

T.C.
YUZUNCU YIL UNIVERSITY
INSTITUTE OF NATURAL AND APPLIED SCIENCE
ELECTRIC AND ELECTRONIC ENGINEERING DEPARTMENT

CONTROL LED STRIP OVER WI-FI NETWORK USING ARDUINO

M.Sc. THESIS

PREPARED BY: Aryan Abdulkarim MAHMOOD
SUPERVISOR: Assist. Prof. Dr. M. Nuri ALMALI

VAN – 2016

T.C.
YUZUNCU YIL UNIVERSITY
INSTITUTE OF NATURAL AND APPLIED SCIENCE
ELECTRIC AND ELECTRONIC ENGINEERING DEPARTMENT

CONTROL LED STRIP OVER WI-FI NETWORK USING ARDUINO

M.Sc. THESIS

PREPARED BY: Arian Abdulkarim MAHMOOD

VAN – 2016

ACCEPTANCE and APPROVAL PAGE

This thesis entitled “**Control LED Strip over Wi-Fi Network Using Arduino**” presented by Arian Abdulkarim Mahmood under supervision of Assist. Prof. Dr. M. Nuri ALMALI in the Department of Electric and Electronic Engineering has been accepted as a M. Sc. thesis according to Guidelines of Graduate Higher Education on 27/10/2016 with unanimity of votes members of jury.

Chair: Prof. Dr.Sabir RÜSTEMLİ

Signature:

Member: Yrd. Doç. Dr. M. Nuri ALMALI

Signature:

Member: Yrd. Doç. Dr. Remzi TUNTAŞ

Signature:

This thesis has been approved by the committee of The Institute of Natural and Applied Science on /.... /..... with decision number.....

Signature

.....
Director of Institute

THESIS STATEMENT

All information presented in the thesis obtained in the frame of ethical behavior and academic rules. In addition all kinds of information that does not belong to me have been cited appropriately in the thesis prepared by the thesis writing rules.

Arian Abdulkarim MAHMOOD

ABSTRACT

CONTROL LED STRIP OVER WI-FI NETWORK USING ARDUINO

MAHMOOD, Aryan Abdulkarim

M. Sc. Thesis, Department of Electrical and Electronic Engineering

Supervisor: Assist. Prof. Dr. M. Nuri ALMALI

October 2016, 43 pages

Light-emitting diodes are usually used as light sources in sciences applications and it is common as a low-cost and flexible way to provide light stimuli. In the world, automatically systems are being chosen over the manual system. With the fast growth in the number of users of the internet through the past decade, the Internet has become a part and section of human life. In this study, a remotely controlled LED using led control application software IOS and arduino microcontroller. Led control application involves the cases of ON/OFF, different colors and patterns changing menu.

The developed system consists of two parts: hardware and software. The hardware is consists of many units such as iPhone, personal computers, Arduino UNO, Arduino Wi-Fi shield, and LED. The software is the second part of this system; it is Arduino IDE's code for design Light emitting-diode strip, is the second part of this system. The Led control application connected to hardware devices over Arduino Wi-Fi shield. Furthermore, it works to control LED, from the Led control application in the iPhone. This system uses an internet network for communication

Keywords: Arduino, Led control application, Wi-Fi Shield, LED Strip.

ÖZET

ARDUINO KULLANARAK WI-FI AĞI ÜZERİNDEN LED ŞERİT KONTROLÜ

MAHMOOD, Aryan Abdulkarim
Yüksek Lisans Tezi, Elektrik-Elektronik Mühendisliği Anabilim Dalı
Tez Danışmanı: Yrd. Doç. Dr. M. Nuri ALMALI
Ekim 2016, 43 Sayfa

Işık yayan diyotlar genellikle bilimsel uygulamalarda ışık kaynağı olarak ve ışık uyarınları sağlamak için düşük maliyeti ve esnek bir şekilde kullanılmıştır. Genellikle dünyada, otomatik sistemler manüel sistem göre tercih edilirler. Geçtiğimiz on yıl içerisinde internet kullanıcılarının sayısındaki hızlı artış insan yaşamının bir parçası olmuştur. Bu çalışmada, bir uzaktan kumandalı LED, LED kontrol uygulama IOS yazılımı ve arduino mikrokontrolcüsü kullanılmıştır. LED kontrol uygulaması, LED'lerin açma-kapama durumlarını, farklı renk ve desen değiştirilmesi menülerini içerir.

Geliştirilen sistem iki kısımdan oluşur: Donanım ve yazılım. Donanım ise iPhone, kişisel bilgisayarlar, Arduino UNO, Arduino Wi-Fi shield ve LED'ler içerir. Yazılım sistemin ikinci kısmıdır; Yazılım, ışık yayan diyot şerit tasarımı için tasarlanan Arduino kodudur. Led kontrol uygulaması, donanım cihazlarına Arduino Wi-Fi shield üzerinden bağlanır. Ayrıca, iPhonelarda Led kontrol uygulaması, LED kontrol etmek için kullanılmaktadır. Bu sistem, iletişim için bir internet ağı kullanır.

Anahtar kelimeler: Arduino, Led kontrol uygulaması, Wi-Fi Shield, LED şerit.

ACKNOWLEDGEMENTS

First, I would like to thank my supervisor, Dr. M.Nuri ALMALI, for her guidance, understanding, support and patience throughout the thesis period. I also appreciate her useful feedback and advice for improving this dissertation.

I must express my warm thanks to my family, which has provided love and support throughout my course of study. In particular, my parents have always believed in me. They have helped me to get to where I am now. Their love always remains the key source of motivation for me.

My special thanks go to my husband (Dr.Shaswar), for his support during my thesis.

Also I would like to thank my sister (Evan) for her unforgettable help, and my friend (Soran) for his help to finish my thesis.

I am blessed to have all these wonderful people in my life and could not have achieved this without their encouragement.

2016

Aryan Abdulkarim MAHMOOD

TABLE OF CONTENTS

	Page
ABSTRACT	i
ÖZET	iii
ACKNOWLEDGMENTS	v
TABLE OF CONTENTS	vii
LIST OF TABLE	ix
LIST OF FIGURES	xi
SYMBOLS AND ABBREVIATIONS	xiii
LIST OF APPENDIX	xv
1. INTRODUCTION	1
2. LITERATURE SURVEY	3
3. MATERIALS AND METHOD	7
3.1. Materials	7
3.1.1. Arduino platforms	7
3.1.2. Arduino hardware	7
3.1.3. Arduino software	8
3.1.4. Arduino UNO	8
3.1.5. Arduino Wi-Fi shield	11
3.1.6. LED strip	12
3.1.7. Breadboard	13
3.1.8. Jump Wires	13
3.1.9. Power Supply	13
3.2. Methods	14
3.2.1. Structure of the system	14
3.2.2. Connection Steps	15
3.2.3. Interfacing the wifishield module	15
3.2.4. Interfacing the LED strip	17
3.2.5. Interfacing the color and pattern	17
3.2.5.1. Interfacing the color and no pattern	18
3.2.5.2. Interfacing the color and color wipe pattern	19

	Page
3.2.5.3. Interfacing the color and Chase pattern	19
3.2.5.4. Interfacing the color and Theater pattern	20
3.2.5.5. Interfacing the color and Rainbow pattern	20
4. IMPLEMENTATION AND RESULTS	21
4.1. Testing the hardware system	22
4.2. Testing the I phone Led control application	24
4.3. Testing the color and pattern.....	27
5. CONCLUSIONS	35
REFERENCES	37
APPENDIX	39
CURRICULUM VITAE	43

LIST OF TABLE

Table	Page
Table 3.1. The summary of hardware capability of Arduino UNO.....	10
Table 4.1. Colors and the patterns (No pattern)	28
Table 4.2. Colors and (color wipe) pattern.....	29
Table 4.3. Colors and (Chase) pattern	30
Table 4.4. Colors and (Theater) pattern	31
Table 4.5. Colors and (Rainbow) pattern	33

x

x

LIST OF FIGURES

Figure	Page
Figure 3.1. Arduino IDE environment.....	8
Figure 3.2. Arduino UNO specific pin	9
Figure 3.3. Arduino Wi-Fi shield	11
Figure 3.4. Light emitting diode (LED) strip	12
Figure 3.5. Block diagram of the structure system.....	14
Figure 3.6. Arduino IDE code for setting up the wifishield	16
Figure 3.7. Wiring connection from the LED to the arduino and breadboard	17
Figure 3.8. Arduino IDE code for Neo pixel strip.....	17
Figure 3.9. Arduino IDE code to accessing the color and pattern.....	18
Figure 3.10. Arduino IDE code to accessing no pattern.....	19
Figure 3.11. Arduino IDE code to accessing Color Wipe pattern.....	19
Figure 3.12. Arduino IDE code to accessing Chase pattern.....	19
Figure 3.13. Arduino IDE code to accessing Theater pattern	20
Figure 3.14. Arduino IDE code to accessing Rainbow	20
Figure 4.1. Final control LED	21
Figure 4.2. Workings of the Wi-Fi shield software.....	23
Figure 4.3. Display Arduino Wi-Fi shield connect to the Wi-Fi.....	24
Figure 4.4. Led control Application	25
Figure 4.5. IP address in the Led Control application	25
Figure 4.6. Led control turn on.....	26
Figure 4.7. Led control turn off	26
Figure 4.8. (violet, green, yellow, red) colors with (No Pattern)	28
Figure 4.9. Blue color with color wipe pattern.....	29
Figure 4.10. (violet, blue, red) colors with chase pattern	30
Figure 4.11. Green and yellow color with Theater pattern.....	31
Figure 4.12. Violet and blue colors with theater pattern.	32
Figure 4.13. Orange and Red color with theater pattern	32

Figure 4.14. Colors with rainbow pattern33

SYMBOLS AND ABBREVIATIONS

Along with a description of some abbreviations used in this study are presented below:

Abbreviation	Explanation
GND	Ground
I/O	Input / Output
IDE	Integrated Development Environment
IP	Internet Protocol
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
RGB	Red, Green, and Blue
RX	Receiver
TCP	Transmission Control Protocol
TX	Transmitter
UDP	User Datagram Protocol
UNO	One In Italian
USB	Universal Serial Bus
WLED	White light-emitting diode
EEPROM	Electrically Erasable Programmable Read Only Memory
SRAM	Static Random Access Memory
PWM	Pulse-Width modulation
EMI	Equated monthly installments
CRT	Cathode Ray Tube

LIST OF APPENDIX

APPENDIX	Page
APPENDIX 1. Geniletilmiş Türkçe Özet (Extended Turkish Summary).....	41

1. INTRODUCTION

Control Light emitting-diode is widely used. The use of the system developed simple, functional, installation is easy and inexpensive. LED was found first in lab and electronic test equipment, and then later evolved for use in TVs, radios, calculators and even in watches (Anonymous, 2016i). LED are being used for easier and more adaptable control of light characteristics when compared to other light Sources such as metal halide, mercury and halogen lamps which often require different auxiliary devices such as a set of filters for spectral adjust and shutters to control exposure duration (Schubert et al., 2005). LED are monochromatic light sources which provide straight light output in response to (PWM) control signal over a prolonged dynamic range (Svilainis., 2008). The time of response of the LED chips is very quick in the command of nanoseconds. The system response of the LED driver and the LED chip together is slower, the response time being in the command of microseconds (Albeanu et al., 2008). Another feature of LED is their low electromagnetic interference EMI emission, when compared to (CRT) monitors that can cause important electromagnetic interference to electrical cables, which make them convenient to be used with electrophysiological techniques such as magneto encephalography MEG, electroretinography ERG, and electroencephalography EEG (Fadda et al., 1997). The LED are controlled with separated on-off PWM signal, in which the on-time (duty cycle) is directly proportional to the light output. An additional advantage of LED strip when compared to other light sources is referring to the noise and stability characteristics, and in biological applications just like in wide field microscopy and visual neuroscience. For a simpler and low cost alternative, an open source electronics prototyping arduino UNO are being used. Arduino has been utilized in scientific applications like LED light control of an open-source in multispectral imaging system for rodents, and in multidisciplinary teaching of computer science and biology (da Silva Pinto et al., 2011). Nowadays, automatically systems are chosen over the manual system. With the fast growth in the number of users of the internet through the past decade, the Internet has become a part and section of human life. In this study, a remotely controlled LED strip using led control application software IOS and arduino microcontroller.

The aim of this study is to find the possibility of using an Arduino board to control LED.

In this thesis, a way to control LED strips over Wi-Fi network using arduino UNO. Arduino is a micro-controller programmed by a specifically writing. Arduino is Programming Language is applied to control the microcontroller and the required appliance. Arduino is allowing to communication and for receiving some command and controls LED. At the end, the command is sent by a central control unit like a remote control or iPhone for control LED strip and change colors and patterns.

This thesis consists of five processes, firstly, the introduction of controlling LED by iPhone Led control application using arduino. Secondly the literature reviews of controlling LED. The third process discuss material and method, show the information about the required constituent components and the Arduino architecture, component description, the method, the structure of the system, circuit diagram and interface, controller programming, and working. Then the enforcement result. Finally the conclusion and suggestion for future work.

2. LITERATURE SURVEY

Control LED matrix using multiplexing, there is a matrix of LED for decrease the matrix number of arduino pins for this purpose, must turn LED on and off. Using 64 Light - emitting diode (LED) matrixes, with cathodes in columns anodes connected in rows, the resistor's value should be chosen to assure that the maximum stream by a pin must not be more than 40 mA, each LED in a small red matrix has a forward voltage of nearly 1.8 volts, each matrix column is connected over the chain resistor to a digital pin, when the row pin goes high and the column pin goes low, the LED will light, if the row pin is low and the column pin is high the LED will not light and no current will flow over the LED, the loop scans over each column, row, turns on and all LED are lit, the loop start with the first row and column and controlling LED matrix Using Multiplexing(Michael., 2012)

Teikari et al. (2012) using a cheap arduino-based LED stimulator for vision research, Light emitting diodes (LED) are used progressively as light sources in sciences applications such as in vision research, fluorescence microscopy, also in brain-computer interfacing. In their study they present a cheap but efficient visual stimulator that based on an open-source Arduino microcontroller prototyping platform and LED. The LED stimulator which is created around the Arduino prototyping microcontroller platform contain five components, a computer with programming environment, the constant-current LED driver, a power supply, the LED, and the Arduino prototyping platform. The computer is used for online control of the light strength, or tuning the light strength by the experimenter manually or making the light strength depend on the subject input or some external trigger such as some other stimulus presentation. The Arduino is used in similar fashion to data purchase device to read analog/digital inputs from external switches, sensors, buttons, etc. and providing Pulse-Width modulation (PWM) signal out for controlling the LED drivers. Simple program of computer-controlled LED driving with Arduino.

Baniz (2009) Control LED using a pushbutton. A pushbutton is a simplest sensor that available, and there is a simple device for take apart of pushbutton. There are two bits of metal and a plastic cap that when compress it brings the two bits of metal into

contact, there is no circulation of current in the pushbutton when the bits of metal are apart, it makes a connection by press it. The LED will be controlled, turn on and off by pressing the pushbutton.

McRoberts (2010) control LED chase effect by using ten string of LED, the part used ten Red LED and ten current Limiting Resistors. First Arduino must powered off by unplugging it from the computer by USB, for connecting LED and resistor using wires then the circuit must be thoroughly before power back to the arduino, the Light-emitting diode (LED) will appear to move along the line and light then rebound back to the start, for stores ten values initializing an array that can stores ten values which are the digital pins that used for the output of the ten Light-emitting diode (LED), in the main loop when the least led Delay millisecond have worked since the last changes of the Light-emitting diode (LED) and control the ten Red Light-emitting diode (LED).

Tariq et al .(2013) designing a simple Wi-Fi communication analyzer using Arduino microcontroller so that it reacts with Wi-Fi Shield and display numeral results of Wi-Fi networks into an LCD/LED monitor. The most important way to connect to the internet worldwide is by using Wi-Fi networks, the project is about Wi-Fi Networks Analyzer. The aim of this project is to find the Wi-Fi networks nearby the user and show the name of each Wi-Fi network with its signal strength. The system was constructed by connecting a Wi-Fi Shield to the Arduino board and show the numerical results to a Liquid Crystal Display (LCD) Screen which is also connected to the Arduino itself. To run this program, the design parts consist of (Arduino microcontroller, Wi-Fi Shield, LCD/LED screen, DC Power Supply).

The Wi-Fi shield is connected to the Arduino board by using long wire-wrap headers which stretch by the shield. This remains the pin layout intact and authorizes another shield to be stacked on the top. This project is used to detect signals communing from Wi-Fi networks in the nearby area. In Liquid Crystal Display (LCD), display is used to display any type of information that needed. It displays text messages and numerical values. It contains everything needed to support microcontroller.

Chukwuebuka et al. (2015) control LED to minimize Energy Consumption. The objective of this research is to show how LED can minimize energy consumption by using an Arduino UNO board and MATLAB and also to discuss the applications of LED, MATLAB is an interactive platform and high-level language used by scientists

and engineers worldwide. It allows one to imagine, explore ideas and cooperate through a variety of disciplines such as communications, image, signal processing, and control systems. In command to control LED from MATLAB, a number of components are required. This project include (Arduino Uno board, MATLAB Support Package for Arduino, MATLAB, Jumper wires, Breadboard, Red LED)

Arduino board that makes the one to use MATLAB program to communicate with the Arduino hardware over a USB cables, they use the serial port on the Arduino hardware to take instructions from MATLAB software. Arduino hardware is connected to the MATLAB Support Package through a USB cable, so Arduino will receive command from MATLAB program by the USB.

Golmohammadi et al. (2015) designed a white LED by using GaN/ InxGa (1-x) N multiquantum well, they determined white light extraction from (MQW) light emitting diode (LED).The suggested white LED is composed of InxGa (1-x)N well layers with various width and mole fractions, The LED emitting an (RGB) colors Red, Green , and Blue color , White light-emitting diode (WLED) was widely used in the area of solid-state lighting and so many efforts have been done to create commercial high-brightness White light-emitting diode (WLED). A QW-WLED structure has three layers of InGaN/GaN QWs are designed and analyzed. These layers were modified that each layer emits one of the Red, Green, and Blue (RGB) colors in a visible range.

Monk (2010) flashing LED by using a bigger external LED and resistor first they load the blink sketch in to the arduino IDE software, it's included as an example when install arduino environment using a file menu, for blink the LED, they modify the rate by changing the value of the delay and this changing of the delay make the turning of the LED on and off from one second to 1/5 second.

Mario (2012) control LED by utilize a digital pin of the ADK as an output port, using Android application for light-emitting diode turn on and off, Arduino ADK board have several output and input pins, and for switch the LED on and off one of these several pins are use, a digital output pin2 uses because it can provide a voltage up to 5v, the hardware that used (ADK breadboard, some wire, LED operation at 5v, resistor) for the ADK board using a digital output port, when ADK board set to HIGH it operates 5v and when it sets to low it operates 0v, LED has longer lifespan because it operates at 5v and for 3.3v using a lower-rated light-emitting diode, to limit the current for LED uses

resistor ,A resistor in an electric component ,the first step connect the resistor to the LED, the ADK board digital output pin 2 will connected to the resistor, resistor is connected to the anode of LED and the ground (GND) connected to the negative lead of the LED. The hardware completed for control the light-emitting diode by using Android application.

Jeremy et al. (2013) Building a controllable LED nightlight colors Red, green, and blue (RGB), LED has four leads, one of the four leads is a cathode pin that shared between all three diodes, and the other pins connect to anodes of all diode color. Wire that LED up to three Pulse-Width modulation (PWM) pins over current-limiting resistors on the Arduino, configure a debounced button to cycle Over a selection of colors all time ,for doing that add an additional function to set setting the Red, green, and blue (RGB) LED to the state in the color cycle, for make option to the colors by changing the value of analog wire then connected arduino to the circuit that build and control LED nightlight Red, green, and blue (RGB) colors.

Wiley et al. (2013) Controlling multiple LED by using Arduino bigger board mega2560, Arduino mega has a lot extra space for all types of output and input, and four serial ports, these four serial ports let Arduino to contact with multiple serial devices in same time, and ability for keeping communication free from the USB to the computer, the project include Arduino Mega 2560, twelve LED, Breadboards, twelve 220 resistor, jump wires, when LED choosing and resistor, the voltage must around 2.5voltage, Arduino able to provide maximum 5 voltage, LED power by using resistor, the pins of arduino mega connect to resistor and the anode long leg of the LED, and short leg cathode connected to ground GND, for controlling multiple LED, the pin number must be correct, and jump wire used correct row for connection the breadboard , LED around right and digital pin running to a resistor to the tall leg and short leg going to ground GND. Arduino able to control multiple LED.

3. MATERIAL AND METHOD

3.1. Material

Control WS2812 neopixel LED strip over Wi-Fi network consist of two main units: Arduino UNO R3 and arduino wifishield. The wifishield used to interface between the arduino UNO and the internet. And arduino is the main unit of the system because it is responsible for controlling the system. Finally, the Led control application that enables the owner to control LED strip.

3.1.1. Arduino platform

Arduino platform is consisting of two parts: arduino board and arduino IDE, arduino board is the hardware that used to build an object and arduino is important device in the world because it is an open source, hardware and software. Also it is simple and easy to building in the AT-mega Microcontroller, and arduino IDE is the piece software that runs in the computer, Arduino software IDE is able to work with Mac operating systems, and Windows. According to the others Microcontroller, Arduino is more appropriate Microcontroller to using. Many kinds of Arduino are available in the market (Anonymous, 2016j). There are many purposes for the Arduino because it is simple, easy to use and cheap.

Arduino platform is a major appliance to developing an excellent object (Anonymous, 2011).

3.1.2. Arduino hardware

Arduino is a significant device because it's an open soft hardware, and Arduino is a small microcontroller which is a little circuit that composed a whole computer on a small chip (Massimo, 2009). Arduino hardware has many different kinds like, Arduino UNO, Mega, Lily Pad, Arduino BT, Arduino Nano, and Arduino Mini.

3.1. 3. Arduino software

Arduino IDE is another part of arduino platform, this software is available in the Arduino site. It is created in Java, installing arduino version 1.0.2. After installing Arduino software it can write code and upload it to the Arduino(Anonymous, 2016i), when the file is ready to write to the memory on the Arduino board, then it will be send to the Arduino through a USB port.

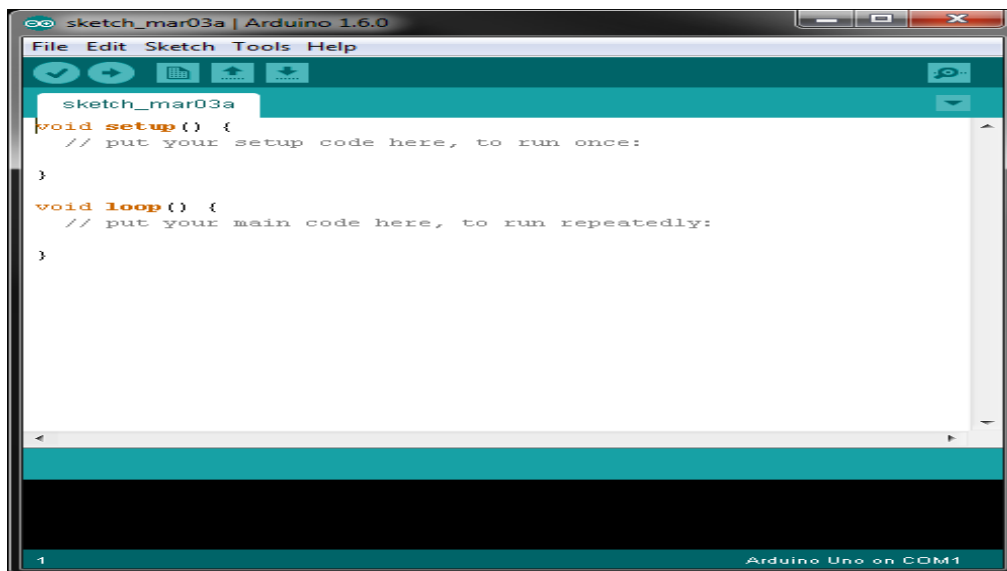


Figure 3.1. Arduino IDE environment.

Figure 3.1. Displays the page of the IDE operating environment, that uses arduino UNO and version 1.6.0 , Arduino software contain two functions (void setup() and void loop()), when a sketch starts the void setup() function called, it means that this function is only run once ,and it's use to initialize pin modes ,variable ,and start using libraries and set the initial value.

The void loop() function part keeps looping and its allow the program to change and answer , and this function is used to control the actively of the Arduino board.

3.1.4. Arduino UNO

Arduino UNO is based on the ATmega328 microcontroller, ATmega328 is the core component of this board, which works as a processor, and Arduino UNO hardware has three specific pins in a microcontroller : 1. Digital pins (from 0 to 13) 2. Analog

pins (A0, A1, A2, A3, A4, and A5) 3. Power pins (5V, 3.3V, GND, Reset, voltage)
 Figure 3.2. showed Arduino UNO specific pins.

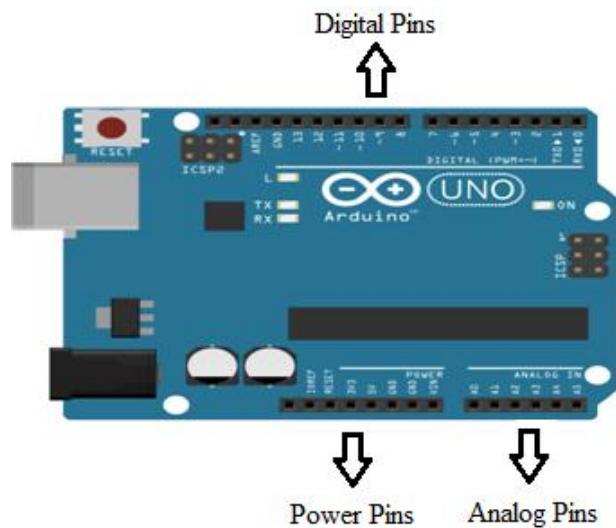


Figure 3.2. Arduino UNO specific pin.

The first pins that talk about digital pins headers. Digital pins is called digital pins because only they work with zeros and ones and it's a plastic mind that's going to bunch the holes and its bunch the numbers next to it. The number start from zero up to 13 right to left and 14 little holes there. And those gives you access to the pins and chip right there and those pins connect to input, so they can read voltage from something or they connect to output that can apply voltage. Some of digital pins has (~) with the number which are six number (~3 , ~5 , ~6 , ~9 , ~10 , ~11), those pins can be used with a technique called (PWM) that stands for Pulse Width Modulation which basically mean they can adjust the main voltage they apply between zero and five voltage.

There is another pin zero and one they have Tx and Rx (Rx 0, Tx 1). The pins Tx are used for transmit and the pins Rx used for receive. Arduino used these two pins to communication between their computers. For example using those two pins for doing a serial communication between arduino and computer. And also there is two Led of Tx and Rx and this led will blink every time when sending information back between arduino and computer. And there is pin (13) it's an board Led (Anonymous, 2016e).

The second pin is analog pins that stand for analog, it's Analog-to-Digital. Analog pin can uses for input and output like the other digital pins.

The last pin is power pins that include 5v which is stand for five volte. The next pins is 3.3v which is stand for three, three volte and the next two pins are ground GND

those two pins give access to lower voltage on arduino board and its 0 volt also there is another GND pins in digital pin, and the important things are all these GND pins in which they are the same, they are connect to each other so we can use which one we decided to use. In the power pins, there is a RESET pin. This pin uses for reset the program. The arduino hardware has a RESET, this reset when we press on, the program that currently run on the arduino board it starts back to the beginning. 5V pins is similar to the 3.3 volt, and 5 volts is always in this pin when the Arduino board is powered, there is two GND pins .The last pins is VIN and refers to external power sources (Anonymous, 2016d). Arduino connected to computer via USB cable (Figure 3.2.). Displays arduino UNO specific pin (Table 3.1.) display the summary of hardware capability of arduino UNO.

Table 3.1. The summary of hardware capability of Arduino UNO (Anonymous, 2016a)

Microcontroller	ATmega328
Operation Voltage	5V
Input Voltage((recommended))	7-12V
Input Voltage(limits)	6-20V
Digital I/O pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O pins	40mA
Dc Current 3.3V pins	50mA
Flash Memory	32 KB of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16MHz
Length	68.6mm
Width	53.4mm
Weight	25g

3.1.5. Arduino Wi-Fi shield

Arduino Wi-Fi Shield allows an Arduino board to connect to the internet using the 802.11 wireless specifications (Wi-Fi). It is based on the HDG204 Wireless Local Area Network (LAN) 802.11b/g System in-Package. An AT32UC3 provides a network (IP) stack capable of both Transmission Control Protocol (TCP) and User Datagram UDP (Anonymous, 2016b). Figure 3.3. shows the arduino Wi-Fi shield.

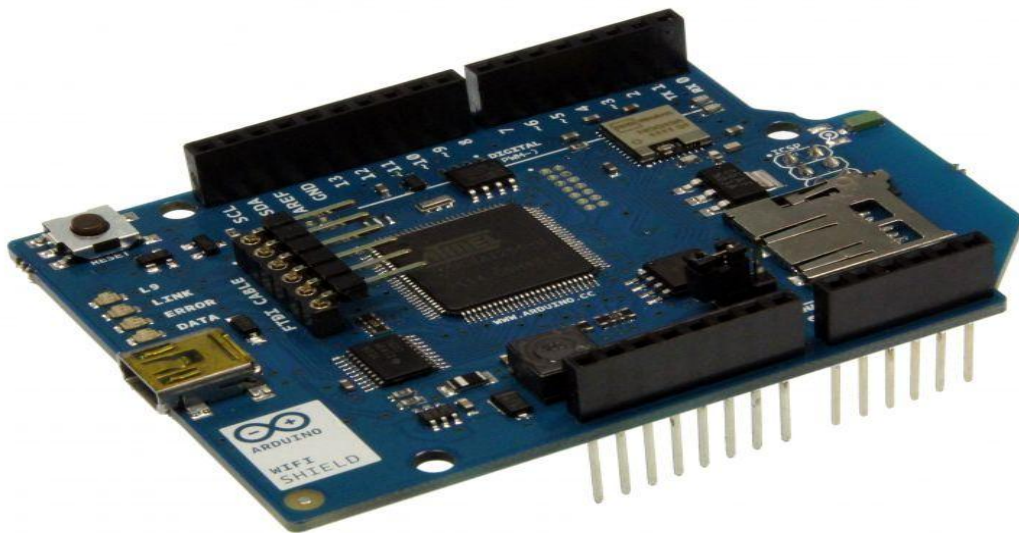


Figure 3.3. Arduino Wi-Fi shield.

The Wi-Fi shield contains some informative LED:

- L9 (yellow): attached at digital pin 9.
- LINK (green): displays a connection to the network.
- ERROR (red): displays when the communication has an error
- DATA (blue): displays when data being transmitted (TX) and received (RX)

3.1.6. LED strip

The word of LED stands for (Light Emitting Diode). LED became more patented and as improvements were made, it slowly began to enter the market. The first commercial LED functioned as replacements for incandescent lamps and in seven segment displays. LED was found first in lab and electronic test equipment, and then later evolved for use in TVs, radios, calculators and even in watches (Anonymous,2016f). We have a lot of LED in this project uses LED Strip because it's more beautiful and it can change to more than one Colors like (Orange , Red ,Yellow , Green , Blue , Violet ,Indigo) and the pattern contains (No pattern , Color wipe , Chase , Theater , Rainbow), and we can control the LED strip and change of the colors and the pattern by using the application of iPhone mobile and the application called Led Control. The Monsanto Company became the first company to produce (in massive levels) visible LED. They used gallium arsenide phosphide (GaAsP) in 1968 in command to create red light-emitting diodes that are appropriate for indicators. A company called Hewlett Packard pioneered LED in 1968, using GaAsP that was supplied by Monsanto.



Figure 3.4. Light emitting-diode (LED) strip.

3.1.7. Breadboard

Electronics is often useful to draw the circuit fast. Using a breadboard, it's a structure base for prototyping of electronics. It is easily plug elements together. The pins on the breadboard flanked by blue and red lines in which the red is (+) and the blue is (-). The layout of a typical solder less breadboard is made up from two types of areas, called strips (Bus strips. Terminal strips) The Bus strips used to give power to the electronic components. A bus strip contains two columns, the first column for ground and the second one for supply voltage (Anonymous, 2016c).

The Breadboard has ten clips on the left and the right of the notch that each connected in a radial way .The five clip marked as (A , B , C , D , E) on the left of the notch that often while (F , G , H , I , G) are marked on the right of the notch

3.1.8. Jumpers

Jump wires is a short wire with a firm tip at each end and the jump wire is usually used to interconnect the parts in a breadboard and they are used to transport electrical signals from anywhere on the breadboard to input and output pins of a microcontroller(Anonymous.2016h). Also the jump wires are used for make a power by connecting the battery to the breadboard and connect the battery terminal to the end of the breadboard, the +terminal will go to the red side marked + and the –terminal will go to the blue side marked- and these steps are for powering the Led.

3.1.9. Power supply

In most of the arduino project the battery uses, and all power supply must obtain the energy it supply to its load .LED can be powered by connecting the jump wires from the battery to the breadboard. By connecting the positive terminal to the outer rail and the negative terminal to the inner rail and then the led strip powered.

3.2. Method

In this thesis arduino board was connected with a Wi-Fi shield, and there was a connection between the relay board and the wifishield, after that hardware connection, the Arduino board was programed to enter this system anywhere by this static IP address that configured on the Wi-Fi shield from the iPhone Led control application, after entering the system all devices which connected with relay board can be control the LED strip and change of colors and patterns.

3.2.1. Structure of the system

The system consists of three parts: First, the wifishield which is responsible for giving the control to the Led control application and receiving responses from the serial monitor. The second part is arduino UNO which is responsible for controlling the devices. The last part is Led Control which is responsible for controlling the Led strip and change of colors and pattern from the iPhone. A block diagram of the Structure system showed Figure 3.5.

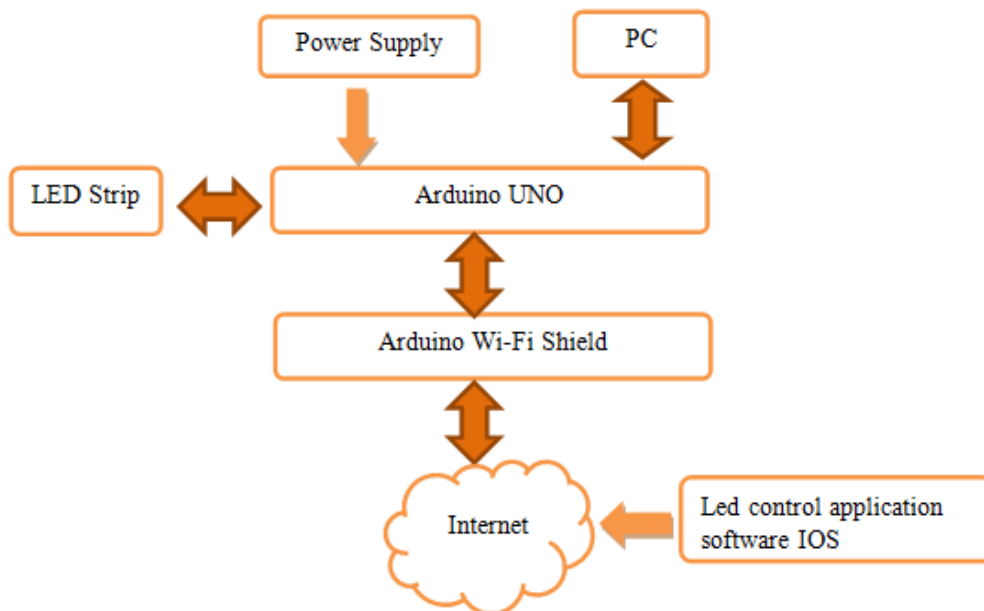


Figure 3.5. Block diagram of the structure system.

From this block, arduino was connected with a Wi-Fi shield, and there was a connection between the Arduino board and the Wi-Fi shield, after the connection, the Arduino board was programmed to access this system anywhere via this static IP address that configured on the Wi-Fi shield from the iPhone Led control application. Actually, the Wi-Fi Shield is the interface between the Microcontroller and Led control application software IOS by using the internet. During this operation, the information transfer from the Microcontroller to the Led control Application software IOS. The commands sent by the user from a Led control application are executed by the Microcontroller, after accessing the system the device that connected with relay board can be control the LED strip and change of colors and patterns.

3.2.2 Connection Steps

- 1- Mount Arduino Wi-Fi shield on the Arduino UNO
- 2- Connect a battery to the outer rails of the breadboard
- 3- Connect the LED strip Ground wire to the breadboard rail that connected to the negative terminal of the battery and connect the LED strip power wire to the breadboard rail that connected to the positive terminal of the battery. Then connect the data pin of the LED strip to digital pin 6 of the Arduino.
- 4- The Arduino can be powered by USB or from another power source.

3.2.3. Interfacing the Wi-Fi shield module

The arduino Wi-Fi shield is the prime unit in the system. The Wi-Fi shield can be used to connect the Arduino board to the internet wirelessly, using 802.11 wireless specification, then how to program the wifi shield and connect it to the arduino UNO, and use library in the project for write sketch that connects to the internet using the wifishield. In this thesis, mount arduino on the top of the wifi shield, the wifi shield and arduino are used for controlling LED from the Led control application, and this application can control the LED by the static IP address. After starting a browser and searching for wifi shield IP address, the IP address of network is registered in the

program to match the network. The below code show in figure 3.6. It is for setting up the wifi shield from the arduino.

```
// check for the presence of the shield:
if (WiFi.status() == WL_NO_SHIELD) {
  Serial.println("WiFi shield not present");
  // don't continue:
  while (true);
}
String fv = WiFi.firmwareVersion();
if (fv != "1.1.0") {
  Serial.println("Please upgrade the firmware");
}
// attempt to connect to Wifi network:
while (status != WL_CONNECTED) {
  Serial.print("Attempting to connect to SSID: ");
  Serial.println(ssid);
// Connect to WPA/WPA2 network. Change this line if using open or WEP
network:
  status = WiFi.begin(ssid, pass);
  // wait 10 seconds for connection:
  delay(10000);
}
Serial.println("Done");
server.begin();
// you're connected now, so print out the status:
printWifiStatus();
}
void loop() {
  client = server.available(); // listen for incoming clients
  if (client) { // if you get a client,
    getOnlineData();
  }
  if (!parseData && command != ""){
    colorIndex = stringToInt(command.substring(command.indexOf("C")+1,
command.indexOf("P"))); // get the color index
    //if(colorIndex != 0)colorIndex = colorIndex - 1;
    patternIndex = stringToInt(command.substring(command.indexOf("P")+1,
command.indexOf("\n"))); // get the pattern index
    onOff = command[0] - '0';
    Serial.print("Command: ");Serial.println(command);
    Serial.print("Status: ");Serial.println(onOff);
    Serial.print("Color index: ");Serial.println(colorIndex);
    Serial.print("Pattern: ");Serial.println(patternIndex);
    if (onOff == 0){
      Serial.println("Clear color");
      colorFill(strip.Color(0,0,0)); // clear led strip
    }
    command = "";
  }
}
```

Figure 3.6. Arduino IDE code for setting up the Wi-Fi shield.

3.2.4. Interfacing the LED Strip

Light emitting diode strip is another main unit in the system. It is an electrical application that contains 30 lights and it has 6 data pins from the first side to the last side. One side of the LED has (+5V, DIN, GND) and the other side has (+5V, DO, GND). Now how to connect the wires from the LED to the arduino and the bread board. In this thesis the Din wires are connecting from the LED to the -6 digital pin in the arduino board, and the two other wires the +5v are connect from the LED to the outer rail of the breadboard and GND are connecting from the LED to the inner rail of the breadboard. Figure 3.7. Displays the wiring connection from the LED to the arduino and breadboard. Figure 3.8. Displays the code in IDE to access LED.

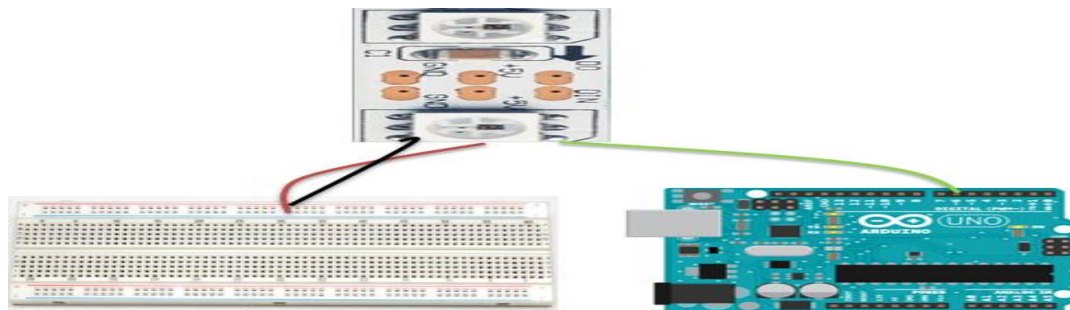


Figure 3.7. Wiring connection from the LED to the arduino and breadboard

```
Adafruit_NeoPixel strip = Adafruit_NeoPixel(30,dataPin, NEO_GRB + NEO_KHZ800); //declare led strip
```

Figure 3.8. Arduino IDE code for NeoPixel strip.

3.2.5. Interfacing the colors and patterns

The iPhone application controls the color and patterns on an LED strip via Wi-Fi. The Arduino is used as a web server and the iPhone Led control application sends a get request which contains the color and pattern commands to the Arduino. The Arduino

then changes the color and pattern on the LED according to the way that iPhone Led control application has been configured

The Led control application contains seven colors and five patterns. The color combo box has the colors (Orange, Red, Yellow , Blue, Green , Violet, Indigo) , the pattern combo box has (No pattern , Color wipe , Chase , Theater , Rainbow).

```

if (onOff == 1){
if (patternIndex == 0){ // if there is no pattern
colorFill(colors[colorIndex]); // fill led strip with chosen color
Serial.println ("no pattern"); }

else if (patternIndex > 0){
switch (patternIndex){
case 1:
colorWipe(colors[colorIndex], 50); // apply color wipe pattern
colorWipe(strip.Color(0,0,0), 50); // clear colors
Serial.println ("color wipe");
break;
case 2:
theaterChase(colors[colorIndex], 50); // apply chase pattern
Serial.println ("theaterChase");
break;
case 3:
theaterChaseRainbow(50); // apply theater chase rainbow
Serial.println ("theatre");
break;
case 4:
rainbowCycle(20); // rainbow cycle
Serial.println ("rainbow");
break;
} .} ..}

```

Figure 3.9. Arduino IDE code for accessing the color and pattern

3.2.5.1. Interfacing the colors and no pattern.

No pattern is the first option in the Led control application. When the application sends no pattern and choose the color and serial monitor accept it and the LED light to this color that send from the application without any pattern. The code for no pattern bellow in Figure 3.10.

```

if (onOff == 1){
if (patternIndex == 0){ // if there is no pattern
colorFill(colors[colorIndex]); // fill led strip with chosen color
Serial.println ("no pattern");
}
}

```

Figure 3.10. Arduino IDE code to accessing no pattern.

3.2.5.2. Interfacing the colors and color wipe pattern

The Color wipe pattern is the second pattern in the Led control application, over the length of the strip, paints a color, one pixel at time. The function of the color wipe initialize the neo pattern object to execute the Color Wipe pattern, the color parameter specifies the color to 'wipe' across the strip. The code below that shown in Figure 3.11. It is the code for read the color and color wipe pattern.

```

case 1:
colorWipe(colors[colorIndex], 50); // apply color wipe pattern
colorWipe(strip.Color(0,0,0), 50); // clear colors
Serial.println ("color wipe");
break;

```

Figure 3.11. Arduino IDE code to accessing color wipe pattern.

3.2.5.3. Interfacing the colors and Chase pattern

The Chase pattern is the third pattern in the Led control application, while chase pattern is turn on and off the LED bellow like a cycle through colors, when send a command from the application, example: send red color, it turns on then the light turns off, then yellow color turns on, then the yellow color turn off, then green on, off again, and it lights like a cycle through colors. The code below that shown in Figure 3.12.

```

case 2:
theaterChase(colors[colorIndex], 50); // apply chase pattern
Serial.println ("theaterChase");
break;

```

Figure 3.12. Arduino IDE code to accessing Chase pattern

3.2.5.4. Interfacing the colors and Theater pattern

Theater pattern is the penultimate pattern, the function of theater chase () initializes the new pattern object for executing the theater pattern. When the command sends from the Led control application to serial monitor in theater pattern two colors mixes together and then these two colors change to another color, for example, green and blue turn on together then these two colors change to yellow and blue. Figure 3.13 it is code for read theater pattern.

```
case 3:
  theaterChaseRainbow(50); // apply theater chase rainbow
  Serial.println ("theatre");
  break;
```

Figure 3.13. Arduino IDE code to accessing Theater pattern.

3.2.5.5. Interfacing the colors and Rainbow pattern

The Rainbow pattern is the last pattern in the Led control application, the function of Rainbow cycle () initializes the New Patterns class for running the Rainbow Cycle pattern. The Rainbow Cycle uses the color haste to make a rainbow effect that cycles over the length of the strip, and this is an unpretentious re-structuring of the Rainbow Cycle pattern in the Strand Test, when send a command from the Led control application for light LED in rainbow pattern, all colors turn on together and changing on their colors and all colors mixed together. Figure 3.14 it is code for read rainbow pattern.

```
case 4:
  rainbowCycle(20); // rainbow cycle
  Serial.println ("rainbow");
  break;
```

Figure 3.14. Arduino IDE code to read Rainbow pattern

4. IMPLEMENTATION AND RESULTS

In this chapter results of the implementation of controlling LED strip over Wi-Fi network using arduino will be discussed, which includes the methods and details information of the system. After programming it and testing the hardware system for controlling the LED strip by IOS mobile. Led control application software bought from the apple developer program, and installs it from apple app store which cost the apple developer program provides resource for developing and distributing IOS, Mac, after bought and install the application, Led control application able to control the LED strip and changes of colors and pattern. This system has been performed on the Arduino Uno. The system uses Wi-Fi shield module to interface with the internet to control devices and statues. Furthermore a USB port used to connect Microcontroller with a personal computer for uploading command. Figure 4.1. Shows the total controlling LED

The controlling LED strip system consists of Arduino UNO R3 , Arduino Wi-Fi shield , WS2812 neopixel LED strip , Breadboards , Jumper wires , Battery (between 2.5V and 7V) .

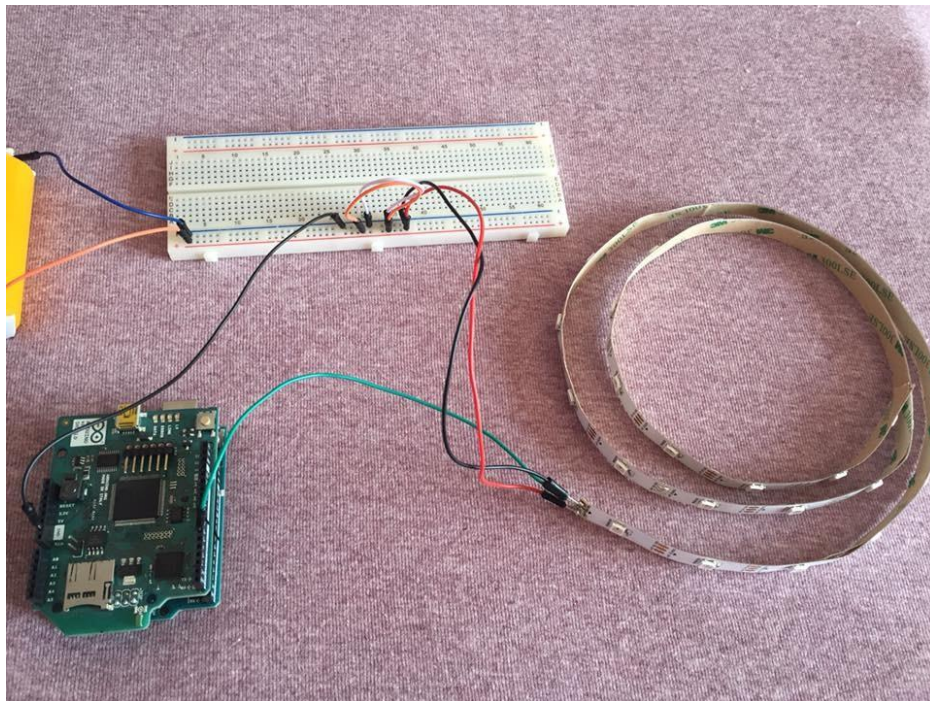


Figure 4.1: Final controlling LED.

4.1. Testing the Hardware System

Firstly, all hardware devices were checked and tested to obtain that all devices were in a perfect working situation, after that, all devices were tested separately with the microcontroller to obtain the needful software in this implementation and to discover any mistakes in each of hardware devices easily, after this test, it was obtained that all hardware devices were working perfectly, and then all hardware devices connected together and test the overall system, this step was to check the main important hardware in the system that is the connection of the Wi-Fi shield to the internet of thing and it worked exactly with the Arduino UNO . It was observed that the system was ready to use. Arduino connect to the computer by using USB cable, and Wi-Fi hotspot connected to internet by using the name of the Wi-Fi and the password. Figure 4.1. Shows the flow chart of the Wi-Fi shield testing. Figure 4.2. show Arduino Wi-Fi shield connected to the Wi-Fi.

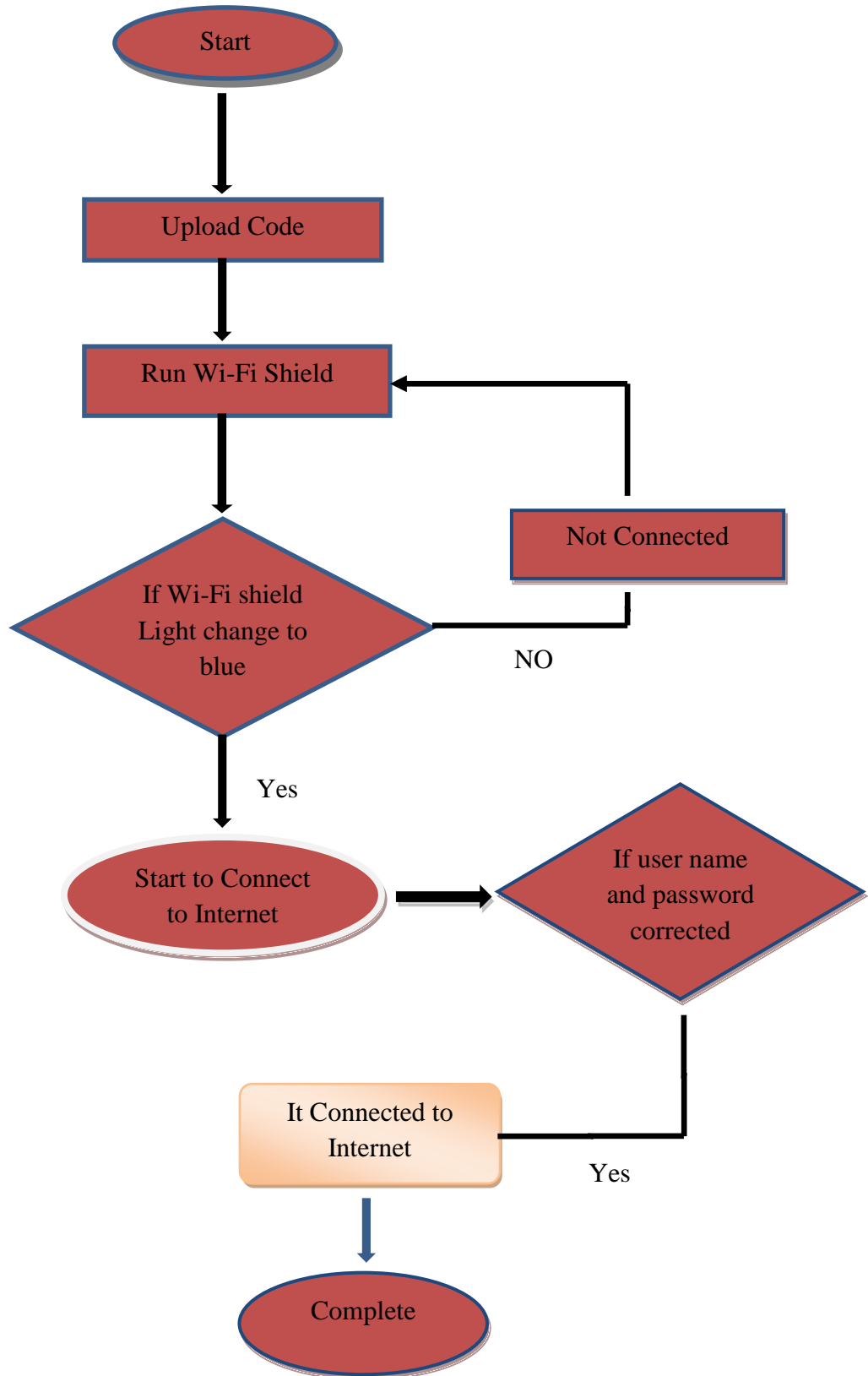


Figure 4.2. Workings of the Wi-Fi shield software.

Wi-Fi connected Wi-Fi shield which lets simple textual data to be send to and from the board.

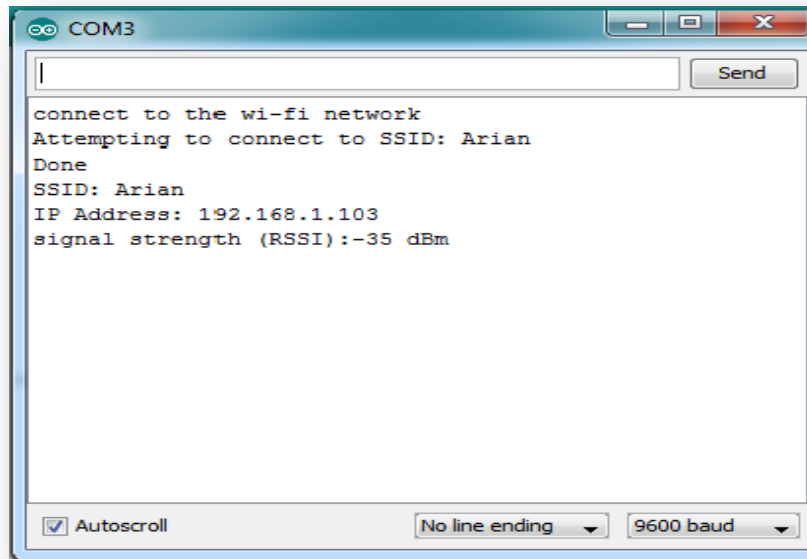


Figure 4.3. Display Arduino Wi-Fi shield connect to the Wi-Fi.

4.2. Testing the iPhone Led control application

Light-emitting diode (LED) can control by iPhone Led control application, this application can be downloaded from <https://diawi.com>. This service used to upload and share the application, this application costs \$99.99 after the application installed for testing device using the IDE code. iPhone Led Control application can control the Light-emitting diode (LED) and this application includes seven colors and five patterns. Then Arduino changes the colors and patterns on the Light-emitting diode (LED) according to the way that the iPhone app has been configured. For iPhone Led Control application configures, it has shown in below steps:

1-Led Control in the application that installed in iPhone IOS and has the ability to control Light-emitting diode (LED) and change of colors and pattern. As shown in Figure 4.4.



Figure 4.4. Led control Application

2-Configuring the system of static IP address in the setting of the Led Control Application, when the Arduino Wi-Fi shield connect to the Wi-Fi it has IP address, this IP wrier is in the setting of the Led Control Application . As shown in figure 4.4.

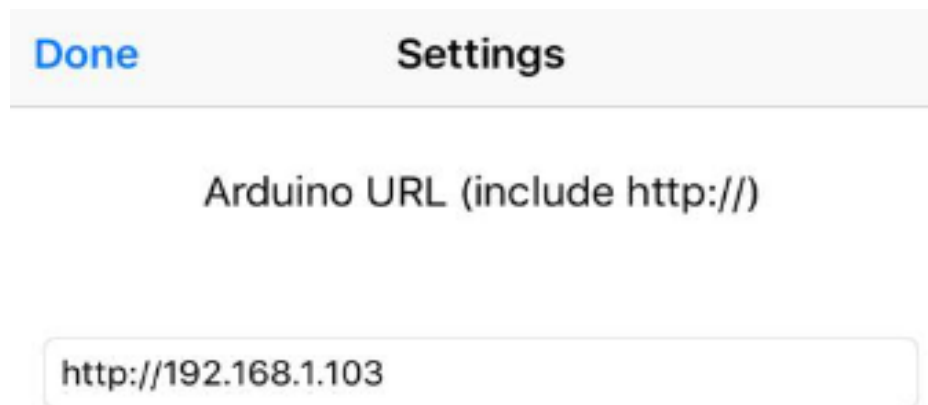


Figure 4.5. IP address in the Led control application.

3-Configure the Led Control application turn on firstly one color and pattern chose, then click on SEND the command will send to the Wi-Fi shield and the Led Control application can control the Light-emitting diode (LED). As shown in figure 4.6.

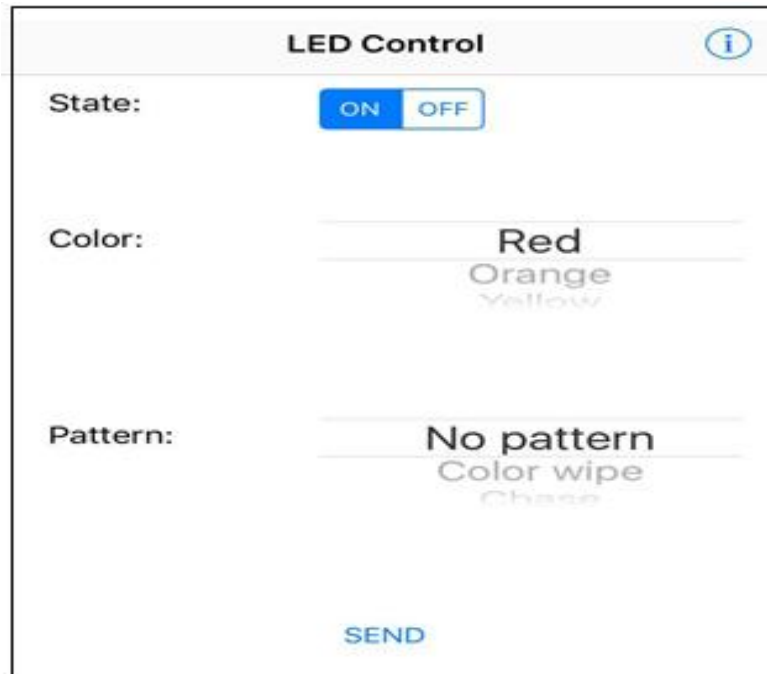


Figure 4.6. Led Control turn on.

4-Configure the Led Control turn off when the Wi-Fi shield connected the Led Control application that can turn off the Light-emitting diode (LED). As shown in Figure 4.7.

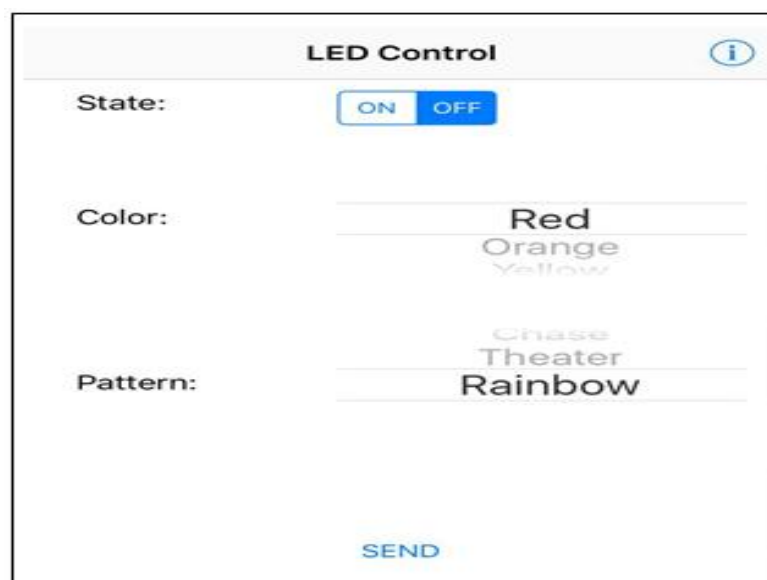


Figure 4.7. Led Control turn off.

4.3. Testing the colors and patterns

The iPhone Led Control application has seven colors and five patterns

Colors:

- 1) Red
- 2) Orange
- 3) Yellow
- 4) Green
- 5) Blue
- 6) Indigo
- 7) Violet

Pattern:

- 1) No pattern
- 2) Color wipe
- 3) Chase
- 4) Theater
- 5) Rainbow

Table 4.1. Content colors with the patterns (no pattern), the command send from Led Control application and Wi-Fi shield accept it, then the color changes and no pattern make the color to be standard, it means just the color without the pattern. There are four colors that are tested which are (A, B, C, D). (A) Color happened when a Violet color and no pattern send with the (statues=1, color index =6, and the pattern =0), then the Violet color turns on. And sending a green color and no pattern means (B), with the (statues=1, color index =3, and the pattern =0) then the green color turns on. (C) Happened after sending yellow color and no pattern with the (statues=1, color index =2, and the pattern =0) then the yellow color turns on. The last color that tested (D) after sending Red color and no pattern with the (statues=1, color index =0, and the pattern =0) then the red color turns on. Figure 4.8. Display the color and no pattern.

Table 4.1. Colors and the pattern (No pattern)

Color	pattern	command	status	Color index	pattern
Red	No pattern	1C0P0	1	0	0
Orange	No pattern	1C1P0	1	1	0
Yellow	No pattern	1C2P0	1	2	0
Green	No pattern	1C3P0	1	3	0
Blue	No pattern	1C4P0	1	4	0
Indigo	No pattern	1C5P0	1	5	0
Violet	No pattern	1C6P0	1	6	0

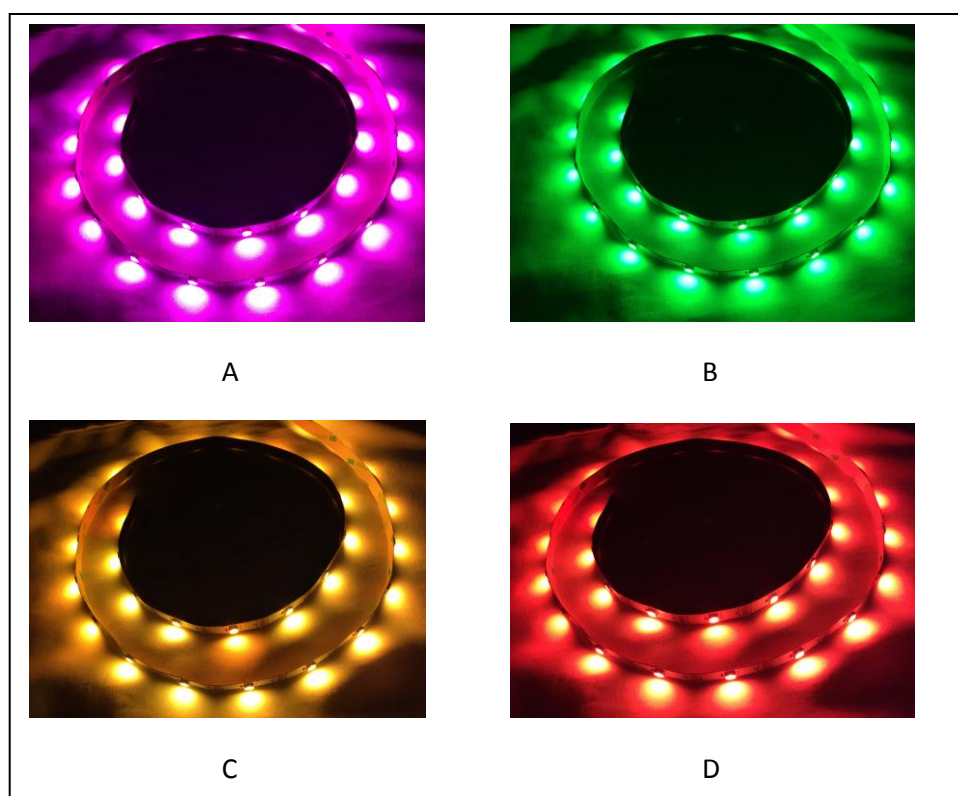


Figure 4.8. (violet, green, yellow, red) colors with (No Pattern).

Table 4.2. Content all colors with color wipe pattern. The command send from Led Control application and Wi-Fi shield accept it. In this type, the lights of LED strip is turn on from the first one to the last one which is number 30, and when the light of second LED is turn on, the first LED will turn off, and this happen to the third and

fourth and other LEDs, this means that the lights of LED will turn on one by one. The Wi-Fi connected and test the Blue color when the statue =1 and the color index= 4 and the pattern =0. In the (A) all lights turn on, then some of the lights turn off in (B), after that in (C) half of the lights turn on, then in the last (D) just a little lights turn on. Figure 4.9. Show the steps of Red colors and color wipe pattern.

Table 4.2. Colors and (color wipe) pattern.

Color	Pattern	Command	Status	Color index	Pattern
Red	Color wipe	1C0P1	1	0	1
Orange	Color wipe	1C1P1	1	1	1
Yellow	Color wipe	1C2P1	1	2	1
Green	Color wipe	1C3P1	1	3	1
Blue	Color wipe	1C4P1	1	4	1
Indigo	Color wipe	1C5P1	1	5	1
Violet	Color wipe	1C6P1	1	6	1

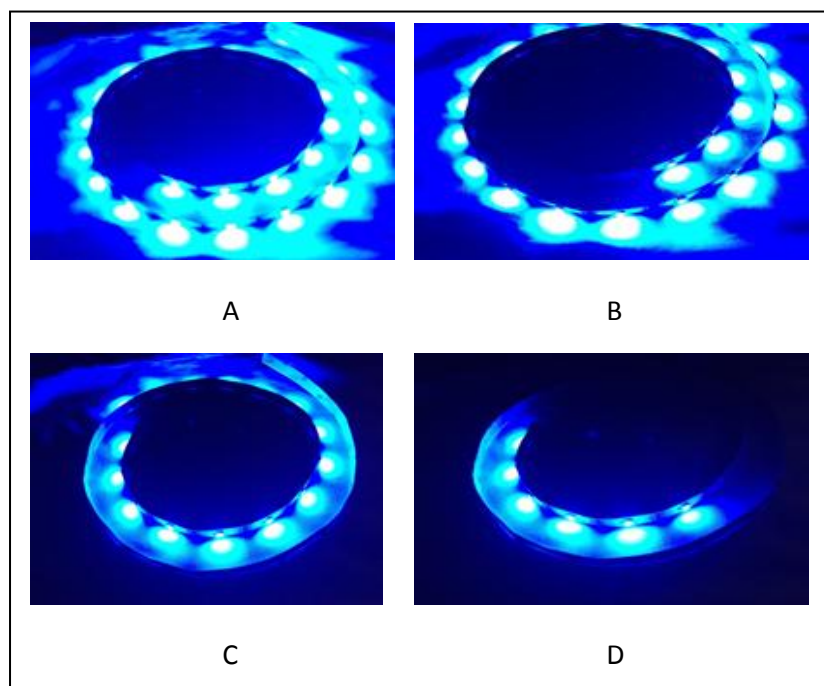


Figure 4.9. Blue color with color wipe pattern.

Table 4.3. Content all colors with chase pattern, this pattern is like the pattern (color wipe) but in this pattern the command send from Led Control application and Wi-Fi shield accept it, then from the iPhone the LED strip can be controlled, the lights of the LED strip is turn on like a cycle through colors, for the chase pattern the colors that tested are violet, blue and red colors. The violet turns on when (statue =1, color index =6, and pattern=2) and the blue color turns on when (statue =1, color index=4, and pattern=2) and for the last color it turns on when (statue =1, color index=0, and pattern=2) and this pattern makes the light turns on and off fast. Figure 4.10. Display the chase pattern.

Table 4.3. Colors and (Chase) pattern.

Color	Pattern	Command	Status	Color index	Pattern
Red	Chase	1C0P2	1	0	2
Orange	Chase	1C1P2	1	1	2
Yellow	Chase	1C2P2	1	2	2
Green	Chase	1C3P2	1	3	2
Blue	Chase	1C4P2	1	4	2
Indigo	Chase	1C5P2	1	5	2
Violet	Chase	1C6P2	1	6	2



Figure 4.10. (violet, blue, red) colors with chase pattern.

Table 4.4. Content all colors and Theater pattern. In this pattern the command send from Led Control application and Wi-Fi shield accept it, then the light of the LED strip of two colors mix together, like (green and blue) colors are turning on together , then change to the two different colors such as (Orange and Yellow , Violet and Blue , Red and Orange...etc.). Figure 4.11 and figure 4.12 and figure 4.13 show how two colors turn on together with the theater pattern.

Table 4.4. Colors and (Theater) pattern.

Color	Pattern	Command	Status	Color index	Pattern
Red	Theater	1C0P3	1	0	3
Orange	Theater	1C1P3	1	1	3
Yellow	Theater	1C2P3	1	2	3
Green	Theater	1C3P3	1	3	3
Blue	Theater	1C4P3	1	4	3
Indigo	Theater	1C5P3	1	5	3
Violet	Theater	1C6P3	1	6	3



Figure 4.11. Green and yellow color with theater pattern.



Figure 4.12. Violet and blue color with theater pattern.



Figure 4.13. Orange and red color with theater pattern.

Table 4.5. Content all colors and rainbow pattern, in this type the command send from Led Control application and Wi-Fi shield accept it, after that all colors are turning on together, like rainbow in the sky, and the colors grouped respectively from the first LED to the last LED, and the groups change their location in the LED, and it is Slightly different, this makes the rainbow equally distributed. Figures 4.14. Shows how the colors turn on together with the rainbow pattern.

Table 4.5. Colors and (Rainbow) pattern.

Color	Pattern	Command	Status	Color index	Pattern
Red	Rainbow	1C0P4	1	0	4
Orange	Rainbow	1C1P4	1	1	4
Yellow	Rainbow	1C2P4	1	2	4
Green	Rainbow	1C3P4	1	3	4
Blue	Rainbow	1C4P4	1	4	4
Indigo	Rainbow	1C5P4	1	5	4
Violet	Rainbow	1C6P4	1	6	4



Figure 4.14. Colors with rainbow pattern.

5. CONCLUSIONS

The objective of this study was to control LED strip, turns on and off and changing the colors and patterns using iPhone Led Control Application. The hardware that used for controlling LED strip includes Arduino UNO, Arduino Wi-Fi shield, LED strip and the application that controlled the LED, the internet network was used because it's low cost and it is covering a big zone. It is applied to send information to the system to control LED and receive statuses of the appliances. The application had been carried out successfully. These electronic devices controlled by iPhone Led Control application via the internet. As a result, the light emitting diode strip was controlled by iPhone led control application. Led control is the application that created and designed in IOS company that contain seven colors and five patterns and this application connect with arduino by IP address.

This project allows easy control of LED strip lighting as it has a simple interface that is easy to understand and enables remote control of the LED strip, so a person does not have to be in the proximity of the controller to change the color and patterns of the LED strips. And also this project eliminates the need for the creation of a physical LED light control circuit, which saves time and money, it is easy to setup, so as long as one has the phone application and Arduino, the project can be used anywhere, and specially if the person has a phone that can host a Wi-Fi hotspot.

The disadvantage of this project is that, the Wi-Fi settings of the Arduino are not easily customizable, since one has to edit the code to be able to change the settings and the number of LED that can be controlled by the setup and it is limited to about 200 LED. To increase the number of LED, an Arduino mega can be used.

There is much to be considered as future work; firstly can be used as a smart home lighting system. Secondly, it can light programming system for shows and stages. Thirdly, it can be used as a decoration lights during festivals such as Christmas. Finally, it can be used for Security lighting system if the LED strips are replaced with security light.

REFERENCE

- Albeanu, D. F., Soucy, E., Sato, T. F., Meister, M., Murthy, V. N., 2008. LED arrays as cost effective and efficient light sources for widefield microscopy. *PLoS One*, **3**(5), e2146.
- Anonymous, 2011. *C-Bus Product Overview*, schneider electric (HK) Ltd. Hong Kong, China.
- Anonymous, 2016a. Arduino website .Retrieved from <http://www.arduino.cc/> Data of access: February 15, 2016.
- Anonymous, 2016b. Website, Arduino wifishield. <http://arduino.cc/en/Main/ArduinoWiFiShield> . Data of access: 18.4.2016
- Anonymous, 2016c. Wikipedia, BreadBoards <https://en.wikipedia.org/wiki/Breadboard> Data of access:18.5.2016.
- Anonymous, 2016d. Wikipedia. Arduino UNO Description <http://www.arduino.cc/UNO>. Date of access: 5.3.2016.
- Anonymous, 2016e. ArduinoWikipedia <http://en.wikipedia.org/wiki/Arduino#Software>, Data of access: 12.4.2016
- Anonymous, 2016f. "LED" <http://www.graybar.com/applications/lighting/led> Data of access:18.5.2016.
- Anonymous, 2016j. Arduino website <https://www.arduino.cc/en/Guide/Introduction>. Date of access:3.4.2016.
- Anonymous, 2016h. Wikipedia, Jump wire. https://en.wikipedia.org/wiki/Jump_wire Data of access:4.5.2016.
- Anonymous, 2016i. <http://processing.org/>. Date of access: 1.7.2016.
- Banzi, M., Shiloh, M., 2014. *Getting Started with Arduino: The Open Source Electronics Prototyping Platform*. Maker Media, Inc. 85-96.
- Chukwuebuka, E. E., Baton, R. L., 2015 .Using LED to Reduce Energy Consumption. College of Sciences of Southern University and A & M College . *In Partial Fulfillment of the Requirements*. 1-85
- da Silva Pinto, M. A., de Souza, J. K. S., Baron, J., Tierra-Criollo, C. J., 2011. A low-cost, portable, micro-controlled device for multi-channel LED visual stimulation. *Journal of Neuroscience Methods*, **197**(1): 82-91.

- Fadda, A., Falsini, B., 1997. Precision LED-based stimulator for foc electroretinography. *Medical and Biological Engineering and Computing*, **35**(4): 441-444.
- Golmohammadi, S., Rabbani-Shabestari, S. J., 2015. Design of white LED using GaN/In_xGa_(1-x)N multiquantum well. *Optik-International Journal for Light and Electron Optics*, **126**(24): 5820-5824.
- Jeremy, B., Scott, F., 2013. *Exploring Arduino Tools and Techniques for Engineering Wizardry Nightlight Building a Controllable RGB LED Nightlight*. Canada: John Wiley & Sons. 35-41.
- McRoberts, M., Levy, B., Wootton, C., 2010. *Beginning Arduino*. 1st ed. New York.: Apress. 51-57.
- Michael, M., 2012. *Arduino Cookbook Controlling an LED Matrix Using Multiplexing*. 1st ed. O'Reilly Media, 252-256
- Monk, S., 2010. *30 Arduino Projects for the Evil Genius*. United States. McGraw-Hill Professional. 8-10.
- Schubert, E. F., Kim, J. K., 2005. Solid-state light sources getting smart science, **308**(5726): 1274-1278.
- Sun, R., Bouchard, M. B., Hillman, E. M., 2010. SPLASSH: Open source software for camera-based high-speed, multispectral in-vivo optical image. *Biomedical Optics Expresses*, **1**(2), 385-397.
- Svilainis, L., 2008. LED PWM dimming linearity investigation. *Displays*, **29**(3): 243-249.
- Tariq, A. K., Ziyad, A. T., & Abdullah, A. O., 2013. Arduino Wi-Fi network analyzer. *Procedia Computer Science*, **21**, 522-529.
- Wiley, B., John, N., 2013. *Arduino for Dummies Controlling Multiple Light Emitting Diodes (LED)*. John Wiley & Sons. 315-318.

APPENDIX

APPENDIX 1. Geniletilmiş Türkçe Özet (Extended Turkish Summary)

ÖZET

ARDUINO KULLANARAK WI-FI AĞI ÜZERİNDEN LED ŞERİT KONTROLÜ

MAHMOOD, Aryan Abdulkarim
Yüksek Lisans Tezi, Elektrik-Elektronik Mühendisliği Anabilim Dalı
Tez Danışmanı: Yrd. Doç. Dr. M. Nuri ALMALI
Ekim 2016, 43 Sayfa

Işık yayan diyotlar genellikle bilimsel uygulamalarda ışık kaynağı olarak ve ışık uyarınları sağlamak için düşük maliyeti ve esnek bir şekilde kullanılmıştır. Genellikle dünyada, otomatik sistemler manuel sistem göre tercih edilirler. Geçtiğimiz on yıl içerisinde internet kullanıcılarının sayısındaki hızlı artış insan yaşamının bir parçası olmuştur. Bu çalışmada, bir uzaktan kumandalı LED, LED kontrol uygulama IOS yazılımı ve arduino mikrokontrolcüsü kullanılmıştır. LED kontrol uygulaması, LED'lerin açma-kapama durumlarını, farklı renk ve desen değiştirilmesi menülerini içerir.

Geliştirilen sistem iki kısımdan oluşur: Donanım ve yazılım. Donanım ise iPhone, kişisel bilgisayarlar, Arduino UNO, Arduino Wi-Fi shield ve LED'ler içerir. Yazılım sistemin ikinci kısmıdır; Yazılım, ışık yayan diyot şerit tasarımı için tasarlanan Arduino kodudur. Led kontrol uygulaması, donanım cihazlarına Arduino Wi-Fi shield üzerinden bağlanır. Ayrıca, iPhone'larda Led kontrol uygulaması, LED kontrol etmek için kullanılmaktadır. Bu sistem, iletişim için bir internet ağı kullanır.

Anahtar kelimeler: Arduino, Led kontrol uygulaması, Wi-Fi Shield, LED şerid.

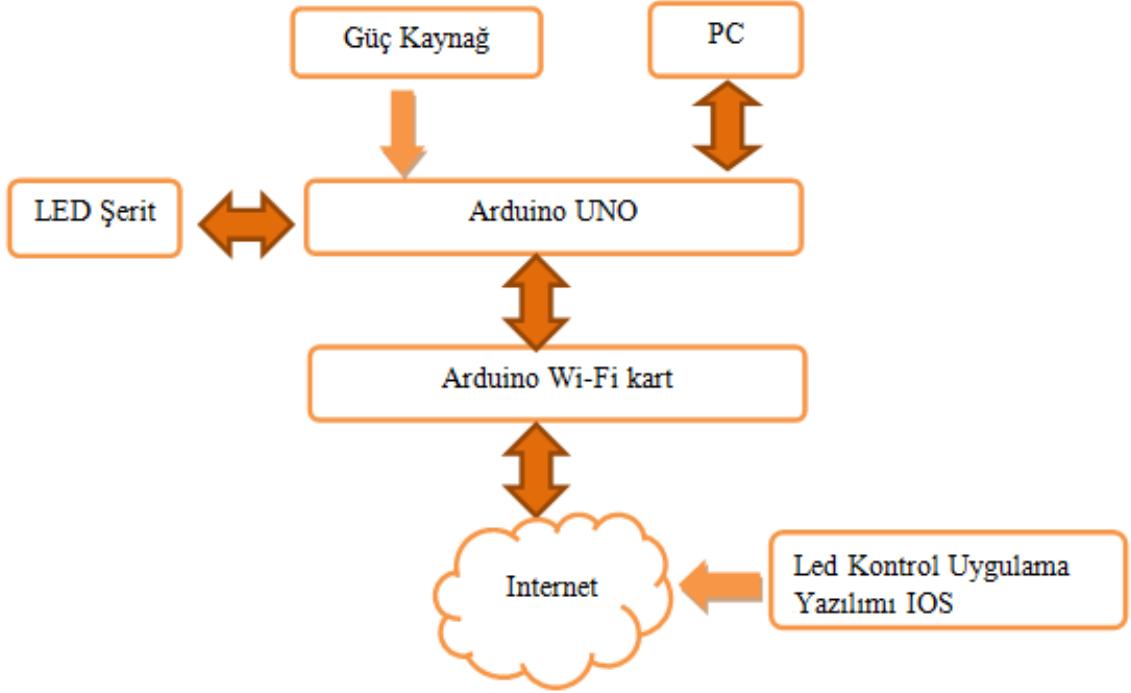
1. GİRİŞ

Işık yayan diyotu(LED) ışık kaynağı olarak geniş ölçüde kullanılmaktadır. Sistemin kullanımı basit, işlevsel, kolay ve ucuzdur. LED ilk önce laboratuvarında elektronik test cihazlarında bulundu ve daha sonra TV'ler, radyolar, hesap makineleri ve hatta saatler için kullanılmıştır. LED'ler uzun bir dinamik aralık üzerinde PWM kontrol sinyaline yanıt olarak, düz ışık çıkışı sağlayan tek renkli ışık kaynağıdır. LED'ler, diğer ışık kaynakları arasında karşılaştırıldığında, ışık özelliklerinin daha kolay ve daha uyarlanabilir kontrolü için kullanılmaktadır.

Bu çalışmanın amacı, bir Arduino mikrokontrolcü kullanarak uzaktan bir yazılım ile LED şeridin renk ve desenlerini kontrol etmek ve LED ışıkları yakıp söndürmektir. Bu çalışmada uzak erişim için bir Wi-Fi ağı, Arduino mikrokontrolcü olarak Arduino UNO, Wi-Fi ağ bağlantısı için de Arduino için Wi-Fi kartı kullanılmıştır. iOS işletim sisteminde yazılmış bir program aracılığı ile LED şeritteki LED renkleri, desenleri değiştirilmektedir.

2. MATERYAL ve METOD

Sistem üç bölümden oluşmaktadır: İlk olarak, Led kontrol uygulaması ile Arduino arasındaki komutların aktarılması için kullanılan Wi-Fi kartı, ikinci kısımda, cihazları kontrol etme için kullanılan Arduino UNO mikrokontrolcüsü ve son kısım ise Led şeridi kontrol etmek için iOS da yazılmış program tanıtılmıştır. Tasarlanan sisteme yapısına ait blok diyagramı Şekil 1 de verilmiştir.



Şekil 1: Sistem yapısının blok diyagramı

Bu diyagramdan, arduino, Wi-Fi shield'e bağlanmıştır ve arduino ile Wi-Fi shield arasında bir bağlantı vardır, Arduino ile herhangi bir yerdeki sistemle haberleşmek için IP adresini kullanır. Bu IP LED control uygulamasından iPhone Wi-Fi kart internet üzerinden konfigüre edilir. Aslında Wi-Fi kart, internet kullanarak mikroişlemci ve IOS yazılımlı LED control uygulaması arasındaki bir ara yüzüdür. Bu işlem sırasında bilgiler, mikroişlemciden IOS yazılımlı Led kontrol uygulamasına aktarılmaktadır. Bir Led control ile kullanıcı tarafından gönderilen komutlar Mikroişlemci tarafından yürütülmektedir. Bağlı olan cihazlara eriştikten sonra LED şerid kontrol edilebilir ve renkler, desenler değiştirilebilir.

3. UYGULAMA SONUÇLARI VE TARTIŞMA

Bu sistem Arduino UNO platformu üzerinde yapılmıştır. Sistem Arduino Wi-Fi shield üzerinden uygulamayı ve renk durumlarının statülerini kontrol etmek için internet ara yüz modülü kullanır. Üstelik, mikrokontrolcüye ve kişisel bilgisayara bağlanmak için bir USB port kullanılır.

3.1 Donanım Sistemi Testi

Tüm donanım cihazları kontrol edildi ve çalışma esnasında tüm ekipmanların çalışması gözlemlendi. Daha sonra, bu uygulamada gerekli olan yazılım gerçekleştirilerek mikroişlemci ile ayrı ayrı test edildi ve her bir donanım için hata kontrolü yapıldı. Bu testten sonra, tüm cihazların mükemmel bir şekilde çalıştığı gözlemlendi. Tüm sistemin birbiri ile olan fiziksel bağlantıları gerçekleştirildi. Bu sistemin Arduni UNO ile uyum içerisinde çalıştığı gözlenmiştir. Son olarak sistem kullanıma hazır hale getirildi.

3.2 iPhone LED Kontrol Uygulaması Testi

iOS işletim sistemli Iphone yazılımı, internet aracılığıyla sistemi kontrol etmek için gerçekleştirilen donanımla kullanıldı. Bu yazılım <https://diawi.com> adresinden yüklenmiştir. Bu yazılım sayesinde, kullanıcı renkleri ve desenleri değiştirebilme özelliğine sahip olmuştur.

4. SONUÇ

Bu çalışmanın amacı LED şeridi kontrol etmektir. iPhone Led kontrol uygulamasını kullanarak açma/kapama işlemi dışında, renkleri ve desenleri değiştirmek için de kullanılmıştır. LED şeridi kontrol etmek için kullanılan donanım; Ardunio UNO, Ardunio Wi-fi Shield, LED şerit ve LED kontrol uygulamasını içerir. İnternet ağı, düşük maliyetli ve geniş kapsama alanı özelliğinden dolayı kullanılır. Uygulama, LED kontrol sistemine bilgiyi göndermek ve statülerini almak için kullanılır. Uygulama başarılı bir şekilde gerçekleştirilmiştir. Bu elektronik cihazlar internet aracılığıyla iPhone Led kontrol uygulaması tarafından kontrol edilir. Sonuç olarak, LED şerid uygulaması iPhone Led kontrolcü tarafından kontrol edilmiştir. LED kontrol programı, 7 renk ve 5 desen içerir ve IP adresi ile Ardunio ile bağlantı kurmaktadır.

CURRICULUM VITAE

She was born in 1992 in Erbil, Iraqi. She completed his primary and secondary education in Sulimany, Iraqi. She started learning from University Bachelor of Statistic and Computer in university of Sulimany /Iraq, she graduated in 2014. She started his graduated studies Yüzüncü Yıl University Electrical and Electronics Engineering Department in 2014. She speaks fluent Arabic, English and Kurdish.