.2 Preparation of the Materials

During the ERRL project development, from the beginning to the end, all the literature information searched. To make the development useful, in the light of literature review, a system requirement analysis questionnaire was prepared for the target users. These questions were generally about the learning styles of different group of students, which information must be included and how to give them to the user for different group of academicians, and the questions about the easy usage and appearance for different group of technicians. This questionnaire were prepared by the project group and sent to all the other seven countries universities. Then the results were collected to develop a better system.

After the development of the prototype was finished, it was firstly used in a course in Atılım University. The students used the first system and told their ideas about the system. According to this analysis, the new version was prepared. At the end a new questionnaire was prepared about the system analysis. The questions were about the usage of the system, detailed information, visual information, animations, etc.. All the details about these questionnaires are in Chapter 5 and in Appendices A and B.

3.3 Participants

In this project the target groups were students, engineers and technicians. Because it is a remote radio laboratory project, students are from computer or electric and electronic department. They are approximately in 18 and 25 age range. Both requirement and system analysis questionnaires, these students from seven partner's universities filled necessary parts. They also helped to test the prototype of the project.

Engineers and technicians are graduated or working again at the same department as students. They are in the partner's universities. They are approximately in 25 and 45 age range. They especially helped to prepare the contents of the equipments. They provide some necessary information about the related subject or even they prepared the animations for the related equipment. They filled the necessary question in both requirement and system analysis questionnaires. Their knowledge was used in the development face of the project.

The details of the software development are in Chapter 4. Before EPSS details, ERRL project must be understood.

3.4 European Remote Radio Laboratory (ERRL)

The following Figure 3.2 shows a very simple model of the ERRL project. With this figure, it can be seen that this is a really big project and it has many components. There are three important parts which are in common producing the ERRL project. These parts are EPSS, Learning Management System (LMS) and Workbench Server Software (WBSS) as follows.

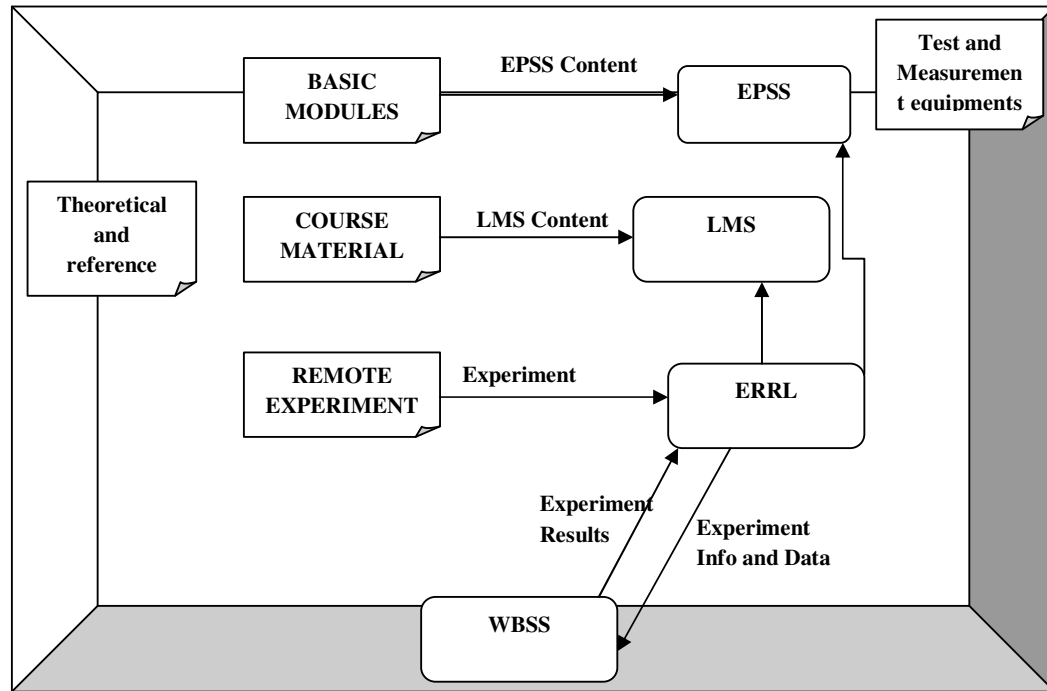


Figure 3.3 Simple model of ERRL project

Here, the general structure of the ERRL project is briefly discussed. Figure 3.3 shows the main architecture of the project.

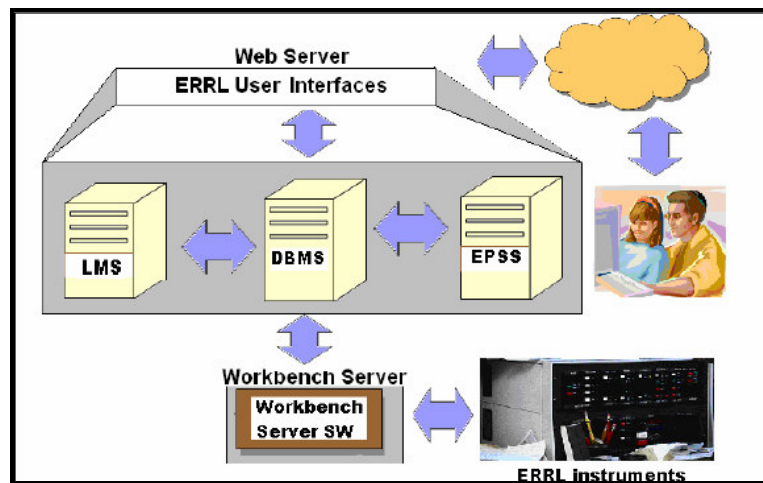


Figure 3.4 Architecture of ERRL Project [39]

In this architecture learners; students, technicians and the engineers will use the system via web server and workbench server. ERRL user interface have three

different services as shown in the Figure 3.2. The first one is the Learning Management System (**LMS**), which is a software package that enables the management and delivery of online content to learners. Most LMSs are web-based to facilitate "anytime, anyplace, any pace" access to learning content and administration. The second one is Database Management System (**DBMS**), to hold and manage all the necessary data according to the devices and the learners. The last one is the Electronic Performance Support System (**EPSS**), which stores and distributes personal (individual) or corporate knowledge to enable people to reach necessary levels of performance in the fastest possible time and with minimum teaching support of other people.

In these steps, user will read some information about the equipment that they want to use via web. Then the system will be sure that the users really understand the basic usage and the basic information about the needed equipment by giving small quizzes.

After all these steps the learners will be able to connect to the equipment needed via workbench server real time and can make some experiments according to their needs and get some outputs of their experiments to see the results. Learners are not obligated to learn any equipment's properties in detailed. They can only look for the necessary information needed at the time of work or experiment. These specifications lead us to develop an electronic performance support system as we mentioned above.

This remote radio laboratory contains many different types of equipment. In this study EPSS is developed for each of the following equipments of the remote laboratory: "Vector Network Analyzer", "Spectrum Analyzer", "Oscilloscope", "Waveform Generator" and "RF Signal Generator". These are complicated equipments and are not very easy to use. So, electronic performance support system is really necessary for each of these equipments.

CHAPTER 4

ELECTRONIC PERFORMANCE SUPPORT SYSTEM (EPSS) FOR EUROPEAN REMOTE RADIO LABORATORY (ERRL)

In order to develop an appropriate EPSS system for the ERRL project, we have established a system requirement investigation study. According to the collected data, which is deeply discussed in Chapter 5 (Requirement Analysis Results) and the other requirements of EPSSs were investigated to develop more appropriate systems. Then, the developed EPS Systems deeply discussed in the light of the requirement analysis.

4.1 Main Specifications of EPSS

Main purpose of the ERRL project is to serve several people (students of the universities, engineers and the technicians) all over the world. Accordingly, the background levels of these learners are not the same. This requires a system that provides information for expectations of different learner groups. For example, some learners might be well informed about the equipment but just need to know the meaning of a button or such a little information. On the other hand, others can start learning the equipment for the first time and need any detailed information of the equipment. Accordingly, the system then should provide different levels of information and let its users easily go directly to the requested part.

Some learners will use the equipments while they are doing their daily work in their environment, while other will use the system while doing some experiments on their classes or for their courses. So, the system should be accessible any time while the learners are performing their tasks.

Learners are not necessarily had to follow each instruction in the system provided for different equipments. They shall be able to just reach the necessary information which is needed at the moment of the work. So the system must be self-directed and support also non-linear instructions. Another example is that, if an engineer tries to get some little information about the equipment, and if s/he has to go through the whole the irrelevant content, it might also be annoying. The system must provide the needed information at the moment of need. On the other hand, the system should also support linear instructions and guidance as well. From the requirements analyses we understand that the learners prefer both forms.

The system will be used from different countries. So, it is not clear who will use the system and when use it. All the learners can connect to the system whenever they want to. Accordingly, the information-base of the system must also be reachable at the time of need. Another issue is that, technology is growing every day. The radio laboratory equipment can also be adapted to the technological changes. The system then can easily be updated according to the technological changes.

In the light of all these necessities, we have decided to develop an Electronic Performance Support System to be able to meet all these requirements. It is clear to see that an EPSS can meet all these requirements.

4.2 Integrated Components of EPSS

ERRL-EPSS includes the following components as shown in Figure 4.1. The advisory system builds on a question and answer system between the user and the computer.

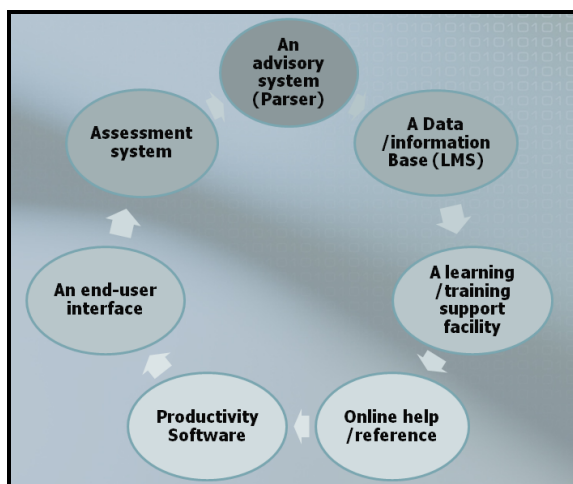


Figure 4.1 Components of EPSS [39]

By means of a parser, the system gets some questions or some key words about the studied equipment from the learners. The EPSS parses them and returns some results. The advices generally cover the content that is related to the learner's question and previously defined in the EPSS information base.

EPSS information base is formed by means of a database which will support whole system (LMS Database) and the special database of the EPSS to hold some necessary information about the content provided through the EPSS. This structure builds the *data/information base* of the EPSS. The system will have *learning/training support facility* because it is not a linear system; it is a self-directed one. Also, our system includes an *online help/reference* that supports the users on how to use the software easily. It has also an *end-user interface* to be able to make easy to use of the software. The system is a *productivity system* because the learners will be able to get some outputs of the pilot experiments on the equipments' screens.

In addition to these six components, our system also has an *assessment system* that provides education of individual knowledge or skill and level of expertise either prior to performing a job or in assessing learner competency as shown in Figure 4.1. The assessment part of the EPSS is developed on top of LMS assessment module [33].

4.3 System Requirements for ERRL - EPSS

After deciding the pilot experiment, the working group was decided the system requirements of the EPSS. Since the system aimed to be active through the internet environment, PHP is selected as coding language. Accordingly, the pages of the laboratory equipments, button's pop-ups, and texture explanations are all developed by using HTML, PHP and JavaScript technologies.

One of the most important features of an EPSS is that, it must be updated easily. Because the technology is developing every day, the information related a subject may change or new things can be added. To be able to catch this improvement, it is necessary to use PHP and HTML technologies. According to these requirements, the system has to get APACHE server on it. Videos and animations are developed by using FLASH technologies. All of them are embedded by links into the EPSS interfaces.

Also the non-linear learning is the most important property of the EPSS. In this thesis, the developed EPSS supports this type of learning by offering "search" textbox and button. To let the system to search the necessary keywords, the system should have "GREP command" for windows. The installation of "grep-2.5.3-setup" is done in the system.

Lastly, EPSS menus are developed by using XML technology. All the menu options, link and button names are coming from an XML file. Because the dynamic development is important, the XML files are chosen to get all these textures of the menus.

4.4 General Properties of Remote Radio Laboratory Equipments

According to the results of the requirement analysis of this study, the ERRL team is decided to develop EPSS for each of the remote radio laboratory equipment. All these equipments are really hard to find, expensive enough to buy and can also easily be broken. These properties show that physical interaction with these equipments is dangerous, especially with people who do not know how to use them. The aim is to increase the peoples' knowledge about the equipments without physical interaction. This is possible with the development of EPSSs for each of these equipments. The EPSS interfaces are developed for the equipments; "Vector Network Analyzer", "Spectrum Analyzer", "Oscilloscope", "Waveform Generator"

and “RF Signal Generator”. The general properties of these equipments are as follows:

4.4.1 Vector Network Analyzer (VNA)

“A **vector network analyzer** is a kind of network analyzer which is an instrument used to analyze the properties of electrical networks, especially those properties associated with the reflection and transmission of electrical signals known as scattering parameters (S-parameters). Network analyzers are used mostly at high frequencies; operating frequencies can range from 9 kHz to 110 GHz” [32]. “Special types of network analyzers can also cover lower frequency ranges down to 10 Hz. These network analyzers can be used for example for the stability analysis of open loops or for the measurement of audio and ultra sonic components.” [31].

This equipment is most frequently used one and very important for the laboratory and also it is one of the basic measurement instruments. For these reasons, the ERRL project team is decided to develop firstly the VNAs’ EPSS, as a pilot equipment of the project.

4.4.2 Spectrum Analyzer (SA)

“A RF Spectrum Analyzer is a very special kind of super-heterodyne receiver which receives a chosen range of signals and displays the relative signal strength on a logarithmic display, usually a cathode ray oscilloscope – CRO” [32].

After the pilot experiment, the second equipment selected was the Spectrum Analyzer. This equipment is also an element of the remote radio laboratory. The users (students, technicians or teachers) need to reach this equipment to be able to receive a range of signals and do their experiment.

4.4.3 Oscilloscope (OSC)

An oscilloscope is a type of electronic test equipment that allows signal voltages to be viewed, usually as a two-dimensional graph of one or more electrical potential differences (vertical axis) plotted as a function of time or of some other voltage (horizontal axis). With oscilloscope, it is possible to have graphs of an electrical signal in correlation with the time. In most applications the graph shows how signals change over time: the vertical (Y) axis represents voltage and the horizontal (X) axis represents time. Sometimes the intensity or brightness of the

display is sometimes called the Z axis [41]. This machine is also necessary for people while they are doing their experiments.

4.4.4 RF Signal Generator (RF)

Signal Generator is an electronic test instrument that delivers an accurately calibrated signal at frequencies from the audio to the microwave ranges. It is valuable in the development and testing of electronic hardware. The signal generator provides a signal that can be adjusted according to frequency, frequency reference, frequency offset, output voltage, impedance and waveform. Agilent PSG Family comprises two series, the PSG-A and PSG-L. The PSG-A Series provides analog modulation in addition to continuous wave (CW) signals. The PSG-L Series provides CW signals only [42]. The RF Signal generator is again one of the basic machines that can test the electronic hardware. Thus, people need this equipment.

4.4.5 Waveform Generator (WFG)

An arbitrary waveform generator is used in a variety of applications where it might be otherwise difficult or impossible to generate complex output waveforms. With an arbitrary waveform generator, signal imperfections such as rise time, ringing, glitches, noise, and random timing variations can be easily simulated in a controlled manner [43].

4.5 Properties of Designed EPSSs for ERRL Project

All the five equipments, which are mentioned above, are selected to be the part of remote radio laboratory project. Accordingly, in this thesis, all the EPSSs of these equipments are developed separately as the part of the ERRL project. Each of the selected equipment has a different EPSS because the basic knowledge and the aim of usage are different for each of them. It is not possible to develop a unique interface because to give information for all of them in the same area may be very confusing for the new learners of the laboratory equipments. The basic knowledge is provided by the Electric and Engineering Department of the Atılım University. They designed how to teach all the equipments, what are the basic points, what must be given to the learners and what the learners may need while they are doing their experiments or doing their jobs. The documents were prepared to contain the very basic objects about the equipment which produces the learning objects. Also, the

necessity of developing different EPSS interfaces for each of the selected equipment is also decided by that department. The videos and audios showing the experiments are also developed by the team of ERRL project. A partner school, Balıkesir University, helped to prepare the videos of the necessary experiments.

During the development of EPS Systems in this study, the characteristics of an EPSS are well analyzed as mentioned in Chapter 2.2.2 Characteristics of EPSS. For example, all designed systems are computer based; users are capable to reach them via computer and Internet. They can also reach while the users are performing their experiments via a link which is provided on the Moodle site of the Atılım University. This indicates that the systems are available whenever the user wants to reach them. Figure 4.2 shows the links of each EPSS from the Moodle site of the Atılım University.



Figure 4.2 ERRL MOODLE web site

The integration of EPSS with ERRL project is possible both with the ERRL Moodle website and directly with the experiment page itself. The users have chance to first study the chapters and then go through the experiment as shown in Figure 4.2 above, or to do an experiment and go to the necessary help by clicking the link provided by EPSS project as shown in Figure 4.3 below.

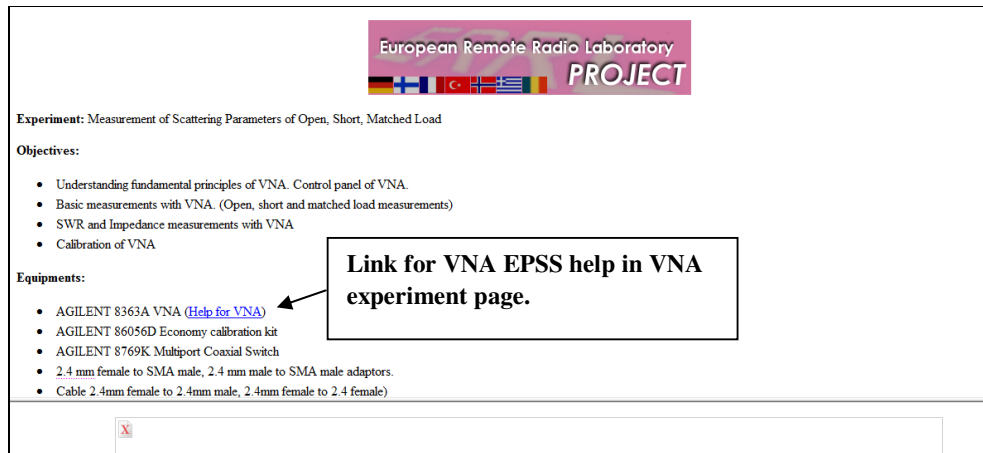


Figure 4. 3 EPSS – ERRL Integration by Experiment Page

From the ERRL Moodle web page (Figure 4.2) if the first link selected, or from the VNA experiment page (Figure 4.3) if the “Help for VNA” link selected, then the user faced with the interface of the VNA. Figure 4.4 shows the VNA interface.

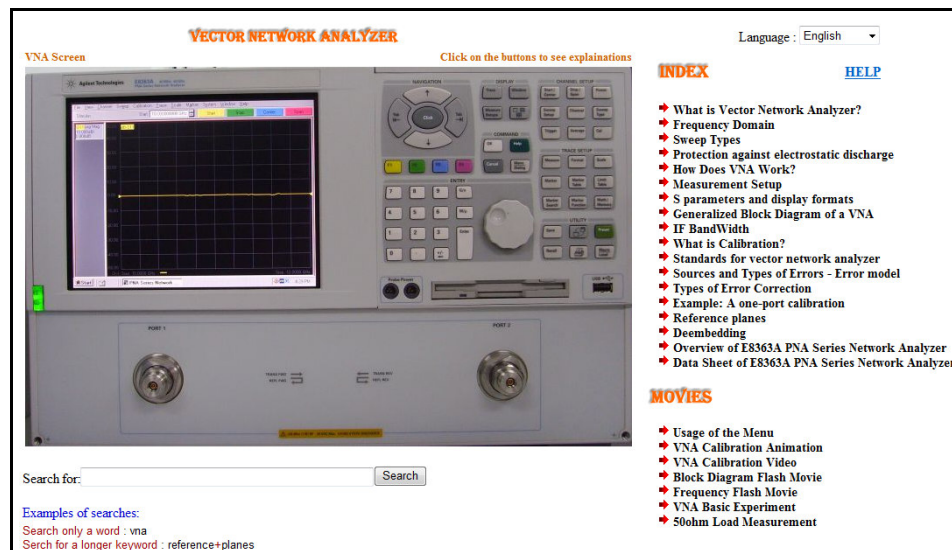


Figure 4. 4 VNA EPSS Interface

Also, if the user wants to reach Spectrum Analyzer while doing an experiment, then it is enough to select the related link from the Moodle site. Figure 4.5 is the SA EPSS interface.

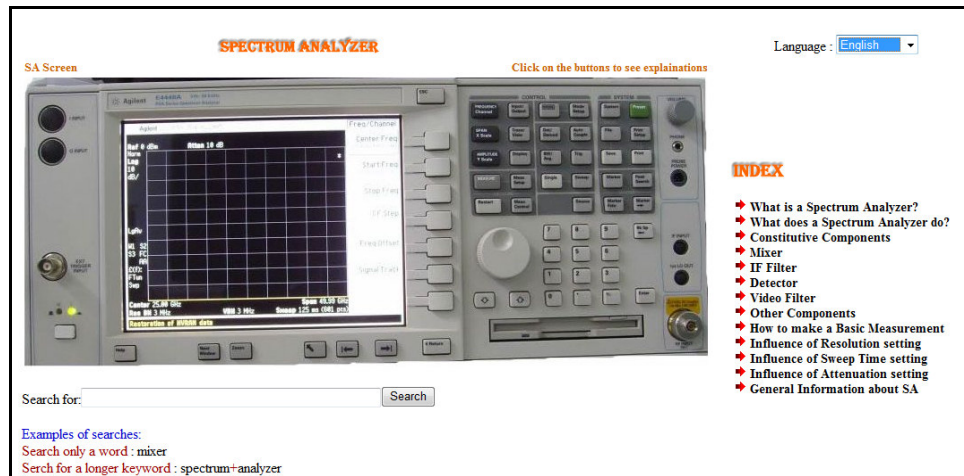


Figure 4. 5 SA EPSS Interface

Another important property is that the developed systems are controlled by the user. As seen from the interfaces above, the users decide what to learn and search information accordingly. The motivation is provided by the users' desire to accomplish the task. There are no teachers who are deciding what information is needed. Users can easily get the information they are looking for. It is important to get the necessary information quickly when it is needed on the job.

These interfaces developments are done both for anyone who does not know anything about this equipment and anyone who knows detailed information but need some more details. Thus, they are designed to allow for different levels of knowledge (students, teachers, technicians). These EPSSs also created with the regard of allowing for different learning styles such as texture, video, audio or pictures. For example, buttons explanations and index part's chapters are composed of textures and pictures. On the other hand, the movies part is composed of many animations about the experiences and the movies that are showing how to make an experiment.

All the systems are designed as they reduce the need for prior training by the help of search opportunity. People have chance to find necessary information to read, not obligated to read all the chapters. They also provide some kind of advisory system by providing the search option. All these properties show that all the developed EPSSs are containing at least the key characteristics of an EPSS.

According to the analysis of the Ranges of Technologies Classified as EPSS in Chapter 2.2.6, it is clear that the developed EPS Systems are not containing the

whole characteristics of an EPSS. It contains the key characteristics and additionally advisory system property. This shows that designed systems are included in a Mid-Level EPSSs.

At the beginning of the ERRL project, with the help of the requirement analysis, “which and how many EPSS characteristics are needed” is dedicated for this study’s EPSSs. The developed EPSSs are not embedded into a system, but were developed for helping people to teach some equipment while they are doing their experiments in the remote laboratory environment. So, these systems are stand-alone systems because they can be used apart from the program, and support only the use of the specified equipment. These classifications are seen in Chapter 2.2.5 Classification of the Range of EPSS Design.

As mentioned before, the VNA is selected as the pilot equipment of ERRL project. So, the interface of this equipment is more sophisticated than other ones. In this interface there are six important parts which carry the properties of an EPSS. These parts are; the visual part (visual usage), index part (texture, linear learning), movies part (animation and videos), language option part (language selection), help for helping users to use the interface and search part (non-linear learning). All the EPSSs do not provide the movies part that contains the videos and audios and help part. Movies part is a special part because the preparation is very hard. Since the VNA is the pilot equipment, the movies part and the help part is only generated for this interface. These parts will be updated for the other equipments when the ERRL team is finished to develop them. Table 4.1 summarizes which of the EPSS characteristics are included (which are briefly explained in Chapter 2) in the developed systems in this study.

Table 4.1 Summary of the developed systems

EPSS Characteristics	Developed EPSSs in this study
Computer-based	✓
Access to information and tools when needed to perform a task	✓
Used on the job, in simulations, or other practice	✓
Controlled by the worker	✓
Reduce the need for prior training in order to accomplish the task	✓
Easily updated	✓
Fast access to specific, task-related information	✓
Irrelevant information excluded	✓

Allow for different levels of user knowledge	✓
Allow for different learning styles	✓
Integrate information, advice, and instruction	✓
Artificial Intelligence	X

4.5.1 Visual Parts of the Developed EPSSs

First part is the visual part explanation of the equipments. The visualization of the developed systems is approximately the same as real equipment's front panel. This is necessary for the student's who has no chance to use real equipment. These interfaces are to get familiar the users with the usage of the real machines. So, the high resolution picture was taken to show all the details as seen in Figure 4.4 and 4.5 above. On the other hand, if the user wants to learn the usage of the buttons in the visual part; it is enough to click on the button to see its explanation as seen in the Figures 4.6 and 4.7.

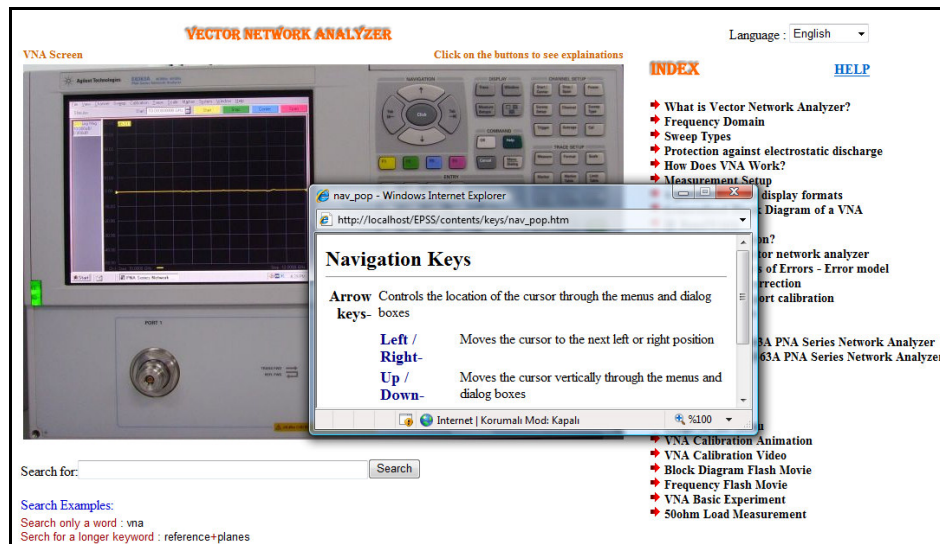


Figure 4. 6 VNA buttons

Over the picture of the equipment, there is a hint about the usage of the buttons, which is saying to click on them to see the explanations. This hint is to guide the users while they are using the interfaces. If the user clicks on “Navigation Keys” from the interface, a pop-up is opened to explain what these keys are for as seen in Figure 4.6. Or for example, if the “floppy drive” is selected a pop-up will be opened to give information about this part of the equipment shown in Figure 4.7.

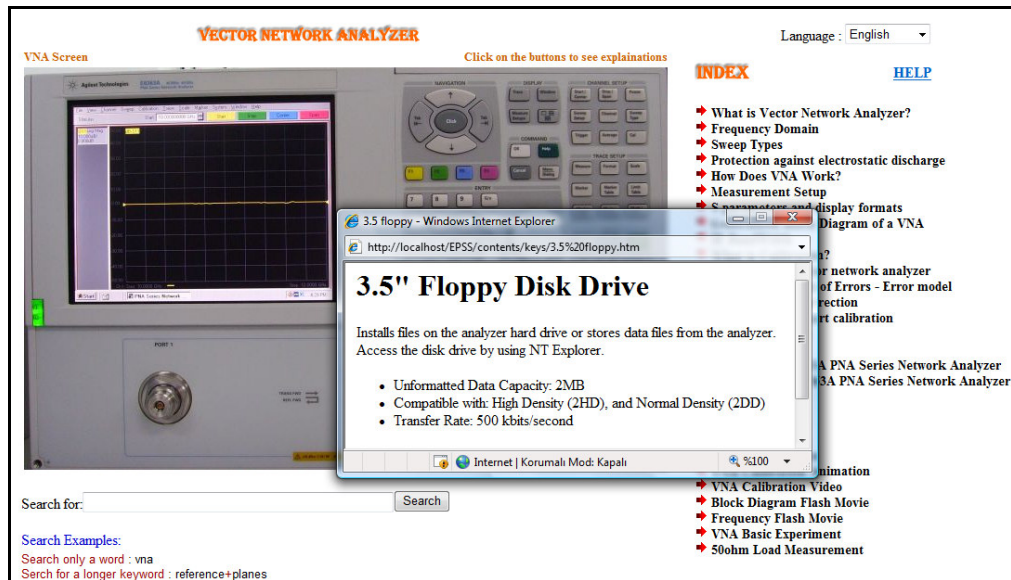


Figure 4. 7 VNA buttons

All the other EPSSs have the visual part. All of them have the high resolution picture in the left part which is containing the button explanations. In Figure 4.8 the Waveform Generators' Arb List button pop-up is demonstrated.

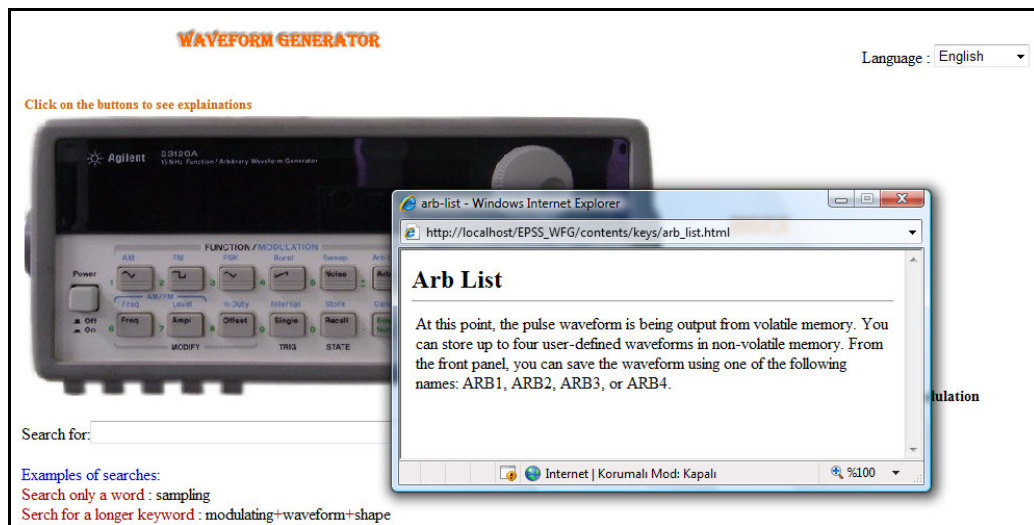


Figure 4. 8 WFG Buttons

Another example can be Oscilloscopes' Math Menu explanation as in Figure 4.9.

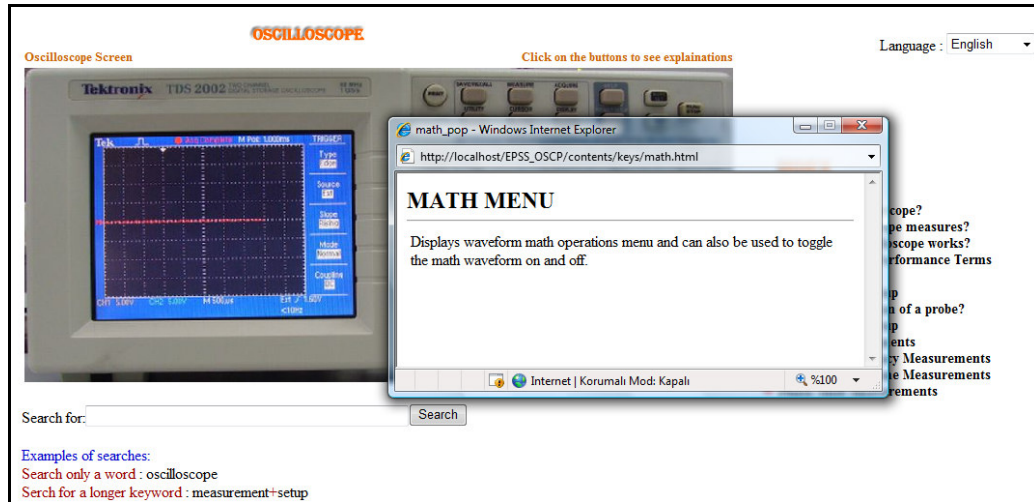


Figure 4. 9 OSC Buttons

This part of the designed systems also shows that the users are self directed. They decide which button to learn and which information to select. They have many choices to get the necessary information for them.

4.5.2 Index Parts of Developed EPSSs (Linear Learning)

In the system requirement analysis results, we conducted that some people prefer to reach all the information step by step. Thus, according to this need the index part was designed. The index is for providing whole information about the equipment chapter by chapter. This allows users to have the linear education option. This option is a chance for people who prefer the classical ways of learning. Accordingly, the Atılım University's Electric and Electronic Engineering department (ERRL project team) was decided to divide each equipments into smaller parts that is called learning objects. They prepared many chapters for each of the equipments.

This part contains the textures and images about the chapter. It gives the detailed information about the related chapter. The index menu has the chapter names clearly. For example, if the user wants to find information about "Frequency Domain" of a VNA, it is enough to click on the Frequency domain link as seen in the Figure 4.10.

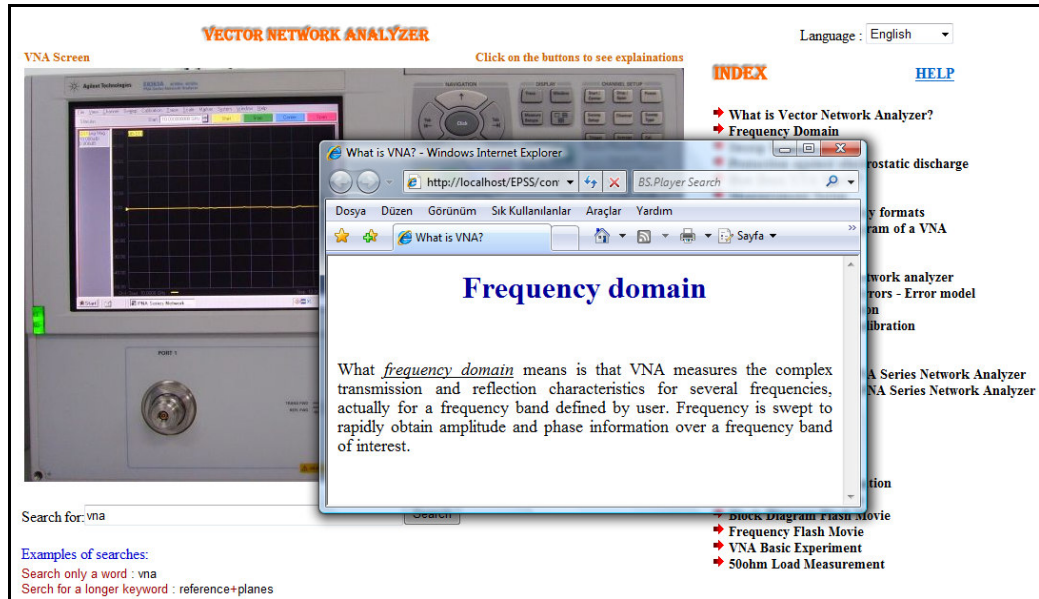


Figure 4. 10 VNA Index Chapters

If user wants to get some knowledge about the “one-port calibration” of the VNA, he/she will use the related link as seen in the Figure 4.11. The necessary information about the selected chapter is given in detail.

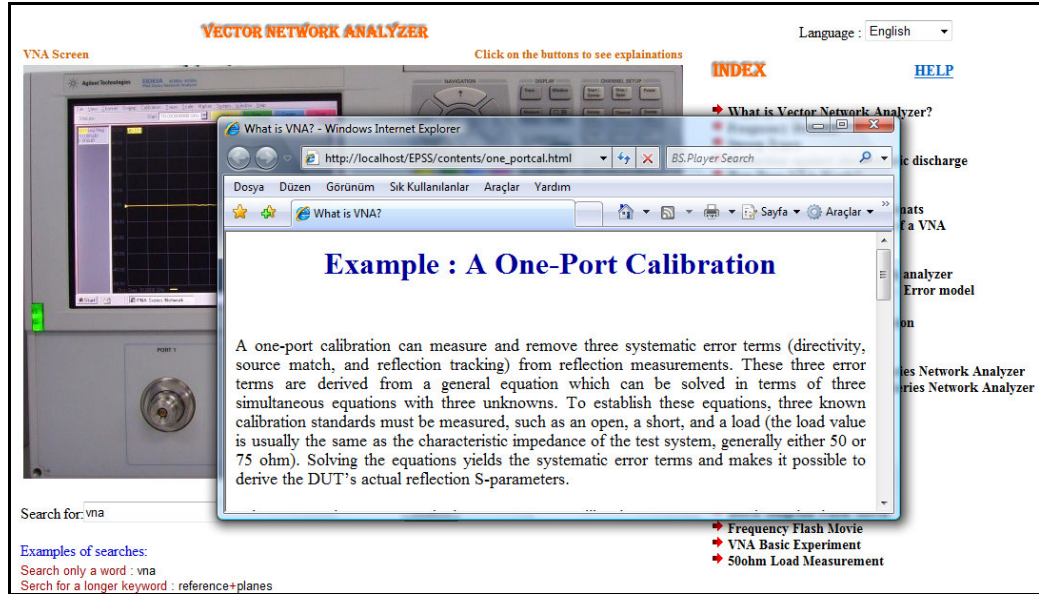


Figure 4. 11 VNA Index Chapters

Not only the VNA EPSS contains the index part, but also all the other EPSSs interfaces have it. Figure 4.12 is an example of a selected chapter from RF Signal Generator.

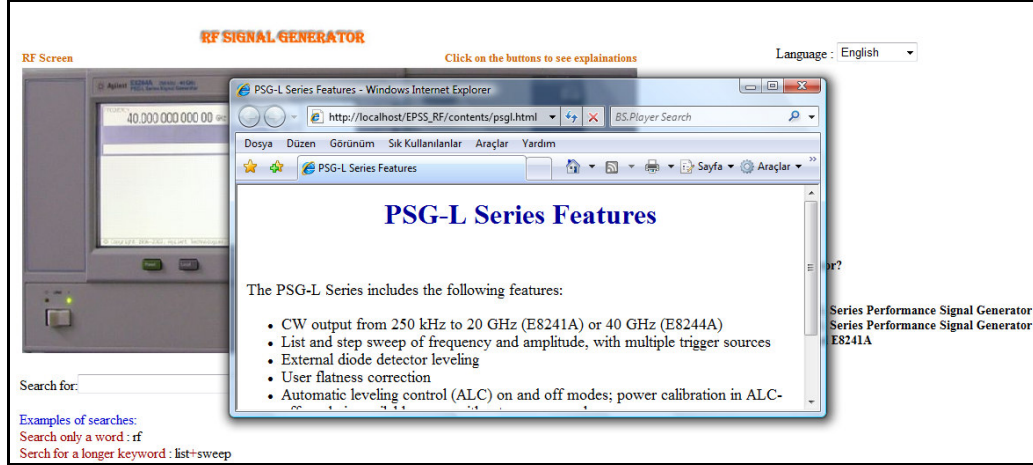


Figure 4. 12 RF Index Chapter

4.5.3 Language Parts of the Developed EPSSs

The third important part of this interface is the “Language” option. On the right upper part of the interfaces there is a language selection combo box. There are five different language options for the VNA interface. These are: Turkish, English, Romanian, French and German. For the other interfaces only Romanian and English translations can be added to the systems. These translations are done by the partner countries of the ERRL project.

This option gives the user to read all the information provided in any language preferred. This property also enables to reach easily the information. If the users can read all the documents in the language that they prefer, then the information is easily reachable. This is an important property for an EPSS structure such as mention in Chapter 2.2.2.

In all of the interfaces, the default language is English. However, as seen in Figure 4.13 the user can choose a different language by clicking the Language combo box and then selecting the preferred language option.

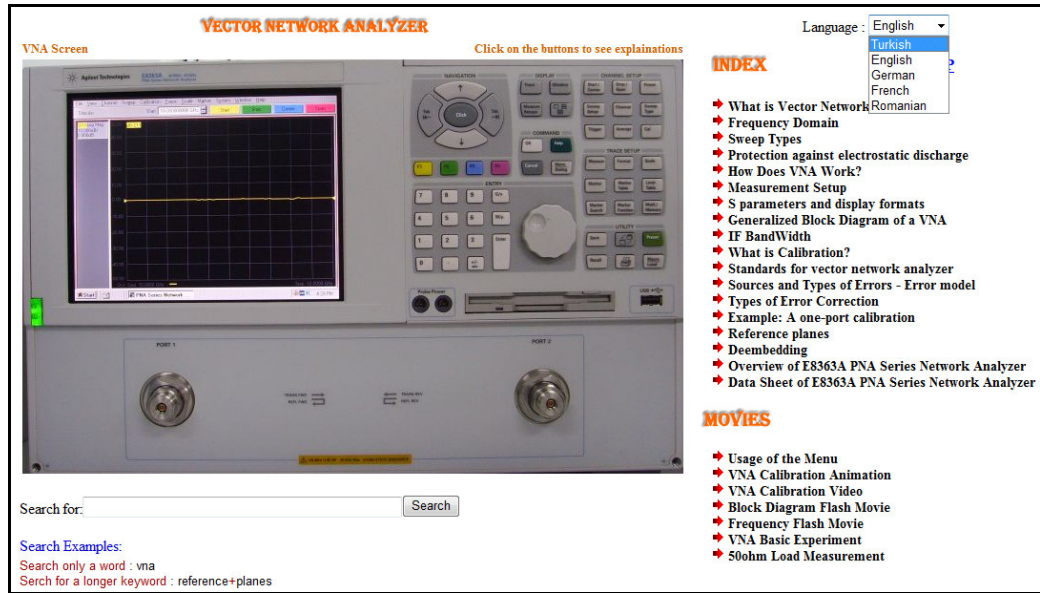


Figure 4. 13 VNA Language Option

As the language is selected, the whole menu, all the keypad explanations and texture information are translated to that language as shown in Figure 4.14. In this picture Turkish is selected and all menu items become Turkish.

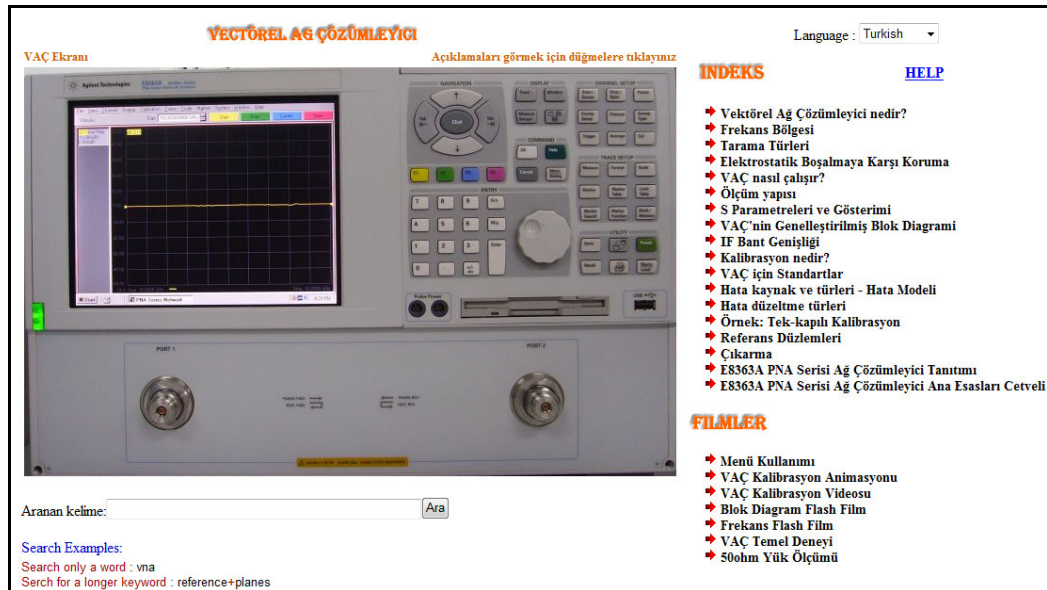


Figure 4. 14 Interface in Turkish

Not only menu options but also button explanations and index part chapters are translated to the selected language. Figure 4.15 shows the Turkish button explanations. Figure 4.16 shows a chapter explanation in Turkish.

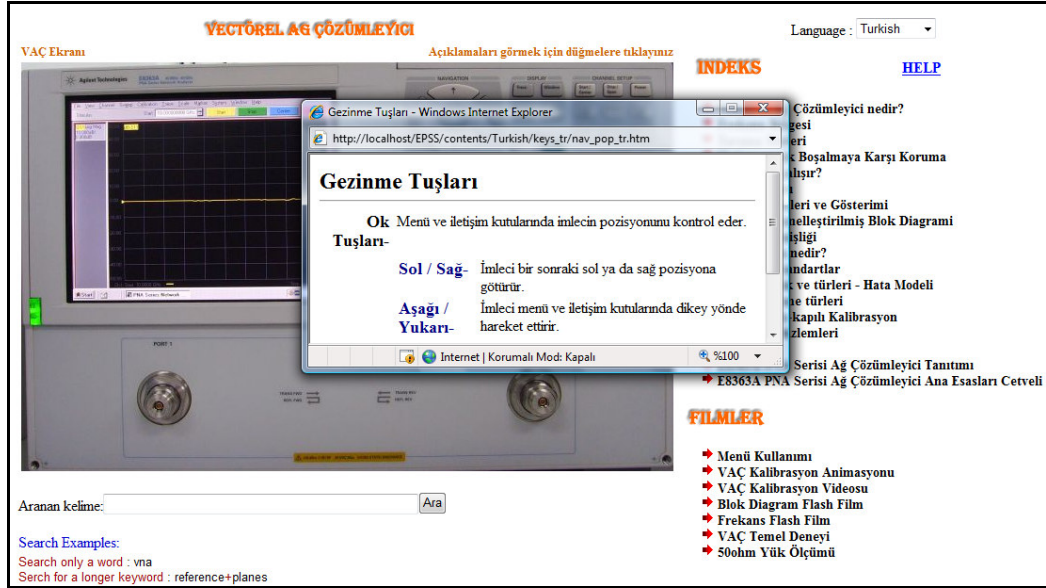


Figure 4. 15 Buttons explanation in Turkish

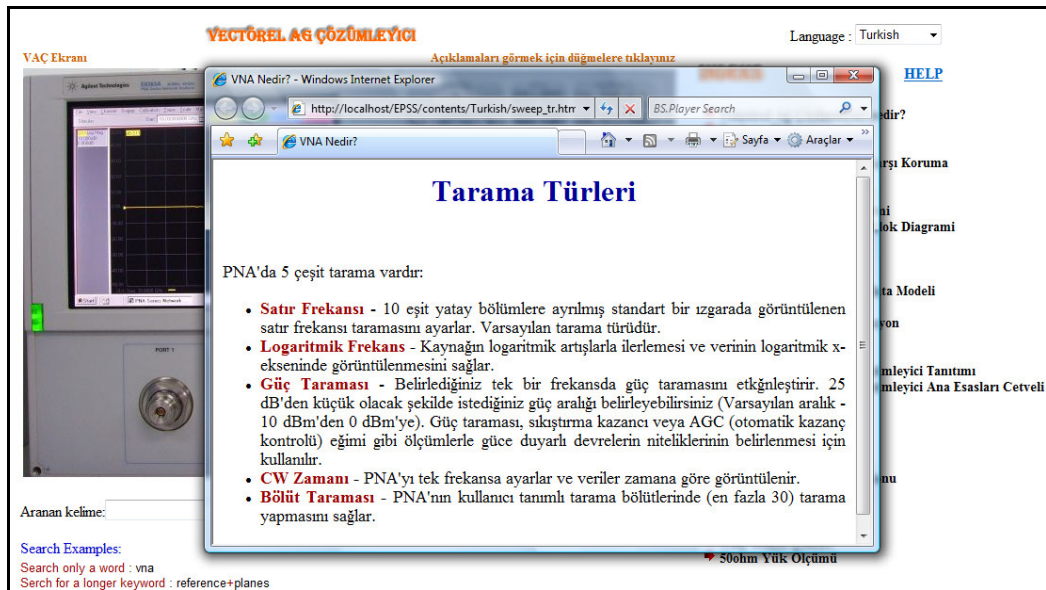


Figure 4. 16 Chapters in Turkish

In Figure 4.17, German is selected and all information in the system is translated in to German.

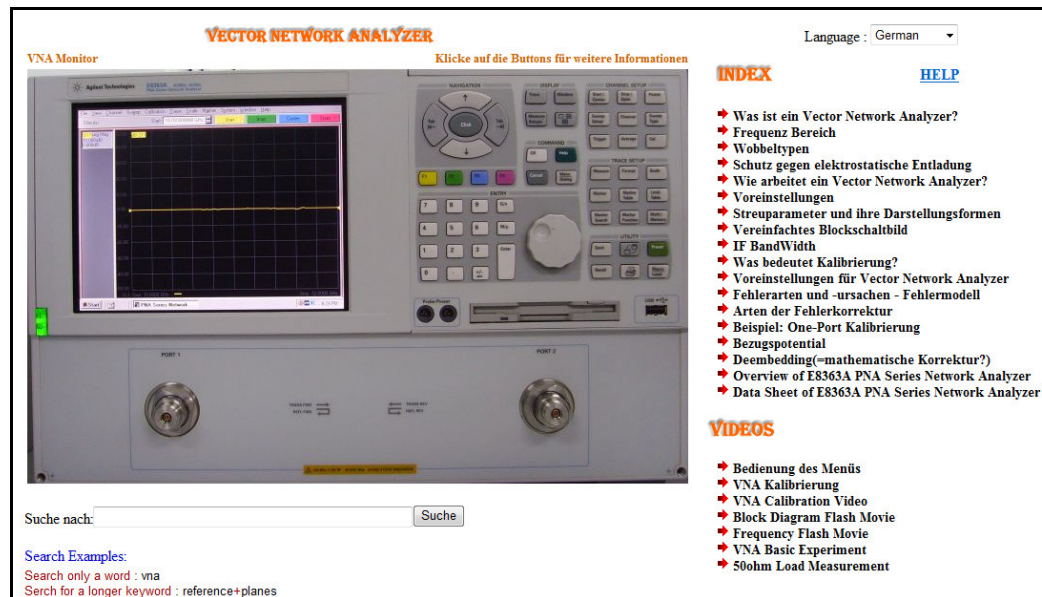


Figure 4. 17 Interface in German

This part is also for every other developed EPSS. Because the VNA interface is the pilot one, all the translations are finished by the partner countries and sent to us to integrate them into the system. However, the other EPSSs only have the Romanian and English option as a language part. Figure 4.18 indicates the language option menu of the Spectrum Analyzer.

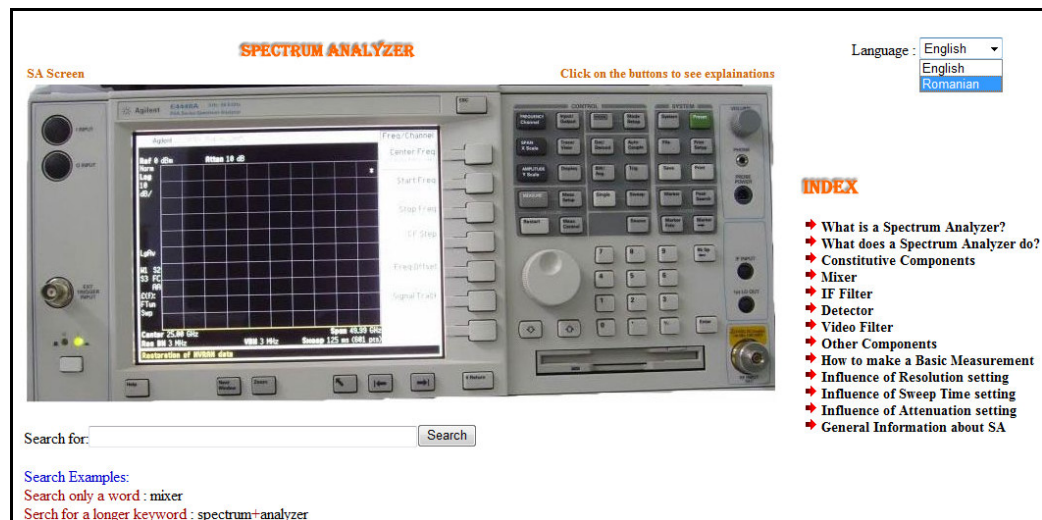


Figure 4. 18 SA Language Option

Figure 4.19 shows the Romanian translation of the interface after the option is selected. And Figure 4.20 is about one of the chapter explanation in the selected language.

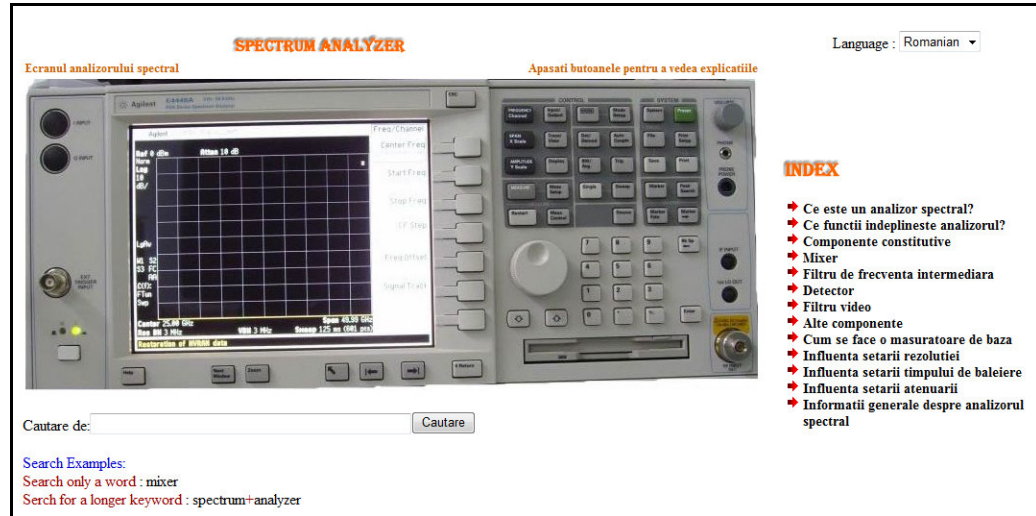


Figure 4. 19 SA in Romanian

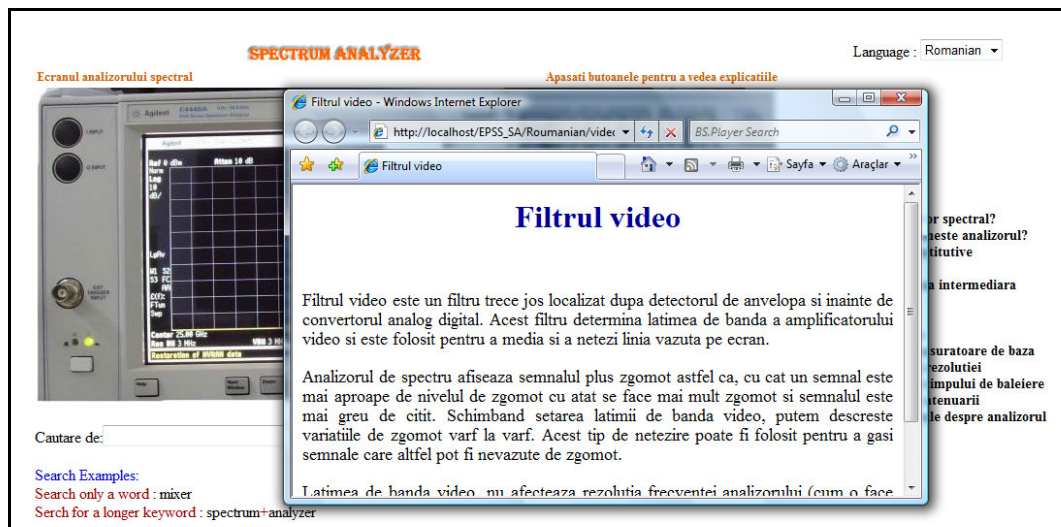


Figure 4. 20 SA Chapters in Romanian

4.5.4 Movies Part of the Developed EPSSs (Video, Animation and Audio)

From the requirement analysis results, it was clear that some people prefer to learn with visual tools because they understand the data much easier in that way.

Accordingly, the movies part was designed. This part is only generated for VNA interface of the project. The other interfaces will have this part, after the movies are prepared. In the movies part, the most important chapters are explained by animations or videos. Providing various types of information is an important characteristic of an EPSS as mentioned in Chapter 2, because it makes easier to understand the difficult chapters. These animations are created by the help of experienced academicians of Balıkesir University and Atılım University.

Some of the movies or videos are also supported by the audios. Some chapters need to be explained by speeches to be able to give every detail to the users. This helps some kind of users who really understands the information by visual ways and can easily learn it by listening.

For example if the user wants to learn how to use the VNA menu, then click on the first link of the movies part to watch the menu animation as seen Figure 4.21.

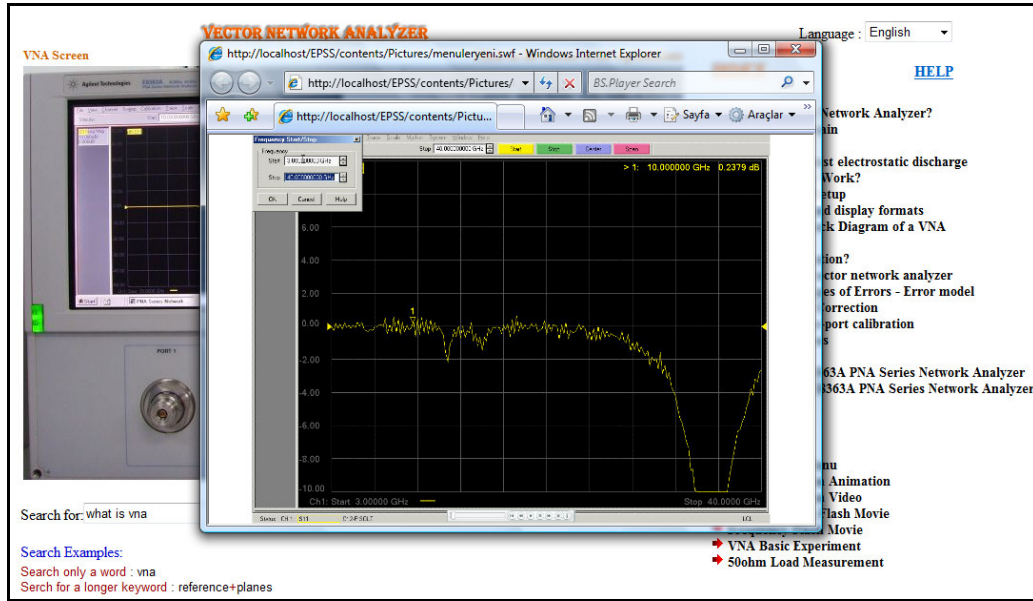


Figure 4. 21 VNA Movies Part Animations

This animation helps the user visually how to use the screen menu options of the VNA to be able to make a measurement with the equipment.

Also the user can see the block diagram animation to understand the measurements, as seen in Figure 4.22 and Figure 4.23.

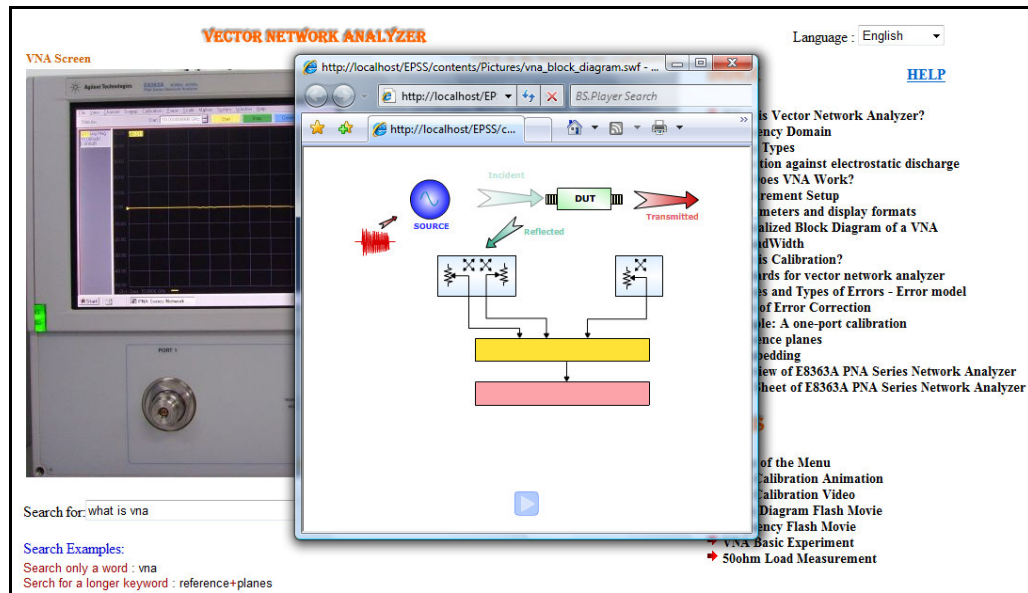


Figure 4. 22 VNA Movies Part Animations

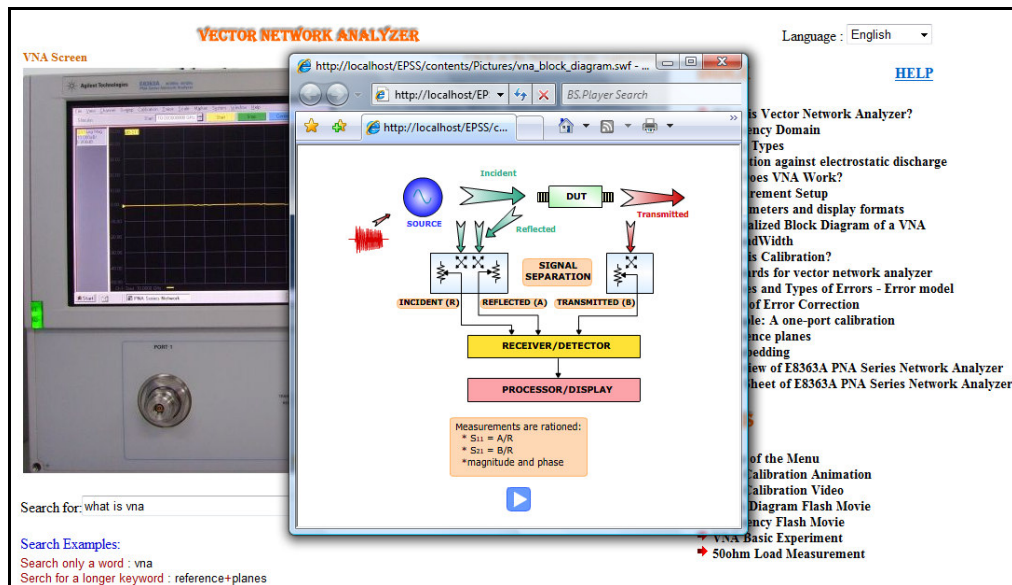


Figure 4. 23 VNA Movies Part Animations

4.5.4 Help Part of the Developed EPSSs

This part is the online help option which is one of the key characteristics of an EPSS as deeply explained in Chapter 2.2.2. This allows users to get familiar with

the software. However, the other developed interfaces are not containing this part. Only VNA interface has help option.

One of the aims of this EPSS is to help university students of six partners. All the students will use this EPSS to learn how to use the equipments of the laboratory. Because it is a new item, a help link is added to the interface. Figure 4.24 shows this help content.

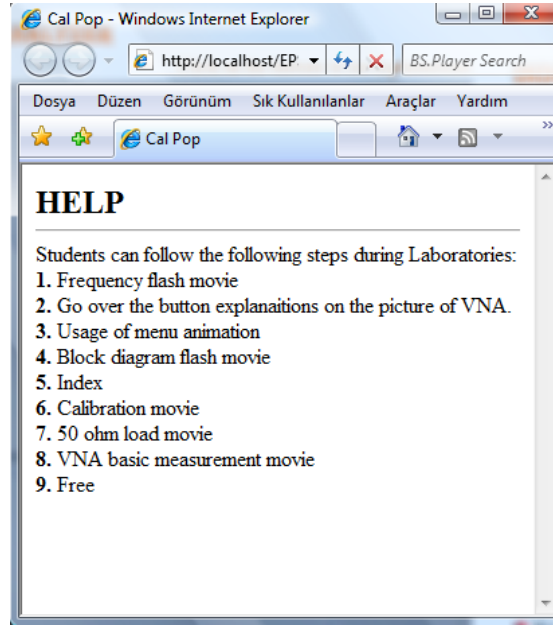


Figure 4. 24 VNA Help

In the laboratory sessions of the courses, students can follow a way to better understand the equipment. This help link supports the information of how the students can best understand a VNA usage.

4.5.6 Search Parts of the Developed EPSSs (Non-Linear Learning)

The last and the most important part of the interface is the “Search” part. This part is designed to provide non-linear information. Some users such as teachers or technicians, who are much more informed than a student, may only want to learn about a specific topic. Accordingly, s/he does not need to check every index part to get or to reach the necessary information. This part is provided for ever EPSS interfaces of the project. However, the search option is only working with the English language.

In order to provide such a facility, there is a part where the user can enter a key word, a sentence or a series of keywords, below the VNA picture. Figure 4.25 and Figure 4.26 are showing the search area in detail.

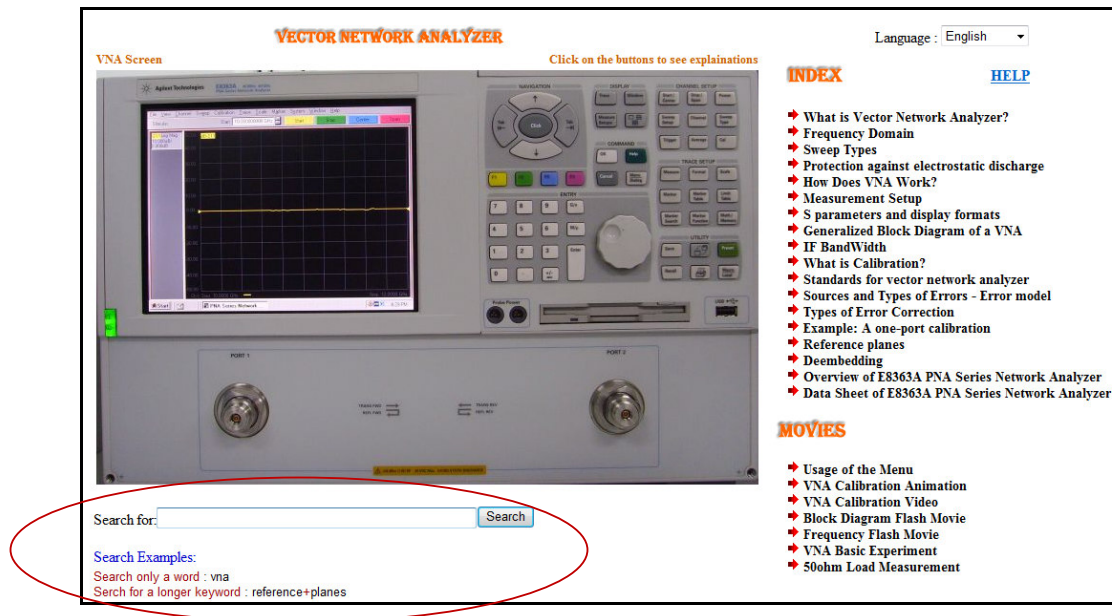


Figure 4. 25 VNA Search

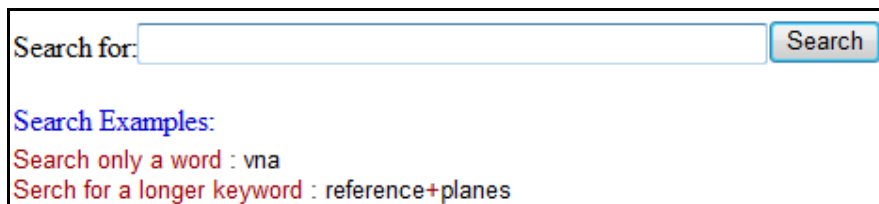


Figure 4. 26 VNA Search in detail

The Figure 4.25 is showing the contents of the search area. This part contains a text area to get the user's keywords or key sentences, a button to activate the search operation and a short explanation to give a hint about the usage of the search idea. These hints are about some search explanations. The "Search Examples" part is prepared to be able to help user, while s/he is doing a keyword search.

This part is containing four different types of search; a single keyword search, combination of more than one keyword search, two different sets of keyword search and questioning in the search. The main working methodology is the same for all the search types. The only difference comes out while creating the search word. Before explaining the different types of search, the main methodology must be understood.

4.5.6.1 Main Working Methodology for Search

The ERRL project works over an APACHE server. The main folder of the project is “HTDOCS”. All the necessary information, which is given to the user over MOODLE, is under this folder. Accordingly, search is done under this folder. The algorithm of the search button can be given in detail by following steps (See APPENDIX C for detailed algorithm):

1. User writes the word/s or a question sentence from the text area of the search environment,
2. User presses the “Search” button which is next of the text area,
3. Search button gets the text which is written by the user,
4. Then the search word/s or sentence is created as follows:
 - a. First of all, all the unnecessary blanks are removed from the text received from the user.
 - b. The search word is created according to the keywords of each of the equipments. As mentioned, in the Chapter 4.5, all the equipments are divided into learning objects.
 - c. Then each learning object has its own keywords or sentences.
 - d. These keywords are located in many text files.
 - e. The text which is written on the text area is parsed according to these keywords.
5. When the search word/s or sentence are ready after the above steps, with windows “GREP” command, all the “HTDOCS” folder is checked whether any documents contain the searched word/s.
6. If there are any documents that is containing the searched word, then they are stored in an array list.
7. After storing them, a filter operation is done for the documents.
 - a. The list is controlled to classify the documents with the extensions; “.doc”, “.pdf”, “.jpeg”, “.jpg”, “.htm”, “.html”, “.png” and “.gif”.
 - b. The documents, with the extensions above are separated from the real list.

8. The selected documents names which are stored in the eliminated list array, contains the full path of the document. Because it is nonsense to show the full path of the document name, a new elimination is done to separate the path from the name of the document before introducing it to the user.
9. After the document name is parsed from the full path, it is displayed to the user in a PHP table in a new pop-up window.

If the general working methodology is understood, the different search types can be deeply analyzed.

4.5.6.2 A Single Keyword Search

The only difference between all these search types is in the search word creation part of the algorithm. If the user enters only a single word about the VNA in the text area, the search word is created as that word as follows (See APPENDIX C for detailed algorithm):

1. The word is obtained from the textbox of the search area,
2. Checked whether the word is the keyword of a learning object,
3. If it is a keyword then the searching word is created,
4. The search operation starts.

Figure 4.27 and Figure 4.28 is showing the search of “sweep” keyword. This means that the search word will be created as the word entered as mentioned in part 4.5.6.1. The simplest search is this search type. The word will be created automatically and the results will be created.

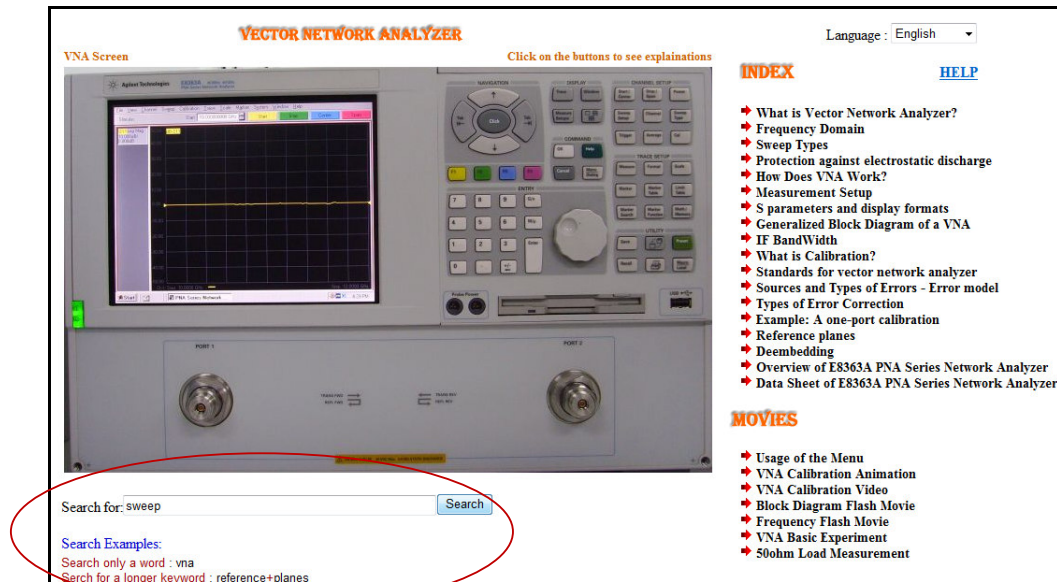


Figure 4. 27 VNA Example Search of keyword “sweep”

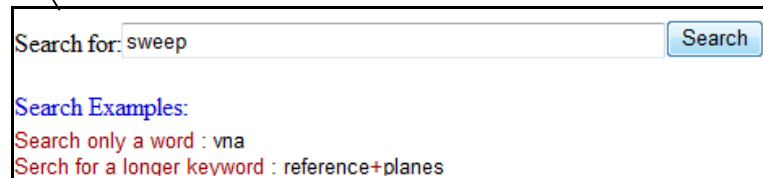


Figure 4. 28 Sweep Search Detail View

Figure 4.29 shows the result pop-up of the “sweep” search word.

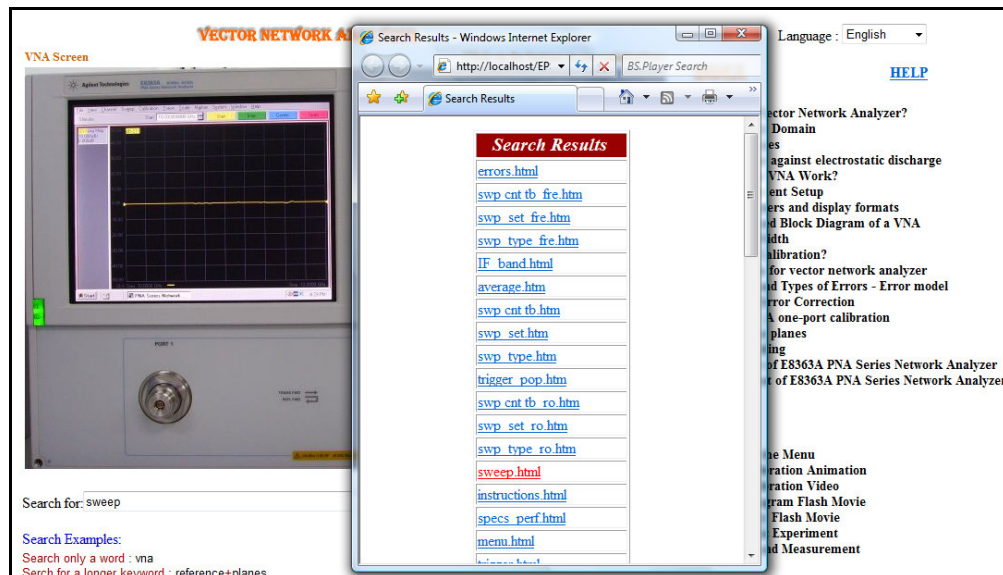


Figure 4. 29 Sweep word Search Results

Then the user can click on any document that contains the “sweep” word. For example, if s/he selects and clicks on the “sweep.html”, then may read the following document shown in Figure 4.30.

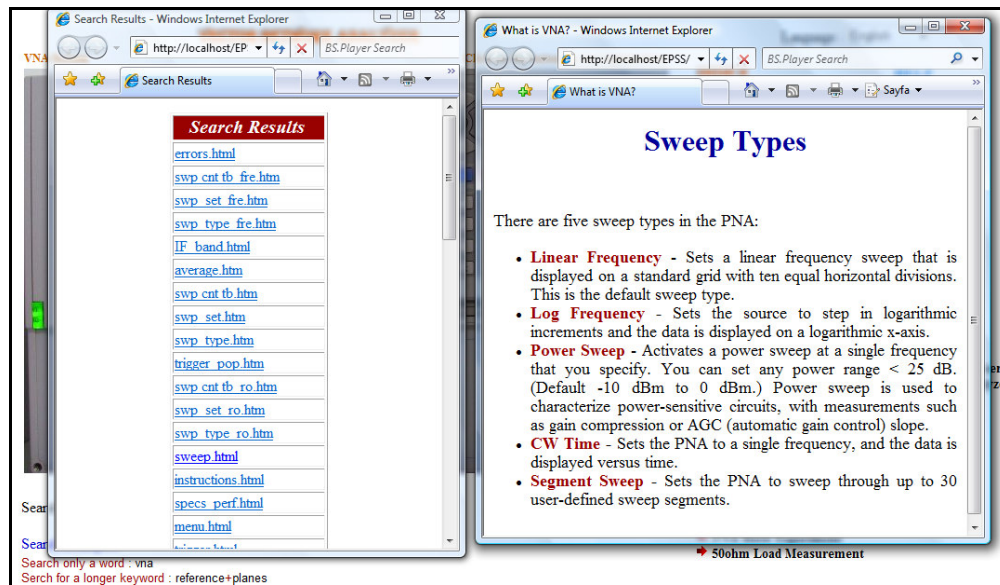


Figure 4. 30 Sweep Types

4.5.6.3 Combination of More Than one Keyword Search

The second type is searching a combination of keywords. The general working methodology is the same. The only difference comes out while creating the search word. Here the steps of the search word creation are as follows (See APPENDIX C for detailed algorithm):

1. Get the combination of words from the textbox,
2. The plus sign means that this must be a whole keyword of the learning object (the words are not separated, has a meaning all together). Accordingly, put a blank character instead of plus signs,
3. Then check whether the whole word is one of the keywords of the learning object,
4. If yes create the searching word combination.
5. The search operation starts.

For example, if the user wants to search more than one word like “error correction”, then text box must contain these words with a plus sign between each of the words (See Figure 4.31 and Figure 4.32).

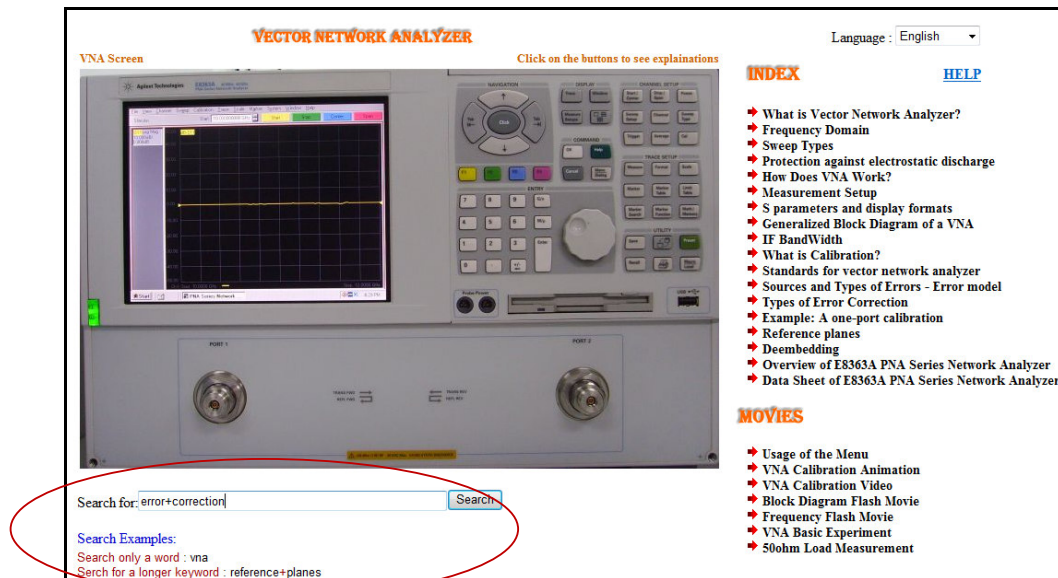


Figure 4. 31 Example Multiple Word Searches

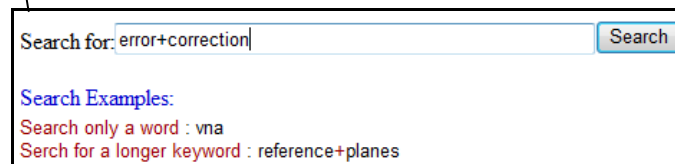


Figure 4. 32 Multiple Word Search in Detail

The result of this search is shown in Figure 4.33.

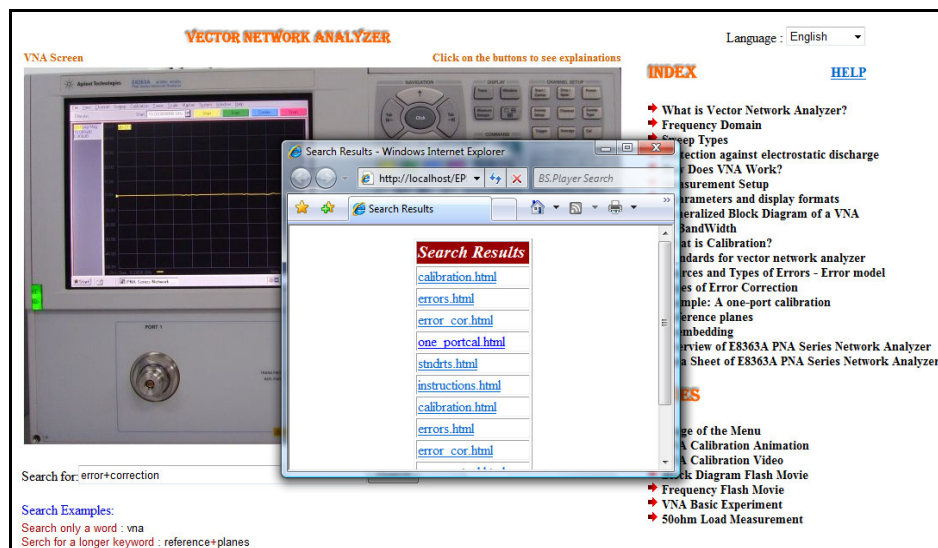


Figure 4. 33 Result of Multiple Word Search

Now the user is free to select one of the resulted links and study on this document. In Figure 4.34, the chapter “types of error correction” is selected.

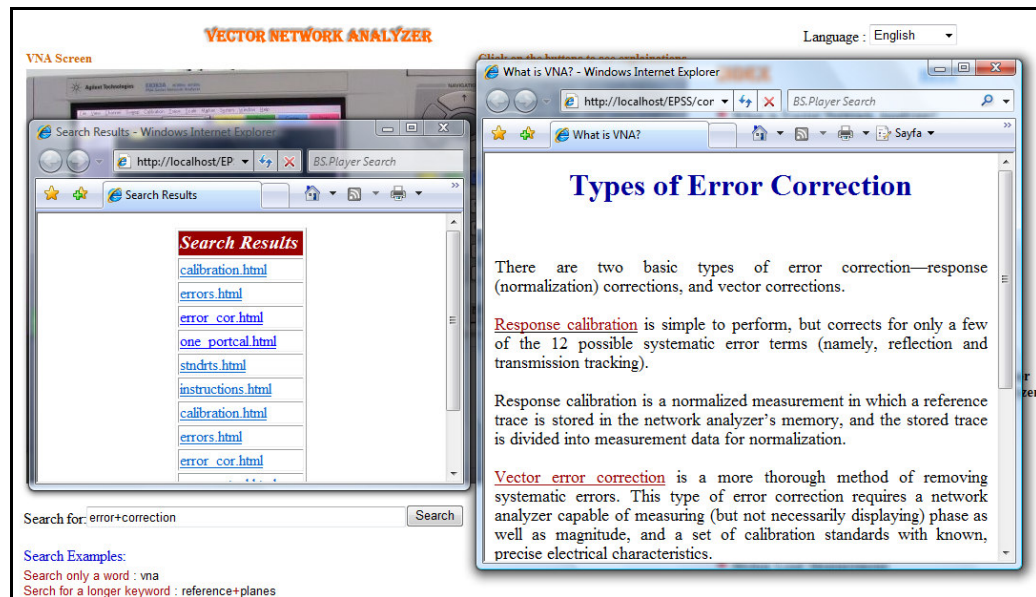


Figure 4. 34 Chapter Types of Error Correction

4.5.6.4 Two Different Sets of Keyword Search

There is also another facility about the search textbox. If the search will be done according to two different keywords at the same time then it must be entered such as “reference+planes vna+blog+diagram”. So, the steps of creating the search words combination is as follows (See APPENDIX C for detailed algorithm):

1. Get the combination of words from the textbox,
2. Parse the first part and the second part of the combination means get the first part until the blank character is reached, then get the second part until the end,
3. Replace the plus sign with a blank character for each of the parts,
4. Check whether they are key words combinations of the learning objects,
5. If both of them are the keywords, search starts for each of the combination,

6. If only one of them is a keyword then only that word combination is searched.

Figure 4.35 and 4.36 shows an example of two different sets of keyword search:

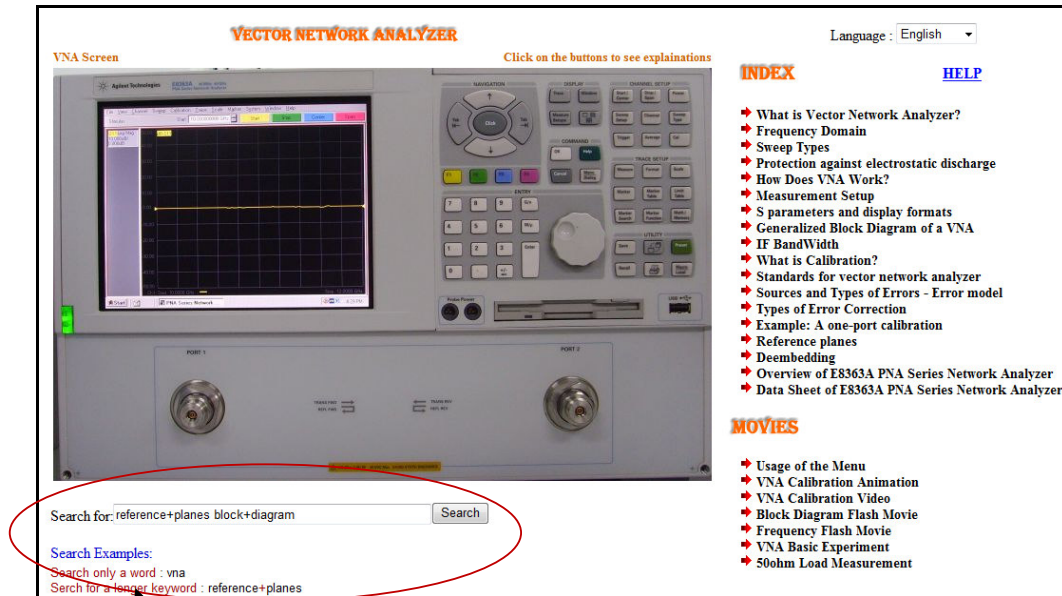


Figure 4. 35 Searching Two Different Keywords at the Same Time

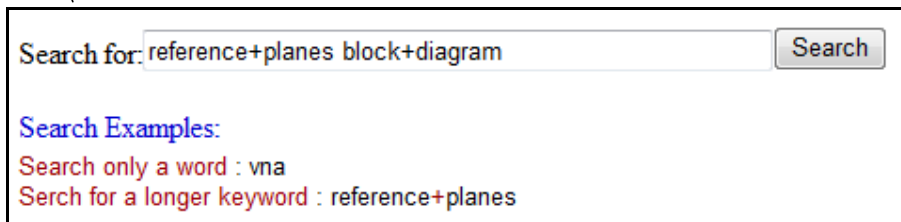


Figure 4. 36 Two Keywords Detail

The results are listed as links that contains both “reference planes” chapters and “VNA block diagram” chapters as shown in Figure 4.37. They can be read at the same time because the result page will never be disappeared while reading a selected document.

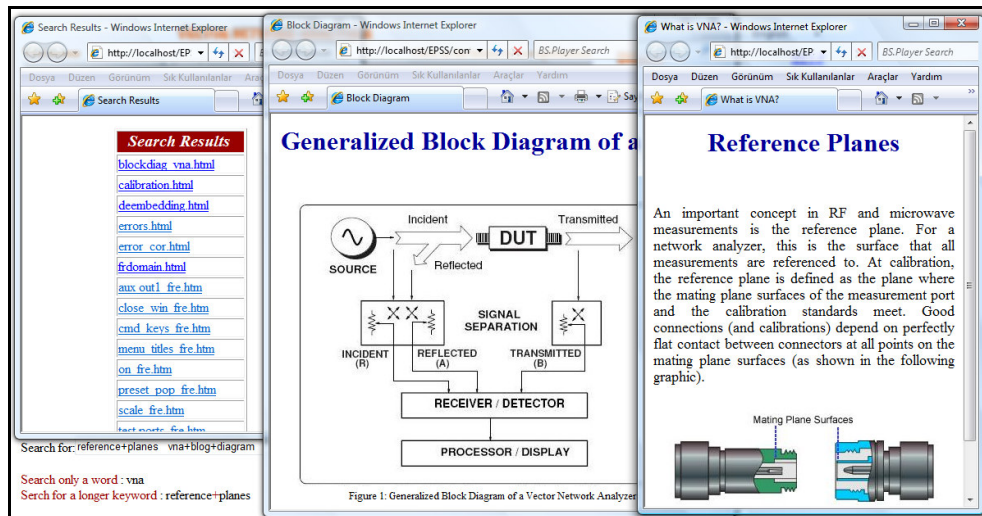


Figure 4.37 Reading two different chapters at the same time

4.5.6.5 Questioning in the Search

There are also other possibilities about a search such as a whole sentence can also be entered in the textbox area. See figure 4.38 and Figure 4.39.

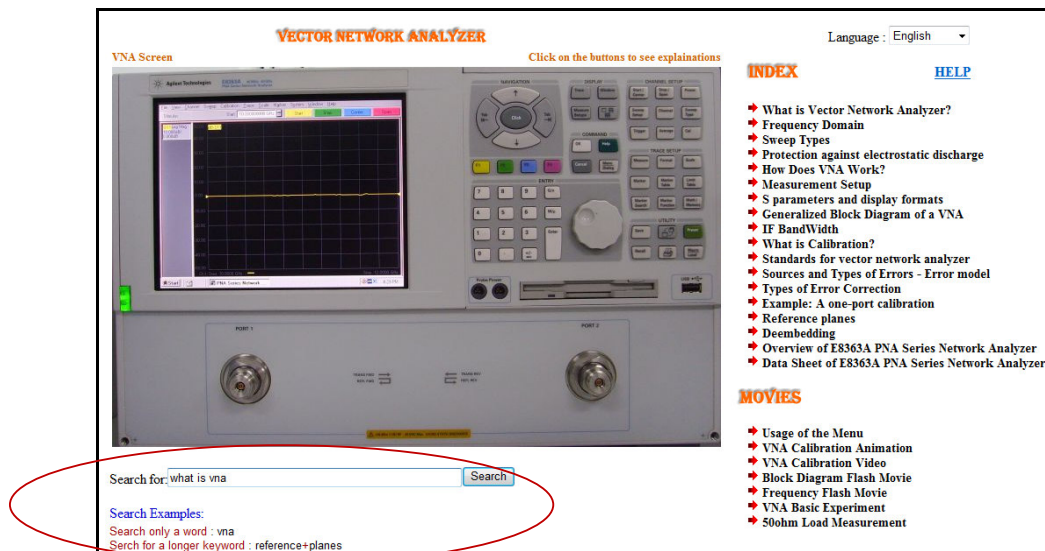


Figure 4.38 Example of a Sentence Search

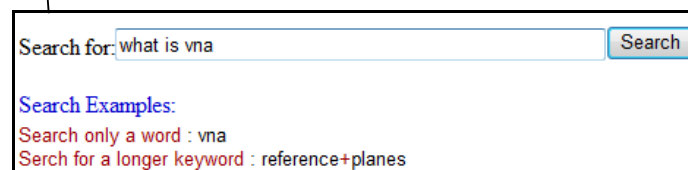


Figure 4.39 Sentence Search in Detail

In this case, the following steps are done to create the searching word (See APPENDIX C for detailed algorithm):

1. Sentence is parsed into words,
2. All the words are checked whether they are keywords or not,
3. With the words that are in the keyword list, the searching word is created,
4. The search operation starts.

Figure 4.40 shows the result of the “what is VNA” sentence.

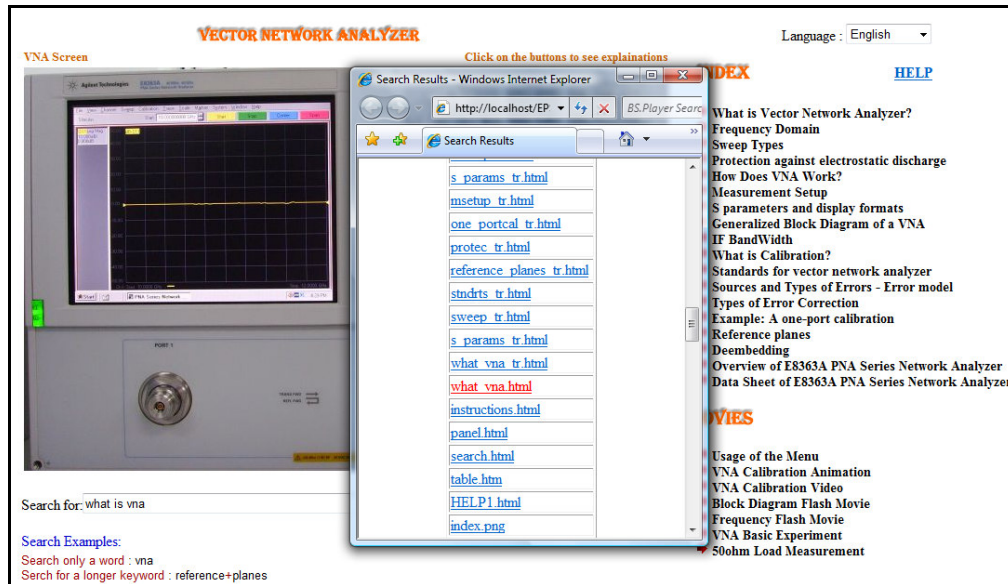


Figure 4. 40 Result of a sentence search

Then the related document can be read as in Figure 4.41.

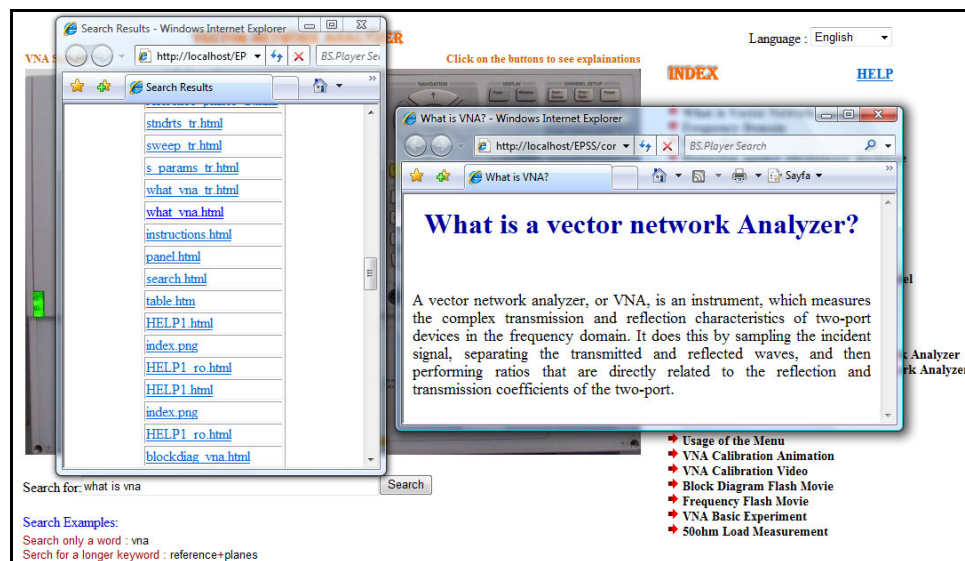


Figure 4. 41 Related document of sentence searched

CHAPTER 5

RESULTS

In this study we have applied a questionnaire both for requirement analysis and system analysis to people who are our possible target users. In this part of the thesis, the results of these questionnaires are described of those users.

5.1 Requirements of an EPSS in the ERRL Project

To better understand the requirements of the ERRL-EPSS, a requirements analyses study was conducted on the possible users of the system. To be able to do this, a questionnaire was developed and implemented it to the engineers, students and technicians. The results are summarized in Table 5.1.

Table 5. 1 Participants of the requirements collection study

Participant		%
Engineer	39	23
Technician	15	9
Student	116	68
Total	170	100

As shown in Table 5.1, 145 (85 %) participants are male, and 25 (15 %) of them are female. The questions were about the subjects, when people learning a new subject which of the following methods do they prefer. Their responses are shown in Table 5.2. Most of the participants (53%) prefer to study with someone who knows the subject well. However, still some participants prefer to study their own (27%) or within a group (20%).

Table 5. 2 Preferred way of Studying (in groups or individually)

	Frequency	%
Studying with someone who knows the subject well	90	53
Studying on their own	46	27
Studying within a group	34	20

Under this dimension, it is also asked that their preferred way of studying a new subject in the sense of linear or non-linear way of studying. Table 5.3 summarized results of the participants' responses on this question. 61% of the participants prefer studying a concept by starting from the beginning and go through the chapters one by one in the given order (linear way of studying). On the other hand 17% prefers reading the chapter(s) that they are interested in and never read rest of the content and 16% prefer to search on a keyword and then study on that specific topic only or reading the chapter(s) that they are interested in and never read rest of the content (non-linear way of studying). Only 10% have chosen to study on the examples and exercises and never read the rest of the chapters. Accordingly, 33% preferred non-linear instructions.

Table 5. 3 Preferred way of Studying (in linear or non-linear order)

	Frequency	%
Starting a concept from the beginning and go through the chapters one by one in the given order	103	61
Reading the chapter(s) that they are interested in and never read rest of the content	29	17
Search on a keyword and then study on that specific topic only	27	16
Trying to understand the end of the chapter examples and never read the rest	10	6

It is also asked the participants to order their preferred way of studying a new concept by using a web site. It is multiplied the total number of first place choices by 3 and total number of second place choices by 2 in order to calculate the total scores. The calculated total scores are reported in Table 5.4. As seen from Table 5.4, participants mostly prefer to go through the chapters in a given order (linear order) while studying subjects on the web.

Table 5. 4 Preferred way of Studying on the web (in linear or non-linear order)

	Score
Go through the chapters in a given order one by one	349
Reach the information by means of keywords and read only the chapters you need	246
By means of questions and answers between the system and you	191

Table 5.5 shows the participants' preferences while performing experiments on computer. The score is calculated the same was as in Table 5.4 Participants mostly prefer interaction, figures on the subjects and story-based instructions follow it.

Table 5. 5 Participants' Preferences while performing an Experiment on Computer

Preferred way of Instructions	Score
Interactive	1081
Figures on the subjects	622
Story based	611
Animations on the subject	543
Batch jobs	524
Games related with the subject	484
Several problems and exercises	464
Text-based instructions	417
Sound-based instructions	332

After all the developments of EPSSs, it was necessary to understand if the systems are achieved to fulfill the needs of the target users. In order to do this, a study has been established. In this study, first of all, the pilot experiment system (VNA) used in one of the courses at the Atılım University's Electric and Electronic Engineering Department in Spring semester, 2007-2008. The target users (students, technicians and academicians), used the EPSSs links during their laboratory hours while they are trying to do their experiments on the selected equipment. They especially used the VNA link to get well informed about the equipment. During the courses, we realized some needs and weak parts of the systems by interacting with the students who are using them. Then the developed systems are improved

accordingly. At the end of the course, a questionnaire was applied to some of the students who are taking the course. In this part of the thesis, the results of the questionnaire are analyzed.

5.2. System Analysis Questionnaire Results

To better understand the developed system's deficiencies, a questionnaire was applied to the possible target users (students, technicians and academicians) of the system. The results are summarized in Table 5.6.

Table 5. 6 Participants of the system analysis study

Participant		%
Academicians	3	15
Technician	2	10
Student	15	75
Total	20	100

Three (15%) participants are female, and 17 (85%) of them are male. Four (20%) participants are between 26 and 35 age range and 16 (80%) of them are between 17 and 25. The questions were generated under six groups. The first group questions were about the interfaces of the developed equipments questions if the interfaces realistic or close to the real ones and was it easy to use them while looking for the information. According to Table 5.7, most of the participants (75%) agreed that the interfaces were good enough. The equipment's photographs are also asked as if they are qualified enough. One of the participants neither agreed nor disagreed with this idea. On the other hand, 13 agreed and also 6 of them strongly agreed. The other first group questions were on the buttons of the equipments. We asked that if the buttons were easy to find and easy to use. Fifteen percent (15%) of the participants neither agreed nor disagreed about the button explanations. However, 45% of them said that they easily found and used the buttons while 40% of them strongly agreed with this idea.

Table 5. 7 Interface Questions

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
The user interface of the laboratory equipments learning system (EPSS) is realistic.	0 (0%)	0 (0%)	2 (10%)	3 (15%)	15 (75%)
The user interface of the laboratory equipments learning system (EPSS) is close to real equipment.	0 (0%)	0 (0%)	2 (10%)	3 (15%)	15 (75%)
The user interfaces of the equipments are easy to use	0 (0%)	0 (0%)	2 (10%)	3 (15%)	15 (75%)
The pictures of the equipment are qualified enough to realize the real one.	0 (0%)	0 (0%)	1 (5%)	13 (65%)	6 (30%)
I easily find the buttons explanations of the equipment.	0 (0%)	0 (0%)	3 (15%)	9 (45%)	8 (40%)
Buttons explanations are clear to understand how to use each button in the front-panel of the equipment.	0 (0%)	1 (5%)	2 (10%)	11 (55%)	6 (30%)

The second group questions were about which part of the developed systems were used by the users while they were learning something on the equipments. The results are shown in Table 5.8.

Table 5. 8 Participant's Preferences while learning

Preferred parts of EPSS	%	
Linear Learning (index part)	17	85
Non- Linear Learning (search part)	5	25
Movies and Animations parts	15	75

According to the Table 5.8, it can be said that most of the participants selected both reading all the chapters (85%) and watched the animations and videos (75%) at the same time to understand the equipment. Only a small percentage of the participants (25%) preferred to search the needed data to read. However, 16 of the participants were satisfied to have the opportunity of having both linear learning and non-linear learning. Only 4 of them had no comments on it.

The third group questions were about the movies part of the developed EPSSs. Approximately all of the participants (95%) agreed and strongly agreed that the movies and animations were qualified enough and sufficient to understand the experiments.

The other group of the questions was about the search part (non-linear learning) of the EPSSs. Because this part was developed much more later than the other parts, the users could not use it very sufficiently. According to Table 5.9, three of the participants (15%) said that they never used the search button, 8 of them (40%) never tried to use it. On the other hand, 9 (45%) said that they had experiences on the search button. Also the same number of them claimed that they reached enough search results. The other question of that group was on the explanation under the search text box. The data showed that it was clear enough to understand how to make a search. Most of the participants (85%) agreed and strongly agreed with this question, while 1 (5%) of them had no idea. One (5%) of them disagreed and one (5%) strongly disagreed.

Table 5. 9 Search Questions

	Strongly Disagree	Disagree	Neither Disagree / Agree	Agree	Strongly Agree
I often use the search button to find a keyword while using EPSS.	3 (15%)	8 (40%)	0 (0%)	9 (45%)	0 (0%)
I found enough documents to read in the search results.	3 (15%)	8 (40%)	0 (0%)	9 (45%)	0 (0%)
The explanation about the search under the search area is clear enough.	1 (5%)	5 (25%)	1 (5%)	10 (50%)	3 (15%)

The other group question group is on the language option of the EPSSs. According to Table 5.10, nineteen (95%) of the participants are strongly agreed and agreed that the language option is a good choice. Only one (5%) had no idea. Besides, 18 of them (90%) think that reading the chapters and explanations in preferred language is a good chance. However, 2 of them (10%) state that they have no idea about the language option.

Table 5. 10 Language Option Questions

	Strongly Disagree	Disagree	Neither Disagree / Agree	Agree	Strongly Agree
Language selection option is a good property (Turkish, Romanian, French, English, German).	0 (0%)	0 (0%)	1 (5%)	0 (0%)	19 (95%)
It is very useful to have a chance to read the documents in the preferred language.	0 (0%)	0 (0%)	2 (10%)	18 (90%)	0 (0%)

The last group of the question where general questions about EPSSs to better understand if they are capable to satisfied the needs of an EPSS. Table 5.11 summarizes the result of these questions.

Table 5. 11 General Purpose Questions

Answers	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
I usually use the EPSS link while doing my experiments	0 (0%)	1 (5%)	11 (55%)	8 (40%)
EPSS helps and fastened my time of learning	0 (0%)	4 (20%)	6 (30%)	10 (50%)
EPSS makes it easy to learn about the each equipment	1(5%)	4 (20%)	10 (50%)	5 (25%)
I saved time by using EPSS then searching or looking for the information about the equipment	1(5%)	0 (0%)	17 (85%)	2 (10%)

According to the Table 5.11 most of the participants (75%) who used and analyzed the developed systems preferred to use EPSS links to get information about the experiments or equipments. In addition, most of them (80%) thought that these EPSSs helped and fastened their time of learning while they were on the job. Only 5 of them had no idea about these statements. Twenty five percent (25%) of the participants said that they strongly agreed with the statement, EPSS made it easy to understand each of the equipments and 10% of them again agreed with it. Twenty percent (20%) of them had no idea and only 5% of them disagreed to the statement. Ninety five percent (95%) of them strongly agreed and agreed that they saved time by using EPSS then searching or looking for the information about the equipment. Five percent (5%) of the participants disagreed about the subject.

In the light of the collected answers from the questionnaire and the comments of the participants, it is clear that the developed EPSSs are successfully satisfied the user needs and the key characteristics of an EPSS. The interfaces, language option, index and button usage, and movies parts are useful enough to satisfy the requirements. However, the textures and explanations can be improved. The advisory (search) part is also useful but it must be examined after it is frequently used.

CHAPTER 6

DISCUSSIONS and CONCLUSIONS

In this chapter I summarize the work accomplished and give some directions for future work. The main objective and aim of this thesis was to find out “if an EPSS is an appropriate approach for training people on how to use remote or virtual laboratory equipment and accordingly to develop the most suitable EPSS interfaces for the potential users of ERRL project”. As mentioned in the introduction part the aim was tried to proof during the all chapters and can be said that this objective has been accomplished according to the requirement and system analysis questionnaire’s results. EPSS designs were completed so that all the users may easily reach the detailed information about the laboratory equipments. The system analysis questionnaire results showed that the information about the related equipments was detailed enough. Also, movies and animations are understandable enough. These interfaces helped especially students who really do not know anything about the equipments. The major benefits of the designed EPSSs can be listed as follows:

- The users can reach these EPSSs wherever and whenever they want. There are no time and place limitations because it is a computer based project.
- The user can reach these EPSSs while doing their jobs or experiments on the laboratory equipments. This means they can be used at the time of work and increase work efficiency.

- The information which is integrated on the systems is for every type of users such as students who have no experience on the equipments and technicians or even academicians who are fully informed but need some more details.
- The interfaces are developed so that the user can use both linear and non-linear learning strategy with the help of index part, where the necessary information is given chapter by chapter, and with the help of the search area, where the user can search a keyword to find some documents to read.
- Many types of materials are provided to the users such as textures, videos, audios, animations and pictures to supply variety of learning.
- Language option is also integrated to the interfaces so that the user can reach the information in the preferred language.

However, developing an EPSS is a very difficult task. Because it is a part of a big project, the steps must be followed very carefully. It is really important to understand the key characteristics of an EPSS, and to integrate and design a new EPSS for the remote laboratory equipments, with this knowledge. Based on user requirements, the general parts were decided and designed an interface for pilot equipment (VNA). The design phase was difficult, but the integration and the translation of the information into five different languages took much longer time than planned because the data was prepared by the partner countries of the ERRL project and Electric and Electronic Engineering Department of Atılım University. To complete the design, it is obvious to wait these details of the interfaces. It is not easy to get various types of data about the equipment. That takes time to produce them. Also the language translations are done by each of the partner countries (France, German, and Rumanian). This took time to receive all of them and integrate to the pilot system. The other difficulty of the system was creating non-linear learning part of the project (search part). It was really difficult to find how to search a specific directory to find and display the information needed to the user. It also took much longer time because it must be found the most suitable way for PHP development and XP operating system.

Besides the problems and advantages, the use of EPSSs presents several potential advantages for the higher education institutions, which are the partners of the ERRL project, such as they will use these systems in their laboratory hours of the related courses while the students are doing their experiments. This will help both students and teachers by reducing the necessity of the physical interaction with the equipments.

6.1 Limitations of the Study

There were some limitations in this study. One of them was the translation of the information. The pilot experiment's (VNA) translations are finished but the other systems translations cannot be done because of the lack of communication of with other partner countries.

The videos and animations are very difficult to produce. This job is also done by Balıkesir University which is one of the partners of the project. So, the pilot equipment has enough movies or animations, however the other systems have not.

Another important limitation was about database tables of the EPSS. The first design was created as EPSS has its own database different than ERRL project's database. After risk analysis phase of the project, because the project is integrated with Moodle, it was impossible to work with our database. So, I had to change the database model to XML model to get all the information of the main menus.

6.2 Future Study

In this thesis, the videos and language translations were not enough for the SA, OSC, RF Signal Generator and WFG equipments' EPSSs. In the future, these parts of the interfaces can be improved.

Also, this system is a stand-alone system. In the future, the system can be developed as it becomes integrated with MOODLE by converting it to API and Java Development environment.

Lastly, a new interface can be developed so that people can easily create an EPSS for new laboratory equipment. For this interface, it is enough to standardize the XML structures for images, content pages and movies.

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APPENDIX A

Requirement Analysis Questionnaire



Leonardo da Vinci Pilot Projects



Questionnaire for Students

Q1. Please select the best matches with you:

- ☐ BS student ☐ MS student
☐ Other (Please describe) _____

Q2. Please select your gender: ☐ Male ☐ Female

Q3. Please select your age interval:

- ☐ 15-19 ☐ 20-25 ☐ 26-35 ☐ 36-45 ☐ 46-

Q4. When learning a new subject, which one do you prefer? (*Please select only one*)

- ☐ studying on your own
☐ studying with someone who knows the subject well
☐ studying with a group

Q5. Which of the followings best matches with your learning abilities? (*Please select only one*)

- ☐ starting from the beginning of the subject and go through the chapters by order
☐ read the chapter that you want to know and leave the rest
☐ trying to understand the end of chapter examples & questions never read the rest
☐ searching on the keywords (by using search engine of the site or the index part of the book) and then studying on the results

Q6. Do you need to be guided when learning a new subject? *(Please select only one)*

- ☐ Yes, I need someone to teach me ☐ No, I can handle it on my own

Q7. When you try to learn a new subject by using a web-site, how do you prefer to study? (Please order the items below according to your preference, 1 is the most preferred one)

- ☐ Go through the chapters in a given order one by one
☐ Reach the information by means of keywords and read only the chapter you need
☐ By means of questions and answers between the system and you

Q8. When performing experiments on a computer I prefer: (Please order the items below according to your preference, 1 is the most preferred one)

- | | |
|---|---|
| ☐ Interactive | ☐ Batch jobs |
| ☐ Story based | ☐ By means of games |
| ☐ Figures on the subjects | ☐ Several problems and exercises |
| ☐ Games related with the subject | ☐ Animations on the subject |
| ☐ Text-based instructions | ☐ Sound-based instructions |
| ☐ Never study from a web-site | |

because_____

- ☐ Other (please

explain)_____

Q9. Please select the necessary ones for your carrier in radio communication area?

- | | |
|---|--|
| ☐ Electronics | ☐ RF |
| ☐ Electromagnetics | ☐ Telecommunication |
| ☐ Microwave | ☐ Antenna and propagation |

Q10. Please select the advantages you consider important for you in computer mediated communication

- ☐ Geographic independence
☐ Temporal independence
☐ You are not embarrassing for teacher's presence
☐ Silent (nobody disturb you)
☐ You can find quickly elements of all past communications

Q11. Please select the disadvantages you consider important for you in computer mediated communication

- ☐ Absence of immediately feedback for asynchronous communication
- ☐ Imperfect technology
- ☐ Not yet sufficient experience with the web and the Internet
- ☐ Reading online especially if the amount of information to be read online is significant
- ☐ You may not be certain whether other participants have received your message

APPENDIX B

System Analysis Questionnaire

QUESTIONNAIRE ABOUT ELECTRONIC PERFORMANCE SUPPORT SYSTEM (EPSS) EUROPEAN REMOTE RADIO LABORATORIES (ERRL) EQUIPMENT'S

Please do not leave unanswered questions for the first three!!

Q1. My gender is:

☐

Male

☐

Female

Q2. My age is between:

☐

17-25

☐

26-35

☐

36-45

Q3. My occupation is:

☐

Student

☐

Academician

☐

Technician

Please indicate how strongly you agree or disagree with each following statement:

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
1. The user interface of the laboratory equipments learning system (EPSS) is realistic.					
2. The user interface of the laboratory equipments learning system (EPSS) is close to real equipment.					
3. The user interfaces of the equipments are easy to use					
4. The pictures of the equipment are qualified enough to realize the real one.					
5. I easily find the buttons explanations of the equipment.					
6. Buttons explanations are clear to understand how to use each button in the front-panel of the equipment.					

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
7. I generally prefer linear learning (index part, reading chapter by chapter) while using the EPSS.					
8. I generally prefer non-linear learning (by searching the keywords) while using the EPSS.					
9. I generally prefer to watch and listen the videos and the audios while using the EPSS.					
10. When I choose to read index part of the system, I have a really good idea about the equipment.					
11. I really like to have both linear (index part, chapters) and non-linear (search and results keywords) learning together.					
Please explain the reasons about the question 11:					
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
12. I mostly prefer text material while using the EPSS.					
13. I mostly prefer to watch videos while using the EPSS.					
14. I mostly prefer animations while using the EPSS.					
15. The videos and animations are clear to understand.					
Please add your reasons about the question 15:					
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
16. I often use the search button to find a keyword while using EPSS.					

17. I found enough documents to read in the search results.					
18. The explanation about the search under the search area is clear enough.					
Please give your reasons about the question 18:					
19. Language selection option is a good property (Turkish, Romanian, French, English, German).					
20. It is very useful to have a chance to read the documents in the preferred language.					
Please state your other comments on language option of the EPSS:					
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
21. I usually use the EPSS link while doing my experiments.					
22. EPSS helps and fastened my time of learning.					
Please explain your reasons about question 22:					
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
23. EPSS makes it easy to learn about the each equipment.					
Please explain:					
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
24. I saved time by using EPSS then searching or					

looking for the information about the equipment.					
Please add your comments about the problems on EPSS:					

Please add your comments about how we can improve the interfaces of the equipment:					

Please state your other comments about EPSS:					

Thank you for your time!!

APPENDIX C

XML Structures

VNA XML STRUCTURE

```
<?xml version="1.0" encoding="iso-8859-1"?>
<FRONTPANEL>
  <FRAME>
    <TITLE>Vector Network Analyzer </TITLE>
    <SCREEN>VNA Screen</SCREEN>
    <BUTTON>Click on the buttons to see explanations</BUTTON>
    <STITLE>Search for:</STITLE>
    <SBUTTON>Search</SBUTTON>
    <LINK1>What is Vector Network Analyzer?</LINK1>
    <LINK2>Frequency Domain</LINK2>
    <LINK3>Sweep Types</LINK3>
    <LINK4>IF BandWidth</LINK4>
    <LINK5>Protection against electrostatic discharge</LINK5>
    <LINK6>How Does VNA Work?</LINK6>
    <LINK7>Measurement Setup</LINK7>
    <LINK8>S parameters and display formats</LINK8>
    <LINK9>Generalized Block Diagram of a VNA</LINK9>
    <LINK10>What is Calibration?</LINK10>
    <LINK11>Standards for vector network analyzer</LINK11>
    <LINK12>Sources and Types of Errors - Error model</LINK12>
    <LINK13>Types of Error Correction</LINK13>
    <LINK14>Example: A one-port calibration</LINK14>
    <LINK15>Reference planes</LINK15>
    <LINK16>Deembedding</LINK16>
    <LINK17>Overview of E8363A PNA Series Network Analyzer</LINK17>
    <LINK18>Data Sheet of E8363A PNA Series Network Analyzer</LINK18>
    <LINK19>Usage of the Menu</LINK19>
    <LINK20>VNA Calibration Animation</LINK20>
    <LINK25>VNA Calibration Video</LINK25>
    <LINK21>Block Diagram Flash Movie</LINK21>
    <LINK22>Frequency Flash Movie</LINK22>
    <LINK23>VNA Basic Experiment</LINK23>
    <LINK24>50ohm Load Measurement</LINK24>
  </FRAME>
</FRONTPANEL>
```

OSC XML STRUCTURE

```
<?xml version="1.0" encoding="iso-8859-1"?>
<FRONTPANEL>
  <FRAME>
    <TITLE>Oscilloscope </TITLE>
    <SCREEN>Oscilloscope Screen</SCREEN>
    <BUTTON>Click on the buttons to see explanations</BUTTON>
    <STITLE>Search for:</STITLE>
    <SBUTTON>Search</SBUTTON>
    <LINK1>What is an oscilloscope? </LINK1>
    <LINK2>What an oscilloscope measures?</LINK2>
    <LINK3>How does an oscilloscope works?</LINK3>
    <LINK4>Main Specs and Performance Terms</LINK4>
    <LINK5>Time domain</LINK5>
    <LINK6>Measurement Setup</LINK6>
    <LINK7>What is Calibration of a probe?</LINK7>
    <LINK8>Measurement Setup</LINK8>
    <LINK9>Voltage Measurements</LINK9>
    <LINK10>Time and Frequency Measurements</LINK10>
    <LINK11>Pulse and Rise Time Measurements</LINK11>
    <LINK12>Phase Shift Measurements</LINK12>

  </FRAME>
</FRONTPANEL>
```

RF XML STRUCTURE - ENG

```
<?xml version="1.0" encoding="iso-8859-1"?>
<FRONTPANEL>
  <FRAME>
    <TITLE>RF Signal Generator </TITLE>
    <SCREEN>RF Screen</SCREEN>
    <BUTTON>Click on the buttons to see explanations</BUTTON>
    <STITLE>Search for:</STITLE>
    <SBUTTON>Search</SBUTTON>
    <LINK1>What is RF Signal Generator? </LINK1>
    <LINK2>PSG-L Series Features</LINK2>
    <LINK3>Swept RF Output</LINK3>
    <LINK4>Overview of E8244A PSG-L Series Performance Signal Generator</LINK4>
    <LINK5>Overview of E8241A PSG-L Series Performance Signal Generator</LINK5>
    <LINK6>User Manual of E8244A and E8241A</LINK6>
  </FRAME>
</FRONTPANEL>
```

RF XML STRUCTURE - RUMANIAN

```
<?xml version="1.0" encoding="iso-8859-1"?>
<FRONTPANEL>
  <FRAME>
    <TITLE>Generator de semnal de radiofrecventa </TITLE>
    <SCREEN>Ecranul generatorului</SCREEN>
    <BUTTON>Apasati pe butoane pentru a vedea explicatiile</BUTTON>
    <STITLE>Cautare de:</STITLE>
    <SBUTTON>Cautare</SBUTTON>
    <LINK1>Ce este un generator de semnal de radiofrecventa</LINK1>
    <LINK2>Caracteristicile seriilor PSG-L</LINK2>
```

```

<LINK3>Iesirea de radiofrecventa baleiata</LINK3>
<LINK4>Privire de ansamblu a generatorului de semnal din seria E8244A PSG-L</LINK4>
<LINK5>Privire de ansamblu a generatorului de semnal din seria E8241A PSG-L</LINK5>
    <LINK6>Manual de utilizare pentru E8244A si E8241A</LINK6>
</FRAME>
</FRONTPANEL>

```

SA XML STRUCTURE – ENG

```

<?xml version="1.0" encoding="iso-8859-1"?>
<FRONTPANEL>
  <FRAME>
    <TITLE>Spectrum Analyzer </TITLE>
    <SCREEN>SA Screen</SCREEN>
    <BUTTON>Click on the buttons to see explanations</BUTTON>
    <STITLE>Search for:</STITLE>
    <SBUTTON>Search</SBUTTON>
    <LINK1>What is a Spectrum Analyzer? </LINK1>
    <LINK2>What does a Spectrum Analyzer do?</LINK2>
    <LINK3>Constitutive Components</LINK3>
    <LINK4>Mixer</LINK4>
    <LINK5>IF Filter</LINK5>
    <LINK6>Detector</LINK6>
    <LINK7>Video Filter</LINK7>
    <LINK8>Other Components</LINK8>
    <LINK9>How to make a Basic Measurement</LINK9>
    <LINK10>Influence of Resolution setting</LINK10>
    <LINK11>Influence of Sweep Time setting</LINK11>
    <LINK12>Influence of Attenuation setting</LINK12>
    <LINK13>General Information about SA</LINK13>

  </FRAME>
</FRONTPANEL>

```

WFG XML STRUCTURE – ENG

```

<?xml version="1.0" encoding="iso-8859-1"?>
<FRONTPANEL>
  <FRAME>
    <TITLE>Waveform Generator </TITLE>
    <SCREEN>Waveform Generator Screen</SCREEN>
    <BUTTON>Click on the buttons to see explanations</BUTTON>
    <STITLE>Search for:</STITLE>
    <SBUTTON>Search</SBUTTON>
    <LINK1>Agilent 33120A - Theory</LINK1>
    <LINK9>Direct Digital Synthesis</LINK9>
    <LINK2>Creating Arbitrary Waveforms</LINK2>
    <LINK3>Modulation</LINK3>
    <LINK4>Output Configuration</LINK4>
    <LINK5>Amplitude Modulation (AM)</LINK5>
    <LINK6>Frequency Modulation (FM)</LINK6>
    <LINK7>Frequency-Shift Keying (FSK) Modulation</LINK7>
    <LINK8>INDICATIONS </LINK8>

  </FRAME>
</FRONTPANEL>

```

APPENDIX D

Vector Network Analyzer Index Page with PHP

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<!--<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-9" />-->
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-9" />
<title>Vector Network Analyzer</title>
<link REL="StyleSheet" href="reference.css">
</head>
<style type="text/css">
a.men:link {color: black;font-weight:bold ; text-decoration: none ; font-size:90%;}
a.men:visited {color: black;font-weight:bold ; text-decoration: none ; font-size:90%;}
a.men:hover {color: black;font-weight:bold ; text-decoration: none ; font-size:90%;}
a.men:active {color: black;font-weight:bold ; text-decoration: none ; font-size:90%;}
li.men { list-style-image:url('./contents/Pictures/arrow1.gif'); }
</style>
<?php
    $dil = 1 ; // default inglizce
    if (isset($_GET["dil"])) )
        $dil = $_GET["dil"] ;
?>
<SCRIPT LANGUAGE="javascript">
function yonlendir()
{
    var secilen = myForm.dil.value ;
    window.location.href = '<?=$_SERVER["PHP_SELF"] ?>' + '?dil=' + secilen ;
}
function openWin(url){
subWindow1=window.open(url,"def","status=no,menubar=no,resizable=no,toolbar=no,scrollbars=yes
,height=200,width=500,top="+screen.height/4)+",left="+screen.width/4)
}

</SCRIPT>
<body >
<td colspan="2">
<table width="1100" height="526" border="0" noresize="noresize">
<tr>
<td width="620" height="474" rowspan="2" align="left">
<?
    if( $dil==1)
    {
        echo '<div align="center"></div>';
        echo '<xml src="front_panel.xml" id="xmldso" async="false"> </xml>';
```

```

echo '<table border="0">';
echo '<tr>';
echo '<td><div align="left"><font size="-1" color="#CC6600"> <b><span datasrc="#xmldso"
datafld="SCREEN"></span></b> </font></div></td>';
echo '<td><div align="right"><font size="-1" color="#CC6600"> <b><span datasrc="#xmldso"
datafld="BUTTON"></span></b> </font></div></td>';
echo '</tr>';
echo '<tr>';
echo '<td colspan="2"> ';
echo '</td>';
echo '</tr>';
echo '</table>';
echo '<map name="MAP274426669">';
echo '<area shape="rect" coords="462,245,624,267" href="#"
onclick="openWin(\./contents/keys/3.5 floppy.htm\)" />';
echo '<area shape="rect" coords="521,148,586,211" href="#" class="BSSCPopup"
onclick="openWin(\./contents/keys/rpg.htm\)" />';
echo '<area shape="RECT" coords="410,19,508,103" href="#" class="BSSCPopup" id="AREA1"
onclick="openWin(\./contents/keys/nav_pop.htm\)" />';
echo '<area shape="RECT" coords="409,103,512,130" href="#" id="AREA2"
onclick="openWin(\./contents/keys/f_keys_pop.htm\)" />';
echo '<area shape="RECT" coords="406,134,488,203" href="#" id="AREA3"
onclick="openWin(\./contents/keys/numeric.htm\)" />';
echo '<area shape="RECT" coords="406,203,435,225" href="#" id="AREA4"
onclick="openWin(\./contents/keys/numeric.htm\)" />';
echo '<area shape="RECT" coords="436,203,461,226" href="#" id="AREA5"
onclick="openWin(\./contents/keys/decimal_pop.htm\)" />';
echo '<area shape="RECT" coords="462,203,488,226" href="#" id="AREA6"
onclick="openWin(\./contents/keys/pmb_pop.htm\)" />';
echo '<area shape="RECT" coords="488,180,518,226" href="#" id="AREA7"
onclick="openWin(\./contents/keys/enter_pop.htm\)" />';
echo '<area shape="RECT" coords="488,134,516,179" href="#" id="AREA8"
onclick="openWin(\./contents/keys/units_pop.htm\)" />';
echo '<area shape="RECT" coords="518,102,550,127" href="#" id="AREA9"
onclick="openWin(\./contents/keys/cancel_pop.htm\)" />';
echo '<area shape="RECT" coords="617,99,645,122" href="#" id="AREA10"
onclick="openWin(\./contents/keys/format_pop.htm\)" />';
echo '<area shape="RECT" coords="520,40,547,61" href="#" id="AREA11"
onclick="openWin(\./contents/keys/meas_set.htm\)" />';
echo '<area shape="RECT" coords="403,235,453,274" href="#" id="AREA12"
onclick="openWin(\./contents/keys/probe_pwr.htm\)" />';
echo '<area shape="RECT" coords="648,146,678,167" href="#" id="AREA13"
onclick="openWin(\./contents/keys/math_mem.htm\)" />';
echo '<area shape="RECT" coords="587,64,614,85" href="#" id="AREA14"
onclick="openWin(\./contents/keys/trigger_pop.htm\)" />';
echo '<area shape="RECT" coords="550,79,581,102" href="#" id="AREA15"
onclick="openWin(\./contents/keys/help_pop.htm\)" />';
echo '<area shape="RECT" coords="614,40,645,63" href="#" id="AREA16"
onclick="openWin(\./contents/keys/channel_pop.htm\)" />';
echo '<area shape="RECT" coords="616,19,644,39" href="#" id="AREA17"
onclick="openWin(\./contents/keys/stop_span.htm\)" />';
echo '<area shape="RECT" coords="586,20,616,38" href="#" id="AREA18"
onclick="openWin(\./contents/keys/strt_cntr.htm\)" />';
echo '<area shape="RECT" coords="590,176,616,200" href="#" id="AREA19"
onclick="openWin(\./contents/keys/save_pop.htm\)" />';
echo '<area shape="RECT" coords="618,66,644,85" href="#" id="AREA20"
onclick="openWin(\./contents/keys/average.htm\)" />';

```

```

        echo '<area shape="rect" coords="636,233,683,266" href="#"
onclick="openWin(\'./contents/keys/usb.htm\')"/>';
        echo '<area shape="RECT" coords="590,202,617,225" href="#" id="AREA22"
onclick="openWin(\'./contents/keys/recall_pop.htm\')"/>';
        echo '<area shape="RECT" coords="649,97,679,121" href="#" id="AREA23"
onclick="openWin(\'./contents/keys/scale.htm\')"/>';
        echo '<area shape="rect" coords="617,175,648,201" href="#" id="AREA42"
onclick="openWin(\'./contents/keys/restore_pop.htm\')"/>';
        echo '<area shape="RECT" coords="616,145,647,169" href="#" id="AREA24"
onclick="openWin(\'./contents/keys/mkr_func.htm\')"/>';
        echo '<area shape="RECT" coords="618,202,648,225" href="#" id="AREA25"
onclick="openWin(\'./contents/keys/print_pop.htm\')"/>';
        echo '<area shape="RECT" coords="649,202,677,224" href="#" id="AREA26"
onclick="openWin(\'./contents/keys/macro_pop.htm\')"/>';
        echo '<area shape="RECT" coords="648,122,677,144" href="#" id="AREA27"
onclick="openWin(\'./contents/keys/limit_pop.htm\')"/>';
        echo '<area shape="RECT" coords="587,39,614,63" href="#" id="AREA28"
onclick="openWin(\'./contents/keys/swp_set.htm\')"/>';
        echo '<area shape="RECT" coords="518,80,549,101" href="#" id="AREA29"
onclick="openWin(\'./contents/keys/ok_pop.htm\')"/>';
        echo '<area shape="RECT" coords="649,174,677,200" href="#" id="AREA30"
onclick="openWin(\'./contents/keys/preset_pop.htm\')"/>';
        echo '<area shape="RECT" coords="587,146,616,168" href="#" id="AREA31"
onclick="openWin(\'./contents/keys/mkr_sch.htm\')"/>';
        echo '<area shape="RECT" coords="617,121,648,145" href="#" id="AREA32"
onclick="openWin(\'./contents/keys/mkr_tbl.htm\')"/>';
        echo '<area shape="RECT" coords="549,18,577,40" href="#" id="AREA33"
onclick="openWin(\'./contents/keys/window_pop.htm\')"/>';
        echo '<area shape="RECT" coords="647,41,674,61" href="#" id="AREA34"
onclick="openWin(\'./contents/keys/swp_type.htm\')"/>';
        echo '<area shape="RECT" coords="551,104,581,125" href="#" id="AREA35"
onclick="openWin(\'./contents/keys/menu_di.htm\')"/>';
        echo '<area shape="RECT" coords="549,43,575,61" href="#" id="AREA36"
onclick="openWin(\'./contents/keys/arrange_pop.htm\')"/>';
        echo '<area shape="RECT" coords="647,21,671,38" href="#" id="AREA37"
onclick="openWin(\'./contents/keys/power_pop.htm\')"/>';
        echo '<area shape="RECT" coords="589,121,616,146" href="#" id="AREA38"
onclick="openWin(\'./contents/keys/mkr.htm\')"/>';
        echo '<area shape="RECT" coords="646,64,676,84" href="#" id="AREA39"
onclick="openWin(\'./contents/keys/cal_pop.htm\')"/>';
        echo '<area shape="RECT" coords="587,97,616,121" href="#" id="AREA40"
onclick="openWin(\'./contents/keys/meas.htm\')"/>';
        echo '<area shape="RECT" coords="516,19,546,38" href="#" id="AREA41"
onclick="openWin(\'./contents/keys/trace_pop.htm\')"/>';
        echo '<area shape="rect" coords="124,315,580,388" href="#"
onclick="openWin(\'./contents/keys/test_ports.htm\')"/>';
        echo '</map>';
    }
else if( $dil==4)
    {
        echo '<div align="center"></div>';
        echo '<xml src="front_panel_ro.xml" id="xmldso_ro" async="false"> </xml>';
        echo '<table border="0">';
        echo '<tr>';
        echo '<td><div align="left"><font size="-1" color="#CC6600"> <b><span datasrc="#xmldso_ro"
datafld="SCREEN"></span></b> </font></div></td>';
        echo '<td><div align="right"><font size="-1" color="#CC6600"> <b><span
datasrc="#xmldso_ro" datafld="BUTTON"></span></b> </font></div></td>';
        echo '</tr>';
    }

```

```

echo '<tr>';
echo '<td colspan="2">';
echo '</td>';
echo '</tr>';
echo '</table>';
echo '<map name="MAP274426669">';
echo '<area shape="rect" coords="463,244,625,266" href="#"
onclick="openWin(\./contents/Roumanian/keys_ro/3.5 floppy_ro.htm\)" />';
echo '<area shape="rect" coords="521,148,586,211" href="#" class="BSSCPopup"
onclick="openWin(\./contents/Roumanian/keys_ro/rpg_ro.htm\)" />';
echo '<area shape="RECT" coords="410,19,508,103" href="#" class="BSSCPopup" id="AREA1"
onclick="openWin(\./contents/Roumanian/keys_ro/nav_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="409,103,512,130" href="#" id="AREA2"
onclick="openWin(\./contents/Roumanian/keys_ro/f_keys_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="406,134,488,203" href="#" id="AREA3"
onclick="openWin(\./contents/Roumanian/keys_ro/numeric_ro.htm\)" />';
echo '<area shape="RECT" coords="406,203,435,225" href="#" id="AREA4"
onclick="openWin(\./contents/Roumanian/keys_ro/numeric_ro.htm\)" />';
echo '<area shape="RECT" coords="436,203,461,226" href="#" id="AREA5"
onclick="openWin(\./contents/Roumanian/keys_ro/decimal_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="462,203,488,226" href="#" id="AREA6"
onclick="openWin(\./contents/Roumanian/keys_ro/pmb_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="488,180,518,226" href="#" id="AREA7"
onclick="openWin(\./contents/Roumanian/keys_ro/enter_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="488,134,516,179" href="#" id="AREA8"
onclick="openWin(\./contents/Roumanian/keys_ro/units_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="518,102,550,127" href="#" id="AREA9"
onclick="openWin(\./contents/Roumanian/keys_ro/cancel_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="617,99,645,122" href="#" id="AREA10"
onclick="openWin(\./contents/Roumanian/keys_ro/format_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="520,40,547,61" href="#" id="AREA11"
onclick="openWin(\./contents/Roumanian/keys_ro/meas_set_ro.htm\)" />';
echo '<area shape="RECT" coords="403,235,453,274" href="#" id="AREA12"
onclick="openWin(\./contents/Roumanian/keys_ro/probe_pwr_ro.htm\)" />';
echo '<area shape="RECT" coords="648,146,678,167" href="#" id="AREA13"
onclick="openWin(\./contents/Roumanian/keys_ro/math_mem_ro.htm\)" />';
echo '<area shape="RECT" coords="587,64,614,85" href="#" id="AREA14"
onclick="openWin(\./contents/Roumanian/keys_ro/trigger_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="550,79,581,102" href="#" id="AREA15"
onclick="openWin(\./contents/Roumanian/keys_ro/help_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="614,40,645,63" href="#" id="AREA16"
onclick="openWin(\./contents/Roumanian/keys_ro/channel_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="616,19,644,39" href="#" id="AREA17"
onclick="openWin(\./contents/Roumanian/keys_ro/stop_span_ro.htm\)" />';
echo '<area shape="RECT" coords="586,20,616,38" href="#" id="AREA18"
onclick="openWin(\./contents/Roumanian/keys_ro/strt_cntr_ro.htm\)" />';
echo '<area shape="RECT" coords="590,176,616,200" href="#" id="AREA19"
onclick="openWin(\./contents/Roumanian/keys_ro/save_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="618,66,644,85" href="#" id="AREA20"
onclick="openWin(\./contents/Roumanian/keys_ro/average_ro.htm\)" />';
echo '<area shape="rect" coords="636,233,683,266" href="#"
onclick="openWin(\./contents/Roumanian/keys_ro/usb_ro.htm\)" />';
echo '<area shape="RECT" coords="590,202,617,225" href="#" id="AREA22"
onclick="openWin(\./contents/Roumanian/keys_ro/recall_pop_ro.htm\)" />';
echo '<area shape="RECT" coords="649,97,679,121" href="#" id="AREA23"
onclick="openWin(\./contents/Roumanian/keys_ro/scale_ro.htm\)" />';
echo '<area shape="rect" coords="617,175,648,201" href="#" id="AREA42"
onclick="openWin(\./contents/Roumanian/keys_ro/restore_pop_ro.htm\)" />';

```

```

echo '<area shape="RECT" coords="616,145,647,169" href="#" id="AREA24"
onclick="openWin(\'./contents/Roumanian/keys_ro/mkr_func_ro.htm\')' />';
echo '<area shape="RECT" coords="618,202,648,225" href="#" id="AREA25"
onclick="openWin(\'./contents/Roumanian/keys_ro/print_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="649,202,677,224" href="#" id="AREA26"
onclick="openWin(\'./contents/Roumanian/keys_ro/macro_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="648,122,677,144" href="#" id="AREA27"
onclick="openWin(\'./contents/Roumanian/keys_ro/limit_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="587,39,614,63" href="#" id="AREA28"
onclick="openWin(\'./contents/Roumanian/keys_ro/swp_set_ro.htm\')' />';
echo '<area shape="RECT" coords="518,80,549,101" href="#" id="AREA29"
onclick="openWin(\'./contents/Roumanian/keys_ro/ok_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="649,174,677,200" href="#" id="AREA30"
onclick="openWin(\'./contents/Roumanian/keys_ro/preset_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="587,146,616,168" href="#" id="AREA31"
onclick="openWin(\'./contents/Roumanian/keys_ro/mkr_sch_ro.htm\')' />';
echo '<area shape="RECT" coords="617,121,648,145" href="#" id="AREA32"
onclick="openWin(\'./contents/Roumanian/keys_ro/mkr_tbl_ro.htm\')' />';
echo '<area shape="RECT" coords="549,18,577,40" href="#" id="AREA33"
onclick="openWin(\'./contents/Roumanian/keys_ro/window_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="647,41,674,61" href="#" id="AREA34"
onclick="openWin(\'./contents/Roumanian/keys_ro/swp_type_ro.htm\')' />';
echo '<area shape="RECT" coords="551,104,581,125" href="#" id="AREA35"
onclick="openWin(\'./contents/Roumanian/keys_ro/menu_di_ro.htm\')' />';
echo '<area shape="RECT" coords="549,43,575,61" href="#" id="AREA36"
onclick="openWin(\'./contents/Roumanian/keys_ro/arrange_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="647,21,671,38" href="#" id="AREA37"
onclick="openWin(\'./contents/Roumanian/keys_ro/power_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="589,121,616,146" href="#" id="AREA38"
onclick="openWin(\'./contents/Roumanian/keys_ro/mkr_ro.htm\')' />';
echo '<area shape="RECT" coords="646,64,676,84" href="#" id="AREA39"
onclick="openWin(\'./contents/Roumanian/keys_ro/cal_pop_ro.htm\')' />';
echo '<area shape="RECT" coords="587,97,616,121" href="#" id="AREA40"
onclick="openWin(\'./contents/Roumanian/keys_ro/meas_ro.htm\')' />';
echo '<area shape="RECT" coords="516,19,546,38" href="#" id="AREA41"
onclick="openWin(\'./contents/Roumanian/keys_ro/trace_pop_ro.htm\')' />';
echo '<area shape="rect" coords="124,315,580,388" href="#"
onclick="openWin(\'./contents/Roumanian/keys_ro/test_ports_ro.htm\')' />';
echo '</map>';

}
else if( $dil==3)
{
    echo '<div align="center"></div>';
    echo '<xml src="front_panel_fr.xml" id="xmldso_fr" async="false"> </xml>';
    echo '<table border="0">';
    echo '<tr>';
    echo '<td><div align="left"><font size="-1" color="#CC6600"> <b><span datasrc="#xmldso_fr"
datafld="SCREEN"></span></b> </font></div></td>';
    echo '<td><div align="right"><font size="-1" color="#CC6600"> <b><span datasrc="#xmldso_fr"
datafld="BUTTON"></span></b> </font></div></td>';
    echo '</tr>';
    echo '<tr>';
    echo '<td colspan="2">';
    echo '</td>';
    echo '</tr>';
    echo '</table>';
    echo '<map name="MAP274426669">';

```

```

echo '<area shape="rect" coords="462,245,624,267" href="#"
onclick="openWin(\'./contents/French/keys_fr/3.5 floppy_fre.htm\')' />';
echo '<area shape="rect" coords="521,148,586,211" href="#" class="BSSCPopup"
onclick="openWin(\'./contents/French/keys_fr/rpg_fre.htm\')' />';
echo '<area shape="RECT" coords="410,19,508,103" href="#" class="BSSCPopup" id="AREA1"
onclick="openWin(\'./contents/French/keys_fr/nav_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="409,103,512,130" href="#" id="AREA2"
onclick="openWin(\'./contents/French/keys_fr/f_keys_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="406,134,488,203" href="#" id="AREA3"
onclick="openWin(\'./contents/French/keys_fr/numeric_fre.htm\')' />';
echo '<area shape="RECT" coords="406,203,435,225" href="#" id="AREA4"
onclick="openWin(\'./contents/French/keys_fr/numeric_fre.htm\')' />';
echo '<area shape="RECT" coords="436,203,461,226" href="#" id="AREA5"
onclick="openWin(\'./contents/French/keys_fr/decimal_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="462,203,488,226" href="#" id="AREA6"
onclick="openWin(\'./contents/French/keys_fr/pmb_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="488,180,518,226" href="#" id="AREA7"
onclick="openWin(\'./contents/French/keys_fr/enter_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="488,134,516,179" href="#" id="AREA8"
onclick="openWin(\'./contents/French/keys_fr/units_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="518,102,550,127" href="#" id="AREA9"
onclick="openWin(\'./contents/French/keys_fr/cancel_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="617,99,645,122" href="#" id="AREA10"
onclick="openWin(\'./contents/French/keys_fr/format_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="520,40,547,61" href="#" id="AREA11"
onclick="openWin(\'./contents/French/keys_fr/meas_set_fre.htm\')' />';
echo '<area shape="RECT" coords="403,235,453,274" href="#" id="AREA12"
onclick="openWin(\'./contents/French/keys_fr/probe_pwr_fre.htm\')' />';
echo '<area shape="RECT" coords="648,146,678,167" href="#" id="AREA13"
onclick="openWin(\'./contents/French/keys_fr/math_mem_fre.htm\')' />';
echo '<area shape="RECT" coords="587,64,614,85" href="#" id="AREA14"
onclick="openWin(\'./contents/French/keys_fr/trigger_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="550,79,581,102" href="#" id="AREA15"
onclick="openWin(\'./contents/French/keys_fr/help_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="614,40,645,63" href="#" id="AREA16"
onclick="openWin(\'./contents/French/keys_fr/channel_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="616,19,644,39" href="#" id="AREA17"
onclick="openWin(\'./contents/French/keys_fr/stop_span_fre.htm\')' />';
echo '<area shape="RECT" coords="586,20,616,38" href="#" id="AREA18"
onclick="openWin(\'./contents/French/keys_fr/strt_cntr_fre.htm\')' />';
echo '<area shape="RECT" coords="590,176,616,200" href="#" id="AREA19"
onclick="openWin(\'./contents/French/keys_fr/save_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="618,66,644,85" href="#" id="AREA20"
onclick="openWin(\'./contents/French/keys_fr/average_fre.htm\')' />';
echo '<area shape="rect" coords="636,233,683,266" href="#"
onclick="openWin(\'./contents/French/keys_fr/usb_fre.htm\')' />';
echo '<area shape="RECT" coords="590,202,617,225" href="#" id="AREA22"
onclick="openWin(\'./contents/French/keys_fr/recall_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="649,97,679,121" href="#" id="AREA23"
onclick="openWin(\'./contents/French/keys_fr/scale_fre.htm\')' />';
echo '<area shape="rect" coords="617,175,648,201" href="#" id="AREA42"
onclick="openWin(\'./contents/French/keys_fr/restore_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="616,145,647,169" href="#" id="AREA24"
onclick="openWin(\'./contents/French/keys_fr/mkr_func_fre.htm\')' />';
echo '<area shape="RECT" coords="618,202,648,225" href="#" id="AREA25"
onclick="openWin(\'./contents/French/keys_fr/print_pop_fre.htm\')' />';
echo '<area shape="RECT" coords="649,202,677,224" href="#" id="AREA26"
onclick="openWin(\'./contents/French/keys_fr/macro_pop_fre.htm\')' />';

```

```

        echo '<area shape="RECT" coords="648,122,677,144" href="#" id="AREA27"
onclick="openWin(\'./contents/French/keys_fr/limit_pop_fre.htm\')"/>';
        echo '<area shape="RECT" coords="587,39,614,63" href="#" id="AREA28"
onclick="openWin(\'./contents/French/keys_fr/swp_set_fre.htm\')"/>';
        echo '<area shape="RECT" coords="518,80,549,101" href="#" id="AREA29"
onclick="openWin(\'./contents/French/keys_fr/ok_pop_fre.htm\')"/>';
        echo '<area shape="RECT" coords="649,174,677,200" href="#" id="AREA30"
onclick="openWin(\'./contents/French/keys_fr/preset_pop_fre.htm\')"/>';
        echo '<area shape="RECT" coords="587,146,616,168" href="#" id="AREA31"
onclick="openWin(\'./contents/French/keys_fr/mkr_sch_fre.htm\')"/>';
        echo '<area shape="RECT" coords="617,121,648,145" href="#" id="AREA32"
onclick="openWin(\'./contents/French/keys_fr/mkr_tbl_fre.htm\')"/>';
        echo '<area shape="RECT" coords="549,18,577,40" href="#" id="AREA33"
onclick="openWin(\'./contents/French/keys_fr/window_pop_fre.htm\')"/>';
        echo '<area shape="RECT" coords="647,41,674,61" href="#" id="AREA34"
onclick="openWin(\'./contents/French/keys_fr/swp_type_fre.htm\')"/>';
        echo '<area shape="RECT" coords="551,104,581,125" href="#" id="AREA35"
onclick="openWin(\'./contents/French/keys_fr/menu_di_fre.htm\')"/>';
        echo '<area shape="RECT" coords="549,43,575,61" href="#" id="AREA36"
onclick="openWin(\'./contents/French/keys_fr/arrange_pop_fre.htm\')"/>';
        echo '<area shape="RECT" coords="647,21,671,38" href="#" id="AREA37"
onclick="openWin(\'./contents/French/keys_fr/power_pop_fre.htm\')"/>';
        echo '<area shape="RECT" coords="589,121,616,146" href="#" id="AREA38"
onclick="openWin(\'./contents/French/keys_fr/mkr_fre.htm\')"/>';
        echo '<area shape="RECT" coords="646,64,676,84" href="#" id="AREA39"
onclick="openWin(\'./contents/French/keys_fr/cal_pop_fre.htm\')"/>';
        echo '<area shape="RECT" coords="587,97,616,121" href="#" id="AREA40"
onclick="openWin(\'./contents/French/keys_fr/meas_fre.htm\')"/>';
        echo '<area shape="RECT" coords="516,19,546,38" href="#" id="AREA41"
onclick="openWin(\'./contents/French/keys_fr/trace_pop_fre.htm\')"/>';
        echo '<area shape="rect" coords="124,315,580,388" href="#"
onclick="openWin(\'./contents/French/keys_fr/test_ports_fre.htm\')"/>';
        echo '</map>';
    }
    else if( $dil==2)
    {
        echo '<div align="center"></div>';
        echo '<xml src="front_panel_ger.xml" id="xmldso_ger" async="false"> </xml>';
        echo '<table border="0">';
        echo '<tr>';
        echo '<td><div align="left"><font size="-1" color="#CC6600"> <b><span datasrc="#xmldso_ger"
datafld="SCREEN"></span></b> </font></div></td>';
        echo '<td><div align="right"><font size="-1" color="#CC6600"> <b><span
datasrc="#xmldso_ger" datafld="BUTTON"></span></b> </font></div></td>';
        echo '</tr>';
        echo '<tr>';
        echo '<td colspan="2">';
        echo '</td>';
        echo '</tr>';
        echo '</table>';
        echo '<map name="MAP274426669">';
        echo '<area shape="rect" coords="462,245,624,267" href="#"
onclick="openWin(\'./contents/keys/3.5 floppy.htm\')"/>';
        echo '<area shape="rect" coords="521,148,586,211" href="#" class="BSSCPopup"
onclick="openWin(\'./contents/keys/rpg.htm\')"/>';
        echo '<area shape="RECT" coords="410,19,508,103" href="#" class="BSSCPopup" id="AREA1"
onclick="openWin(\'./contents/keys/nav_pop.htm\')"/>';
    }

```

```

echo '<area shape="RECT" coords="409,103,512,130" href="#" id="AREA2"
onclick="openWin(\'./contents/keys/f_keys_pop.htm\')"/>';
echo '<area shape="RECT" coords="406,134,488,203" href="#" id="AREA3"
onclick="openWin(\'./contents/keys/numeric.htm\')"/>';
echo '<area shape="RECT" coords="406,203,435,225" href="#" id="AREA4"
onclick="openWin(\'./contents/keys/numeric.htm\')"/>';
echo '<area shape="RECT" coords="436,203,461,226" href="#" id="AREA5"
onclick="openWin(\'./contents/keys/decimal_pop.htm\')"/>';
echo '<area shape="RECT" coords="462,203,488,226" href="#" id="AREA6"
onclick="openWin(\'./contents/keys/pmb_pop.htm\')"/>';
echo '<area shape="RECT" coords="488,180,518,226" href="#" id="AREA7"
onclick="openWin(\'./contents/keys/enter_pop.htm\')"/>';
echo '<area shape="RECT" coords="488,134,516,179" href="#" id="AREA8"
onclick="openWin(\'./contents/keys/units_pop.htm\')"/>';
echo '<area shape="RECT" coords="518,102,550,127" href="#" id="AREA9"
onclick="openWin(\'./contents/keys/cancel_pop.htm\')"/>';
echo '<area shape="RECT" coords="617,99,645,122" href="#" id="AREA10"
onclick="openWin(\'./contents/keys/format_pop.htm\')"/>';
echo '<area shape="RECT" coords="520,40,547,61" href="#" id="AREA11"
onclick="openWin(\'./contents/keys/meas_set.htm\')"/>';
echo '<area shape="RECT" coords="403,235,453,274" href="#" id="AREA12"
onclick="openWin(\'./contents/keys/probe_pwr.htm\')"/>';
echo '<area shape="RECT" coords="648,146,678,167" href="#" id="AREA13"
onclick="openWin(\'./contents/keys/math_mem.htm\')"/>';
echo '<area shape="RECT" coords="587,64,614,85" href="#" id="AREA14"
onclick="openWin(\'./contents/keys/trigger_pop.htm\')"/>';
echo '<area shape="RECT" coords="550,79,581,102" href="#" id="AREA15"
onclick="openWin(\'./contents/keys/help_pop.htm\')"/>';
echo '<area shape="RECT" coords="614,40,645,63" href="#" id="AREA16"
onclick="openWin(\'./contents/keys/channel_pop.htm\')"/>';
echo '<area shape="RECT" coords="616,19,644,39" href="#" id="AREA17"
onclick="openWin(\'./contents/keys/stop_span.htm\')"/>';
echo '<area shape="RECT" coords="586,20,616,38" href="#" id="AREA18"
onclick="openWin(\'./contents/keys/strt_cntr.htm\')"/>';
echo '<area shape="RECT" coords="590,176,616,200" href="#" id="AREA19"
onclick="openWin(\'./contents/keys/save_pop.htm\')"/>';
echo '<area shape="RECT" coords="618,66,644,85" href="#" id="AREA20"
onclick="openWin(\'./contents/keys/average.htm\')"/>';
echo '<area shape="rect" coords="636,233,683,266" href="#"
onclick="openWin(\'./contents/keys/usb.htm\')"/>';
echo '<area shape="RECT" coords="590,202,617,225" href="#" id="AREA22"
onclick="openWin(\'./contents/keys/recall_pop.htm\')"/>';
echo '<area shape="RECT" coords="649,97,679,121" href="#" id="AREA23"
onclick="openWin(\'./contents/keys/scale.htm\')"/>';
echo '<area shape="rect" coords="617,175,648,201" href="#" id="AREA42"
onclick="openWin(\'./contents/keys/restore_pop.htm\')"/>';
echo '<area shape="RECT" coords="616,145,647,169" href="#" id="AREA24"
onclick="openWin(\'./contents/keys/mkr_func.htm\')"/>';
echo '<area shape="RECT" coords="618,202,648,225" href="#" id="AREA25"
onclick="openWin(\'./contents/keys/print_pop.htm\')"/>';
echo '<area shape="RECT" coords="649,202,677,224" href="#" id="AREA26"
onclick="openWin(\'./contents/keys/macro_pop.htm\')"/>';
echo '<area shape="RECT" coords="648,122,677,144" href="#" id="AREA27"
onclick="openWin(\'./contents/keys/limit_pop.htm\')"/>';
echo '<area shape="RECT" coords="587,39,614,63" href="#" id="AREA28"
onclick="openWin(\'./contents/keys/swp_set.htm\')"/>';
echo '<area shape="RECT" coords="518,80,549,101" href="#" id="AREA29"
onclick="openWin(\'./contents/keys/ok_pop.htm\')"/>';

```

```

    echo '<area shape="RECT" coords="649,174,677,200" href="#" id="AREA30"
onclick="openWin(\'./contents/keys/preset_pop.htm\')"/>';
    echo '<area shape="RECT" coords="587,146,616,168" href="#" id="AREA31"
onclick="openWin(\'./contents/keys/mkr_sch.htm\')"/>';
    echo '<area shape="RECT" coords="617,121,648,145" href="#" id="AREA32"
onclick="openWin(\'./contents/keys/mkr_tbl.htm\')"/>';
    echo '<area shape="RECT" coords="549,18,577,40" href="#" id="AREA33"
onclick="openWin(\'./contents/keys/window_pop.htm\')"/>';
    echo '<area shape="RECT" coords="647,41,674,61" href="#" id="AREA34"
onclick="openWin(\'./contents/keys/swp_type.htm\')"/>';
    echo '<area shape="RECT" coords="551,104,581,125" href="#" id="AREA35"
onclick="openWin(\'./contents/keys/menu_di.htm\')"/>';
    echo '<area shape="RECT" coords="549,43,575,61" href="#" id="AREA36"
onclick="openWin(\'./contents/keys/arrange_pop.htm\')"/>';
    echo '<area shape="RECT" coords="647,21,671,38" href="#" id="AREA37"
onclick="openWin(\'./contents/keys/power_pop.htm\')"/>';
    echo '<area shape="RECT" coords="589,121,616,146" href="#" id="AREA38"
onclick="openWin(\'./contents/keys/mkr.htm\')"/>';
    echo '<area shape="RECT" coords="646,64,676,84" href="#" id="AREA39"
onclick="openWin(\'./contents/keys/cal_pop.htm\')"/>';
    echo '<area shape="RECT" coords="587,97,616,121" href="#" id="AREA40"
onclick="openWin(\'./contents/keys/meas.htm\')"/>';
    echo '<area shape="RECT" coords="516,19,546,38" href="#" id="AREA41"
onclick="openWin(\'./contents/keys/trace_pop.htm\')"/>';
    echo '<area shape="rect" coords="124,315,580,388" href="#"
onclick="openWin(\'./contents/keys/test_ports.htm\')"/>';
    echo '</map>';
}
else if( $dil==0)
{
    echo '<div align="center"></div>';
    echo '<xml src="front_panel_tr.xml" id="xmldso_tr" async="false"></xml>';
    echo '<table border="0">';
    echo '<tr>';
    echo '<td><div align="left"><font size="-1" color="#CC6600"> <b><span datasrc="#xmldso_tr"
datafld="SCREEN"></span></b> </font></div></td>';
    echo '<td><div align="right"><font size="-1" color="#CC6600"> <b><span datasrc="#xmldso_tr"
datafld="BUTTON"></span></b> </font></div></td>';
    echo '</tr>';
    echo '<tr>';
    echo '<td colspan="2">';
    echo '</td>';
    echo '</tr>';
    echo '</table>';
    echo '<map name="MAP274426669">';
    echo '<area shape="rect" coords="463,244,625,266" href="#"
onclick="openWin(\'./contents/Turkish/keys_tr/3.5 floppy_tr.htm\')"/>';
    echo '<area shape="rect" coords="521,148,586,211" href="#" class="BSSCPopup"
onclick="openWin(\'./contents/Turkish/keys_tr/rpg_tr.htm\')"/>';
    echo '<area shape="RECT" coords="410,19,508,103" href="#" class="BSSCPopup" id="AREA1"
onclick="openWin(\'./contents/Turkish/keys_tr/nav_pop_tr.htm\')"/>';
    echo '<area shape="RECT" coords="409,103,512,130" href="#" id="AREA2"
onclick="openWin(\'./contents/Turkish/keys_tr/f_keys_pop_tr.htm\')"/>';
    echo '<area shape="RECT" coords="406,134,488,203" href="#" id="AREA3"
onclick="openWin(\'./contents/Turkish/keys_tr/numeric_tr.htm\')"/>';
    echo '<area shape="RECT" coords="406,203,435,225" href="#" id="AREA4"
onclick="openWin(\'./contents/Turkish/keys_tr/numeric_tr.htm\')"/>';

```

```

echo '<area shape="RECT" coords="436,203,461,226" href="#" id="AREA5"
onclick="openWin(\'./contents/Turkish/keys_tr/decimal_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="462,203,488,226" href="#" id="AREA6"
onclick="openWin(\'./contents/Turkish/keys_tr/pmb_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="488,180,518,226" href="#" id="AREA7"
onclick="openWin(\'./contents/Turkish/keys_tr/enter_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="488,134,516,179" href="#" id="AREA8"
onclick="openWin(\'./contents/Turkish/keys_tr/units_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="518,102,550,127" href="#" id="AREA9"
onclick="openWin(\'./contents/Turkish/keys_tr/cancel_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="617,99,645,122" href="#" id="AREA10"
onclick="openWin(\'./contents/Turkish/keys_tr/format_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="520,40,547,61" href="#" id="AREA11"
onclick="openWin(\'./contents/Turkish/keys_tr/meas_set_tr.htm\')' />';
echo '<area shape="RECT" coords="403,235,453,274" href="#" id="AREA12"
onclick="openWin(\'./contents/Turkish/keys_tr/probe_pwr_tr.htm\')' />';
echo '<area shape="RECT" coords="648,146,678,167" href="#" id="AREA13"
onclick="openWin(\'./contents/Turkish/keys_tr/math_mem_tr.htm\')' />';
echo '<area shape="RECT" coords="587,64,614,85" href="#" id="AREA14"
onclick="openWin(\'./contents/Turkish/keys_tr/trigger_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="550,79,581,102" href="#" id="AREA15"
onclick="openWin(\'./contents/Turkish/keys_tr/help_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="614,40,645,63" href="#" id="AREA16"
onclick="openWin(\'./contents/Turkish/keys_tr/channel_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="616,19,644,39" href="#" id="AREA17"
onclick="openWin(\'./contents/Turkish/keys_tr/stop_span_tr.htm\')' />';
echo '<area shape="RECT" coords="586,20,616,38" href="#" id="AREA18"
onclick="openWin(\'./contents/Turkish/keys_tr/strt_cntr_tr.htm\')' />';
echo '<area shape="RECT" coords="590,176,616,200" href="#" id="AREA19"
onclick="openWin(\'./contents/Turkish/keys_tr/save_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="618,66,644,85" href="#" id="AREA20"
onclick="openWin(\'./contents/Turkish/keys_tr/average_tr.htm\')' />';
echo '<area shape="rect" coords="636,233,683,266" href="#"
onclick="openWin(\'./contents/Turkish/keys_tr/usb_tr.htm\')' />';
echo '<area shape="RECT" coords="590,202,617,225" href="#" id="AREA22"
onclick="openWin(\'./contents/Turkish/keys_tr/recall_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="649,97,679,121" href="#" id="AREA23"
onclick="openWin(\'./contents/Turkish/keys_tr/scale_tr.htm\')' />';
echo '<area shape="rect" coords="617,175,648,201" href="#" id="AREA42"
onclick="openWin(\'./contents/Turkish/keys_tr/restore_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="616,145,647,169" href="#" id="AREA24"
onclick="openWin(\'./contents/Turkish/keys_tr/mkr_func_tr.htm\')' />';
echo '<area shape="RECT" coords="618,202,648,225" href="#" id="AREA25"
onclick="openWin(\'./contents/Turkish/keys_tr/print_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="649,202,677,224" href="#" id="AREA26"
onclick="openWin(\'./contents/Turkish/keys_tr/macro_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="648,122,677,144" href="#" id="AREA27"
onclick="openWin(\'./contents/Turkish/keys_tr/limit_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="587,39,614,63" href="#" id="AREA28"
onclick="openWin(\'./contents/Turkish/keys_tr/swp_set_tr.htm\')' />';
echo '<area shape="RECT" coords="518,80,549,101" href="#" id="AREA29"
onclick="openWin(\'./contents/Turkish/keys_tr/ok_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="649,174,677,200" href="#" id="AREA30"
onclick="openWin(\'./contents/Turkish/keys_tr/preset_pop_tr.htm\')' />';
echo '<area shape="RECT" coords="587,146,616,168" href="#" id="AREA31"
onclick="openWin(\'./contents/Turkish/keys_tr/mkr_sch_tr.htm\')' />';
echo '<area shape="RECT" coords="617,121,648,145" href="#" id="AREA32"
onclick="openWin(\'./contents/Turkish/keys_tr/mkr_tbl_tr.htm\')' />';

```

```

    echo '<area shape="RECT" coords="549,18,577,40" href="#" id="AREA33"
onclick="openWin(\'./contents/Turkish/keys_tr/window_pop_tr.htm\')' />';
    echo '<area shape="RECT" coords="647,41,674,61" href="#" id="AREA34"
onclick="openWin(\'./contents/Turkish/keys_tr/swp_type_tr.htm\')' />';
    echo '<area shape="RECT" coords="551,104,581,125" href="#" id="AREA35"
onclick="openWin(\'./contents/Turkish/keys_tr/menu_di_tr.htm\')' />';
    echo '<area shape="RECT" coords="549,43,575,61" href="#" id="AREA36"
onclick="openWin(\'./contents/Turkish/keys_tr/arrange_pop_tr.htm\')' />';
    echo '<area shape="RECT" coords="647,21,671,38" href="#" id="AREA37"
onclick="openWin(\'./contents/Turkish/keys_tr/power_pop_tr.htm\')' />';
    echo '<area shape="RECT" coords="589,121,616,146" href="#" id="AREA38"
onclick="openWin(\'./contents/Turkish/keys_tr/mkr_tr.htm\')' />';
    echo '<area shape="RECT" coords="646,64,676,84" href="#" id="AREA39"
onclick="openWin(\'./contents/Turkish/keys_tr/cal_pop_tr.htm\')' />';
    echo '<area shape="RECT" coords="587,97,616,121" href="#" id="AREA40"
onclick="openWin(\'./contents/Turkish/keys_tr/meas_tr.htm\')' />';
    echo '<area shape="RECT" coords="516,19,546,38" href="#" id="AREA41"
onclick="openWin(\'./contents/Turkish/keys_tr/trace_pop_tr.htm\')' />';
    echo '<area shape="rect" coords="124,315,580,388" href="#"
onclick="openWin(\'./contents/Turkish/keys_tr/test_ports_tr.htm\')' />';
    echo '</map>';
}
?>
<br />
<?
    echo "<form method='GET' action='search.php' target='_blank'>";
    //echo "<p align='center'>";
    if($dil==1 )
    {
        echo "<xml src='front_panel.xml' id='xmldso' async='false'></xml>";
        echo "<span datasrc='\"#xmldso\"' datafld='STITLE'></span>";
        echo "<input type='text' size='50' name='search'>";
        echo "<input type='submit' name='submit' value='\" <? echo \"<span
datasrc='\"#xmldso\"' datafld='SBUTTON'></span> ";
    }
    else if($dil==4)
    {
        echo "<xml src='front_panel_ro.xml' id='xmldso_ro' async='false'></xml>";
        echo "<span datasrc='\"#xmldso_ro\"' datafld='STITLE'></span>";
        echo "<input type='text' size='50' name='search'>";
        echo "<input type='submit' name='submit' value='\" <? echo \"<span
datasrc='\"#xmldso_ro\"' datafld='SBUTTON'></span> ";
    }
    else if($dil==3)
    {
        echo "<xml src='front_panel_fr.xml' id='xmldso_fr' async='false'></xml>";
        echo "<span datasrc='\"#xmldso_fr\"' datafld='STITLE'></span>";
        echo "<input type='text' size='50' name='search'>";
        echo "<input type='submit' name='submit' value='\" <? echo \"<span
datasrc='\"#xmldso_fr\"' datafld='SBUTTON'></span> ";
    }
    else if($dil==2)
    {
        echo "<xml src='front_panel_ger.xml' id='xmldso_ger' async='false'></xml>";
        echo "<span datasrc='\"#xmldso_ger\"' datafld='STITLE'></span>";
        echo "<input type='text' size='50' name='search'>";
        echo "<input type='submit' name='submit' value='\" <? echo \"<span
datasrc='\"#xmldso_ger\"' datafld='SBUTTON'></span> ";
    }
    else if($dil==0)

```

```

{
    echo '<xml src="front_panel_tr.xml" id="xmldso_tr" async="false"></xml>';
    echo "<span datasrc=\"\#xmldso_tr\" datafld=\"STITLE\"></span>";
    echo "<input type=\"text\" size=\"50\" name=\"search\">";
    echo "<input type=\"submit\" name=\"submit\" value=\"<? echo \"<span
datasrc=\"\#xmldso_tr\" datafld=\"SBUTTON\"></span> ";
}
echo "</form>";
?>
<span style="color:#0000CC">Search Examples: </span><p> <span
style="color:#990000">Search only a word </span>: vna <br /> <span style="color:#990000">Serch
for a longer keyword </span>: reference<span style="color:#990000">+</span>planes</td>
<td width="446" height="1px" align="center">
    <form name='myForm' action="">
        Language : <select name="dil" onchange="yonlendir()">
            <?php
            $diller = array('Turkish', 'English', 'German', 'French', 'Roumanian' ) ;
            for ( $i=0 ; $i<count($diller); $i++)
                if ( $dil == $i)
                    print '<option value='.$i.' selected>'.$diller[$i].'</option>';
                else
                    print '<option value='.$i.'>'.$diller[$i].'</option>';
            ?>

        </form> </td>
</tr>
<tr>
<td>

<?
    if($dil==1 )
    {
        echo '<xml src="front_panel.xml" id="xmldso" async="false"></xml>';
        echo '<table width="280">';
        echo '<tr><td align="left"></td>';
        echo '<td align="right"><a href="contents/keys/HELP.html"
target="_blank"><b>HELP</b></a></td></tr></table>';
        echo '<ul>';
        echo '<li class="men"><a href="./contents/what_vna.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK1"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/frdomain.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK2"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/sweep.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK3"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/protec.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK5"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/how_work.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK6"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/msetup.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK7"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/s_params.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK8"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/blockdiag_vna.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK9"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/IF_band.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK4"></span></b></a></li>';
        echo '<li class="men"><a href="./contents/calibration.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK10"></span></b></a></li>';
    }
}

```

```

        echo '<li class="men"><a href="/contents/stdntrts.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK11"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/errors.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK12"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/error_cor.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK13"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/one_portcal.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK14"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/reference_planes.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK15"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/deembedding.html" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK16"></span></b></a></li>';
        echo '<li class="men"><a
href="http://www.home.agilent.com/agilent/product.jsp?cc=US&lc=eng&ckey=100000460
8:epsg:pro&nid=-536902667.536881742.00&id=1000004608:epsg:pro" target="_blank"
class="men"><b><span datasrc="#xmldso" datafld="LINK17"></span></b></a></li>';
        echo '<li class="men"><a href="http://cp.literature.agilent.com/litweb/pdf/5988-
3992EN.pdf" target="_blank" class="men"> <b><span datasrc="#xmldso"
datafld="LINK18"></span></b></a></li>';
        echo '</ul>';
        echo '';
        echo '<ul>';
        echo '<li class="men"><a href="/contents/Pictures/menuleryeni.swf"
target="_blank" class="men"> <b><span datasrc="#xmldso" datafld="LINK19"></span></b></a>
</li>';
        echo '<li class="men"><a href="/contents/Pictures/vnacal1port.swf"
target="_blank" class="men"> <b><span datasrc="#xmldso"
datafld="LINK20"></span></b></a></li>';
        echo '<li class="men"><a href="/Atilim_317.flv" target="_blank" class="men">
<b><span datasrc="#xmldso" datafld="LINK25"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/Pictures/vna_block_diagram.swf"
target="_blank" class="men"> <b><span datasrc="#xmldso"
datafld="LINK21"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/Pictures/frekans_8.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK22"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/Pictures/weberrl.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso" datafld="LINK23"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/Pictures/animasyon2.swf"
target="_blank" class="men"> <b><span datasrc="#xmldso"
datafld="LINK24"></span></b></a></li>';
        echo '</ul>';
    }
    else if($dil==4)
    {
        echo '<xml src="front_panel_ro.xml" id="xmldso_r" async="false"></xml>';
        echo '<table width="280"><tr><td>';
        echo '</td>';
        echo '<td align="right"><a href="contents/keys/HELP.html"
target="_blank"><b>HELP</b></a></td></tr></table>';

        echo '<ul>';
        echo '<li class="men"><a href="/contents/Roumanian/what_vna_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK1"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/Roumanian/frdomain_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK2"></span>
</b></a></li>';
        echo '<li class="men"><a href="/contents/Roumanian/sweep_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK3"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/Roumanian/protec_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK5"></span></b></a></li>';

```

```

echo ' <li class="men"><a href="/contents/Roumanian/how_work_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK6"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/msetup_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK7"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/s_params_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK8"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/blockdiag_vna_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK9"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/IF_band_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK4"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/calibration_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK10"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/stdtrts_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK11"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/errors_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK12"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/error_cor_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK13"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/one_portcal_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK14"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/reference_planes_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK15"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Roumanian/deembedding_ro.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK16"></span></b></a></li>;
echo ' <li class="men"><a
href="http://www.home.agilent.com/agilent/product.jsp?cc=US&lc=eng&ckey=1000004608:epsg:pr
o&nid=-536902667.536881742.00&id=1000004608:epsg:pro" target="_blank"
class="men"><b><span datasrc="#xmldso_r" datafld="LINK17"></span></b></a></li>;
echo ' <li class="men"><a href="http://cp.literature.agilent.com/litweb/pdf/5988-3992EN.pdf"
target="_blank" class="men"> <b><span datasrc="#xmldso_r"
datafld="LINK18"></span></b></a></li>;
echo ' </ul>;
echo ' ;
echo ' <ul>;
echo ' <li class="men"><a href="/contents/Pictures/menuleryeni.swf" target="_blank" class="men">
<b><span datasrc="#xmldso_r" datafld="LINK19"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Pictures/vnacal1port.swf" target="_blank" class="men">
<b><span datasrc="#xmldso_r" datafld="LINK20"></span></b></a></li>;
echo ' <li class="men"><a href="/Atilim_317.flv" target="_blank" class="men"> <b><span
datasrc="#xmldso_r" datafld="LINK25"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Pictures/vna_block_diagram.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_r" datafld="LINK21"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Pictures/frekans_8.swf" target="_blank" class="men">
<b><span datasrc="#xmldso_r" datafld="LINK22"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Pictures/weberrl.swf" target="_blank" class="men">
<b><span datasrc="#xmldso_r" datafld="LINK23"></span></b></a></li>;
echo ' <li class="men"><a href="/contents/Pictures/animasyon2.swf" target="_blank" class="men">
<b><span datasrc="#xmldso_r" datafld="LINK24"></span></b></a></li>;
echo ' </ul>;
}

else if($dil==3)
{
echo ' <xml src="front_panel_fr.xml" id="xmldso_fr" async="false"></xml>;
echo ' <table width="280"><tr><td align="left">;
echo ' </td>;
echo ' <td align="right"><a href="contents/keys/HELP.html"
target="_blank"><b>HELP</b></a></td></tr></table>;
echo ' </ul>;

```

```

echo '<li class="men"><a href="/contents/what_vna.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_fr" datafld="LINK1"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/frdomain.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK2"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/sweep.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK3"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/protec.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK5"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/how_work.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK6"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/msetup.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK7"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/s_params.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK8"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/blockdiag_vna.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK9"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/IF_band.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK4"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/calibration.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK10"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/stdrts.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK11"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/errors.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK12"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/error_cor.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK13"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/one_portcal.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK14"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/reference_planes.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK15"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/deembedding.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK16"></span></b></a></li>';
    echo '<li class="men"><a
href="http://www.home.agilent.com/agilent/product.jsp?cc=US&lc=eng&ckey=100000460
8:epsg:pro&nid=-536902667.536881742.00&id=1000004608:epsg:pro" target="_blank"
class="men"><b><span datasrc="#xmldso_fr" datafld="LINK17"></span></b></a></li>';
    echo '<li class="men"><a href="http://cp.literature.agilent.com/litweb/pdf/5988-
3992EN.pdf" target="_blank" class="men"> <b><span datasrc="#xmldso_fr"
datafld="LINK18"></span></b></a></li>';
    echo '</ul>';
    echo '';
    echo '<ul>';
    echo '<li class="men"><a href="/contents/Pictures/menuleryeni.swf"
target="_blank" class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK19"></span></b></a>
</li>';
    echo '<li class="men"><a href="/contents/Pictures/vnacal1port.swf"
target="_blank" class="men"> <b><span datasrc="#xmldso_fr"
datafld="LINK20"></span></b></a></li>';
    echo '<li class="men"><a href="/Atilim_317.flv" target="_blank" class="men">
<b><span datasrc="#xmldso_fr" datafld="LINK25"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/Pictures/vna_block_diagram.swf"
target="_blank" class="men"> <b><span datasrc="#xmldso_fr"
datafld="LINK21"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/Pictures/frekans_8.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK22"></span></b></a></li>';
    echo '<li class="men"><a href="/contents/Pictures/weberrl.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_fr" datafld="LINK23"></span></b></a></li>';

```

```

        echo '<li class="men"><a href="/contents/Pictures/animasyon2.swf"
target="_blank" class="men"> <b><span datasrc="#xmldso_fr"
datafld="LINK24"></span></b></a></li>';
        echo '</ul>';

    }
    else if($dil==2)
    {
        echo '<xml src="front_panel_ger.xml" id="xmldso_ger" async="false"></xml>';
        echo '<table width="280"><tr><td>';
        echo '</td>';
        echo '<td align="right"><a href="contents/keys/HELP.html"
target="_blank"><b>HELP</b></a></td></tr></table>';
        echo '<ul>';
        echo '<li class="men"><a href="/contents/what_vna.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK1"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/frdomain.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK2"></span> </b></a></li>';
        echo '<li class="men"><a href="/contents/sweep.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK3"></span></b></a></li>';

        echo '<li class="men"><a href="/contents/protoc.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK5"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/how_work.html" target="_blank" class="men">
<b><span datasrc="#xmldso_ger" datafld="LINK6"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/msetup.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK7"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/s_params.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK8"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/blockdiag_vna.html" target="_blank" class="men">
<b><span datasrc="#xmldso_ger" datafld="LINK9"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/IF_band.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK4"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/calibration.html" target="_blank" class="men">
<b><span datasrc="#xmldso_ger" datafld="LINK10"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/stdnrt.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK11"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/errors.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK12"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/error_cor.html" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK13"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/one_portal.html" target="_blank" class="men">
<b><span datasrc="#xmldso_ger" datafld="LINK14"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/reference_planes.html" target="_blank" class="men">
<b><span datasrc="#xmldso_ger" datafld="LINK15"></span></b></a></li>';
        echo '<li class="men"><a href="/contents/deembedding.html" target="_blank" class="men">
<b><span datasrc="#xmldso_ger" datafld="LINK16"></span></b></a></li>';
        echo '<li class="men"><a
href="http://www.home.agilent.com/agilent/product.jsp?cc=US&lc=eng&ckey=1000004608:epsg:pr
o&nid=-536902667.536881742.00&id=1000004608:epsg:pro" target="_blank"
class="men"><b><span datasrc="#xmldso_ger" datafld="LINK17"></span></b></a></li>';
        echo '<li class="men"><a href="http://cp.literature.agilent.com/litweb/pdf/5988-3992EN.pdf"
target="_blank" class="men"> <b><span datasrc="#xmldso_ger"
datafld="LINK18"></span></b></a></li>';
        echo '</ul>';
        echo '';
        echo '<ul>';
        echo '<li class="men"><a href="/contents/Pictures/menuleryeni.swf" target="_blank" class="men">
<b><span datasrc="#xmldso_ger" datafld="LINK19"></span></b></a></li>';

```

```

        echo ' <li class="men"><a href="/contents/Pictures/vnacallport.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_ger" datafld="LINK20"></span></b></a></li>;
        echo ' <li class="men"><a href="/Atilim_317.fly" target="_blank" class="men"> <b><span
datasrc="#xmldso_ger" datafld="LINK25"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Pictures/vna_block_diagram.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_ger" datafld="LINK21"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Pictures/frekans_8.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_ger" datafld="LINK22"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Pictures/weberrl.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_ger" datafld="LINK23"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Pictures/animasyon2.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_ger" datafld="LINK24"></span></b></a></li>;
        echo ' </ul>;

    }
    else if($dil==0)
    {
        echo ' <xml src="front_panel_tr.xml" id="xmldso_tr" async="false"></xml>;
        echo ' <table width="280"><tr><td>;
        echo ' </td>;
        echo ' <td align="right"><a href="contents/keys/HELP.html"
target="_blank"><b>HELP</b></a></td></tr></table>;
        echo ' <ul>;
        echo ' <li class="men"><a href="/contents/Turkish/what_vna_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK1"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/frdomain_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK2"></span> </b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/sweep_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK3"></span></b></a></li>;

        echo ' <li class="men"><a href="/contents/Turkish/protec_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK5"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/how_work_tr.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK6"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/msetup_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK7"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/s_params_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK8"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/blockdiag_vna_tr.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK9"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/IF_band_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK4"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/calibration_tr.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK10"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/stdnrts_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK11"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/errors_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK12"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/error_cor_tr.html" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK13"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/one_portal_tr.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK14"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/reference_planes_tr.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK15"></span></b></a></li>;
        echo ' <li class="men"><a href="/contents/Turkish/deembedding_tr.html" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK16"></span></b></a></li>;
        echo ' <li class="men"><a
href="http://www.home.agilent.com/agilent/product.jspx?cc=US&lc=eng&ckey=1000004608:epsg:pr

```

```

o&nid=-536902667.536881742.00&id=1000004608:eps:pro" target="_blank"
class="men"><b><span datasrc="#xmldso_tr" datafld="LINK17"></span></b></a></li>;
echo ' <li class="men"><a href="http://cp.literature.agilent.com/litweb/pdf/5988-3992EN.pdf"
target="_blank" class="men"> <b><span datasrc="#xmldso_tr"
datafld="LINK18"></span></b></a></li>;
echo '</ul>';
echo '';
echo '<ul>';
echo '<li class="men"><a href="/contents/Pictures/menuleryeni.swf" target="_blank" class="men">
<b><span datasrc="#xmldso_tr" datafld="LINK19"></span></b></a></li>;
echo '<li class="men"><a href="/contents/Pictures/vnacallport.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK20"></span></b></a></li>;
echo '<li class="men"><a href="/Atilim_317.flv" target="_blank" class="men"> <b><span
datasrc="#xmldso_tr" datafld="LINK25"></span></b></a></li>;
echo '<li class="men"><a href="/contents/Pictures/vna_block_diagram.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK21"></span></b></a></li>;
echo '<li class="men"><a href="/contents/Pictures/frekans_8.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK22"></span></b></a></li>;
echo '<li class="men"><a href="/contents/Pictures/weberrl.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK23"></span></b></a></li>;
echo '<li class="men"><a href="/contents/Pictures/animasyon2.swf" target="_blank"
class="men"> <b><span datasrc="#xmldso_tr" datafld="LINK24"></span></b></a></li>;
echo '</ul>';

}
?> </td>
</tr>
</table>
</body>
</html>

```

APPENDIX E

Search with PHP

```
<!doctype HTML public "-//W3C//DTD HTML 4.0 Frameset//EN">
<html>
<!--(=====)-->
<!--(Document created with RoboEditor. )=====-->
<!--(=====)-->
<head>
<title>Search Results</title>
<!--(Meta)=====-->

<meta name=generator content="Atilim University - www.atilim.edu.tr">
<meta name=date content="04 30, 2007 20:30:29 PM">

<!--(Links)=====-->
<link REL="StyleSheet" href="reference.css">
</head>
<body>
<table border="1" align="center">
<tr bgcolor="#990000" align="center"><th><span style="background:#990000; font-size:20px; font-
style:italic; color:#FFFFFF"> Search Results</span></th></tr>
<tr>

<?
    //$filewords = array("VNA", "DEEMBEDDING", "CEREN", "SCATTERING",
"PARAMETERS");
        $sentence = trim($_GET["search"]);
        $word = explode(' ', $sentence);
        $k=0;
        for ( $i=0 ; $i<count($word); $i++){
            if ( strlen(trim($word[$i])) != 0 ){
                $words[$k] = trim($word[$i]) ;
                $k++;
            }
        }
        //print_r($words);

        $filewords=file("c:/apache/htdocs/EPSS/keywords.txt", FILE_IGNORE_NEW_LINES |
FILE_SKIP_EMPTY_LINES);
        for ( $i = 0 ; $i<count($filewords); $i++) {
            $filewords[$i] = rtrim($filewords[$i], "\r\n");
        }
        //print_r($filewords);
        //$saranan="";
        /* $w = "VNA" ;
        if ( in_array("VNA", $filewords ) )
```

```

    {
        $saranan .= " VNA";
    }
print "Aranan : " . $saranan ;
print_r ($filewords);*/
/*foreach ( $words as $w )
{
    $w = strtoupper($w) ;
    if ( in_array($w."\n", $filewords ) )
    {
        $saranan .= " $w";
    }
}
print "Aranan : " . $saranan ;*/
$t = 0 ;
for($i=0;$i<count($words);$i++)
{
    for($k=0;$k<count($filewords);$k++)
    {
        $w = str_replace( "+", " ", $words[$i]);
        //print $w;
        if(strcmp(strtoupper($w),strtoupper($filewords[$k])) == 0)
        {

            // $saranan .= " $words[$i]";
            $saranan[$t] = $w ;
            $t++;
            break;
        }
    }
}
//print_r ($saranan) ;
// Form query using grep format..
if ( count($saranan) > 0 )
{
    $query = $saranan[0];
    for ( $i=1; $i<count($saranan); $i++)
        $query .= "\". $saranan[$i];
    exec("grep -i -l \"$query\" -r ..", $list,$ret);
    /* for($i=0;$i<count($list);$i++)
    {
        $ylist=explode("/", $list[$i]);
        $ylast=end($ylist);

        for($k=0;$k<count($list);$k++)
        {
            $ylist=explode("/", $list[$k]);
            $ylast=end($ylist);
            //print "YELAST". $ylast;
            if(strcmp($ylist,$ylast)==0)
                $newlist[$i]=$list[$i];
        }
    }*/
    //print_r($newlist);
    foreach ( $list as $item )
    {
        $itemarr=explode("/", $item);
        $last=end($itemarr);

```

```

        $uzanti=explode(".", $last);
        if($uzanti[1]=="doc" || $uzanti[1]=="pdf" || $uzanti[1]=="htm" || $uzanti[1]=="html" ||
$uzanti[1]=="jpg" || $uzanti[1]=="gif" || $uzanti[1]=="png" || $uzanti[1]=="jpeg")
        print "<td><a href='$item' target='_blank'>$last</a><br></td></tr>";

    }
}
?>
</tr>
</table>
</body>
</html>

```

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**A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
ATILIM UNIVERSITY
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