REPUBLIC OF TURKEY
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GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

IOT APPLICATION FOR FAULT DIAGNOSIS AND PREDICTION IN ELEVATORS

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Master Thesis
Department: Computer Engineering
Supervisor : Prof. Dr. Erhan AKIN

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MASTER THESIS

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ABSTRACT

IOT APPLICATION FOR FAULT DIAGNOSIS AND PREDICTION IN ELEVATORS

In this thesis an elevator monitoring system of rules based on installed system and IOT. Through multi-sensor data obtaining, much data can be gotten to, for example, running noise, vibration, direction, quickening, speed, warmth of the traction machine, floor stopping place, entryway turn of the lift car and power supply voltage, now, in the meantime the noise and the temperature of the PC stay with the data if there is anybody in the lift, etc. A wide area network association between the elevator parameter observing stations and the remote control focus is set up to understand the center on checking and automatic remote disappointment caution for the lift operation. The goal was a find error and detection.

Monitoring air quality in elevator rooms to make more suitable and healthy has tremendously risen. Working at a sensor level, Network level, and Application level. Therefore, our system measures polluted the air in elevator room or closed environment. Such as temperature and humidity, at a certain level. The design which it connects each of sensors, network and application are called a Wireless Sensor Network. This application collects and reads the data from the sensors; it displays the readings and also notifies us whenever there is polluted air in the elevator room. We benefit from IP in order to connect the sensors with the computer application.

The design provides a solution for reforming elevators by IOT. With the application of more advanced sensors, the real time running status of elevator can be sensed more detailed and comprehensively. The elevator monitoring alarm system that made full use of advanced sensing technology and combined with modern communication technology can transfer the information from many elevators in a certain area to the monitor computer.

Keywords: Elevator, IOT, web application, real-time communication, Humidity and Temperature sensor, Wireless sensor network, Application.

ÖZET

ASANSÖRLERDE ARIZA TEŞHİSİ VE TAHMİNİ İÇİN IOT UYGULAMASI

Bu tez, kurulan IOT temelli asansör izleme sisteminin temellerini araştırma toder. Çok sensörlü veri toplama yoluyla, örneğin çalışma gürültüsü, titreşim, yönlendirme, hızlanma, tahrik makinesinin sıcaklığı, zemin durma yeri, asansör kabin giriş yol dönüşü ve güç kaynağı voltajı gibi birçok veriye ulaşılabilir. Asanör parametresi gözlem istasyonları ve uzaktan kumanda odağı arasındaki geniş alan ağı ilişkisi, kaldırma işleminde otomatik kontrol merkezini yönelmek kurulmuştur. hataların bulunması tezin hedefidir.

son zamanlarda Asansör odalarında daha uygun ve sağlıklı hava kalitesinin izlenmesi önemli ölçüde artmıştır. Bu amaçla sensör seviyesinde, Ağ seviyesinde ve Uygulama seviyesinde çalışılmaktadır. Bu nedenle, asansör sistemi havayı asansör odasında veya kapalı ortamda kirletti. Nekader Sıcaklık ve nem hangi seviyede. olduğunu belırlenmelı gerekir sensörlerin, ağların ve uygulamaların her birine bağlanan tasarımı bir Kablosuz Algılayıcı Ağı olarak adlandırılır. Bu uygulama, sensörlerden verileri toplar ve okur; Okumaları gösterir ve ayrıca asansör odasında kirli hava olduğunda bizi bilgilendirir. Algılayıcıları bilgisayar uygulamasına bağlamak için IP'den yararlanıyoruz.

IOT kavramının asansörlerde kullanılması önemli değişimler sağlar. Daha gelişmiş sensörlerin uygulanmasıyla, asansörün gerçek zamanlı çalışma durumu daha ayrıntılı ve kapsamı olarak algılanabilir. Gelişmiş algılama teknolojisini tam kullanımıyla yapılan ve modern iletişim teknolojisi ile birleştirilen asansör izleme alarm sistemi, belirli bir bölgedeki pek çok asansörden monitör bilgisayara bilgi aktarabilir.

Anahtar Kelimeler: Asansör, IOT, web uygulaması, gerçek zamanlı iletişim, Nem ve sıcaklık sensörü, Kablosuz sensör ağı, Uygulama.

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ABBREVIATIONS

IOT : Internet of Thing
2D : Two Dimensional
3D : Three Dimensional
HTML : Hyper Text Markup Language
JQuery : Java Script Library
HVAC : Heating, Ventilation and Air Conditioning
M2M : Machine-to-Machine
4G : Fourth-Generation Programming Language
WIFI : Wireless Fidelity, Wireless Internet
LTE : Long-Term Evolution
WIA : Wireless Internet Access
RFID : Radio Frequency Identification
ACS : Automated Control System
CSS : Cascading Style Sheets
WSN : Wireless Sensor Network
IPv4 : Internet Protocol Version 4
TCP-IP : Transmission Control Protocol-Internet Protocol
URN : Uniform Resource Name
URL : Universal Resource Locator
PC : Personal Computer
IPv6 : Internet Protocol Version 6
AI : Artificial Intelligence
TDMA : Time Division Multiple Access
IOS : IPhone Operating System
O-D : Origin - Destination

GPS : Global Positioning System

GIS : Geographic Information System

CSMA : Carrier Sense Multiple Access

MEM : Microelectronics Mechanical System

IP : Internet Protocol

DHCP : Dynamic Host Configuration Protocol

C# : C-Sharp (Language Programming)

RF : Radio frequency

FDMA : Frequency Division Multiple Access

MRL : Machine-Room-Less

ADC : Analog-to-digital converter

OTP : One-Time programmable

UDP : User Datagram Protocol

1. INTRODUCTION

The Internet of thing (IOT) begins with your things – the things that matter most to your business. IOT is about making your information meet up in new ways. Take of information with IOT dashboards. Reveal actionable realization. And modernize how you work together. IOT is an idea and a worldview that look prevalent attendance in the environment of a variety of things/matters that from wireless and cable associations and one of a kind addressing schemes are capable to react with one another and coordinate with different things/items to make new usage /administrations and achieve shared target. In this setting the research and expansion challenges to make an intelligent world are large [1]. A world where the true, digital and the practical are converging to make clever environments that make transport, power, town and many else regions very smart. Internet of Things with goal is to can things to be linked, anywhere, anytime, with anything and anybody in a perfect use any path/organize and any management. With the progressive progression of World's urbanization, the quantity of building keeps on developing.

The ranges of normal temperature levels are in elevator room to control these parameters and keep them within the threshold. Threshold values are obtained by using Air Quality Index. The Air Quality Index is an index for providing analytical information for the quality of day-to-day air. The Air Quality Index serves the purpose of providing comprehensive information about how important is quality air to our health. Today's largest issue is to find improvements for quality air both for elevator environment. The main target of this plan through software monitoring and warning systems, by using wireless sensor networks is to get information on air quality by choosing temperature and humidity.

The elevator is playing a basic transport in city vertical movement system. At the same time, mishap in elevator happened oftentimes, which is bringing about more extensive worry as of late. Alongside the quick improvement of Internet of Things and the country's strong support, innovations for IOT are connected to different fields increasingly broadly [2]. As a typical

application of IOT, elevator monitoring system can provide a more efficient management model. By using the elevator monitoring system with IOT, the elevator accidents could be predicted successfully and elevator disappointments could be repaired viably in request to warranty the safety of lifts and diminish the mishap recurrence rate and misfortunes [3].

1.1 Project Goal

The objective in this thesis is to Design and build a web application by using simulation software where a user could it's can show us a motion elevator and can see the problem or fault through this program and connected by internet. The goal was a find error and detection. The aim is to create a programing capable of conduct these challenges and to examine the advantages and finding fault in elevator.

One of the main aims of this project is to produce fault diagnosis and prediction in elevators by IOT. The result will be evaluated in terms of select, utilizing software which configured and coded by the author. Also determining fault from server data successfully will be the subjects of this paper. Issue of exporting data were recorded by the server then saving in a file in server that can be read by a mesh processing system applications.

1.2 Methodology to Fault in Elevator

Elevator needed to obtain a competitive brink by centralize on what issue most to its clients in buildings the world up safety. Drawing on the possibility of the internet of thing IOT by communication its lift to the cloud, collection information from its sensors and framework, and convert that information inside worthy work knowledge. Elevator monitoring alarm system is disappointment judgment and cautioning system for elevator, which depends on elevator detection technology. Early elevator detection system has a place with a piece of elevator running control system, which is utilized to enhance elevator's security by nourishing the

ongoing data to control terminal. These real-time data for the most part depend on sensors which are circulated in elevator to accumulate different parameters of running elevator, for example, the weight of the elevator car, the signal of entrance crane, the signal of the layer accuracy of the elevator, the signal of safety. Now the elevator detection system has gradually improved because of the need for elevator fault diagnosis.

With the application of more advanced sensors, the real time running status of elevator can be sensed more detailed and comprehensively. The elevator monitoring alarm system that made full use of advanced sensing technology and combined with modern communication technology can transfer the information from many elevators in a certain area to the monitor computer in Figure 1.1. The computer can analyze and judge the elevator failures. The elevator maintenance staff can deal with these failures according the feedback timely when the elevator is abnormal. According to the function, the monitoring computer applications can be divided into communication, data processing, and transaction processing [4].

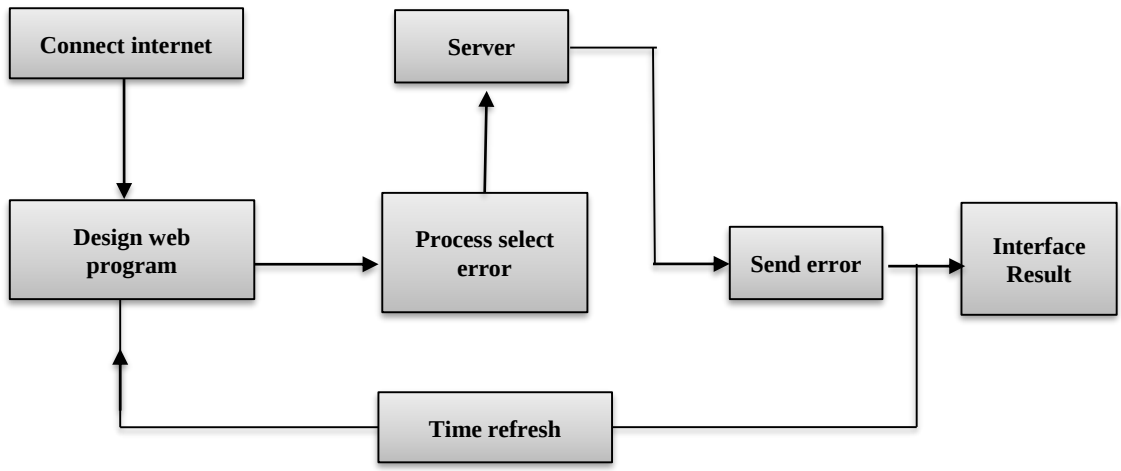


Figure 1.1. Block Diagram for the Process Fault Elevator

1.3 Fault Diagnosis in Elevator

Elevators have confused mechanical structures as per the rating speed and the heap limit. The industry improving trends demands elevators keeps increasing as the rapid development of modem urbanization, the fast growing estate led to the mature of elevator market, customers come to focus on the safety and quality of elevator more and more. To decrease the likelihood of elevator breakdowns and increment unwavering quality, the technique we propose can fulfill the necessity Decision tree is broadly utilized information grouping innovation. Clearly, it needs to investigate some methodology to screen and certification the security of working procedure of lift long-lasting nonstop use, diminish blame event likelihood, which requires investigating rapidly [5]. The objective of lift blame conclusion is to locate the potential blame, enhance gear security and dependability, limit the mischance rate, even drag out the hardware life. Lately, numerous specialists have carried on various answers for comprehending blame determination of vast complex electrical gear, information mining techniques are embraced, for example, neural system, multi-operator framework, affiliation run, fluffy control, and so on. In this paper, the customary choice tree is upgraded by applying the unpleasant set to enhance the finding precision. As per the character of elevator status information gathered by sensors, information vulnerability is normal, it can be caused by different elements including estimations accuracy constraint, informational collections, sensor blunders, field condition [6].

1.3.1 Intelligent Fault Diagnosis for Elevator Operating Safety

It is outstanding that the likelihood of deficiencies is unavoidable. Concerning Elevator, the mishaps are expanding a seemingly endless amount of time. The shortcomings might be caused by the machine or working conditions [7]. It is important to gather the blame manifestation and relating reason as conceivable as possible. The accompanying strides are continued:

A. To gather the framework information data, including the lift control Center working hypothesis at various parameter term, preserve each port modification circumstance in operational process.

B. To characterize the conclusion premise, depict obviously all elements of the lift control framework and the required condition.

C. To list every conceivable blame sort and examine the arrangement and normal for deficiencies, recognize the impact for the elevator control focus.

D. To choose the strategy for blame screen and conclusion by methods for examination of the elevator blame flow. The structure of elevator fundamentally comprises of footing framework, direction framework, entryway framework, elevator auto, stack adjust framework, electric drive, and so on, the development reason of some blame and the strategy to determine the issue can be acquired by factual investigation. The origin of symptom including two categories:

1. The remote screen, information can be exchanged to the finding framework through the web benefit port, the choice tree will dissect it, the side effect might be consistent or list.

2. The administrator inputs the important information, including the side effect and the conceivable outcome. In this review, the circumstances and end results of each peril as far as likelihood of event and the seriousness of its belongings ought to be evaluated. Take the elevator control framework for instance, the blame example and the impacts examination results is indicated mostly in Through investigation of elevator control framework blame wonder, to build up a savvy blame conclusion for elevator working security is basic Figure 1.2.

Name	Function	Fault Pattern	Fault reason
Lift controller	Control the elevator operation according to the input order	the elevator can't run correctly	parameter or power supply is wrong
Frequency converter	Control tractor speed and direction	Self protection wrong speed and direction	Frequency converter parameters
Safety loop	Safety protection for elevator running	Circuit always open or close	Relay adherence or wrong connection
Floor call circuit	Afford the floor call command to the elevator control system and display the reaction	The floor command can't be selected or the call is different with the display result	The interface loose contact

Figure 1.2. Fault and its Corresponding Reason

1.3.2 The Statistical Model Design to Diagnosis Method

It is fundamental for choice tree to have an appropriate technique for classifier determination in light of the fact that the express probabilistic standards can influence the conclusion precision [8]. The choice tree we proposed used the C4.5 algorithms. Brushing the adaptation to internal failure of harsh set hypothesis and quick grouping of choice tree, the answer for finding in light of unpleasant choice tree is portrayed in Figure 1.3. The C4.5 algorithm has the capacity snappy arrange and retain arbitrary example, the era manage is built as a tree structure, the guidelines relationship is clear, the thinking result is anything but difficult to clarify, however the count sum is expansive and the time spent in developing the tree is long. In this proposal, the unpleasant set hypothesis joints with choice tree C4.5 algorithms, which can smooth away the deformities said above.

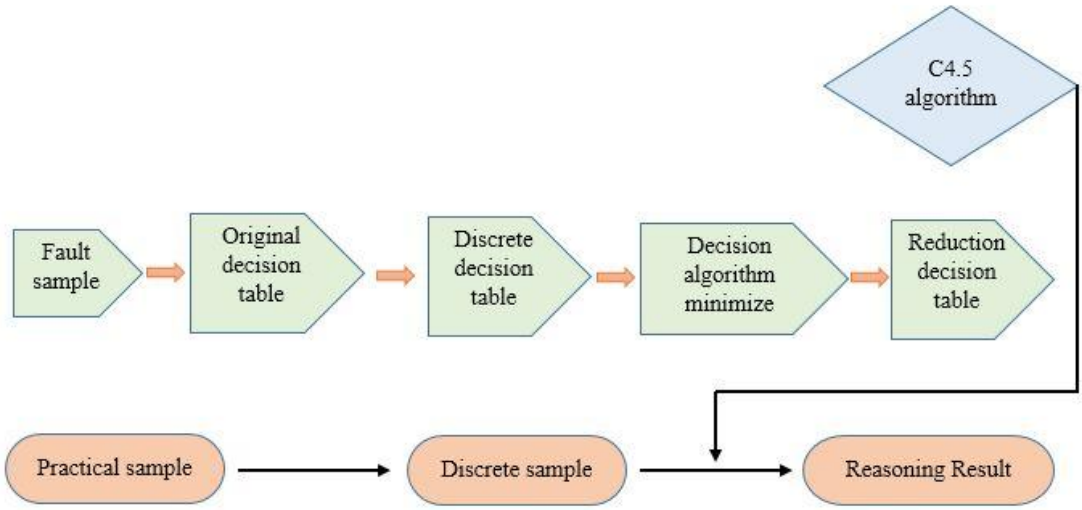


Figure 1.3. Rough Decision Tree Diagnostic Method

A. Diagnosis decision C4.5 algorithms: Accept to rough set theory, the premier Diagnosis decision table is generated based on the history data in Figure 1.4. The table structure is shown in Eq.(l)

$$T = (U, C, D) \quad (1)$$

U^5	C_1	C_2	C_3	C_4	C_5	Real fault	Diagnosis result
1	1	1	0	1	1	D_1	D_1
2	1	0	1	0	1	D_1	D_1
3	1	0	1	1	0	D_1	D_1
4	1	2	1	1	0	D_1	D_1
5	0	2	2	1	0	D_2	D_2
6	1	1	0	0	2	D_2	D_2

Figure 1.4. Result of Fault Diagnosis

1.4 Elevator Monitoring Alarm System

As a typical application of IOT, elevator monitoring system can provide a more efficient management model. By using the elevator monitoring system with IOT, the elevator accidents could be predicted successfully and elevator failures could be repaired effectively so as to ensure the security of lifts and reduce the accident frequency rate and losses [9]. Elevator monitoring alarm system is failure judgment and warning system for elevator, which is based on elevator detection technology. Early elevator detection system belongs to a part of elevator running control system, which is used to improve elevator's stability by feeding the real-time data to control terminal. These real-time data mainly rely on sensors which are distributed in elevator to gather various parameters of running elevator such as the weight of the lift car, the signal of portal crane, the signal of the layer precision of the elevator, the signal of safety gear and so on. Now the elevator detection system has gradually improved because of the need for elevator fault diagnosis. With the application of more advanced sensors, the real time running status of elevator can be sensed more detailed and comprehensively. The elevator monitoring alarm system that made full use of advanced sensing technology and combined with modern communication technology can transfer the information from many elevators in a certain area to the monitor computer. The compute can analyze and judge the elevator failures. The elevator maintenance staff can deal with these failures according the feedback timely when the elevator is abnormal.

Combining such advanced technologies as embedded computer technology, WiMAX wireless communication technology, elevator fault detection technology and IOT technology, this monitoring and alarm system join up the following elements including the end of elevator fault monitoring, residential property, maintenance company, local special equipment inspection institute and the computer of monitoring center to constitute the multi-level elevator monitoring and alarm network implements centralized management of elevator. Bu using this system, the elevator owner can real-time monitor operating condition of elevator and maintenance company can access the operational parameters of elevator to troubleshoot

remotely, make plan and organize maintenance work. The local special equipment inspection institute can effectively supervise the operation of elevator according to the data of maintenance and operating conditions. The system can raise management level of elevator and the level of quality of maintenance. The topology of monitoring and alarm system is shown in Figure 1.5.

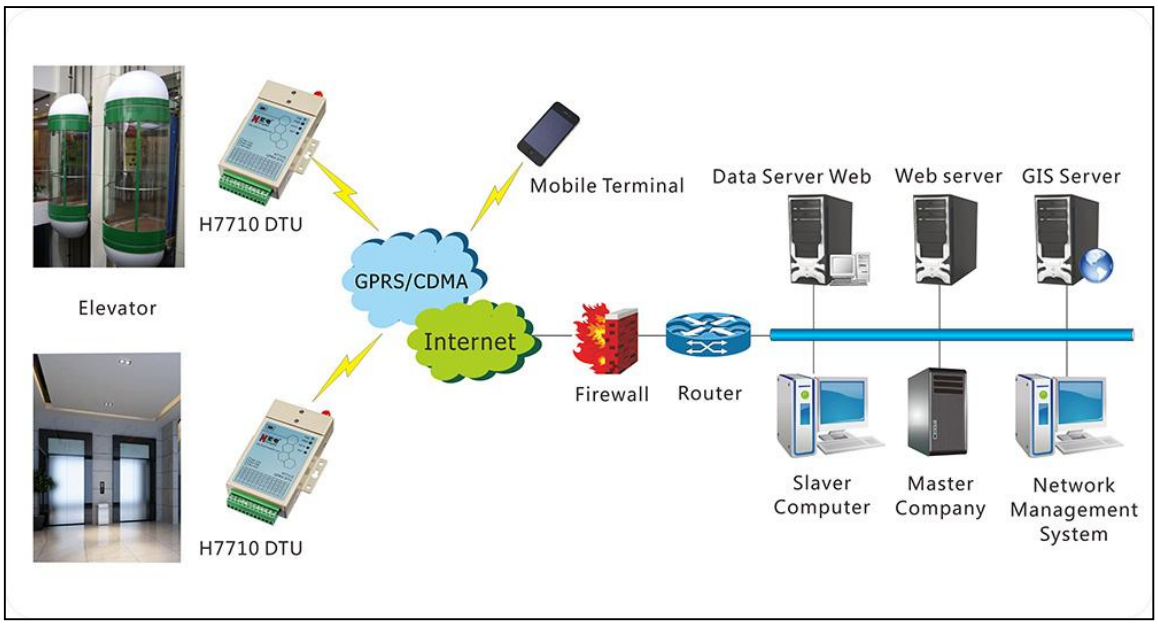


Figure 1.5. Network Topology of Wireless Elevator Monitoring Alarm System [9]

1.4.1 Hardware Constitution of Monitoring and Alarm Terminals

The monitoring and alarm terminals of elevator are key components of fore-end hardware in system, which include embedded ARM computer, data collection module, wireless communication module, control module, multimedia module and power module. The structure of elevator monitoring and alarm terminal is shown in Figure 1.6.

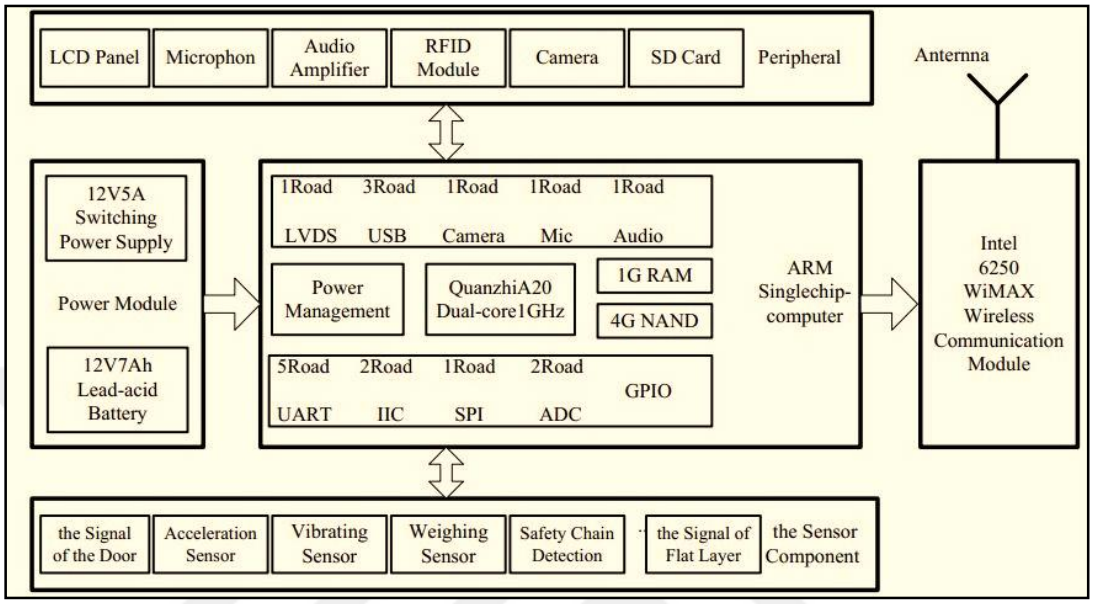


Figure 1.6. Structure of Elevator Monitoring Alarm Terminal

A) The master computer: The master computer adopt industry single-board controller in which Quanzhi A20 chip is kernel component. CPU-ARM Cortex A7 is a dual 32-bit low power microprocessor, which onboard peripheral hardware resources include 1GB memory, 4GB NAND Flash, 5 full duplex serial ports, 2 IIC interfaces, 1 SPI interface, 2 10-bit ADC conversion interfaces and multi common I/O interfaces for connecting various sensors and wireless communication module.

B) Collection module: The collection module is composed of multiple sensors allocated in all parts of elevator. It should be noted that the sensors are independent of the elevator control system and mainly used for collecting operational parameters of key components of elevators in real time.

C) Power module: The power module is consisted of the main power and backup power. The main power is a switching power supply whose input and output is AC150-220V and DC12V5A respectively. The backup power is an uninterrupted power supply which is composed of

12V7AH lead-acid batteries and charge and discharge managing circuit for guaranteeing continued operating for at least one hour after power-off.

D) Communication module: The communications network of elevator monitoring and alarm system is built using WiMAX wireless broadband technologies. The communication module is realized by Intel Centrino Advanced-N + WiMAX6250 wireless card conforming IEEE802.16e Wave2 protocol. Some basic parameters of card are described as: 3.5G working frequency band, 6Mbps uplink bandwidth, 20Mbps downlink bandwidth, Mini PCIe half-high design and USB 2.0 communication port. Intel provides official drivers of Linux and Windows.

E) WiMAX wireless network building: Standard designates two standard networking modes: PMP(point-to-multi-point) and Mesh [10]. Because the requirement of coverage radius of base station is not big, the amount of network terminal is small and the type of terminal is fixed, PMP mode is adopted. The complete network architecture of WiMAX is composed of core network, base station, user base station, radio relays and user terminal equipment.

F) The system software: The system software includes two parts: terminal software and monitoring computer software, programming is used OS (operating system) +APP (application) mode, the terminal of OS using the Linux operating system to remove the graphical interface, the APP software based on the cross platform C++ application framework QT development.

1.4.2 Monitoring Computer Application

According to the function, the monitoring computer applications can be divided into communication, data processing, transaction processing, man-machine interface of four modules. Communication module includes four parts: 1, receiving terminal data package uploaded through TCP protocol, sending instruction to realize communication between the remote monitoring computer and terminal interaction. 2, through the RTCP protocol to receive video telephone terminal data flow, and publish the update advertisement file. 3, If emergency

is happened, expert consultation can be established to realize multi voice communication through IP phone. 4, the necessary elevator status can be sent to rescue or maintenance personnel mobile phone via text message.

1.5 Application for Fault Diagnosis and Prediction Using Internet of Things

One of the significant applications of IoT is its inexorably being utilized as a part of the assembling business. Specifically, modern support contributes to a great extent to this aggressiveness through dependability and accessibility of generation gear. All the more particularly, profitability changes empowered by IoT innovation have real effect on economy and aggressiveness in assembling industry, particularly when the humankind are entering the fourth period of industrialization with the utilization of digital physical frameworks to screen, break down, and computerize business [11]. We address the blame location and framework disappointment expectation issue in the process business by utilizing IoT innovation. Rather, just the information gathered from the gadget sensors are required to fabricate fitting prescient models and key framework wellbeing list for checking.

A) SAP HANA Program: SAP answers for the IoT are based on the SAP HANA stage, which offers access to an extensive variety of utilizations, advancement apparatuses, and combination administrations. In this work, the IoT information gathered from gadget sensors of our industry accomplice are gushed into a SAP HANA in-memory database for further handling and investigation. Also, the clients pick up the capacity to prepare amazingly vast volumes of IoT information continuously.

B) SAP Predictive Analysis Library: SAP Predictive Analysis Library (PAL) is an extra arrangement of use capacities that execute an extensive variety of investigation calculations in the territories of bunching, grouping, affiliation, and so forth. In this work, we utilize SAP PAL to manufacture prescient models from the gathered IoT information that are kept up in SAP

HANA in-memory database. It comes locally with elite in light of the fact that the unpredictable and overwhelming expository calculations are executed straightforwardly into the database as opposed to being raised to the application server.

C) SAP Sybase Event Stream Processor: SAP Sybase Event Stream Processor (ESP) is a complex event processing (CEP) stage for fast advancement and sending of business basic applications that break down and follow up on high speed and high volume spilling information continuously. As the main CEP stage in the market and the main CEP offering that has been benchmarked for low inertness, SAP Sybase ESP controls ongoing Continuous Intelligence by giving the capacities to screen, identify, examine, and react to occasions as they happen. Figure 1.7, gives the deliberation of an IoT answer for prescient upkeep application. As an ongoing insight arrangement, SAP Sybase ESP encourages a quicker and more prompt time to activity and additionally the ability to make the most ideal remedial, productive, focused or esteem include choices. In light of this gathered IoT information, prescient models, for example, visit examples of status changes and gadget solid lists are manufactured utilizing the SAP HANA Predictive Analytics Library.

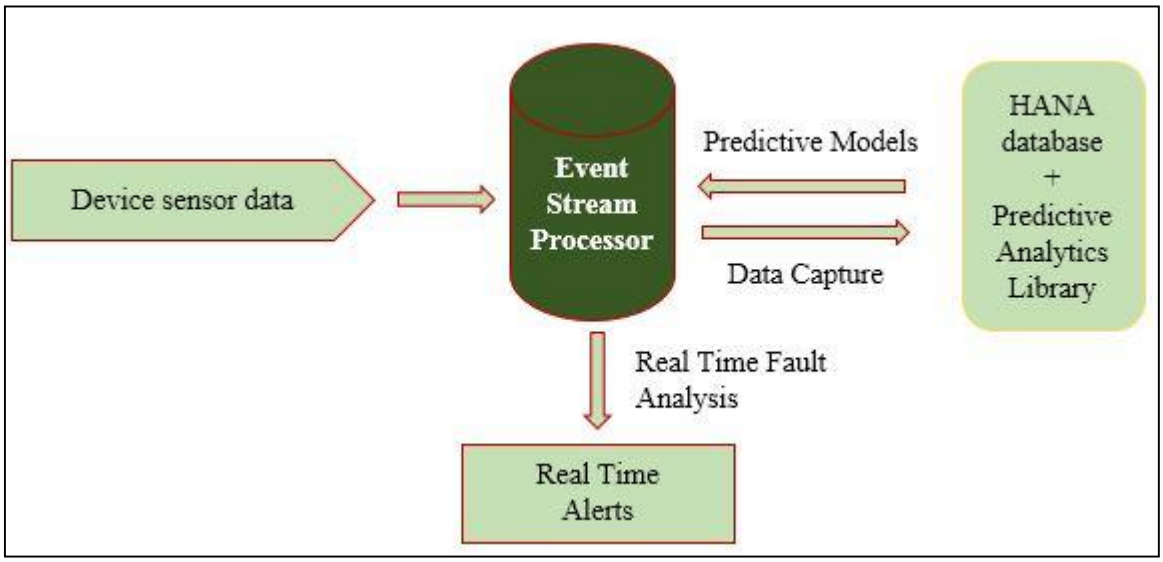


Figure 1.7. Architecture of an IoT Solution for Predictive Maintenance [11]

1.5.1 Structure Predictive Models for Fault Detection from IOT Data

In this area the calculations used to fabricate prescient models for blame recognition from IoT information are portrayed in subtle elements. In particular, the initial two calculations are valuable to distinguish the causal connections among sensors and gadgets, while the last calculation is contrived to screen the status of gadgets.

A) Conditional Probability Analysis: This algorithm is intended to find the causal connections between any two sensors. On the off chance that the two sensors connected to two machine gadgets that have impacts on each other in operation, the glitch or disappointment of one sensor or gadget can prompt the breakdown or disappointment of another sensor or gadget inside a brief timeframe period. In light of this perception, it is imperative to discover the connection between any two sensors in light of the cautions produced by them. That is, all alerts are considered as one sort of occasion on the off chance that they share a typical sensor ID and message code. The decision of this time window length relies on upon the dynamics of the system. Specifically, let NA denote the number of event of Event A, T be the time window length, NB (A, T) denote the number of occurrence of Event B if it occurs shorter than time length T after Event A in Figure 1.8.

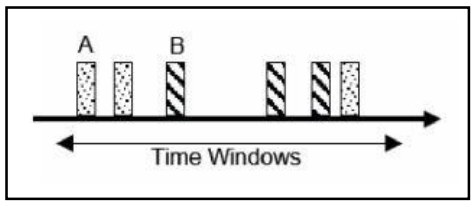


Figure 1.8. An Example of Event Pairing in one-time Window

Fixed a time window and the events happen within it there may be multiple Event A and Event B. Assuming all events in the time window are assigned with event IDs in ascending request according to their event timestamps. Given all possible event ID pairs (e.g., pairs of

Event A and B as shown in Figure 1.9. At the start of the algorithm, all event pairs (e.g., Event B following Event A) within a time window can be returned and assigned to one cursor by one select statement.

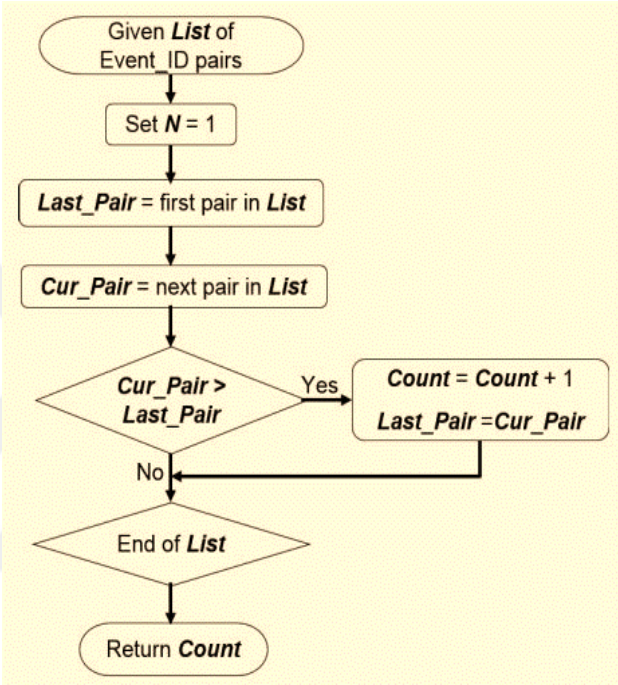


Figure 1.9 Diagram of Pairing Algorithm

B) Mining Frequent Pattern of Alarm Events: Another system we use to distinguish the connections among sensors and gadgets is Apriori calculation [12], for mining regular example of alert occasions. Apriori is initially intended to work on exchanges, e.g., things purchased by clients in grocery stores. It recognizes visit things in exchanges and stretches out them to bigger and bigger thing sets. These regular thing sets controlled by Apriori characterize affiliation rules which is like what we need to find in our application, i.e., visit example of caution occasions Figure 1.10.

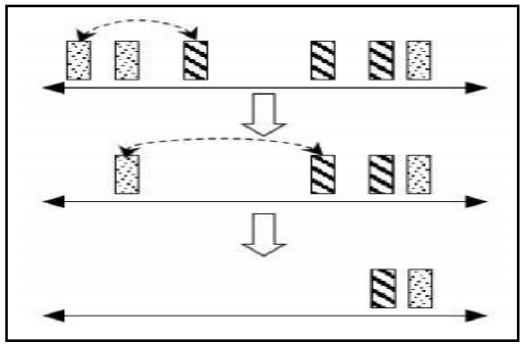


Figure 1.10. Paring Procedure [12]

In the wake of characterizing the exchanges, the issue of discovering successive example of caution occasions is in the configuration resolvable by Apriori calculation which is executed in the SAP HANA Predictive Analysis Library (PAL) [13]. Figure 1.11, indicates how the Apriori calculation is utilized as a part of AFM. The information is a table comprising two sections: one for keeping up exchange IDs while the other one for keeping up the occasion names. The Result table incorporates five segments, indicating individually the name of the main occasion.

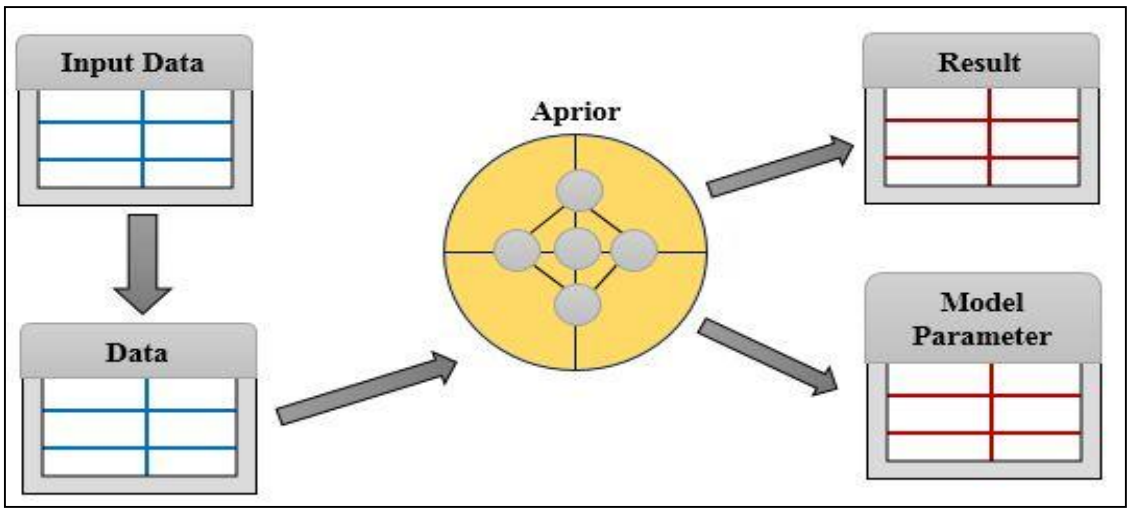


Figure 1.11. Application of Apriori Approach using Function in SAP HANA Studio

C) Device Health Index: Given the connections found utilizing the methodologies talked about in Section IV-A and IV-B, we can foresee the disappointment of a device if another exceptionally related device fizzles. To distinguish the disappointment or glitch of a device, we characterize Device Health Index (DHI) in this segment and screen this index progressively with SAP Sybase Event Stream Processor Figure 1.12. Along these lines, our initial step is to transform one-measurement sensor readings into three-measurement tuples which gives more data.

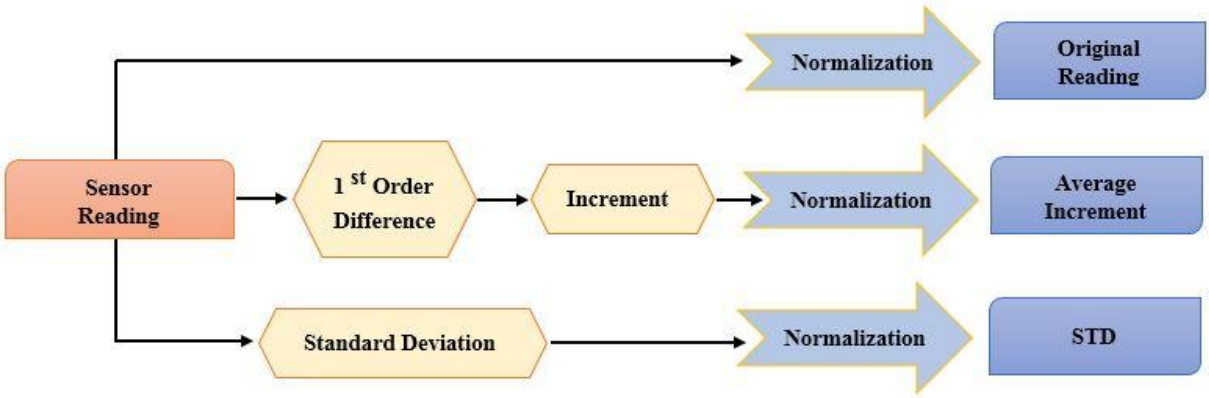


Figure 1.12. Data Processing on Sensor Readings

The above standardized sensor perusing, normal augmentation and moving standard deviation are adequate to characterize DHI for gadgets or even a plant. Normally one gadget is outfitted with various sensors, for example, temperature, weight, and fluid level. Utilizing these specimens, we can prepare the peculiarity prescient model given by SAP HANA PAL, and utilize the came about model to decide anomalies progressively with SAP Sybase ESP. DHI can be characterized as the normal of the three-measurement tuple of every one of its sensors, yet it is not really valid for all gadgets Figure 1.13. As per our encounters, as a rule the gadget status is connected more to specific sorts of sensors and maybe a couple components of the information tuple.

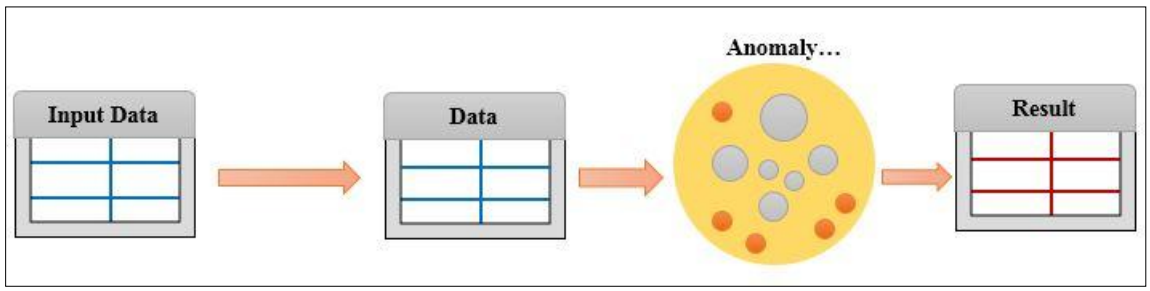


Figure 1.13. Application Function Modeler of Anomaly Detection in SAP HANA

1.5.2 Real World IOT Application in The Process Industry

The thoughts and algorithms examined in this paper have been approved through a co-development extend with a procedure gadget producer. Specifically, the maker produces gadgets for its clients in the process business. Subsequently, our proposed approach is an ideal answer for this issue. In particular, Conditional Probability Analysis and Apriori Analysis are led on the gathered gadget sensor information keeping in mind the end goal to find the causal connections among sensors and further among gadgets. By observing the DHIs of gadgets, it is conceivable to identify glitches of specific gadgets that may prompt disappointments of the entire framework in 6 hours after the fact, which permits the plant administrator enough time to react and keep the entire framework disappointment from happening. Because of protection and lawful issues, we are not ready to portray the information in subtle elements. As a rule, the plant we worked with has several sensors and many gadgets. We have the sensor readings and alert logs of the plant for a 24-hour time frame which is not exactly vast truth be told. As indicated by the physical structure of the plant, almost 70% of these sets are very associated same gadget or close (by each other). When all is said in done, the proposed methodologies and calculations are viable for blame location and disappointment counteractive action in the assembling business.

1.6 Design of Elevator working Parameters and Monitoring System Using IOT

On the device sensing layer of the IoT platform, the number of terminal elevators is increasing. To introduce the IoT technology into the elevator industry has a great significance for the research of elevator running parameter remote monitoring system. How to save the system overhead, keep efficient throughput and let different priority tasks of each terminals be processed timely and effectively is a serious problem [14]. So we designed a User Datagram Protocol (UDP) communication model with multi-priority task and high concurrent. As a new technology and an emerging industry, the IoT is widely used in major industrial sectors [15]. It may reduce the accident loss to a minimum, detect and maintain the elevator and ensure the safe use. This monitoring system has the following features: the terminals all the time handle real-time datagrams when the remote UDP communication server runs stably, so the number of processing tasks is relatively fixed Figure 1.14. However, the handle task such as fault datagram, mainboard parameter datagram is sudden and emergency, It makes the tasks executed in accordance with the different level successively, but it cannot guarantee the threads of each queues can be effectively used all the time [16].

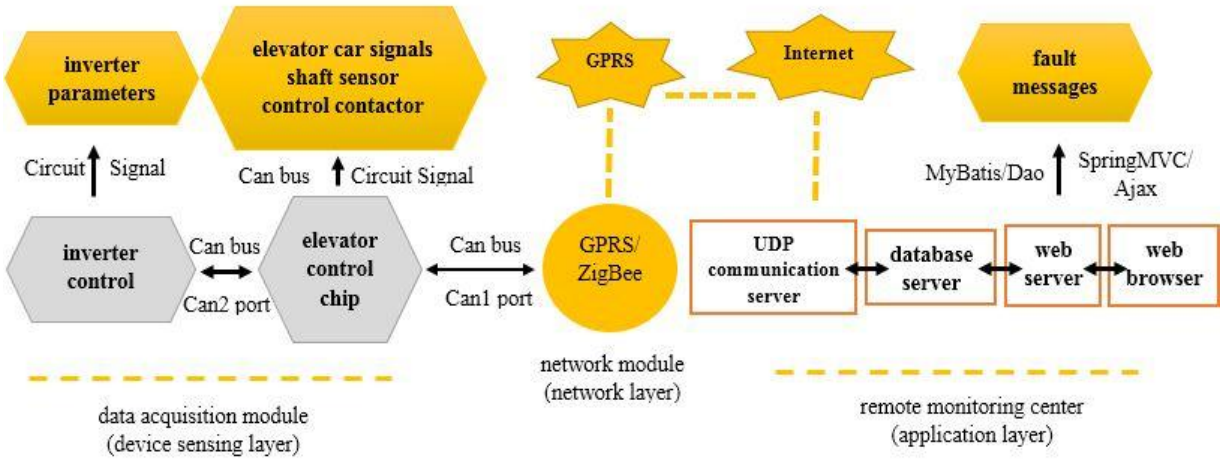


Figure 1.14. Structure of Elevator Running Parameters with IOT [16]

1.6.1 Design of Remote

The sending and receiving UDP datagram module receives the UDP data packets sent by the network module of elevator terminal, and put it into the receiving UDP message module. Handling UDP datagram module gets a UDP datagram from receiving UDP message queue, and a thread is removed from a thread pool to process tasks, a connection is removed from a database connection pool to handle database operations related to the task context. Because the processing task process is synchronized, so for a large number of time-consuming database operations, we put them alone into the batch SQL message module. When the task has been handled, we define the reply datagram, and insert it into the sending UDP message queue. The updating database module receives batch tasks from batch SQL message module. And a database connection is used to perform the batch operations. Due to the narrow GPRS network bandwidth and the longer delay, it is not suitable for using TCP protocol to communicate. So the system uses the UDP protocol, the advantages are high efficiency, small flow rate and network bandwidth resources saving. But it has no confirmation mechanism [17]. The heartbeat is the strategy of maintaining and monitoring during the long connecting. The software architecture of communication server model is shown in Figure 1.15. When the main thread of server program starts, program will create each module by using single thread. And it can be assigned multiple threads to open multiple database updating modules according to actual condition.

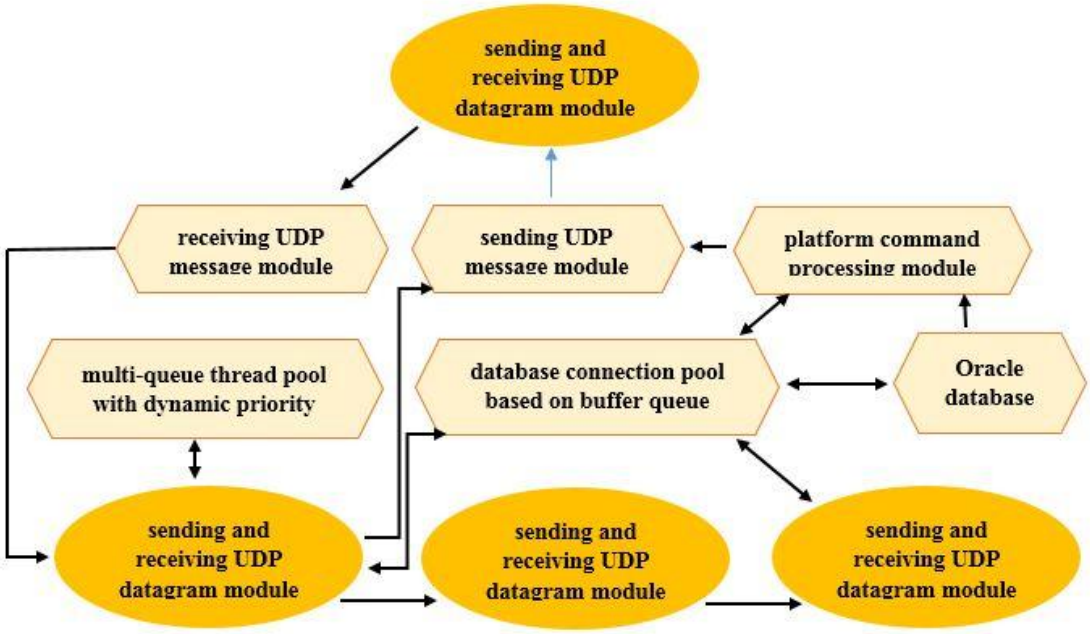


Figure 1.15. Software Architecture of Remote UDP Communication Server Model

1.6.2 The Working Process

particular below are main implemented codes and some important function descriptions of receiving available thread from the thread pool, when UDP datagram arrive handling module Figure 1.16.

```
public synchronized boolean start(Runnable runner, int
priority) {
PooledThread thread = null;
 // create thread for runner task
Vector idleList = idleThreads[priority];
if (idleList.size() > 0) {
   // obtain available thread from queue of the
   corresponding thread priority
   thread = (PooledThread)
   idleList .firstElement();idleList.remove(thread);
  thread.setTarget(runner);
// Wake up and set the thread task
return true;
```

```
// There is no corresponding priority thread in the pool,
traverse the other queue and obtain available thread
 if (threadCreationCounter [priority] <threadCounter
[priority]) {
        Vector idleList_=null;
        for(i=0;i< idleThreads_.size();i++){
          idleList_ = idleThreads[i];
           if (idleList_.size() > 0) {
          // obtain available thread from corresponding
           priority queue in the pool, code is the same as the
           above, the new code is as follows:
               thread.setPriority(priority);
              // reset the awakened thread priority
             thread.setTarget(runner);
          …}
        }
        // there are no available threads, create a thread
        thread = new PooledThread(runner, "PooledThread
         #"+ threadCreationCounter_, this);
        // set the initial priority
        switch (priority) {
        case HIGH_PRIORITY: {
              thread.setPriority(Thread.MAX_PRIORITY);
             // the number of created threads plus one in
              this priority queue
              threadCreationCounter [priority]++;
              break; }
```

Figure 1.16. Codes UDP datagram arrive handling module

1.6.3 Experimental and Result Analysis

In order to verify the property of high-concurrency UDP communication model, we have designed the following test plan and recorded the test results. Test machine is Intel Core 2 Duo PC with 2.5 GHZ, four dual-core thread CPU and 4 GB memory. The main program of remote UDP communication server runs in the development environment of JavaJDK1.7 and MyEclipse8.6.

1) The main program simulates a large number of terminals to send 100 real-time datagrams every 2 s, which lasts 1 min. Comparison and analysis of model (with unused JavaNIO, thread

pool and database connection pool) and the UDP communication model (with a combination of the three techniques) is shown in Figure 1.17. By comparing the experimental data, we know that the combination of the three techniques can greatly and effectively improve the efficiency of the system. JavaNIO eliminates the time that the sending and receiving UDP Datagram module cost to wait for connection, with obvious improvement of receiving ability. This is because the creation of thread and database connections requires a larger memory [18].

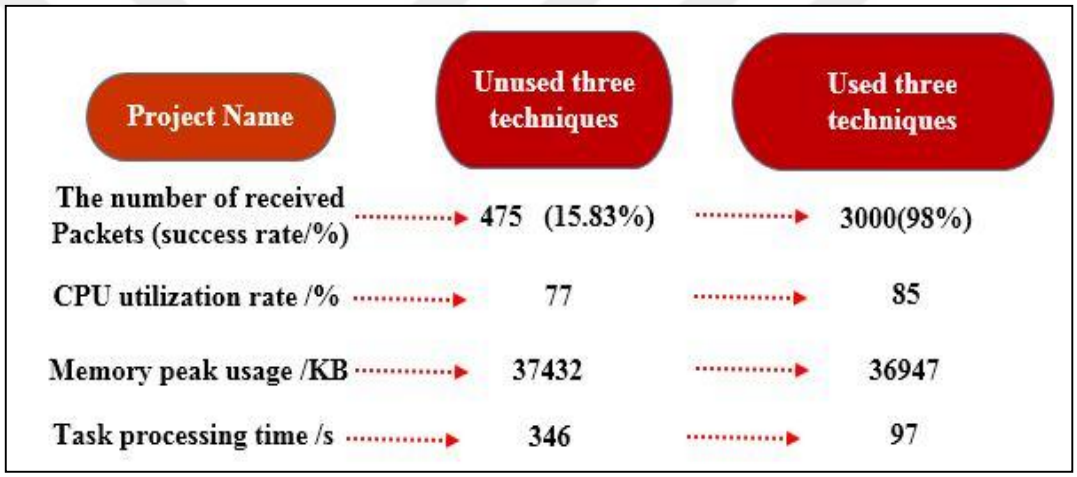


Figure 1.17. Comparison and Analysis of Model with a Combination of the Three Techniques

2) In order to verify the thread pool's ability to handle multiple level tasks, the main program simulates the number of real-time datagrams achieve the priority queue capacity, then sends the fault datagram every 20s. When the task arrives and processes finished respectively records the current system time, in order to get the task processing time. The experimental result is shown in Figure 1.18.

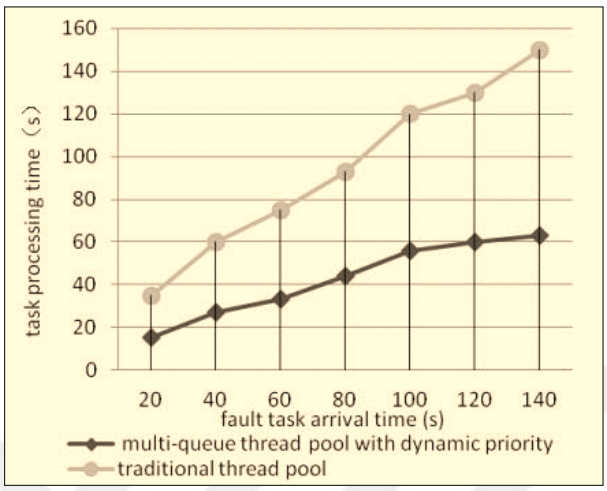


Figure 1.18. Performance Comparison of Multi-Queue and Traditional Thread Pool

1.6.4 The Design of Elevator Remote Real-time Monitoring Module

This paper uses the elevator remote real-time monitoring module as example to introduce the specific development process when SpingMVC and MyBatis develop a Web application system. The module function is as follows: when click on the link of the specific elevator, enter the page of elevator remote real-time monitoring. Left column displays the basic information of the elevator [19]. And including the following button: view parameters, error record, error statistics, remote control, etc. Right column displays animation of the elevator real-time running, hall call and internal call of the elevator, signal strength, work mode, running state, etc. Running effect is shown in Figure 1.19. Design idea is as follows: first, we need configure a View Resolver in the Dispatcher Servlet. Then map the user's request and the corresponding controller using annotations. Controller deals with specific business logic. Finally returns to the view. Business process is as follows:

1) Send the request of monitor elevator real-time data, in the JavaScript of the returned JSP, by using document, ready, sends the Ajax request of obtaining the elevator's basic information.

2) In the specific controller, query the basic information of the corresponding elevator according to the specified elevator number, calculate the rows of hall call box and internal call box,

intervals, total height, padding-top according to the number of floors, return the model to the JSP page.

3) JSP obtain the basic information's of the model, and display in the left column of the page. Setting margin-top, margin-right, height of the right column's hall calls box and internal call box, because the elevator layers is different, the display effect is different.

4) Every 1s sending Ajax requests to obtain the real-time data of elevator running, in order to refresh the part of the page. Query the running data of the corresponding elevator according to the specified elevator number, return the model to the JSP page.

5) According to the difference value between the data insertion time of the elevator real-time data table and the current time, to determine the state of the wireless signal and elevator online status. Determine and display the information according to the elevator work mode and the running state.

6) Controller has put the floor numbers of hall call and internal call into the two arrays and return through the model. In JavaScript of returned page, traverse the floors, judge hall call situation of each floors, draw in hall call box according to the previous settings, similarly draw the hall call box. Determine the number of people in the elevator and draw people according to the number of internal call.

7) Draw the elevator display box and background animation according to the elevator running state signals, up and down signals, the current floor. According to the door lock state judge the switch of door and draw the animation. According to the difference between the last time to obtain real-time data and this time, determine whether to send the request of obtaining real-time data.

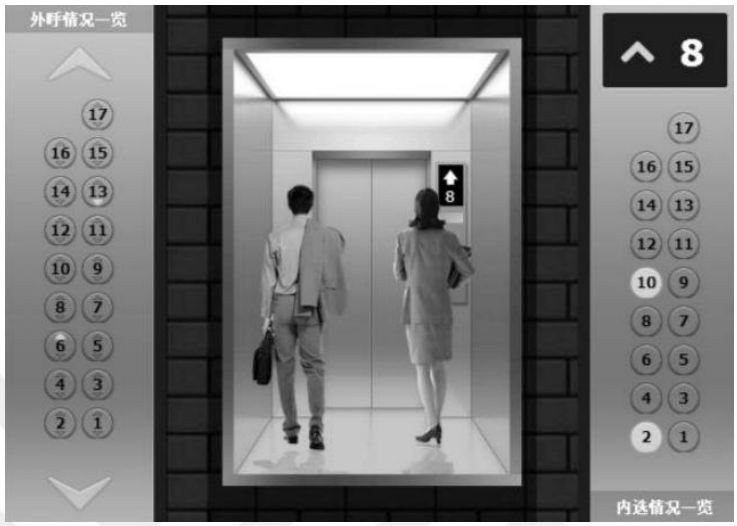


Figure 1.19. Running Effect of Elevator Monitoring

1.7 Contribution to Knowledge

The main point in this thesis is if any error happened in the elevator it should be transformed to the controlling room through IOT. Then in the controlling room at the same time we will select the type of faults with the time and place of happened the fault, it's helpful to repairing the faults as soon as possible, by using a sample of Arduino Uno and temperature and humidity sensor, this system is able to warn the residence of different levels of temperature and humidity in elevator room. Keep them a healthy in elevator, can provide access to the application so that it can reveal to us elevator room is health or not.

1.8 Organization of the Thesis

This project includes five chapters that represent the research work within the project's scope.

Chapter 2: In this chapter had mentioned all details about IOT and how it is useful in different technology's areas, and their relationship with each other, also it is talking about how it's working everywhere, any times and we can connect it with all electronic devices. Depending

on the previous years we can specify the directions of IOT and in how many areas had used for example it has in the connection (machine-to-machine). Also talked about the layer of IOT that is composed of three layers, also mentioned the components of IOT in details and also talking about the programs that has popularity and used now a day widely for example in the field of health, in domestic area, home and cell phone. Also talking about the advantages of IOT and it challenges.

Chapter 3: Chapter three talk about the Implementation hardware and design main structure of thesis, explain about code programming, sensor, and interface application. Also talking about the. Checking the levels of temperature and humidity sensor in the designated environment. This is also to highlight that this system is able to warn the residence of different levels of temperature and humidity in elevator room. The design of connecting this sensor with the computer application is called a Wireless Sensor Networks. this sensor is constantly reading and measuring the air of the elevator room environment and notify us of any pollution present.

Chapter 4: Shows a summary of the results achieved throughout programs and server, with declaration of how the program is working and how the problems occur inside elevator, compose of Client it has created by HTML, CSS and JQuery, also explain about how the server make a connection between client and technical room. The sensors are an important part of this thesis, also the way of receiving information and data that determined the problems that occurred of elevator and shown on computer screen of the technical room to get a proper solution for these problems.

Chapter 5: The conclusion summarizes and discusses the contributions of this research work. It additionally discusses the determination of the elements insert in this research work, and outlook trends of our research.

1.9 Summary

In generally talking about how the elevators are working, the declaration of structure of the used program for elevator with an illustration diagram. In addition, the types of errors and the

link between the elevator and the control system then illustrate them by reports. Also talk about the types of elevator in general.

2. BACKGROUND AND LITERATURE

2.1 Overview on IOT Application

The IOT to that make up the components have been in existence with the possible exception of wearable. Many devices with sensor that are now being connected, the device ability to communicate in a connected, and the devices ability to communicate in a way that is much less ownership and utilizing existing networks to move information. The sheer number of sensor produces big amounts of information. But with big scale storage of data possible, what's more, the simplicity with which the information can be change into helpful information and view on ubiquitous device like smart phone, this data becomes helpful. If people say that internet change society may be right. A several new technologies are in way that means the internet include and expansion as things large or small get connected. Before on from the internet of computers, when personal computers and servers connected to a world network and the internet of phone telephones, the next step growth is the IOT, when more or any objects will be connected and management. In the Figure 2.1. Show a new dimension of internet of things.

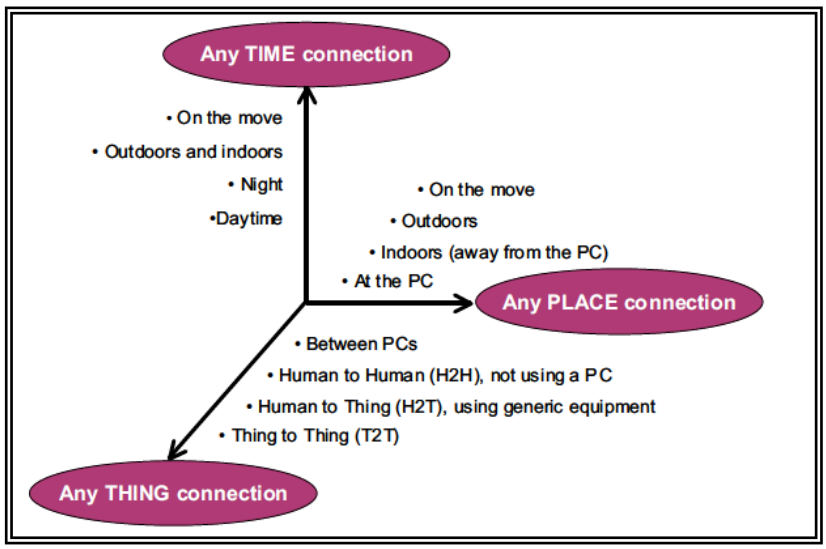


Figure 2.1. Dimension of Internet of Things

During connectedness with present networks intelligent and context-knowing account work on web resource is a needful piece of internet of thing. With the increasing public 4G, wireless internet access WIA, WIFI, LTE, the growth by pervasive datum and connecting webs is formerly clear. The IOT sight the figuring case will require back to exemplary versatile processing script that utilization brilliant portable and portables, and advance into interfacing unequaled existing things and implanting knowledge to condition. For innovation to vanish from the feeling of the client, the IOT repayment a take part conception of the case of its clients and apparatuses, pervasion correspondence systems to process, software architectures and the transfer logical datum to where it is applicable. Also, the analyses material in the IOT that goal for freelance and keen lead. it is finished with keen availability likewise setting mindful calculation and the underlying causes in place.

A Revolutionary growth of the present web into interconnected things that not just cropper datum from nature and interaction with physical world. However, likewise standards web to give administrations to datum transmit, analyses, applications, and correspondences. Raised by the control of gadgets empowered by remote innovation like RFID, Bluetooth, WIFI, and telephone datum administrations. IOT has ventured out of its earliest stages and about to transforming the current static web into complete future web [20]. The linkage between users at an unmatched scale. Only in 2011 interconnected between devices more than actual number of people. Currently 9 billion interconnected devices in 2020 expected to be 24 billion. The underlying thing that makes IOT different is data storage, development tools, network bandwidth, commoditization of sensors and platforms. Computer power to be helpful and ubiquitous internet of things has to use very low cost at all levels. The notion of M2M, automated control systems ACS and more like technologies around for contract, in the last few years the arrangement of all what is needed to make Internet of thing has come about.

2.2 Intelligent Fault Prediction Using Internet of Things

Security of key gear bunches has critical effect on creation and HR and also condition. When blame happens, the creation would be interfered, and huge loss of generation and HR and additionally condition would be caused Key mechanical hardware gatherings, for example, rapid compressors and turbines are the center gear in modern generation. In this manner, how to ensure the protected operation of the key gear gatherings is an imperative issue confronted in the creation. Work has been done in three phases to guarantee key mechanical hardware working safely and dependably, alongside the improvement of PC applications. What's more, the third stage is to anticipate blame, which is generally done before breakdown. The second stage is to analyze blame, which is generally led when glitch happens Figure 2.2. Blame expectation can anticipate the pattern of condition improvement of gear running sooner than blame analysis, and it is one key innovation to guarantee the protected operation of huge key hardware. The related work about blame forecast has been done in numerous nations.

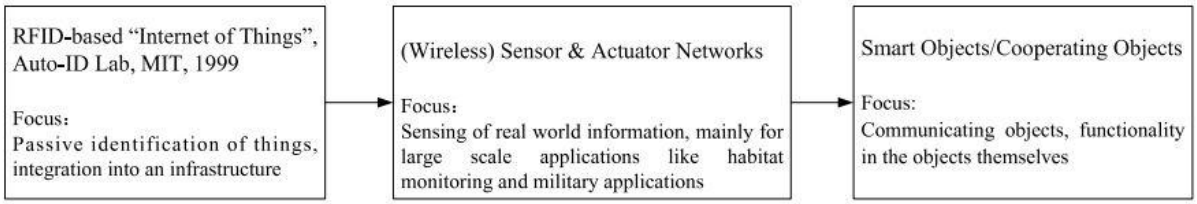


Figure 2.2. Evolution of the Internet of Things

2.2.1 Analysis of Fault Prediction System Based on Internet of Things

Fault prediction framework in view of web of things is another approach to guarantee the protected operation for key mechanical gear gatherings. Also, it can be considered as the new creating method of hardware blame observing, finding and forecast.

A) Internet of Things: The web of things is viewed as the third rush of data industry after the PC and the web and versatile correspondence arrange [21]. The idea was authored by Kevin Ashton of Massachusetts Institute of Technology in 1999. The IOT has encountered three primary advancement phases of RFID-based "web of things" and (remote) sensor and actuator system and savvy objects/coordinating items.

B) Characteristics of the fault prediction system based on internet of things: The equipment observing, determination and forecast framework has encountered three modes, specifically (1) disconnected mode; (2) single hardware online mode; (3) appropriated online mode. This mode is monetary and helpful yet appropriate for general discovery. In disconnected mode, the working data of the gear is observed by different sensors, and exchanged to PC through information securing gadget, and after that the blame finding or the blame forecast is completed. In single gear online mode, an arrangement of condition observing and blame investigation framework is introduced for one or one kind of hardware. This mode appreciates the focal points, for example, great constant execution and high dependability, however it is not financial and difficult to share data among various checking and finding frameworks [22].

2.2.2 Design of Functional Structure and Fault Prediction

The fault prediction framework in view of web of things is intended to be an interconnecting system to anticipate the blame for key mechanical gear gatherings [23]. Its utilitarian structure is made out of four layers, to be specific sensor-checking layer, middleware-transmitting layer, expectation application layer and choice criticism layer as shown in Figure 2.3.

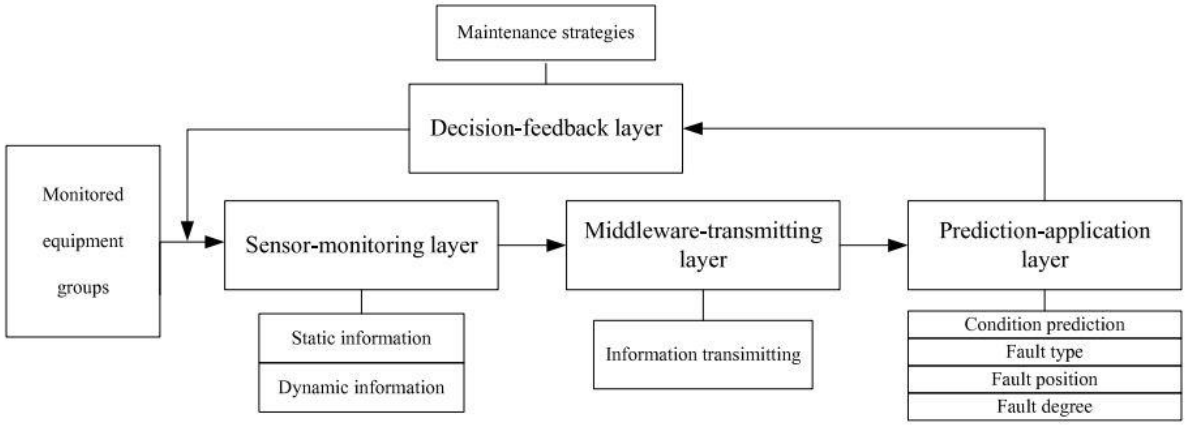


Figure 2.3. Four-layer Functional Structure of the Fault Prediction System Based on IOT

A) Sensor-monitoring layer: The sensor-monitoring layer is the premise of the framework, and it is principally for the checking of the hardware bunches with the static and dynamic data of gear's gathered. It is made out of the checked hardware gatherings, information accumulation gadgets and information accumulation terminals as appeared in Figure 2.4.

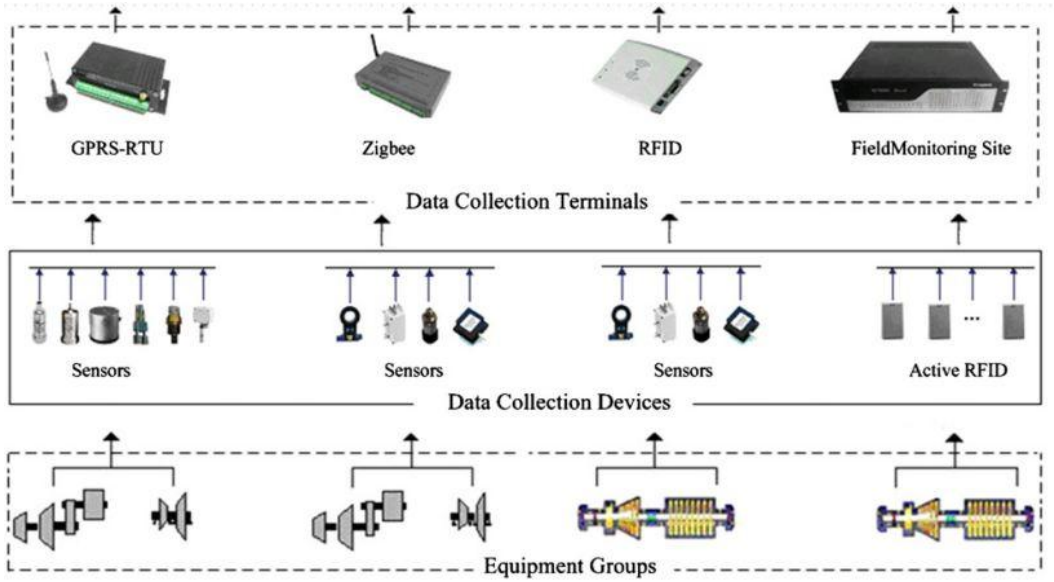


Figure 2.4. Composition of Sensor Monitoring Layer

B) Middleware-transmitting layer: Middleware-transmitting layer is an essential connection part, which associates the sensor-observing layer with the forecast application layer. The layer is predominantly made out of middleware server of the web of things and the multi-convention heterogeneous interfaces to transmit different sorts of data as appeared in Figure 2.5.

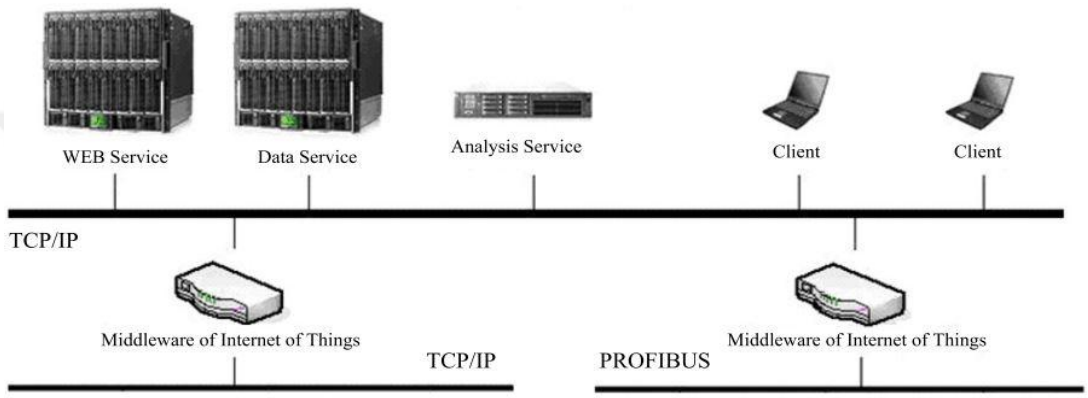


Figure 2.5. Composition of Middleware Transmitting Layer

C) Prediction-application layer: Prediction-application layer is the center application layer, which comprises of remote master groups, singular remote master and information distribution center et cetera appear in Figure 2.6.

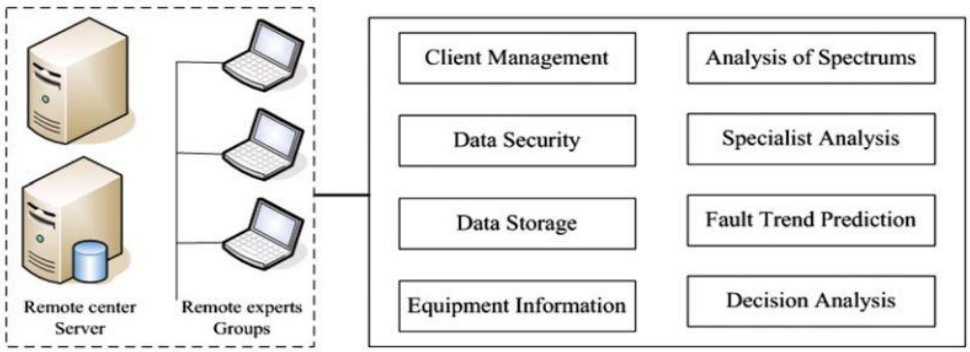


Figure 2.6. Composition of Prediction Application Layer

2.2.3 Discussion of Three Main Difficult Points

There are three primary troublesome focuses confronted in the framework and they are talked about as takes after. (1) The blend trouble of the blame expectation and web of things. Despite the fact that the web of things is the expansion of web, the conveying courses utilized as a part of the web of things are more muddled than those utilized as a part of web. So measures or standards and coding of the imparting conventions are expected to build up further for better mix. (2) Non-stationary and nonlinear blame forecast troubles. Expansive key hardware bunches utilized as a part of the modern site are frequently running with huge power and overwhelming burden, and in long procedure of gear running unsettling influence of non-blame components, for instance, changes of working condition and load are major non-stationary purposes behind accuse gauge. As mechanical hardware is a sort of complex nonlinear power framework and most blames of the mechanical gear encounter the creating procedure of event to disintegration, when blame expectation embraces conventional methodologies, the nonlinear components are typically dismissed. (3) Massive information preparing challenges. The information obtained from the sensor-checking layer are monstrous. Also, the information covers the working conditions, stack and ecological elements of the hardware gatherings. Different sorts of dynamic data are picked up in the layer, including vibration esteem, rotating velocity, temperature and weight et cetera. Instructions to prepare the gigantic information to make powerful portrayal, store, seeking and sharing is an exceptionally troublesome issue confronted.

2.3 Sensors and Applications of IOT

The internet of thing contains three basically layers, application and management layer [24], network layer and sensor layer Figure 2.7.

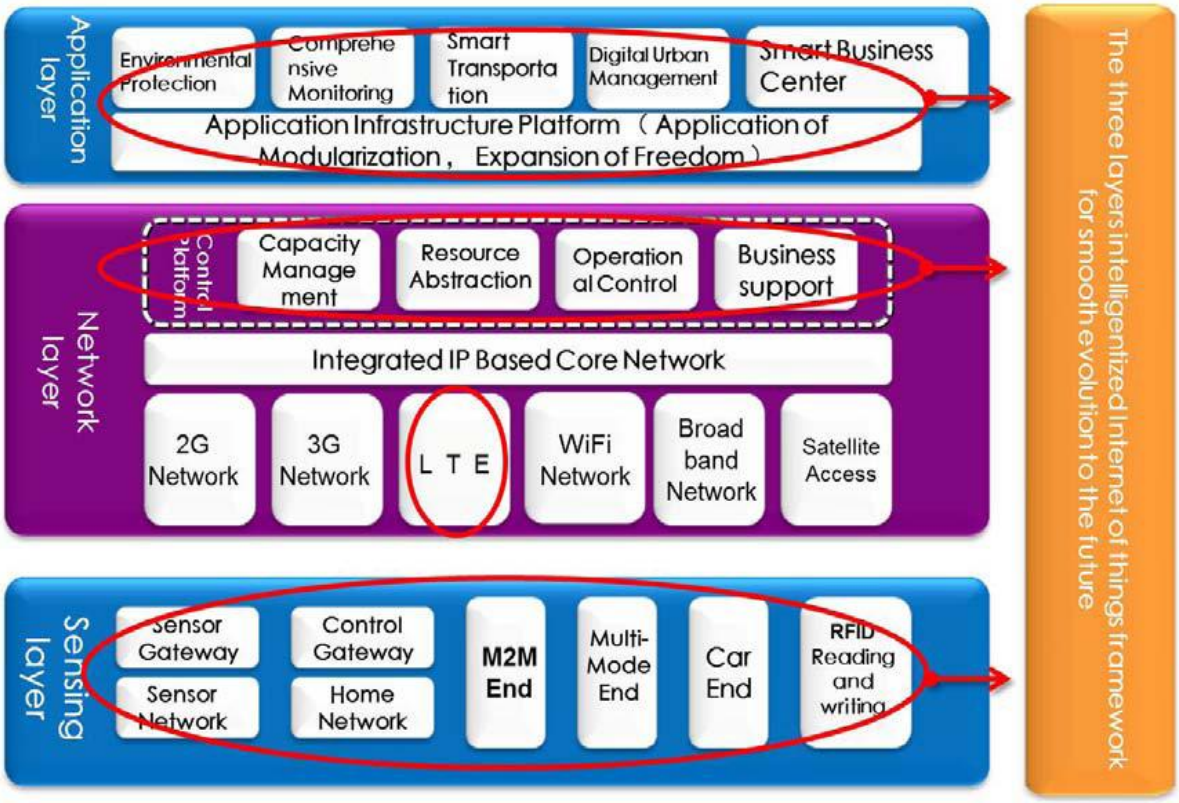


Figure 2.7. Architecture of Internet of Thing [24]

A) Application and Management Layer:

- We are creating digital nervous system with sensors.
- Joint to measure physical amount.
- Connection between digital world and physical.
- In the real time collects and process datum.
- Capturing of cyclic sensory data.
- Data analyses (Extracts relevant datum from enormous amount of raw data).
- Streaming analyses (operation real time datum).
- Ensures safety and privacy of datum.

B) Network Issue Layer:

- Infrastructure network high performance and strong.
- Supports the communication needed for latency, bandwidth or safety.
- Allows multiple organizations to involvement and use the same network freelance.

C) Sensor Layer:

- Provides a user interface for using internet of thing.
- Different applications for different sections for example Transportation, Healthcare, Agriculture, Retail.

2.4 Internet of Things Component to Design Sensor and Application

There are three components of internet of thing which enables seamless, first hardware: sensors, embedded communication and actuators. Second middleware: figuring devices for information analyses and request capacity. Third introduction: easy to comprehend perception and translation instruments which can be closely gotten to on chain stages and which can be intended for various applications [25].

A) Radio Frequency Identification (RFID): Is a main penetration in the implanted correspondence model which empowers styling of microchips for remote information correspondence [26,27]. They helper in the programmed Character revealed of all that they are appended to going about as an electronic standardized identification. The uninvolved Radio frequency identification labels aren't battery controlled and they utilize the force of the per user's cross examination flag to impart the identification to the Radio frequency identification per user. This has brought about all applications especially in retail and show diverse administration.

B) Wireless Sensor Networks (WSN): Recent innovative advances in low power complete circuits and remote communications have made accessible competence, financially savvy, miniature low power gadgets for use about detecting applications remote. The accumulation of these variables has enhanced the reasonability of using a sensor organize Including an extensive number of sensors, preparing, empowering the accumulation, investigation and distributing of important datum, assembling in an assortment of situations [28]. Dynamic radio recurrence recognizable proof is nearly the like as the lower end remote sensor systems hubs with constrained handling Capacity and capacity Figure 2.8. The logical encounters that must be overcome to comprehend the monstrous capability of remote sensor systems are significant and multi-disciplinary in nature.

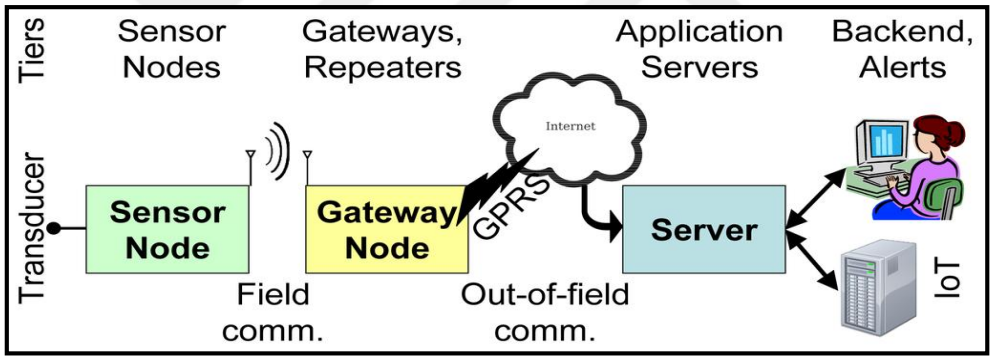


Figure 2.8. Wireless Sensor Network Vision [28]

Sensor information are shared between sensor hubs and sent to an allocation or concentrated framework for analyses, WSN parts that make up the surveillance network include:

1- Wireless sensor network equipment: the hub WSN equipment contains power supply transceiver units, sensor interface and processing units.

2- Wireless sensor network communication: the nodes like ad-hoc are expected to be deployed for generally applications. In a wireless sensor network node to communicate between themselves to transform datum in single of multi bounce to a base station. Customer drop outs, and resultant corrupted system life times, are visit [29].

3- Wireless sensor network middleware: A service oriented architecture vision with cyber infrastructure and sensor webs to offer incoming to various sensor resources in publish independent style. A platform middleware for developing sensor application needed, like web architecture open sensor [30].

4- Shielded information aggregation: an effective and secure information conglomeration strategy is required for protraction the lifetime of the system and additionally make sure solid information composed from sensors. Hub letdowns are a typical normal for Remote sensor networks.

C) Network Issue Protocol: The success of internet of thing is critical the ability to uniquely identify "objects". It is not such as permit us to remarkably distinguish many things of gadgets likewise control remote gadgets in the web. Some important elements of making a special address for things are uniqueness, dependability, perseverance and adaptability. Many elements that is as of now associated together and those will be joined in future, will be recognize by their special recognizable proof, area and operation. IPv4 can be support sensor devices identified geographically, but IPv4 Not can't support individually.

The IPv6 well solve problems identification of sensor devices, however; types of variable data, synchronous procedure and conjunction of information from nodes worsens the trouble promote [31]. When the data traffic channel relentlessly and ubiquitously it will persistent network functioning is other portion of internet of thing. The TCP-IP be careful device to be routing a trustier and efficiency way form source to goal the web of thing appearances a bottleneck at the interface wireless sensor node and the gateway. In addition, node address of the current system for scalability must be supportable. For systems expansion or expansion gadgets must not obstruct the execution working of the system or the reliability of the information. To address these active, the Uniform Asset Name-URN framework is well-thought-out essential for the advancement of web of thing. URN for asset makes imitations that

must be gotten to through the URL. With huge measures of information being collected, it is mostly imperative to give us preferred standpoint of the advantages of properties for transmit the information from a database to the client compare the web [32]. IPv6 it's likewise gives us great alternative for the get to assets remotely and uniquely.

Something else for addressing development is the growth of a lightweight - IPv6 that must empower tending to house device extraordinarily. WSN as building blocks of internet of ting, if compared to the internet it is run on a different stack, can't have IPv6 stack to address separately and subsequently a subnet with a portal so URN will be required. With this consideration, the relevant gateway needed layer for addressing sensor nodes. In the subnet, the uniform resource name for the sensor hubs could be the one of a kind recognizable pieces of proof as opposed to human kindhearted names like in the www and address for this hubs at query table in the entryway. Every sensor hub must have a URN like numbers for tending to sensors by the door.

D) Data Storage and Analytics: Among the most essential consequences of this new field is to make an uncommon measure of information. Capacity, expiry and property of the information wind up noticeably basic cases. The total power generated where the internet consumes up to 5%, It's more critical to development AI Computerized reasoning calculations where could be straightforwardness concentrated and appropriation in light of the need, nonlinear, neural systems and other AI methods are vital auto basic leadership. For both hardware system design and software development also have a modular architecture by and large extremely appropriate for internet of thing implementation.

Importantly a centralized infrastructure to support data storage and analytics is required. As of 2015 cloud based capacity arrangements are getting to be noticeably famous and cloud based analytics are foreseen.

E) Combination of Cloud Computer and IOT: The blend of the web of things and distributed calculate will definitely prompt the advancement of financial. In the event that the mix of the internet of things and distributed computing is intermittently portrayed, it ability generally separated inside the accompanying three stages in the first stage, data and information is taken as variables to be utilized, which enhances the effectiveness of the endeavors. The second stage changed the customary method for creation and administration, upgrading the structure of framework steadily [33]. The third stage prompts the data combination and streamline the structure of industry in general. Fundamental stage of distributed computing joined with IOT is appeared. After distributed calculate joined with Internet of things innovation, it ability get more contact information and data the gigantic registering power and capacity limit of distributed computing can well mirror the condition of the creation operation and opportune address different issues.

Additionally, data and information can be concentrated overseen. A nitty gritty examination of information to get the conclusion and compress and ceaselessly changing and improving the entire framework makes the creation high proficiency and minimal effort [34].

In the second stage, the center is to streamline the method of creation taking into account the administration and utilization of data. Canny Internet of things innovation actualizes the programmed checking and remote planning with respect to the generation process, making the creation achieve the mechanization and concentrated. Also, through the distributed computing wise data stage, it essentially decreases the human blunder, and comes to exact control and the administration design.

F) Visualization: Representation is basic for an internet of things application as this licenses relationship of the customer with nature. With late advances in touch screen innovations, use of brilliant tablets and phones has turned out to be greatly natural. For a layman to totally benefit by the IOT change, engaging and clear representation must be made. As we move from 2D to

3D screens, more information can be given in significant ways to deal with purchasers. This will similarly engage policymakers to change over data into realizing, which is essential in snappy decision making. Extraction of significant information from rough data is non-piddling. This incorporates both event location and representation of the related rough and showed data, with information addressed as demonstrated by the necessities of the end-customer.

2.5 Applications of Internet of Thing

There are a number of application areas which will be affected by the developing IOT. The applications can be Group in light of the kind of system accessibility, encasement, scale, heterogeneity, repeatability, client participation and effect [35]. In internet of things categorize of applications into 4 applications: Enterprise, Personal and home, Utilities, Mobile. There is a large hybrid in applications and the utilization of information between areas. For instance, the Individual and Home Web of things produces power use information in the house and makes it accessible to the power service organization which can thus improve the free market activity in the Utility web of things. The web empowers sharing of information between various specialist organizations in a consistent way making numerous business openings Figure 2.9.

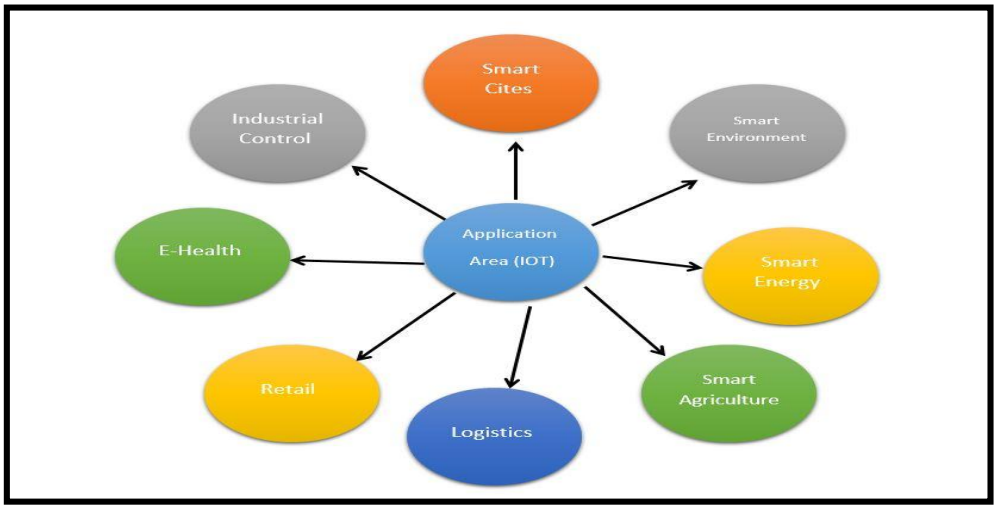


Figure 2.9. Application Area of Internet of Thing [35]

A) particular and Home: The sensor data gathered is utilized just by the individual who straightforwardly claims the system. For the most part WIFI is utilized as the spine empowers over transmission capacity data-video transportation likewise higher testing rates Sound [36]. An expansion of the individual body zone system is construct a home control framework for coldish mind, which permit the specialist to overseer patients and the olds in their homes by that decrease medication costs through early interference and treatment. Control of home hardware like ventilation systems, cold storage, clothes washers and so on., will permit well home and power administration. This will see buyer move toward becoming participate in the internet of thing insurgency in an indistinguishable path from the Internet coup itself. Group systems administration is set to suffer another transmutation with billions of interconnected articles. An amusing advancement will utilize a Twitter like thought where single "Things" in the house could repeated tweet the readings which could be effortlessly taken after from anyplace making a Tweet [37].

B) project: One of the main internet of thing application territories that is earlier drawing consideration is Brilliant Condition internet of thing. There are different test beds being carry out and numerous extra arranged in the coming years. Insightful condition cover subsystems and the typical from an innovative viewpoint. These applications are gathered by their collision ranges. This incorporates the reaction on inhabitant considering wellbeing and prosperity affair, transportation in brilliant of its effect on flexibility, profitability, corruption, and benefits in circumstance of basic society administrations oversaw and supply by nearby government to city resident.

C) Utilities: These are comprised of extremely expanded systems mostly laid out by extensive grouping on a provincial and national range for administer basic usefulness and capable asset administration. It is earlier being utilized by usefulness organizations shrewd meter by power provide organizations for supply administration keeping in mind the end goal to streamline

Installment versus usefulness. The spine arrange utilized could shift betwixt cell, WIFI and satellite connection. Shrewd system and keen metering is another hidden internet of thing application which is being carry out everywhere the world. Effective power utilization can be accomplished by consistently administer each power point inside a house and utilizing this knowledge to fluctuate the way power is expending. This knowledge at the city scale is utilized for continuing the heap adjust inside the system guaranteeing elevated expectation nature of administration [38]. Video based internet of thing, which combines picture preparing, PC vision and systems administration structures, will help advance another testing logical research territory at the interchange of video, infrared, mouthpiece and system innovations.

D) Mobile: Smart transportation and shrewd coordination's are situated in a detached domain thus of the way of information sharing and spine execution needed. Urban activity is the major benefactor to movement din contamination and a main patron to urban air quality declination and nursery gas outflows. Movement crowding specifically forces large expenditure on financial and social exercises in a considerable measure of urban areas. Dynamic activity data will impact cargo development, permit improved arranging and better booking. The vehicle Web of Things will permit the utilization of huge scale WSNs for web based checking of journey times, origin goal O-D, course option performance, line lengths and air contaminant and clamor emanations [39].

The Expansion of Bluetooth innovation gadgets mirrors the current Internet of Things breakthrough in various computerized items for example smart phones, navigation systems, etc. Supplemented by additional information hotspots for instance movement signal, or vehicle GPS, explore issues Could be tended to incorporate automobile travel time on motorways and major lanes, dynamic time dependent O-D matrix on the network, detection of basic convergences, precise and dependable continuous transfer network status information [40]. There are

excessively numerous protection worries by such purpose and advanced missing is a rising space of research in internet of things where secrecy is a nervousness [41].

2.6 Benefits of Internet of Things

- Improved resident's personal satisfaction.

  Social insurance from anyplace.

  Better safety, security and productivity.

- New business openings.

  IOT can be utilized as a part of each vertical for enhancing the productivity.

  Makes new organizations, and new and better occupations.

- Economic development.

  Billions of dollars in reserve funds and new administrations.

- Better condition.

  Spares regular assets and trees.

  Helps in making a savvy, greener and reasonable planet.

- Improved competitiveness.

  Competitive in providing cutting edge products/services.

2.7 Challenges IOT to Fault predictions

The proposed Cloud focal vision involves an adaptable and conquers engineering that is client focal and allows various players to react in the Internet of thing system. Relying on the IOT components prepared earlier some open challenges are debated. It permits a suitable reaction for them possess matters, with thrusting the internet of thing over them. Because of this

the framework consists of thrifts for meeting various requests owing to data property, privacy, sharing information and security Figure 2.10. The challenges contain IOT particular challenges like participatory, detecting, security, information examination, GIS set up representation and Cloud processing far from the standard WSN challenges covering conventions, Quality of Service, energy effectiveness, security and architecture [42].

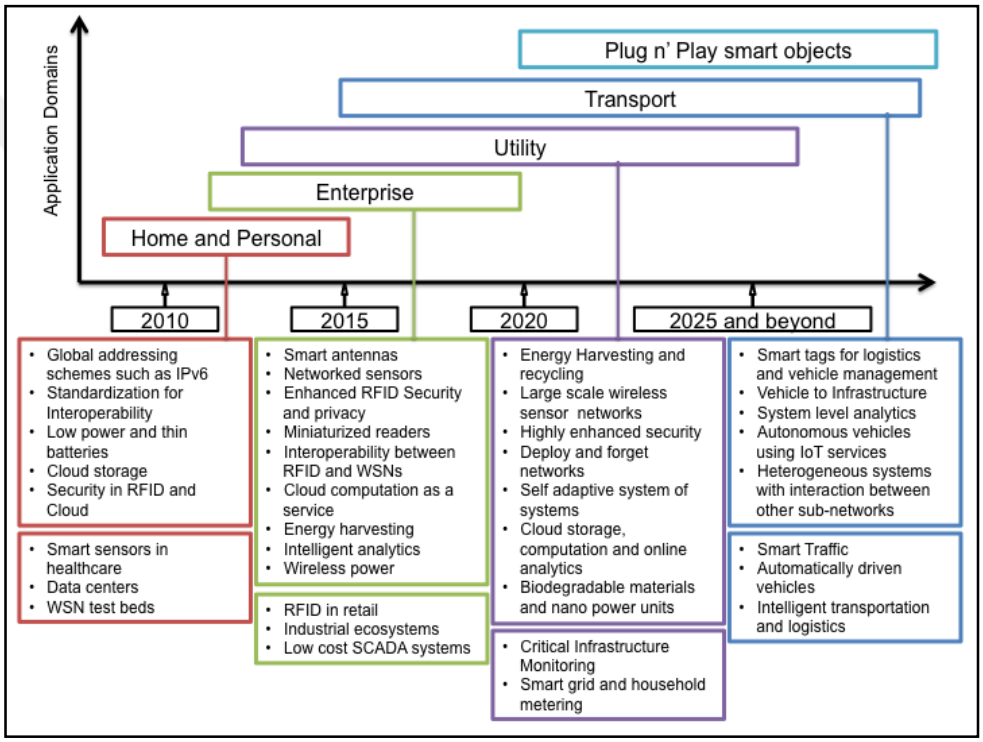


Figure 2.10. Roadmap Technology of Internet of Thing [42]

2.7.1 Architecture of Internet of Things

Chiefly architecture put up at the first phases of internet of thing research will have a sharp firmness in the filed same and required to be examined. Fastening to IOT architecture most of the works have been from the remote sensor systems point of view [43]. IOT - engineering and The projects of European Union of Sensei, own been aiming the take one specially form the

wireless sensor network, abstract also, possess been exceptionally effective in acquainting the engineering for several enforcements.

2.7.2 Energy Efficient Sensing of Internet of Things

Effective heterogeneous feeling of the civic environment demands simultaneously meets competing requirements of multiple feeling modalities. It has an inclusion on data, energy utilization and network traffic. What is important is this covers solved and mobile detecting foundation also, random and persistent inspecting. Information accumulation and demonstrating that viably profits spatial and transient attributes if the information seeks a propagated framework, both in the feeling domain as well as the combined transform areas [44].

2.7.3 Networks and Privacy of IOT

anywhere webs are circulated at big scale security will be a main concern. Security is placed as a basic to any system and the main scope of statement of regret against information debasement cryptography. There are several ways for attacking the system, handicapping the system accessibility, pushing incorrect information into the system; approaching individual data. RFID, WSN and Cloud which are the three physical segments of IOT are helpless for such kind of attacks. RFID sounds to be the most defenseless and this is because it lets a person to track what's more, no abnormal state insight as the objects can be empowered on these gadgets.

Encryption assures data certainly against outsider attackers, while the authentication message codes assure data authenticity and safety. The fact is Encryption doesn’t protect evil insider bad assaults, to address which none of cryptographic means are required, especially in WSNs. New sensor applications should be introduced periodically, or if exists should be refreshed. This work is finished by distant remote reprogramming of all hubs in the system. Conventional system programming contains exclusively scattering convention which dispenses code to every one of the hubs in the system with no confirmation, and it's a security code. A protected reprogramming

convention gives the hubs to validate all code a chance to refresh and boycott noxious establishment. The majority of these conventions are relied on the benchmark convention Storm [45].

Cryptographic additional items are expected to Downpour, which sets the establishment for more advanced calculations to be developed. Another critical zone of research is security which will require more awareness. Cloud also holds economics of Internet of thing along with the presence of the data and tools that will make it a greater risk from assailant. Personality and security insurance winds up plainly basic in half-caste mists where specific and additionally open mists will be utilized by organizations. Also digital forgetting can feature as one of the key ranges of the examination to address the worries and the expansion of a suitable cadre for protecting individual information. Perpetually recalling the setting of IOT will raise numerous personal issues as the information gathered can be utilized as a part of two ways positive and adverse. For positive such as advertising and for passive like throwing [46].

2.8 Summary

Depending on the previous years we can specify the directions of IOT and in how many areas had used for example it has in the connection M2M. Mentioned all details about IOT and show how it is useful in different technology's areas, their relationship with each other, working everywhere and any times and we can connect it with all electronic devices. Layer of IOT that is composed of three layers, also mentioned the components of IOT in details and also talking about the programs that has popularity and used now a day widely for example in the field of health, in domestic area, home and cell phone, etc. Explain the advantages of IOT and it challenges.

3. IMPLEMENTATION HARDWARE AND DESIGN

3.1 Wireless Sensor Network

One of the most important considered technologies of the Twenty First Century is Wireless Sensor Networks WSNs [47]. Recent advances in Microelectronics Mechanical Systems MEMS and technologies of Wireless communication have enabled cheap, small and intelligent sensors to be deployed in physical environments. It is networked by wireless connectivity and presents unprecedented opportunities through the Internet for various military and Civilian applications. For example, battle field surveillance, industry process control and environment monitoring [48]. Such technologies are distinguished from traditional wireless communication networks, in example, mobile Ad-Hoc Networks MANET and Cellular Systems. Unique characteristics are present in WSNs, such as, computation, storage constrains, denser level of node deployment and higher unreliability of sensor nodes [49]. Such examples and illustrations present new challenges in the applications and development of WSNs.

WSNs have received extreme attention from academic and industrial platforms worldwide in the past decade. A magnificent amount of research has been executed to analyze and provide solution for various application and design issues and important advances have been done in the deployment and development of WSNs. It is predicted and forecasted that in the near future, wireless sensor networks will be used in numerous fields of military and consumers and enhance human interaction with the world and the routine of daily living [50].

3.1.1 Establishing Link Between Software and Hardware by Using IOT

In most applications of sensor networks, it is necessary that data delivered over wireless channels that face noise, time-variance and errors in a reliable manner. To achieve this, the dedicated network protocol for the particular sensor network must contain correction and error control mechanisms to guarantee the data delivery is reliable. understanding the fact that sensor nodes are deployed in hostile and unpredictable environments while most of the times

unattended, sensor nodes should be able to recover on their own. Sensor nodes should be able to tolerate faults and be capable of self-calibrating, self-testing and repair themselves [51]. Each of the humidity and temperature sensors are placed alone on top of the Arduino boards just as Modern IoT requires a strong foundation involved sensor hubs, vitality effective correspondence systems, and portals that interface with the Internet and cloud. The datasets created by the sensors go through many stages before getting to be plainly significant for organizations. This article presents the idea of sensor hubs, low-control systems, and IoT Gateways utilized as a part of modern situations. We will use Arduino, XBee, Raspberry Pi 2 and open source software for prototyping an end-to-end solution.

A) IOT Gateway: In a modern IoT situation, there are numerous sensors and actuators that associate with the hardware. Each machine would regularly have numerous sensors following its wellbeing and checking the key parameters identified with the generation. Every sensor and actuator is joined to a microcontroller that is in charge of gaining the information or controlling a switch through a pre-characterized direction set. The microcontroller alongside the sensors, control and a radio is known as a sensor node. It is a self-contained, deployable unit that captures the data generated by sensors. The sensor node doesn't have enough processing power, memory, and storage to deal with the data locally. It uses a low-energy radio communication network to send the data to a central location. The communication link between the sensors' nodes and the central hub is based on ZigBee, Bluetooth Low Energy, or Power over Ethernet. The center point that goes about as an aggregator of various crude datasets produced by the sensor hubs is called an IoT passage. Sensor hubs that are fit for associating with the Internet still need an entryway for information conglomeration and change. They interface with an apparatus running in the cloud called a cloud portal. The local edge device running on-premises is often referred to as a field gateway shown in the Figure 3.1.

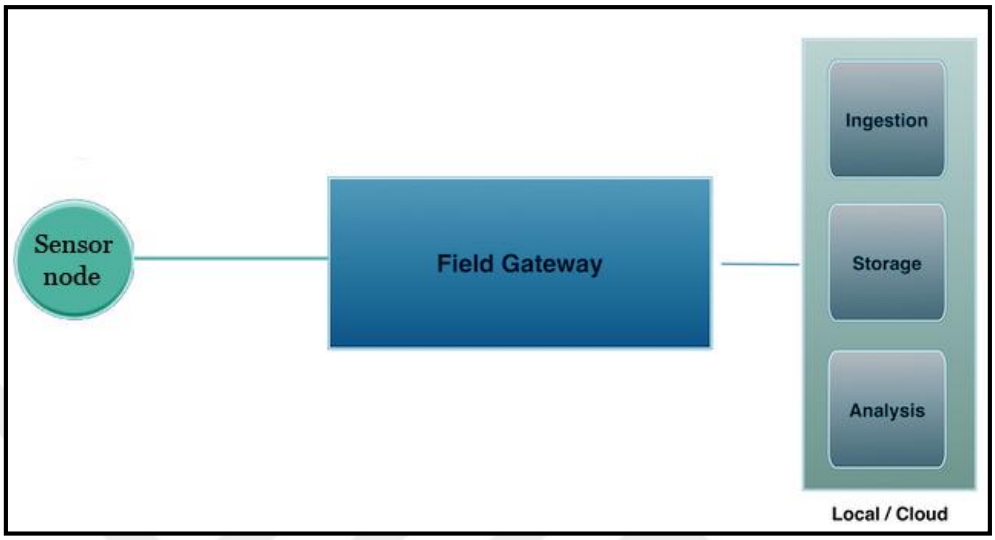


Figure 3.1. Field Gateway

B) XBee Circuit: XBee modules make it easy to create a wireless point-to-point or mesh network. They are configured with the standard AT commands. With implicit blunder revision, XBee modules offer a solid remote connection. They come in numerous flavors, with support for conventions like ZigBee, Bluetooth, and even Wi-Fi. The XBee modules can be arranged to work either in a straightforward information mode or in application programming interface (API) mode. ZigBee is a detail for an abnormal state correspondence convention mostly utilized for individual region organizing in light of little, low-control computerized radios. Its low power utilization limits the transmission go from 10 to 100 meters' observable pathway, contingent upon power yield and ecological qualities. ZigBee devices are capable of transmitting data over long distances by passing through a mesh network of intermediate devices to reach more distant ones.

C) Arduino Uno and Gateway: Since the objective of this project is to build a working prototype, we will keep the sensor node configuration simple. We will use an inexpensive

DHT11 sensor that captures the ambient humidity and temperature and sends it to the gateway Figure 3.2. We use the following components:

1- Sensor Node

- Arduino Uno
- DHT11 humidity / temperature sensor
- XBee breakout board
- XBee series 2

2- IoT Gateway

- Raspberry Pi 2
- XBee series 2
- Wi-Fi Dongle

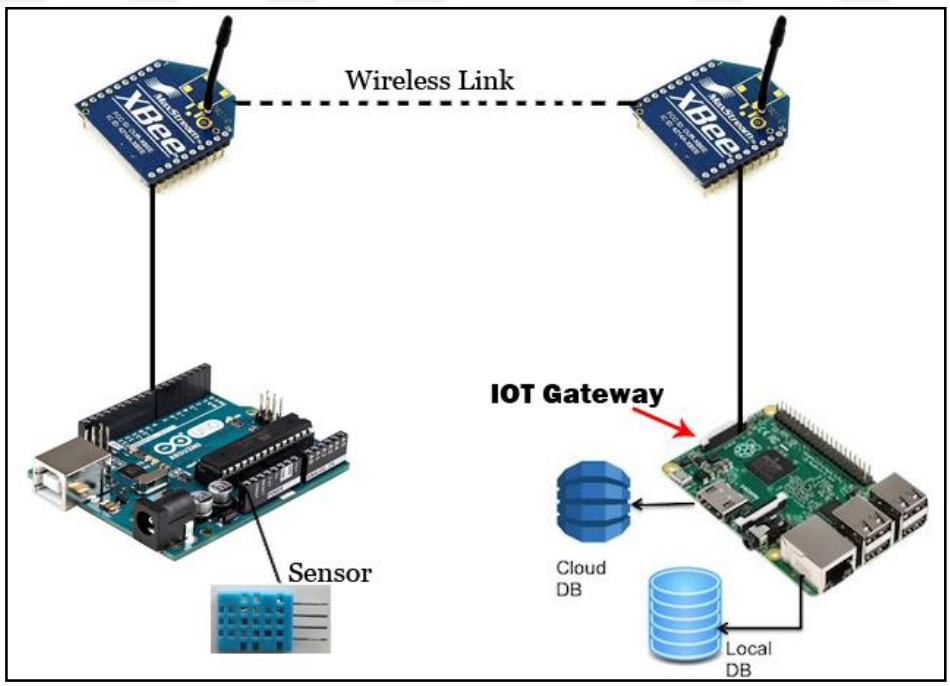


Figure 3.2. Shows the Design of the Connection Between Wireless Sensor Networks

In some application, sensors are installed in military compounds and face unusual threatening environmental issues. Hence, they are susceptible to danger. Given such natural state, precautionary protective measures and mechanism should be put in place to secure data and network operability from unauthorized usage and deliberate attacks. there is limited bandwidth resource in sensor networks. Therefore, protocols designed for communication in sensor networks should possess effective and plentiful channel utilization enhancements.
Different applications may contain variant levels of Quality of Service regarding packet loss and delay in data delivery. Some applications, in example, Fire monitoring Sensors are sensitive to latency and is required to have real-time data traffic delivery.

It was used Arduino board with sensor devices for humidity, temperature, that it can provide us readings on measuring air pollution in elevator room or closed environment. Such as, temperature and humidity, at a preset level, to reveal how unclean the environment have been. To design this system, used 1 Arduino boards, and to link these boards, it was used Wireless Sensor Network WSN as mentioned above. For Arduino board, it was used a wireless board of the kind CC3000. wireless board is required, each of which will be mounted on top of the Arduino board. Each of this board will be connected to an Access Points, which is a MIKROTIK brand, through the wireless boards. In this manner a local network is created. The Arduino board will get an IP address distributed by the DHCP of the Access point, and then statically set the IP the Arduino board by the Mac Address of the Arduino board so that it will choose the same IP address over and over again.

3.2 Wireless Communication Technology to Connecting Application

The primary technology to deploy a normal operation of WSN is Wireless Communication. Wireless networks have been analyzed and evaluated thoroughly over the past few decades, important advantages have been achieved in numerous fields of Wireless Communication. Various synchronizations, Antenna Techniques and Modulations have been put in place for different application requirements and network scenarios at the physical layer. Feasible

communication protocols have been created at higher layers, and enhanced to point out the many issues facing a network, as an example, routing, Qos, Network Security and Medium access control. Such techniques in communication and protocols allow for a technical powerful design background of the wireless communication in WSNs. Most traditional networks implement radio frequency RF for communicating, included is Millimeter ware and microware [52]. The facilitating reason RF is used is that it is Omni-directional and doesn't necessarily need a line-of sight to operate. Nevertheless, there are many obstacles in an RF network, such as, low transmissions efficiencies and huge radiators. From which one can sense that RF is not the most efficient medium of communication for small energy-consuming sensor nodes.

To ease the global transition of WSN application and development, a great requirement poses for manufacturing low-cost products of sensor nodes. At the same time, they need to be specified on their different standards of operations so that sensors can work compatibly between different vendors. Extensive effort has been contributed in the field of standardization of products to achieve a unified market for low cost sensors in a way don't face network protocol incompatibility and proprietary issues [53]. The achieving success of WSNs as a technology will mostly depend on the success of the efforts of such, as it is shown in the Figure 3.3.

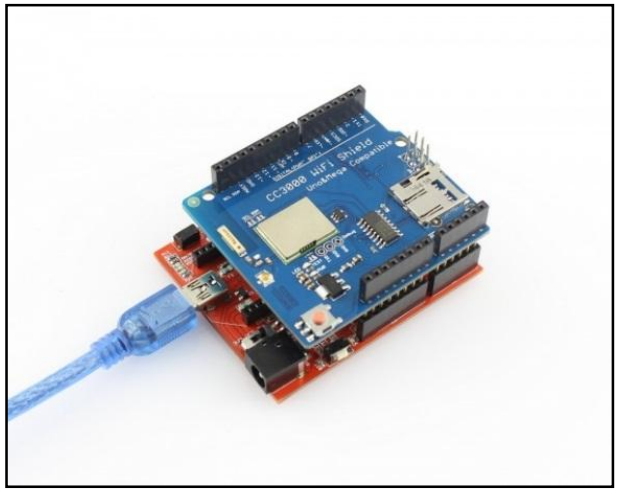


Figure 3.3. Wireless Shield CC3000 [53]

This type of Wi-Fi board is used and mounted on top of the Arduino board to create the communication and program the computer to do the programming by taking an IP from the access point. It was used the provided libraries available by manufacturer that uses the program type of HTTPSERVER. The means of programming the Wi-Fi finds place in two classifications. It is required to input the password of the Access Point to recognize it and establish a connection.

3.3 Sensor Node Structure

A Four parts basically make up a sensor node: Processing Unit, Sensing Unit, Power Unit and Communication Unit, illustrated Within the sensing unit, contains one or more than one sensor, also, it consists of Analog – to – digital converters ADCs. The sensors pick up the physical vibrations in the environment and produce analog signals according to the senses observed [54]. Analog signals are converted to digital signals by the ADCs, then these signals are sent to the unit of processing. Microprocessors or Microcontrollers make up the Processing Unit with memory, sensor nodes fetch intelligent controls from them. Short – range radio for the flow of data reception and transmission through radio channels make up the Communication Unit. The power supply for the communication unit is through a battery to operate all the systems components. The above-mentioned units are ideal to be constructed into a small module with low manufacturing cost and low consumption of energy.

3.3.1 Architecture Humidity and Temperature Sensor

Humidity sensing technology and digital-signal-collecting-techniques have been utilized by the DHT11 digital signal generator, for guaranteeing stability and reliability. It senses through 8-pin single chip computer. Most sensors of this model is adjusted to a certain temperature and marked to provide specific readings, such adjustments and markings are saved in the OTP memory. Attributes such as low power consumption, small in size, and long distance transmission 20m allows DHT11to be reasonable to applications with unsuitable environments.

The connection made very convenient by a single row four pins setup. Figure 3.4. Shows DHT11 Sensor connected with Arduino UNO.

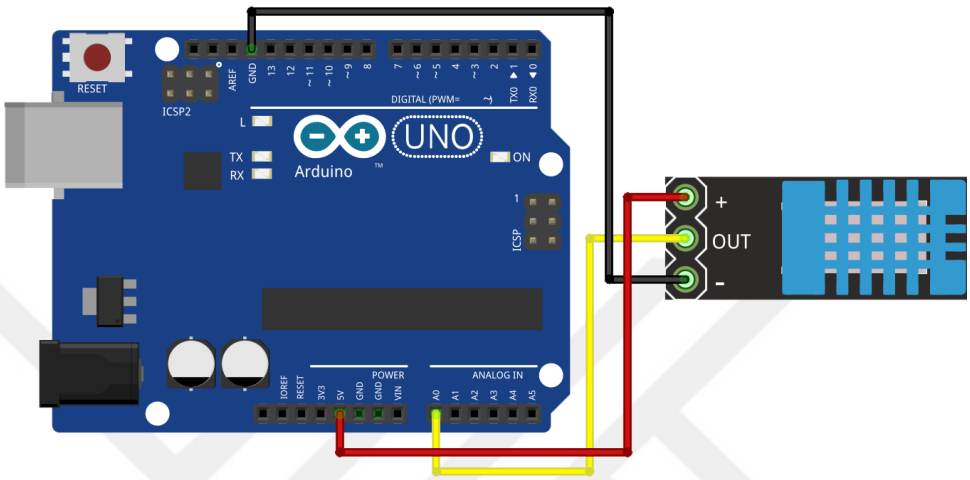


Figure 3.4. Show DHT11 Sensor Connected with Arduino

A) Programming Wireless Board CC3000: This type of Wi-Fi board is used and mounted on top of the Arduino board to create the communication and program the computer to do the programming by taking an IP from the access point. We use the provided libraries available by manufacturer that uses the program type of HTTPSERVER. The means of programming the Wi-Fi finds place in two classifications. It is required to input the password of the Access Point to recognize it and establish a connection. This utilization facilitates fetching its own IP and the right port needed as seen in Figure 3.5.

```
#define WLAN_SSID       "myNetwork"   // cannot be longer than 32 characters!
#define WLAN_PASS       "myPassword"
// Security can be WLAN_SEC_UNSEC, WLAN_SEC_WEP, WLAN_SEC_WPA or WLAN_SEC_WPA2
#define WLAN_SECURITY   WLAN_SEC_WPA2

#define LISTEN_PORT           80
#define MAX_ACTION            10
#define MAX_PATH              64
```

Figure 3.5. Programing for WIFI Board Connection

Now the connection has been established, we need another program to send the collected Data by sensors to the Application program. The script of the program is as follows for each of the sensors; this immediate program is for the Humidity and Temperature. Figure 3.6.

```
 client.fastrprintln(F("HTTP/1.1 200 OK"));
 client.fastrprintln(F("Content-Type: text/plain"));
 client.fastrprintln(F("Connection: close"));
 client.fastrprintln(F("Server: Adafruit CC3000"));
 // Send an empty line to signal start of body.
 client.fastrprintln(F(""));
client.print(DHT11.humidity, DEC);
client.print(".");
client.print(DHT11.temperature, DEC);
```

Figure 3.6. Programing WIFI Board for Send Data

B) Programming Sensors: Measuring pollution in the elevator room is done through the humidity sensor, temperature. explain and how it is programmed on the Arduino board. We use DH11 sensor for humidity and temperature, we place it on top of the Wi-Fi board that is also connected to the Arduino board and is programmed Figure 3.7.

```
delay(1000);
if ( t2 >=31 )
{
  Serial.println(" Red ");
digitalWrite(relay1, LOW);
digitalWrite(10,HIGH);
  digitalWrite(relayh2, HIGH);
 // Serial.println(t2);
}


  if ( t2 <18)
{
  Serial.println(" Green ");
digitalWrite(relayh2, LOW);
digitalWrite(8,HIGH);
  digitalWrite(relay1, HIGH);
  //Serial.println(t2);
}

  if ( h >=19)
{
  Serial.println(" Red ");
digitalWrite(relay3, LOW);
digitalWrite(3,HIGH);
  digitalWrite(relayh4, HIGH);
//  Serial.println(h);
}


  if ( h <19)
{
  Serial.println(" Green ");
digitalWrite(relayh4, LOW);
digitalWrite(2,HIGH);
digitalWrite(relay3, HIGH);
 // Serial.println(h);
}
```

Figure 3.7. Programing the Humidity and Temperature Sensors

3.4 Result Application for Fault Diagnosis and Prediction in Elevator

The purpose for creating this program is to read humidity and temperature in elevator room, created with C# programming, also connected through Wi-Fi shield to the hardware sensor. After the data read from hardware sensor through the router it sends the data to the controlling computer. The data humidity and temperature will display on the application, then we can get benefit from this data. Such as we can control the elevator room environment with the level of humidity and temperature. Figure 3.8.

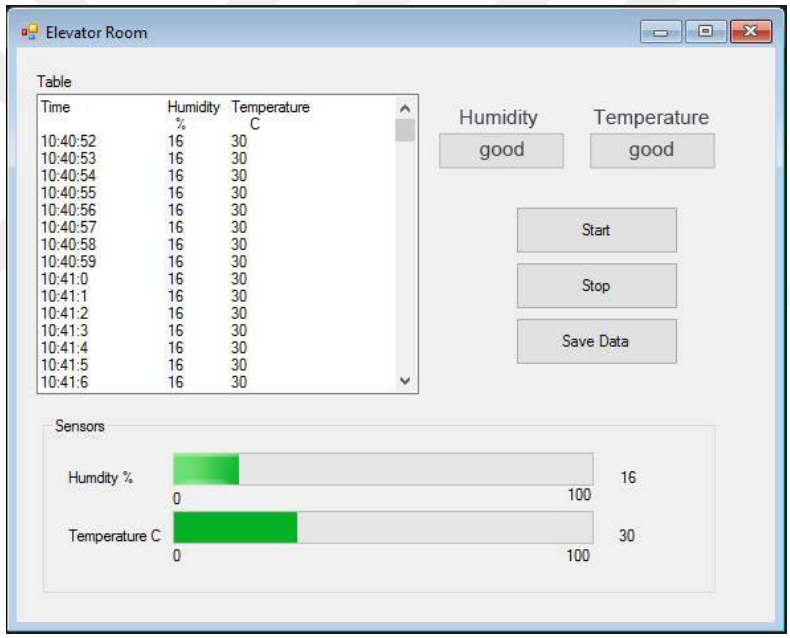


Figure 3.8. Elevator Room Application

Creation of the air of in elevator room measurement program, if use this program, which has been generated is set through of algorithm, is turned by algorithm specific to turn data into information, to notify the user in case that is elevator room air. In the beginning, one can be sure of the compatibility of temperature and humidity in the elevator room with the operation of sensors, at the mean time adjusting to other organs of the sensor that be a reason to read elevator room data in the presence of contamination in the environment of the elevator room or not. If

the humidity level is less than 55%, it is good relative to the temperature [55]. This makes a comfortable elevator room. The range of temperatures between 10 °C and 25 °C, before spend the rest of sensing devices to know the elevator room had been polluted or not [56]. for instance, if the experience of the application for half an hour, then the validity of the ratio of the atmosphere offer two charts about humidity and temperature, which are gathering for a statement that has been collected during the half an hour to be the first chart moisture into the elevator room as below. Figure 3.9. Chart read Humidity for 30 mint.

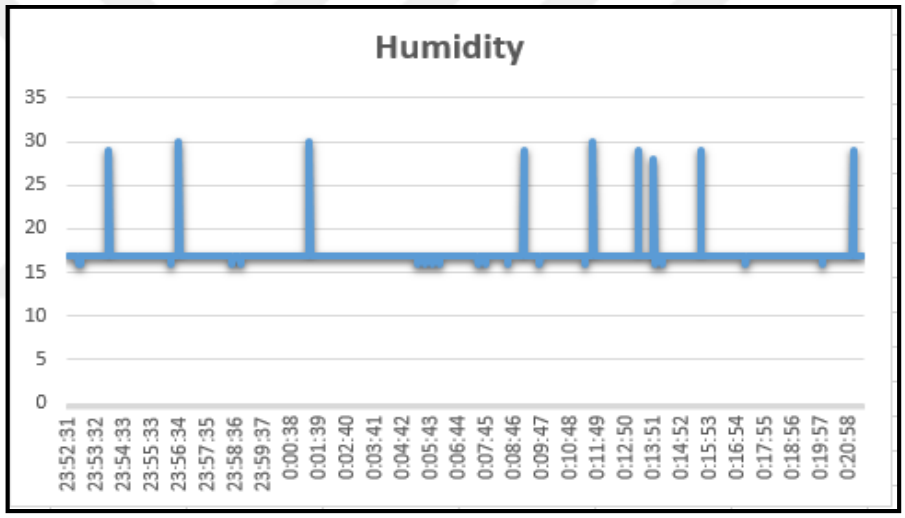


Figure 3.9. Chart Read Humidity for 30 mint

The result of reading humidity in the elevator room, ranging between 15 to 30, did not come out to extend the scope of the program, set up and is normal readers, at the same time, reading through the duration of the application is running is 15 or a little more moisture it means humidity on the occasion of the elevator room. Figure 3.10. Chart read Temperature for 30 mint.

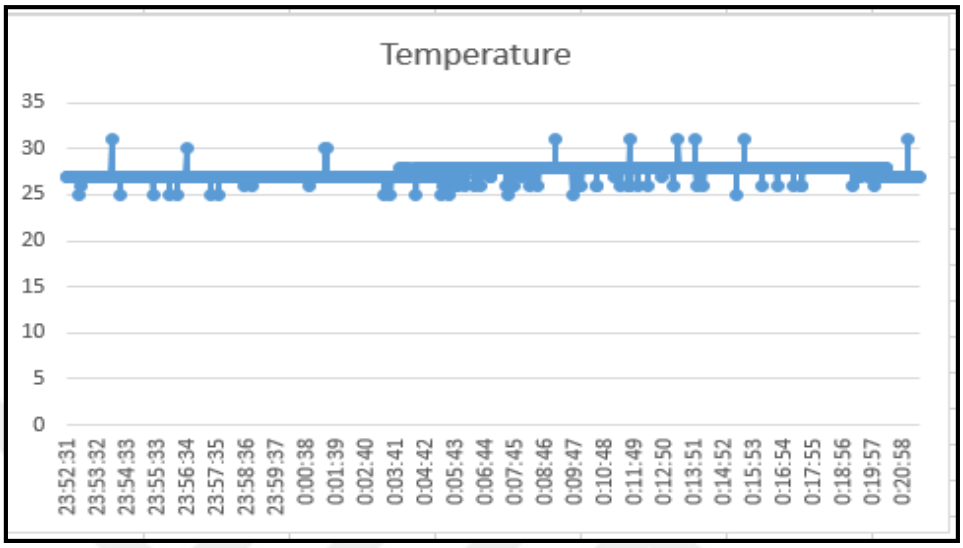


Figure 3.10. Chart Read Temperature for 30 mint

The temperature chart, it is intended to measure elevator room temperature after running the application, which took half an hour to see the result of reading the temperature ranging between 20-25, and this class is suitable for sensors that operate in the elevator room.

4. RESULTS AND DISCUSSION SECOND SOFTWARE DESIGN

4.1 Software and User Interface Design

The software is developed with C# programming and it is able to read and show us the data from the web application and save them in the server when is connected by IOT.

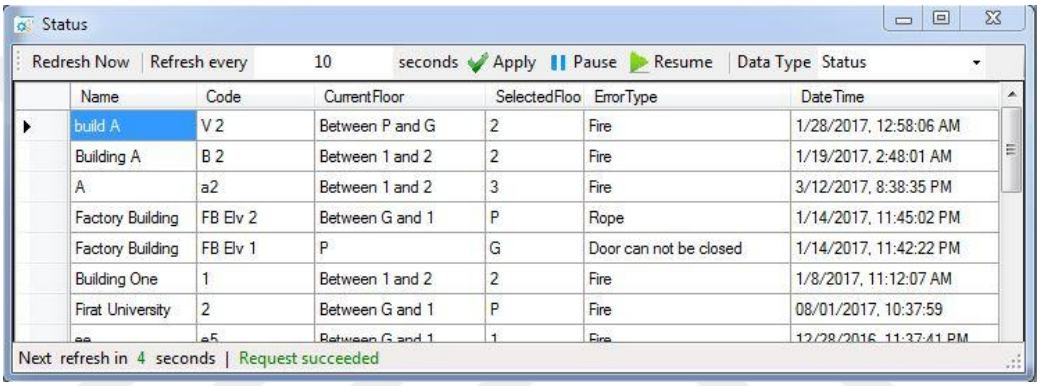


Figure 4.1. Software of Interface Design

After that the software will determine and show us the kind of fault, select which floor, name of building, and give us the date of fault in elevator, and in every 10 second the software is refreshed. Software is created by C# programming and takes in several coding for action Figure 4.1.

Code programming:

1- Class can have obtained all function in Figure 4.2.

```
private com.smartinium.umed.Gate service;
private int count;
int seconds;
```

Figure 4.2. Properties of Class

2- The initial value will be giving to the application; it means that ten seconds enter for refreshing the application also showing the data in log or the current status in Figure 4.3.

```
public Form1()
{
    InitializeComponent();
    toolStripComboBox1.Items.Add("Status");
    toolStripComboBox1.Items.Add("Log");
    toolStripComboBox1.SelectedIndex = 0;

    service = new com.smartinium.umed.Gate();
    GetData();
    seconds = 10;
    count = seconds;
    timerGetData.Interval = seconds * 1000;
    txtSeconds.Text = seconds.ToString();
}
```

Figure 4.3. Initial Value of Application

3- When wanted increase or decrease the refresh time we input the time into the textbox and press apply button for updating the refresh time in Figure 4.4.

```
private void btnApply_Click(object sender, EventArgs e)
{
    try
    {
        seconds = int.Parse(txtSeconds.Text);
        timerGetData.Stop();
        timerCountSeconds.Stop();
        timerGetData.Interval = seconds * 1000;
        count = seconds;
        timerGetData.Start();
        timerCountSeconds.Start();
    }
    catch(Exception ex)
    {
        MessageBox.Show(ex.Message);
        timerGetData.Stop();
    }
}
```

Figure 4.4. Equation Apply Button

4- It’s going to pause the timer in Figure 4.5.

```
private void btnPause_Click(object sender, EventArgs e)
{
    timerGetData.Stop();
    timerCountSeconds.Stop();
    count = seconds;
}
```

Figure 4.5. Equation Pause Button

5- It’s going to resume the timer in Figure 4.6.

```
private void btnResume_Click(object sender, EventArgs e)
{
    timerGetData.Start();
    timerCountSeconds.Start();
}
```

Figure 4.6. Equation Resume Button

6- It’s going to refresh the timer in Figure 4.7.

```
private void btnRefresh_Click(object sender, EventArgs e)
{
    GetData();
}
```

Figure 4.7. Equation Refresh Button

7- After finished 10 second it’s going to import data from server in Figure 4.8.

```
private void timerGetData_Tick(object sender, EventArgs e)
{
    GetData();
    count = seconds;
}
```

Figure 4.8. Import Data Server

8- Its decrease seconds descending one by one from 10 to 0 in Figure 4.9.

```
private void timerCountSeconds_Tick(object sender, EventArgs e)
{
    lblCountDown.Text = count.ToString();
    count--;
}
```

Figure 4.9. Descending Seconds One by One

9- If application hasn't been connected to the internet or data doesn't come from server at this time the color of the request became red but if the application has been connecting to the internet at this time the color of the request became green in Figure 4.10.

```
private void GetData()
{
    try
    {
        if(toolStripComboBox1.SelectedIndex == 0)
        {
            dataGridView1.DataSource = service.GetCurrentStatus();
        }
        else
        {
            dataGridView1.DataSource = service.GetCurrentLog();
        }
        lblSuccess.Text = "Request succeeded";
        lblSuccess.ForeColor = Color.Green;
    }
    catch (Exception ex)
    {
        lblSuccess.Text = "Request failed";
        lblSuccess.ForeColor = Color.Red;
        timerCountSeconds.Stop();
        timerGetData.Stop();
        count = seconds;
        timerGetData.Start();
        timerCountSeconds.Start();
    }
}
```

Figure 4.10. Color of the Request Failed or Successes

4.2 System of Application for Fault Diagnosis and Prediction in Elevator

The testing of the system's performance is performed by the web application. Write the name of client site or web application in the web browser (umed.smartinium.com) in figure 4.11. The web application can show a motion elevator and can see the problem or fault through this program and connected to the internet, after fault happens is automatically sending for server show on another application.

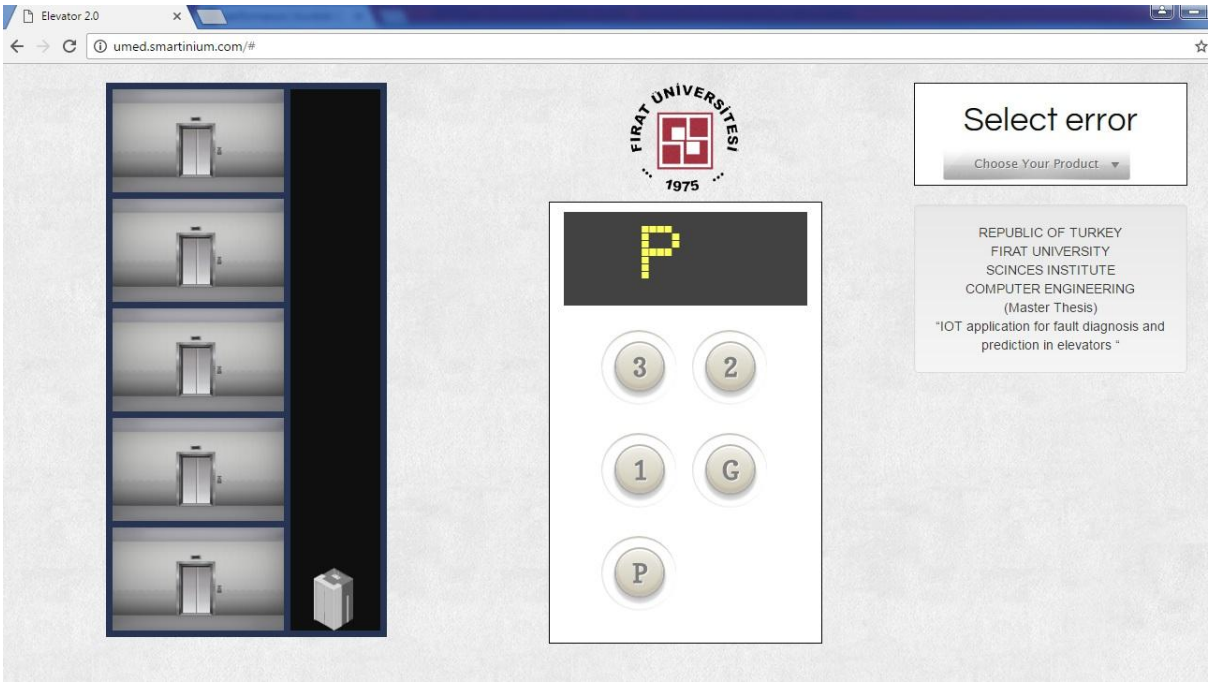


Figure 4.11. Interface Client Site

4.3 Faults of Client Site

This projects as many project faces some problems and its problem has a solution, then the problems that we are talking about in my project each of them should connect with a sensor to detect which kind of problem completely will face, then showing it to the control room who has responsibility for solving problems. Elevator consists of some errors (power off, fire, a door

cannot be closed, a door cannot be opened and rope) and it's consist of some button floors (floor 1, floor 2, floor 3, ground, and parking). Show in Figure 4.12.

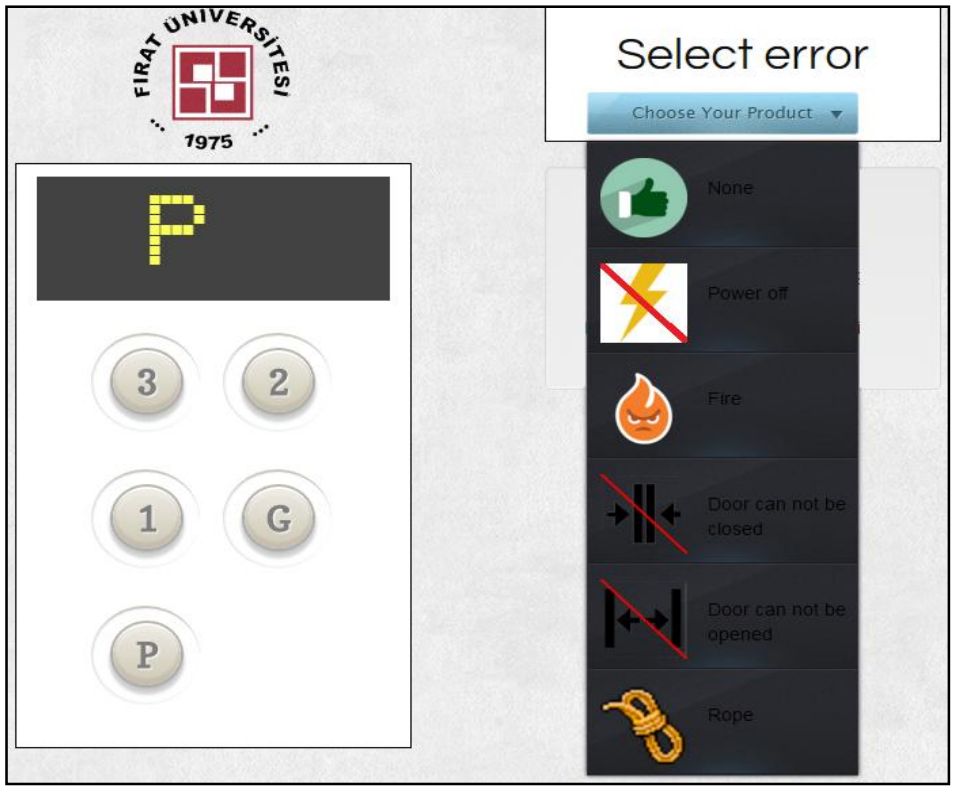
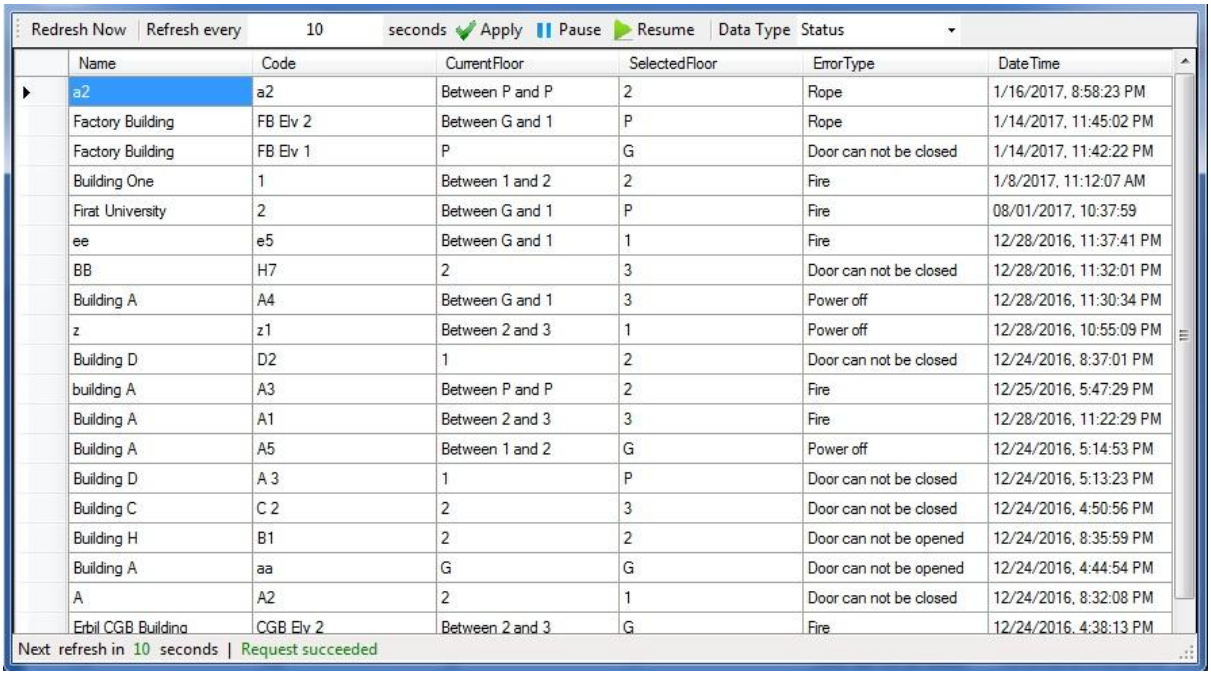


Figure 4.12. Web Application Consist of Errors and Buttons

4.4 Server Systems to Display Fault Diagnosis and Prediction

As mentioned before the definition of the server it's components in detail, also how it connects all parts with each other and transferring data and information's with a high security. Behind this project also have a server that it very important for this project, because it has a role for saving, storing data and show in that application created which is connected with the server through the internet, sending the data and information to the technical room which has been connecting with a prepared application specially created for finding problems and solving

properly. In the same time in technical room when happened Fault in elevator this application to diagnosis prediction in elevator give the kind of fault, give the name of elevator building and which floor happen showing on application it is created by C#, Show in Figure 4.13.



Name	Code	CurrentFloor	SelectedFloor	ErrorType	DateTime
a2	a2	Between P and P	2	Rope	1/16/2017, 8:58:23 PM
Factory Building	FB Elv 2	Between G and 1	P	Rope	1/14/2017, 11:45:02 PM
Factory Building	FB Elv 1	P	G	Door can not be closed	1/14/2017, 11:42:22 PM
Building One	1	Between 1 and 2	2	Fire	1/8/2017, 11:12:07 AM
Firat University	2	Between G and 1	P	Fire	08/01/2017, 10:37:59
ee	e5	Between G and 1	1	Fire	12/28/2016, 11:37:41 PM
BB	H7	2	3	Door can not be closed	12/28/2016, 11:32:01 PM
Building A	A4	Between G and 1	3	Power off	12/28/2016, 11:30:34 PM
z	z1	Between 2 and 3	1	Power off	12/28/2016, 10:55:09 PM
Building D	D2	1	2	Door can not be closed	12/24/2016, 8:37:01 PM
building A	A3	Between P and P	2	Fire	12/25/2016, 5:47:29 PM
Building A	A1	Between 2 and 3	3	Fire	12/28/2016, 11:22:29 PM
Building A	A5	Between 1 and 2	G	Power off	12/24/2016, 5:14:53 PM
Building D	A 3	1	P	Door can not be closed	12/24/2016, 5:13:23 PM
Building C	C 2	2	3	Door can not be closed	12/24/2016, 4:50:56 PM
Building H	B1	2	2	Door can not be opened	12/24/2016, 8:35:59 PM
Building A	aa	G	G	Door can not be opened	12/24/2016, 4:44:54 PM
A	A2	2	1	Door can not be closed	12/24/2016, 8:32:08 PM
Erbil CGB Building	CGB Elv 2	Between 2 and 3	G	Fire	12/24/2016, 4:38:13 PM

Figure 4.13. Application for Fault Diagnosis and Prediction in Elevator

4.5 Collecting and Data Principle Through the Software

The modality of sending and receiving data is depend on type of program that use for showing the information, depends on times, places and the type of the problems will have showing in different way in the program, after receiving the information through the server that has sent by the user this program demonstrate a classify the information in a special way depending on times and the place of the problem that occurred to which be a responsible of finding the solution and fixing it up, this program has created by C# language that mentioned the details about it codes, commands and their function with example figures, this program had designed to make

connection with the server easily through internet with facility for transfer data quickly and receiving data in 10 second or less depending on user desire, on the other hand the user can set and fix the required time for sending and receiving data.

4.6 Result of Application

Showing one fault in one elevator, on client site first must be getting in a building and write a name of elevator, show in Figure 4.14.

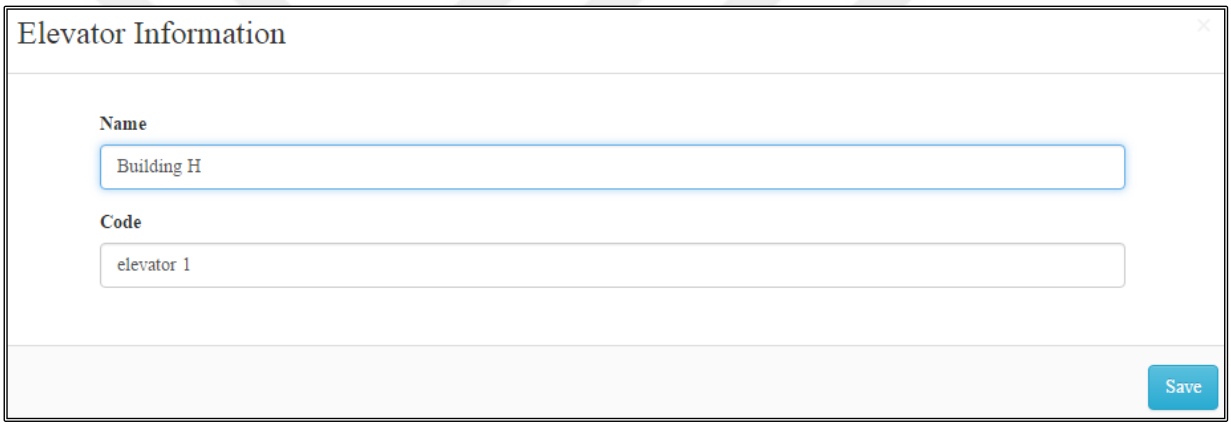


Figure 4.14. Name Building of Elevator

When elevator worked and going to floor 1 after press button 3 in the same time happened Fault (fire), show in Figure 4.15.

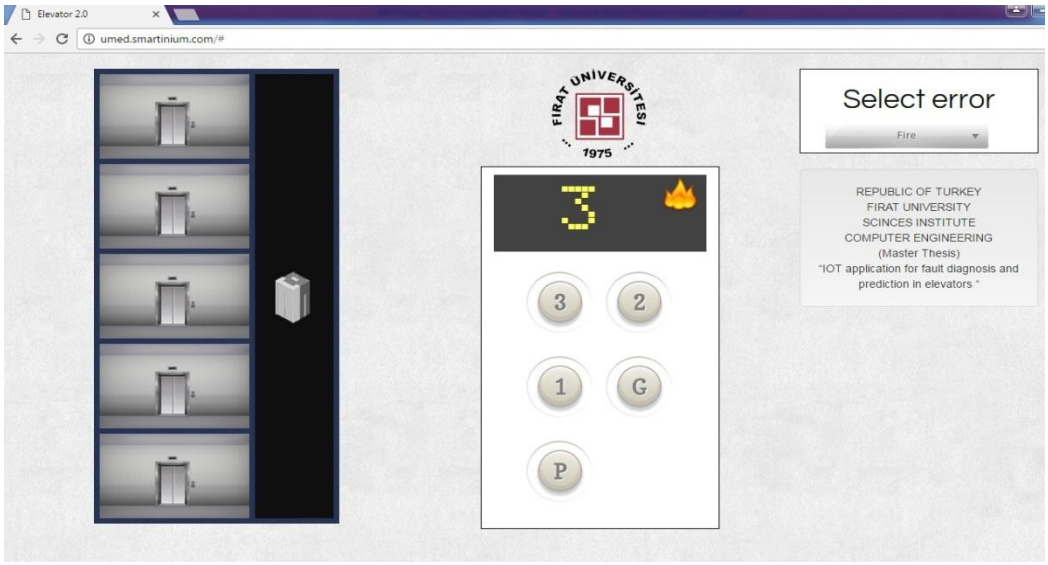


Figure 4.15. Fire Alarm on Web Application

After happen fault in elevator the same time data go to server also in technical room on the application show the result (fault or fire), get all information about it happened in building H, fault is fire, current floor between 1 and 2, and time is 9:15 pm, show in Figure 4.16.

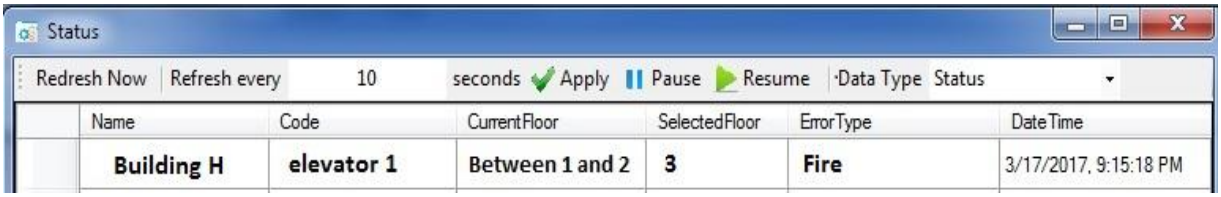


Figure 4.16. Technical Room Application

5. CONCLUSIONS

This thesis agent-based system for an IOT application for fault diagnosis and prediction in elevators framework will be developed. Through the thesis to be always literature review and investigation system would work for implementing the proposed way will be done.

The outcome of this thesis is a combined purpose of measuring the air in elevator room. This includes, checking the levels of temperature and humidity in the designated elevator room. This is also to highlight that this system is able to warn the residence of different levels of temperature and humidity in elevator. The abnormal effects of the environment trigger the sensors to pick up anything that deviates from the normal standards. Those sensors are constantly reading and measuring the air of the elevator room environment and notify us of any pollution present.

For my project create a web application, it’s can show us a motion elevator and can see the problem or fault through this program and connected by internet, after fault happen is automatically sending for server with real time and name program is Front end or Client site or web application, in the same time in technical room have another application it's connected to server and fault diagnosis prediction in elevator give the kind of fault, show the data from the web application and save them in the server when is connected by IOT. When happened a fault and sending for server after can see all fault in technical room by one program created by C#, the software is developed with C# programming. Get all information about it happened in building, fault is what, where current floor between, and time.

5.1 Future Work

The elevator industry’s first real-time, cloud-based predictive servicing arrangement. It's set to take lift accessibility, dependability and productivity higher than ever. Smart, machine learning internet of thing arrangement builds lift accessibility by diminishing out-of-administration circumstances through constant diagnostics. Lift security and unwavering quality

are further improved as any anomalies are immediately reported to a technician when full predictive mode and will be reported even before they occur. Precise fault diagnoses and possible solutions sent to the technician in real time ensure that a solution is found quickly and service disruption times are minimized or even eliminated.

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