OSMAN ALHUSSEIN INTELLIGENT LIGHT CONTROL IN THE IOT ERA NEU 2022

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A THESIS SUBMITTED TO THE INSTITUTE OF GRADUATE STUDIES OF NEAR EAST UNIVERSITY

By
OSMAN ABDALLA KHALFALLA ALHUSSEIN

In Partial Fulfillment of the Requirements for the Degree of Master in Artificial Intelligence Engineering

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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To my parents...

ABSTRACT

In this study, we present an intelligent control system to control the light with Wi-Fi, Bluetooth, and mobile data. We can also control the light with a smartphone at the same time. Our intelligent system achieved satisfying results throughout this project. There are some other related smart-lighting-based projects but the difference in our proposed approach is using different methods: Wi-Fi, mobile data, and Bluetooth, which makes our approach more efficient and increases the lifespan of the lamp. Moreover, our approach has the possibilities to upgrade in the future and add other controlling-systems-based methods. Consequently, the user will have multiple options to choose the method he's more comfortable with more freely.

Keywords*:* ESP32; automation; low-cost; microcontroller; smart homes; intelligent control; Wi-Fi; Bluetooth.

ÖZET

Işığı Wi-Fi, Bluetooth ve mobil verilerle kontrol etmek için akıllı bir kontrol sistemi sunuyoruz. Aynı zamanda bir akıllı telefonla da ışığı kontrol edebiliyoruz.

Bu proje boyunca istihbarat kontrolü yaptık ve tatmin edici sonuçlar aldık.

Akıllı aydınlatmaya dayalı başka projeler de var, ancak önerilen yaklaşımımızdaki fark farklı yöntemler kullanıyor: Wi-Fi, mobil veri ve Bluetooth, yaklaşımımızı daha verimli hale getiriyor ve lambanın ömrünü uzatıyor.

Ayrıca, bu yaklaşım gelecekte yükseltilebilir ve diğer yöntemlere dayalı kontrol sistemleri ekleyebilir. Sonuç olarak, kullanıcı birden fazla seçeneğe sahip olacak ve böylece daha rahat olduğu yöntemi daha özgürce seçebilecek.

Anahtar Kelimeler: ESP32; otomasyon; düşük maliyetli; mikrodenetleyici; akıllı evler; istihbarat kontrolü; Wifi; Bluetooth.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In the world of communication networks, Smart Home systems differ from typical homes that allow gadgets to connect. Smart devices are used to monitor and control the functioning of the home. The use of an integrated communication system, which is accessible in today's modern homes, considerably benefits the occupants. Coolants like air conditioners and other types of heating devices are now installed in most houses, making life easier and more adaptable. Security systems benefit substantially from the usage of fire and security alarms. The usage of home heaters and television is on the rise these days. Therefore, the importance of smart devices is growing every day. These are the systems that are normally not connected. It has the capability of giving data to the user as well as the commands that are given. It provides support for special needs both locally and remotely, with a focus on services for the elderly. Any home's convenience and functionality are considerably enhanced by smart home technology. It allows you to save money while remaining economically stable. (ZARO et al., 2020).

Smart cities are one of the major research topics in the Internet of Things (IoT). Smart cities are designed to make life easier and to have things connected to the internet. The applications of smart cities range from City-planning, transportation, communication, education, health, and tourism are some of the most common applications (F. Al-Turjman, 2019) (F. Al-Turjman, and M. Abujubbeh, 2019)

We are now in the twenty-first century, and automation is playing an increasingly important role in human life. We can operate household equipment thanks to home automation. Smartphones are a big part of it. In the sphere of consumer electronics, significant progress has been made. People of all ages are familiar with cellphones and the basic apps that come with them. The concept of a home automation system has the potential to improve homes' traditional living conditions. The goal is to provide a luxurious living to the elderly and physically disabled. Our home automation system works effectively by providing more personal happiness and consolation to clients by employing this framework. The use of Bluetooth technology in a modern mobile phone is no longer limited to the sharing of information and documents. One of the uses of home automation systems is Bluetooth technology. Bluetooth technology operates at a 2.4 GHz frequency and can connect devices within a 10-100 m range at 3Mbps speed. It demonstrates that Bluetooth can be used for more than just transmitting data. It plays a crucial role in linking the flexible application to the ESP32 microcontroller, which is at the heart of this architecture. It captures the user's input data and sends it to the relay module, which controls the device. the functionality of the appliances' ON/OFF

switches We've also made the fingerprint scanner app incredibly user-friendly so that individuals of all ages can readily grasp home automation procedures. Only the user's fingerprints are recognized as being able to open the fingerprint lock. (Anitha, Sathya, et al., 2021)

The primary goal of technology has always been to increase efficiency while reducing effort. We have been pushing towards ubiquitous computing in all aspects of life since the emergence of the 'Internet of Things in the last decade. As a result, it is critical to make human-technology interaction as simple as possible. Automation is an example of a technology that seeks simplicity while also enhancing efficiency. Controlled by voice, the goal of the House Automation System is to promote automation to attain the goal of simplicity. Voice was discovered to be an excellent means for prehistoric men to interact with one another. Ideas might been conveyed by relative ease with minimal effort. When the first computers were invented, obtaining the degree of sophistication required to narrate commands to the machine via speech was merely a science fiction dream. However, because of significant advancements in the field, we are on the verge of genuinely using voice to interact with electronics. We would greatly humanize technology if we used this effective yet ingrained style of communicating. The use of voice to control devices is implemented in the Voice Controlled House Automation System. The benefits of using voice as a communication channel are numerous.

To begin, we would eliminate or greatly reduce the need for operating technology training. Second, service simplification would result in a greater acceptance of current technology, allowing persons with a variety of disabilities to use the same technology. We chose an Android application as the user front end because of the ease with which the platform allows us to apply complex technology and because of its extensive usage in the mobile sector. Android is the operating system of choice for more than 80% of smartphones. The Arduino-powered voice controlled house automation solution provides a comprehensive voice-controlled automation system. It translates voice to be used for controlling electrical devices using Natural Language Processing and technology found in most smartphones. The advancement of a more contemporary period, as well as technology that continues to advance at a breakneck pace every day. Demand that people produce increasingly complex technology that can aid human activities in everyday life, as well as a tool or system that is not restricted by distance or location, which is one of the most significant barriers to present technological development. The Internet of Things is a trendy technology right now, where everything is connected. A smartphone or website might be used to operate an internet-connected item manually or automatically. The Internet of Things facilitates a lot of human work, including monitoring and managing electrical devices at home through a smartphone. This is thought to be a very effective and efficient way of bringing the Internet of Things into everyday life. You can save time by using the Internet of Things as an automation medium instead of going to a separate location to turn off or on a switch on an electrical item via means of (Sen et al., 2015).

Users may operate many electronic devices at the same time using buttons on the smartphone application. This research is intended to aid human activities at home and serve as a monitoring medium when they leave the house. Users may determine if an electronic device is on or off by checking its status in the NEU application, and they can manage whether it is on or off at that moment. Arduino's ESP32 microprocessor is the company's newest and most sophisticated microcontroller. In addition to being able to be controlled via a Wi-Fi network, the ESP32 can also

be controlled through a Bluetooth network, which may be used as a backup network resource when the internet is unavailable at home. The NEU application, which can be downloaded through a smartphone, was utilized as a controlled media for the system being built in this study. NEU is the ideal choice as a controlled media for the developed system because of its basic and easy-to-understand interface. The public is unaware of the ability to monitor and turn off any electrical devices in a home at the same time. Despite the fact that employing this concept might save energy and time spent simply checking and controlling electrical devices at home. Based on these issues, an "Electronic Device Controller based on Internet of Things Using ESP32 and NEU" was developed, which acts as a monitor and controller for electronic devices in a home via an internet connection, using one of the newest microcontrollers, the ESP32. The ESP32, which can be controlled via Wi-Fi and Bluetooth connections, is expected to provide efficiency. The NEU application, which is loaded on the smartphone, is used to monitor and regulate the media, where the NEU program has a database that can be accessed at any time and from any location as long as the computer is linked to the internet.

1.2 Research problem

The main problem in this research is that there is no smart application that allows the user to use Bluetooth and Wi-Fi at the same time and switches between them easily and simply. In (Sy & Irfan, 2020) authors use Bluetooth only and switching buttons. In (Anitha, Sathya, et al., 2021) authors used Bluetooth only. In (Patil et al., 2021) authors used a voice connected with google assistant only. In (Pandya, Mehta, Jain, et al., 2016) authors used Bluetooth & Voice Command. In (Ahmed, 2019), the authors used only Wi-Fi to control and switch button. (Et.al, 2021) This study used Wi-Fi to connect and google voice assistant.

1.3 Research Aim and Objective

The main aim of this study is to achieve full control over the electrical appliances while realizing the following:

1. To control electrical appliances from an edge device through Wi-Fi, mobile data, and Bluetooth.

2. By controlling the electrical appliances using four different methods: the On/Off button, the voice control, the fingerprint, and the face detection method.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

There are several research papers, published based on smart lighting and smart houses. In this study, efforts are being made to improve smart home automation in such a way that appliances can be controlled at a close range and from anywhere around the globe. In (Bhavsar et al., 2021) authors worked on the smart home Sinric pro website, this helps to connect with the Sinric Pro IoT platform to perform remote operations. This system allows the user to stay connected with their home using Google Assistant Smart Things and Amazon Alexa platforms too. The system improves the user's flexibility with the feature of real-time feedback on any platform and they worked on a good project but the disadvantage of this project is that Sinric website will give you one month for free and then will charge you have to pay 2-3$ for each device, this is expensive. In (Sai Priyanka et al., 2021) authors worked on Using Esp32 IoT Based Wi-Fi Enabled Smart LED Systems to reduce energy wastage Because established street lighting systems are manually operated, they have several limitations. If this system is not adequately managed, it may result in increased energy use. To prevent energy waste, this system requires effective monitoring and energy management procedures. To reduce energy waste, we present a system that functions automatically and can also be remotely supervised and controlled via virtual switches through a graphical user interface. In (Sen et al., 2015), authors worked on the design of an intelligent voice-controlled home automation system (the simplicity of services would need a greater acceptance of current technology and would enable individuals with various impairments to access the same technology) and this app would help people with varied disabilities and it's a very good thing but the app missing some points this app only working with a Bluetooth module, no Wi-Fi, the user can't access his home or he can't open a door or light. In (Anitha, Suganeswar, et al., 2021) authors worked on Bluetooth-based home automation and security system This technology may regulate household appliances by dodging the threats of electric stun and offer a pleasant existence. One of the main goals of this project is to disprove the notion that "there is nothing without the internet" by replacing the Internet with Bluetooth as the communication medium. Accordingly, the idea of this project is nice but still this project is missing something. The authors replaced Wi-Fi with Bluetooth, this makes the system not accessible through internet.

In (ZARO et al., 2020) authors worked on smart home automation system automation, this plays a significant part in the advancement of contemporary technology The system primarily focuses on using voice commands to operate fans and lighting. Normally, household appliances are controlled by manual switches, which require a trip to the switching board. The fundamental issue is that physically challenged persons find it difficult to operate. A smart home automation system is meant to operate electrical items such as fans and lights using Arduino, relays, Bluetooth, and other technologies to assist physically handicapped and elderly persons. The addition of voice recognition to our project significantly enhances modern home's usability and functionalities. The integration of the Blynk Server database from the Blynk application allows the system to be accessible from a great distance where it operates to monitor the condition of electronic in (Rafi, 2021) writers allows this system to control many things at the same time. In this case, the Blynk server is a very good app but the developer needs to register and add a library to the developer's code, it is a little bit complicated for simple users and still, the user cannot change between Wi-Fi and Bluetooth very easily. In the study (Mane et al., 2021) worked on an all-in-one Smart Home that was manual, Internet-connected, and Bluetooth-enabled (MIB-AIO). They present the concept of a household as a communication network that connects numerous electrical equipment and allows these items to be remotely controlled, monitored, and accessed via a smartphone application. Virtual Agent as an Interface for Smart Home Voice Control. In the study (Tastan, Mehmet Gokozan, 2018) authors worked on a smart home air conditioning and lighting management system based on the internet of things. Using IoT technology and the NodeMCU embedded system microcontroller, an example smart home application was created. This system delivers a pleasant and smart climate-lighting system that can be managed by the Blynk SMART HOME interface from any location where the Internet is available. The accomplishments in this sample application, which is a low-cost, rapid, and dependable solution, will allow us to develop new applications in a variety of fields, including industry, health, agriculture, environment, education, and energy.

In (Ahmed, 2019) Employees occasionally forget to switch them off at the end of the day, thus the authors worked on a basic smart house based on IoT utilizing nodemcu and Blynk. The study proposes a strategy that can conserve energy by allowing the security to manage the building's lights with his smart home through Blynk application. The lighting may be controlled via switches spread throughout the building as well as the Blynk application in conjunction with a specific electrical arrangement. This study shows a modest prototype of a smart house, or a simple and low-cost method of controlling loads through a Wi-Fi connection in general. In (Mahindar et al., 2018), a method has been suggested to control household appliances from anywhere in the globe at any time and to use electricity efficiently by appropriately managing equipment. The Blynk app was used to read data from sensors positioned in the home environment, and the user utilized this data to operate home appliances. Due to the hectic routine of everyday life, users may not be able to view sensor

data continually in order to take action via the app. As a result, the system is intended to send an emergency notice to the user's mobile app. In (Pravalika & Rajendra Prasad, 2019), It enables the user to remotely monitor different circumstances in the home, such as room temperature, gas leakage, water levels in the tank, and person detection, as well as operate various appliances such as light, fan, motor, gas knob, and make decisions based on sensor feedback.

In the study carried out by (F. Yang & Wei, 2021), users may remotely monitor home conditions via the mobile client APP, and perform operations such as home temperature management, environmental detection, and curtain control. In (Krishna & Nagendram, 2012), The home automation system is designed to operate all lighting and electrical equipment in a house or workplace using voice commands. The Zigbee may receive the voice and deliver the voice data to the ARM9 controller, which translates the speech into the needed format and then sends the data across the Zigbee to another Zigbee and to the microcontroller where the devices are connected. It turns on or off the gadgets based on the message it receives. In (Vishnoi et al., 2020) the authors use visual input, if the picture is found in the database then the door lock opens and a node is assigned to the person, the node and nearby fan and light are provided power. The person will be informed by an audio announcement about the assigned node. In (Patil et al., 2021) to benefit from this research that a Bluetooth module is interfaced to the Arduino board at the receiver surrender while on the transmitter surrender, a GUI software program on the mobility telecast smartphone sends ON/OFF commands to the receiver in which hundreds are associated. By touching the preferred region on the GUI, the hundreds can be grown to end up ON/OFF remotely via this technology. The hundreds are operated through manner of way of Arduino board via Relay.

In (Et.al, 2021), It relies on Google Assistant, IFTTT software, Blynk software, Raspberry Pi Controllers, and a relay panel. Google Assistant is activated by using native language sounds. All components are linked to the Internet through Wi-Fi, allowing the system to operate on IoT. The IoT project also intends to develop a wireless earth care system that will employ the ESP32 CAM Node MCU module to notify owners when individuals stand at the entrance and snap photos. It makes advantage of Google Assistant. To manage and monitor appliances remotely through smartphones utilizing Wi-Fi connection protocol and raspberry pi as a private server, designer Bharat In (Bohara et al., 2016) authors created a solution built on the Blynk framework. NodeMCU connects all of the appliances and sensors to the internet. In (Nagendra Reddy et al., 2016) commands were sent to the Arduino board using a Wi-Fi module on via android phone, which then processed them to operate all of his household appliances. Home appliances such as fans and lights were controlled by this technology. They were able to track the status of their house equipment on their Android mobile app.

In (Sharma et al., 2017) The authors developed a method that connected a home automation system to Android mobile devices. Wi-Fi enabled communication with both the mobile device and the computer system. In their advanced Internet and Bluetooth home automation project, they used the

ESP-8266 as a Wi-Fi networking module, the Arduino UNO microcontroller, and the HC-05 for Bluetooth. This enables users to control a range of appliances remotely and make decisions based on sensor data. Bluetooth and Wi-Fi must be synchronized for the system to function correctly, which is a challenge because two separate modules are utilized, and there are fewer appliances that can be controlled. There are several ways to control household appliances, including using a Wi-Fi module, a website server, and an Arduino, as described In (Piyare & Tazil, 2011) Arduino may be connected to the internet using a Wi-Fi network.

In (Deepak et al., 2018) the research was described as the process of storing data in the cloud and executing apps that are connected to it. You may access anything from a central cloud that connects numerous PCs and servers. According to the research In(Chung et al., 2011; Piyare & Tazil, 2011; Syed Anwaarullah1, 2013), home automation systems employing Bluetooth technology was used to create Android smartphones that do not have Internet access. This sub-controller is physically, linked to the devices and is accessible and controlled by the Smart phone's built-in wireless Bluetooth capabilities. Although the device can be controlled within a 100-meter radius, it is not mobile and can only be controlled inside a 100-meter radius. Researchers to provide network interoperability and remote access for household electronics and appliances have created home gateways. In (Syed Anwaarullah1, 2013) as a communication channel, Bluetooth has been used to automate a house. As a remote control, and Android mobile phone was utilized, which includes an ON/OFF button interface. When we touch the ON/OFF buttons, the Bluetooth module will send the necessary command to the microcontroller. For example, the microcontroller would determine which relay should be turned ON or OFF. Bluetooth has a significant flaw that makes it unsuitable for controlling appliances from a distance.

A safe, low-cost, and adaptable home automation system is described In (Piyare & Tazil, 2011) Mobile phone commands were received using an Arduino microcontroller. Only authorized users can access this system if the passwords are accurate. Sending ON and OFF signals via the internet. "Face Identification and Recognition System for Smart Home Security" In (Wati & Abadianto, 2018) collects images and processes them using MyRIO 1900 as the primary controller, which includes software for picture acquisition and face detection and recognition. Computers are used as user interfaces, visual displays, and monitoring tools in many industries, including healthcare. MyRIO and PC are both programmed in LabVIEW. MYRIO is substantially more expensive than the Raspberry Pi. Jia Kailin Wang, Jinjin Zheng, Shiwu Zhang, Jijun He Xiao Liang, and Sui Feng demonstrate in detail how local binary patterns work in the facial recognition module, but nothing happens if the power goes off. (Wang et al., 2016)

In (Pawar & Ahuja, 2015), Face Recognition System is described using IoT by Sandesh Kulkarni et al. Because these technologies are not interactive, a potential intruder will not be able to comprehend why they are being denied entry. Reasons for this may be because a person is not permitted or the system is not able to identify their face. They examined existing home automation

systems and presented a new design that accommodates all the new IoT protocols In (Nasrin & Radcliffe, 2014).

Home automation through SMS is the goal of a prototype, a microcontroller is used to connect the GSM network and the devices. As well as security, the researchers presents a home automation system that is both safe and customizable. In(ElKamchouchi & ElShafee, 2012) MQTT is superior to HTTP for nodes with limited resources, according to research published. In(Kodali & Soratkal, 2017) When using 3G for network connectivity, data transfer through MQTT consumes just 0.05 percent of battery per hour. Internet access has become one of life's fundamental necessities. Anyone without a smartphone is unimaginable these days. Creating a system without IoT was a major problem. In (Ramli et al., 2006) Only Bluetooth should be used to transmit data between sender and receiver, and we were convinced that this was the case. This app was also a no-brainer for us because we knew it would be so straightforward. You may use it as a slave or master. As a result, it costs less and is most effective home automation system. It shows how Bluetooth technology may be used in computerization at home and a system administration environment in a "Bluetooth based home automation system in (Sriskanthan et al., 2002), a research is proposed that includes a remote and adaptable host regulator as well as several customer modules (home machines). (Jadhav et al., n.d.) Bluetooth devices are used to communicate between client modules and the host controller.

There is an Android-based home automation system that uses Bluetooth and voice commands, and it is called Android-based Home Automation System using Bluetooth and Voice commands (Pandya, Mehta, & Jain, 2016). (Anandakumar et al., 2017; Devikanniga et al., 2020) developed a system that can decode the user's voice command and extract the precise meaning of the user demand for voice commands. There are several ways to create a successful Home Automation System using IOT and devices, as described in Anand Kishore Azad's "IoT Based home automation via Bluetooth" with increased security (Azad & Tech, 2019). In (Liu et al., 2012; Mittal et al., 2017; Ramesh et al., 2018) It is possible to increase the conventional living standard of homes by implementing a home automation system. The fundamental architecture makes use of a remote Bluetooth device that allows remote access to Smartphones over the Internet. (T. W. Lai et al., n.d.; prabu R, 2019; Vignesh et al., 2019). Home security systems using email-based cameras have been studied by Rajiv in the past In(Rajiv et al., 2016), as part of the face recognition system, a histogram is used to identify faces. Histograms as a feature are regarded as having low precision. The fingerprint-based door security system was also the subject of another research In(Shankar et al., 2015). Because users must touch the sensor with their fingers, fingerprint-based security systems are deemed less effective. They also believe that it is the reason for the virus spreading. There is also the possibility of duplicating fingerprint systems, resulting in a poor security rating. The Principal Component Analysis (PCA) approach was used in another work on facial recognition In(Liton Chandra Paul1, 2012). Due to the inability of the system to distinguish faces in different

poses and orientations. A face database is still used to simulate the research. When choosing a face recognition method, accuracy, time constraints, process speed, and availability should be considered. Following these criteria, face recognition using PCA was chosen as the most straightforward and easiest technique to implement, with a very short calculation time In (Kaur & Himanshi, 2015).

In (Sriskanthan et al., 2002), they demonstrated a Bluetooth Technology application for home automation. This is a nice concept, however Bluetooth technology was developed in the 1990s and is now solely utilized to construct a wireless automation system. To compete with it now that technology has arisen, we must look to new technologies such as the Internet of Things (IoT), which all function as internet-based working systems. This approach they presented will be less expensive and easier to manage. However, the system does not make use of current mobile technologies. S.Sohan, I. Naim, and M.K. Khan have proposed the GSM Home Appliance Control System, which is based on GSM-based communication control for household appliances. A number of commands were utilized to control a range of different devices. Even though GSM has been reinvented, control over GSM can now be compromised, therefore we cannot safeguard GSM-enabled devices. Instead, we may send alerting messages using GSM. This one will be more secure, and we will be able to rely on it (Shahriyar et al., 2008).

In (Venkatesh et al., 2018) Raspberry pi, relay, and other devices have been utilized. When the mobile device sends a command over the internet, the raspberry pi detects it and sends it to the relay, which is attached to the home appliance. Once the application is installed, a user will be able to access the appliance through it. However, even though the system is good and beneficial, it is not self-automating. In (John et al., 2018) this technology is beneficial for physically challenged people who are unable to utilize other devices due to their physical limitations. To create the Web Page, they have employed python. Python, on the other hand, is not ideal for memory-intensive tasks or multitasking applications. Python is not an ideal language to use while attempting to link all of one's household equipment. Walls and other barriers can reduce signal strength, making them less secure. There is one major drawback to utilizing Wi-Fi, and that is reliability.

In (Rana & Jnec, n.d.) The authors utilized Personal Area Networks (PANs) because it is a high-level communication protocol and is widely used. Wired automation has been replaced by this. Even though ZigBee has a longer range than Bluetooth, it is less susceptible. Many resources are expended. In Zigbee, the failure duty is remote monitoring of equipment. In(Piyare & Tazil, 2011) at a reasonable cost. To communicate between the host and client module, they employed Bluetooth technology as well as a mobile phone. It is a simple on-and-off mechanism. It does not require any energy. Bluetooth technology has a major limitation in that it can only be used within a restricted range. Only Symbian-based mobile handsets are supported by the system.

In (V. P. Singh, 2018) Raspberry Pi 3 uses a Facebook profile photo as authentication to operate home appliances. As a result, the user's social networking profile is updated with the sensor information at home. Face recognition is utilized in smart homes and towns as a form of security.

(Adnan OTHMAN & Aydin, 2018) utilizes a PIR sensor to detect movement in a specified region to inform the user if an intruder has entered or not, the taken pictures are identified and sent via telegram application to the user's smartphone as notice. According to the author, LBP characteristics can be used to accomplish real-time face recognition. To recognize the human face properly, In(O. S. Kulkarni et al., 2017) is a lightweight and more efficient feature for KNN classifiers. LBP feature extraction has good discrimination rates. The hair cascade classifier is utilized in the thermal picture to recognize persons.

In (Setjo & Achmad, n.d.). A two-dimensional function called Haar is used to detect objects. Objects are classified using a variety of cascade classifiers. Face integrated with real-time Smart homes receive recognition A cascaded discriminant analysis module was suggested in (Zuo & de With, 2005) for detecting human faces properly. An inability to detect motion and switch on appliances because of a PIR sensor might lead to a lack of safety. A PIR sensor controls the home automation system. With the aid of the Haar Feature-Based Classifier in (Kodali et al., 2016), a vehicle identification system is created for traffic surveillance systems to monitor real-time traffic and communicate with moving automobiles. In addition to detecting vehicle movement, it also provides information on the amount of traffic in each lane. In(Choudhury et al., n.d.). Face recognition IoT-based door access control is used to unlock the door in the house. A copy of the recorded image is delivered to the designated recipients through the mail for security reasons in(Nag et al., 2018). As a means of enhancing house security in IoT, Bluetooth voice recognition on the entry door and a fingerprint scanner to operate smart home devices were suggested.

There are several ways to hack home equipment instead of the password-based system that may be compromised with the assistance of phishing assaults in (A. Singh et al., 2019) Security may be improved by using body movements and eye scanners Proposed. Using MyRIO 1900 as the primary controller, In (Wati & Abadianto, 2018) the author has presented a Face Detection and Recognition System for Smart Home Security that captures photos and does image processing. It is usual to utilize a personal computer (PC) as a user interface, visual display, and monitoring tool. Both MyRIO and PC are programmed in LabVIEW. The price of MYRIO is much more than that of the Raspberry Pi. (Wang et al., 2016) demonstrate in detail how local binary patterns work in the facial recognition module, however nothing is done in the event of a power loss. While (S. Kulkarni et al., 2017) as described in, Face Recognition System Using IoT by authors Sandesh Kulkarni et al., the suggested system is well-presented and the technique is well-explained the quality of indoor positioning systems has been improved by developing a few positioning algorithms in addition to a wide variety of signal-based positioning approaches (IPS). Using weights to increase the accuracy of Euclidean distance, the authors (The Van et al., 2017) suggested an improved KNN model.

Biometric fingerprinting has been more popular as a personal identification tool in(Galy et al., 2007; Jain et al., 2010) than any other biological feature. As a result of our study, we have been able to improve security, costs, and performance. Discuss and compare the differences between the current project and the prior one. In typical nighttime face detection research, there are two primary methods: the multiple camera approach and the single-camera method. Two cameras, a near-infrared (NIR) camera, and a short-wave IR (SWIR) camera are used in the dual-band system in(Pavlidis & Symosek, 2002). As a result of applying a final threshold, a weighted difference between the two camera pictures is generated. If you use the IR-illuminator approach, it is impossible to change its brightness, as well as its angle. Using a thermal camera that is resistant to light fluctuations, in(Ma et al., 2017; Zin et al., 2011) were able to recognize faces at night. Nevertheless, because thermal cameras are costly, they cannot be used in a variety of situations. Facial recognition is also less effective when the ambient temperature is close to a person's body temperature. To test Viola Jones' face detector, NIR pictures were used in (Shamia & Chandy, 2018). As the standoff distance increases, the detection accuracy decreases.

(Hao et al., 2011; Hu et al., 2018; Lemoff et al., 2013; J. Li et al., 2017; Murphy-Chutorian et al., 2007) used a NIR or SWIR camera to tackle the challenge of face identification at low light levels. In these cameras, it is impossible to alter the strength and angle of the infrared light illuminator. It has become more common to use visible-light cameras for face detection due to the difficulties of utilizing infrared and infrared cameras in(Chow, 2006; Moazzam et al., 2011; Technology, 2013), which are affordable and do not require extra equipment. According to in(Chow, 2006; Technology, 2013), a skin segmentation approach was used to study face identification in various light conditions. When Ojo et al. in (Technology, 2013) utilized the rule-based methodology in(W. Lai & Li, 1999), they created a hybrid skin segmentation method. Face detection was proposed by Chow et al. in (Chow, 2006) utilizing skin-color segmentation based on area. When the color information is minimal and the noise level is high, the techniques in(Chow, 2006; Technology, 2013). They have trouble identifying faces at night. Li and colleagues in (J. Li et al., 2017) know that the most prevalent methods of face detection are using local feature representations and learning classifier techniques. To recognize faces in real-time, in (Viola & Jones, 2001) uses rectangular Haar features as part of a cascaded AdaBoost classifier. Around the Viola-Jones detectors, various methods have been developed to improve the current facial detection algorithms. In (Lienhart & Maydt, 2002) suggested a collection of extended Haar-like features that included a rotated 45° rectangle feature. Rectangles can be divided by a variable distance using in (S. Z. Li et al., 2002). A similar set of qualities, termed in (Jones, 2003), was previously presented by Jones and Viola. These characteristics demonstrate the resilience of lighting changes. Haar-like common characteristics, for example, are shown in (Huang et al., 2007), particle space has sparse features, which are symbolized by rectangles, and each sparse feature is analyzed as a combination of particles. Because the joint feature space is so huge, finding the optimal combination becomes a challenge with techniques in (Huang et al., 2007; Mita et al., 2005).

Complex features may give a greater feeling of distinction than the Haar-like features, but they tend to raise the computing costs of face identification applications. As an alternative, the order connections between picture regions are useful image characteristics that are basic and straightforward in (Sinha, 2002) examined different robust ordinals in facial pictures, and created a facial detection technique based on the results. It was Sadr et al.

Many researchers have experimented with different AdaBoost algorithms in conjunction with weak classifiers, in addition to experimenting with different features. According to Brubaker in (Lienhart et al., 2003), weak classifiers are employed for boosting, Classification, and Regression Trees (CART) (Sutton, 2005) outperform simple decision trees in this regard. We may be able to find the optimal sequence/contrast based on a deep quadratic tree. Characteristics as well as their combinations. By using a quadratic tree classifier, uncontrolled facial changes may be classified into distinct leaves. To overcome the limitations of the original viola-jones face detector, a variety of cascaded architectures have been developed in(Bo Wu et al., 2004; Huang et al., 2007; Jones, 2003; S. Z. Li & Zhang, 2004). Facial recognition technology was further developed in(Jones, 2003) by training face detectors for each specific site. Without a correct posture estimation, no faces can be recognized in the second step of this two-stage detection framework. For multiview face identification, in(Bo Wu et al., 2004) proposed a parallel cascade framework. Each scan window requires a different perspective. To determine the acceleration location, they employed the first few tiers of surface detectors. There is a difference between in(S. Z. Li & Zhang, 2004). Unrestricted facial detection has recently been a source of worry. There are several ways to speed up the training of face detectors, including SURF in(Bay et al., 2008) In the AdaBoost cascade, the curve area (AUC) standard is used. Determine the facial landmarks based on the remarks. (Zhu and Ramanan, 2012) conducted a collaborative test of a Deformable Part-based Model (DPM) that evaluated its attitude and located the facial tags ruthlessly. This approach further enhances that joint test. "Facial recognition using accurate landmark detection" is what Chen and colleagues in(Chen et al., 2014) suggested in their study with the help of channel characteristics in (B. Yang et al., 2014).

METHODS APPS	SWITCH BUTTON	VOICE	FINGERPRINT	FACE DETECTİON	DATA	WIFI	BLUETOOTH	Advertisements
NEU	*	*	*	*	*	*	*	
ARDUİNO BLUETOOTH CONTROLLER (Sriskanthan et al., 2002).	*	*					*	*
ARDUİNO VOİCE CONTROLLER (Nag et al., 2018).		*					*	*
ARDUİNO BLUETOOTH CONTROLLER DESIGN (Pandya, Mehta, & Jain, 2016).	*	*					*	*
ARDUİNO WIFI/LAN CONTROLLER (Piyare & Tazil, 2011).	*					*		*

Table 2. 1: Showing a comparison between our app and other apps

Microcontroller	WIFI	BLUETOOTH	COST
ESP32 https://www.espressif.com/en/products/socs/esp32	YES	YES	CHEAP
ARDUINO https://www.arduino.cc/	EXTERNAL	EXTERNAL	CHEAP
RASPBERRY PI https://www.raspberrypi.org/	YES	EXTERNAL	EXPENSIVE

Table 2. 1: showing a comparison between ESP32 and other microcontrollers in terms of cost.

CHAPTER 3

METHODOLOGY

3.1 Mobile App

In this study, a mobile app was designed to control appliances using an ESP32 controller, the mobile app and the ESP was configured to work together. Operate, the mobile app was built in the Kodular environment, kodular allows the creation of Android apps easily with a blocks-type editor, no coding skills are required, with the material design UI. The mobile app allows the user to use the following services:

- Voice to operate it (ON/OFF/HOME).
- Fingerprint.
- Facial recognition.
- Switching buttons.

The user may also choose the following connection method:

- BLUETOOTH if we are close by or WIFI/MOBILE DATA if we are distant.
- WIFI allows the user to access light remotely all around the globe, but it is sluggish due to network and region issues.
- The user can also control everything in the app with our voice with the option of pausing it at any moment

3.1.1 Turn On / off Button

There is a simple button was designed to allow users to on the light with a button click on the power icon and just click to switching “on” and “off”

3.1.2 Voice recognition

The users can on the light with a voice by clicking on the voice icon and saying “on” light switch on, and if you want to switch off just say “off” and say “home” to go back. The algorithm that the app used is MLP classifier algorithm.

Algorithm 1: Voice recognition
1. $\boldsymbol{Create\ the\ MLP\ composed\ by\ one\ hidden\ neuron.}$ 2. $\boldsymbol{Initialize\ the\ weights\ of\ layers\ connections\ with\ a\ random\ values.}$ 3. $\boldsymbol{Selecting\ one\ input\ pattern\ (N_{input} = 1) from\ the\ training\ data\ (TO).}$ 4. ***Training MLP with one input pattern selected*** 5. ***from the training data (TO) to achieve the system error*** 6. ***tolerance specified E.*** 7. ***If the training algorithm can reduce the MSE to*** 8. ***within Eps, go to Step 6; otherwise, go to Step 7.*** 9. ***While the N_input < N_tot patterns from TO,***

10. increase the number of pattern from the TO by one
11. (N_input = N_input + 1) and go to Step 4; otherwise go
12. to Step 10.
13. Store the last weights of layer connections input.
14. : Increase the number of hidden neurons by one
15. (N_hid = N_hid+1).
16. Assign the initial weights and go to Step 3.
17. Take the best architecture which have a
18. minimum number of generalization error corresponding
19. ***to a minimum number of neurons.***

In fact, increasing the size of the database almost invariably leads in a lower mistake rate and the elimination of the overtraining phenomenon.

A constructive approach with incremental training has been presented to train the neural network and select the best architectural voice recognition system with the fewest hidden neurons feasible, corresponding to the fewest generalization errors.

3.1.3 Fingerprint

We can open the light with a biometric fingerprint click on the fingerprint icon so if the user's mobile has a fingerprint sensor, he just put his finger then the sensor will detect if the fingerprint is found, the light will switch on, otherwise just put any other finger to switch it off.

3.1.4 Face Detection

The user can turn on the light with his face by clicking on the camera icon on the app and take a picture, the program will detect if there is any face in the image, and how many faces are on the image after that if there are one or more faces detected the light will be switched on for five seconds and switched off automatically.

Algorithm 2: Face Detection

1. Input the images (x1, y1) …., (xn, yn) where
2. Yi=0,1 for negative and positive examples respectively.
3. Initialize the weights $\omega 1, i = \frac{1}{2m}$, $\frac{1}{2l}$ $for\ yi = 0,1$ respectively, where
4. m and ι are the number of negatives and positives respectively.
5. For t = 1,…., T:
6. Normalize the weights, $\omega t, i \leftarrow \frac{\omega t,i}{\sum_{j=1}^{n} \omega t,j}$
7. Select the best weak classifier with respect to the weights error

    a. $\epsilon t = \min f, p, \theta \sum_i \omega i \, |h\,(xi, f, p, \theta) - yi\,|.$

8. Define $h\tau(x) = h(x, f\tau, p\tau, \theta\tau) where\ f\tau, p\tau\ and\ \theta\tau\ are\ the\ minimizers\ of\ \epsilon\tau.$
9. Update the weights
10. $\omega t + 1, i = \omega t, i\beta_t^{1-ei}$
11. $where\ ei = 0\ if\ eample\ xi\ is\ classified\ correctly, ei = 1$
12. $otherwise, and\ \beta_{t=\frac{\epsilon_t}{1-\epsilon_t}}.$
13. The final strong classifier is:
14. $C(x) = \begin{cases} 1 \\ 0 \quad otherwise \end{cases} \sum_{t-1}^{T} \propto_t h_t(x) \geq \frac{1}{2} \sum_{t=1}^{T} \propto_t$
15. $where\ \propto_t \log \frac{1}{\beta_t}$

In line 5, T hypotheses are constructed each using a single feature. The final hypothesis is a weighted linear combination of the T hypotheses where the weight is inversely proportional to the training errors. In line 1, the total number of distinct thresholds is N. Given a task with $N = 20000$ and $K = 160000$ there are 3.2 billion distinct binary weak classifiers.
The wrapper method can also be used to learn a perceptron which utilizes m weak classifiers. The wrapper method also proceeds incrementally by adding one weak classifier to the perceptron in each round. The weak classifier added is the one which when added to the current set yields a perceptron with lowest error. Each round takes at least $O(NKN)$ (or 60Trillion operations); the time to enumerate all binary features and evaluate each example using that feature. This neglects the time to learn the perceptron weights even so, the final work to learn a 200 feature classifier would be something like $O(MNKN)$ which is 10^{16} operations.

3.2 System Programming

Figure 3.1 describes the Bluetooth process program or system code that was employed in this study to be able to connect to a smartphone via Bluetooth using Arduino IDE and NEU app. Figure 3.2 gives a clear visualization of the Wi-Fi process. Figure 3.3 describes the whole process of the research.

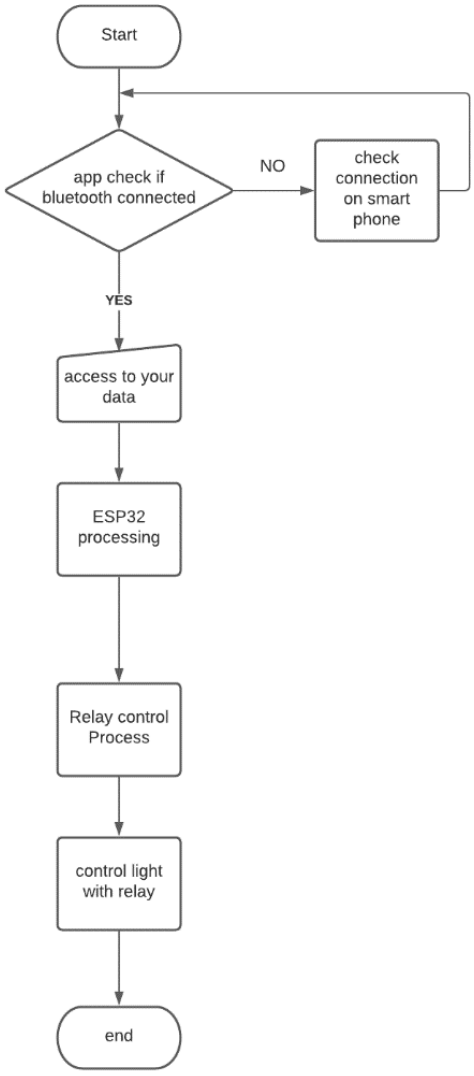

Figure 3. 1: Bluetooth flow chart.

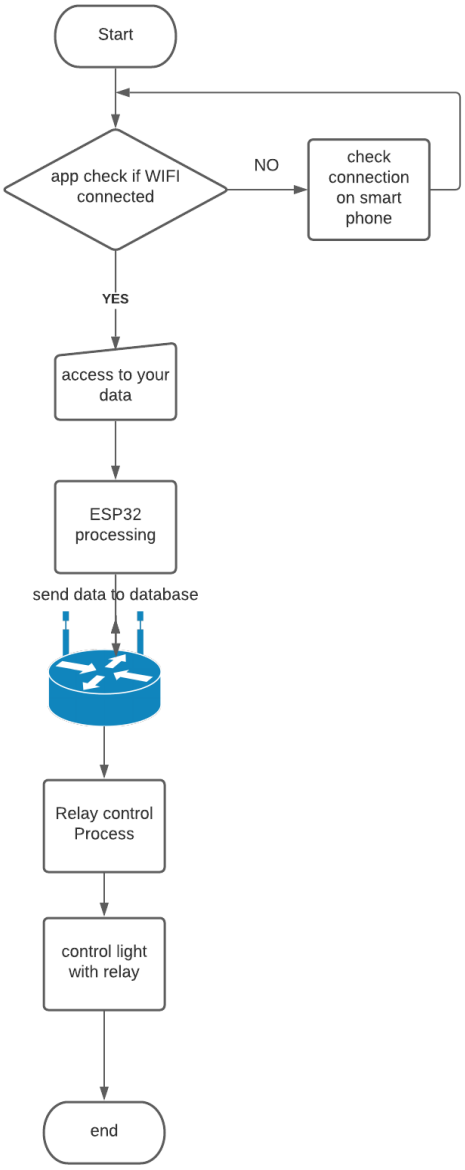

Figure 3. 2: Wi-Fi Flow Chart.

3.3 Our proposed algorithms

In this project, we propose two simple algorithms in order to establish connection through two different methods: Bluetooth and Wi-Fi.

- Algorithm 3: Bluetooth connection algorithm

```
1:Main(Bluetooth node u){
2: root ← u.BD ADDR
3: reset DC TIMER
4: neighbors ← ∅
5: state ← INQUIRY
6: ALT TIMER ← −1
/* beginning of neighbor discovery process */
7: while DC TIMER not timed out {
8: if ALT TIMER timed out {
9: compute new ALT TIMER
10:state ← state /* alternate state */
};
11 if a Bluetooth node v is discovered {
12: neighbors ← neighbors ∪ {v}
13: EXCHANGE INFO(v)
14: if v.root > u.root {
15: u.root ← v.root
/* synchronize with v */
16: compute new ALT TIMER
17: state ← state /* change to v's state */
}
18: reset DC TIMER
}
}
20: ROLE ASSIGNMENT (u, neighbors)
}
```

It is worth noting that, while the overall network construction is not yet complete, the terminating node has complete knowledge about its nearby nodes in the network-to-be-built. As a result, the node may now launch its higher-level application. If a node has to interact with its neighbors in the application but they have not yet launched the application, the communication messages can be queued until they are ready. As a result, even if other nodes are still in the network creation process, a node will not necessarily be prevented from beginning the application.

- Algorithm 4: Wi-Fi connection algorithm

$Input: \alpha - the\ probability\ to\ be\ guaranteed;\ the\ paths\ set\ r_1, r_2, \ldots, r_n$
$Output: the\ number\ of\ APs\ needed\ to\ achieve\ the\ required\ coverage$
1: $l = 0;\ h = the\ number\ of\ APs\ needed\ to\ cover\ all\ the$
2. $paths\ in\ the\ graph;$
3: $while\ (l \leq h)$
4: $mid = (l + h)/2;$
5: $if\ \alpha\ is\ equal\ to\ M\ CC\ opt(mid)\ return\ mid;$
6: $else\ if\ \alpha < M\ CC\ opt(mid)\ h = mid - 1;$
7: $else\ l = mid + 1;$
8: $return\ (mid);$
9: end

The M DC opt method does a binary search to determine the number of APs necessary to provide the desired coverage. M DC opt() has a time complexity of O(mN 2) since the execution time of M CC opt is O(mN 2). (mN 2 log N).

First, the app will check if the connectivity of the user through Bluetooth or Wi-Fi. If the connection is established in algorithm [3-4], the user can use the app to control the light. When the user sends an order from the app to switch ON/OFF, the app send a command to the microcontroller, which will send a command to relay to run ON/OFF. If user decide to use face detection so the app will check the face by using algorithm [2].and for voice recognition will use algorithm [3].

If the user was connecting via Wi-Fi, the user will be able to control light even from outside because he is granted a remote access to the database then send a command to relay to run ON or OFF. Otherwise, the user should connect using one of the main three methods: Bluetooth, Wi-Fi or Mobile Data.

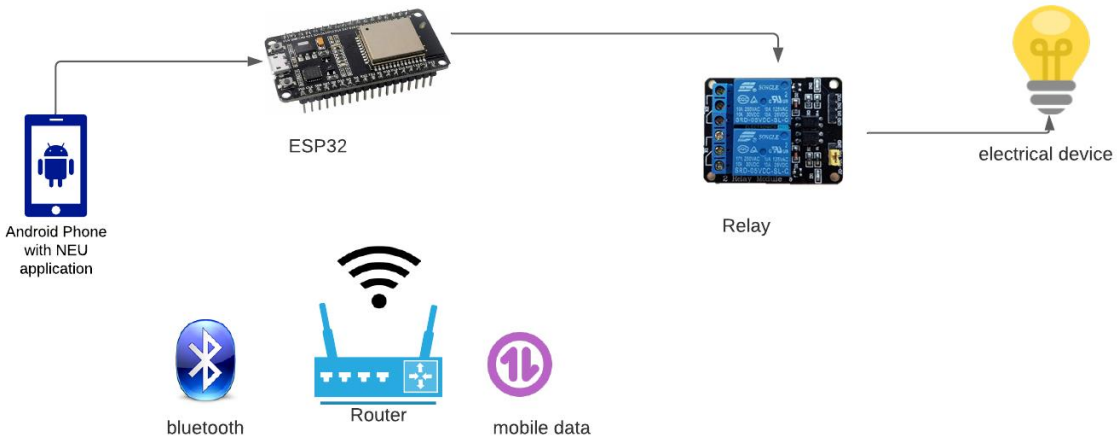

Figure 3. 3: Application System Design.

The ESP32 will be programmed to control the relay module communicates with the Smartphone over the internet network. The relay acts as a replacement switch, disconnecting or connecting electronic power to an electronic equipment via digital control. In addition, we can use Bluetooth to connect and control the light or mobile data and the relay will switch and control the light.

3.4 Materials of the project

In this study, the following system components were used:

- ESP32.
- Jumper Wire Connector.
- Relay Module.
- MySQL database.

3.5 ESP32

ESP32 may be a family of inexpensive, low-power systems-on-chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series is steam-powered by a Tensilica Xtensa LX6 dual-core or single-core microchip, a Tensilica Xtensa LX7 dual-core microchip, or a single-core RISC-V microchip, and includes integral antenna switches, RF balun, power electronic equipment, low-noise receive electronic equipment, filters, and power management modules. Expressive Systems, a Shanghai-based Chinese firm, designed and developed the ESP32.

It is the successor of the ESP8266 microcontroller. (Figure 3.4).

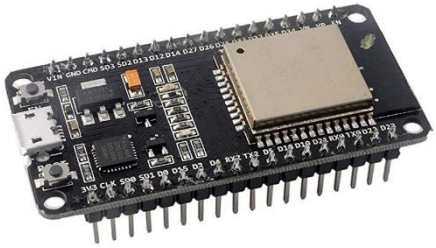

Figure 3. 4: ESP32.

3.6 Jumper Wire Connector

A jump wire (also referred to as a jumper, jumper wire, lead, DuPont wire, or cable) is an electrical wire, or a gaggle of them in an exceeding cable, with a connection or pin at every finish (or generally while not – merely "tinned") as shown in figure 3.5, that's unremarkable won't to interconnect the elements of a board or different paradigm or take a look at circuit, internally or with different instrumentality or elements, while not fastening. Individual jump wires are connected by slithering their "end connectors" into slots on a board, a circuit board's header connection, or a bit of equipment.

Figure 3. 5: Jumper Wires.

3.7 Relay Module

A Relay Module is a very valuable component since it enables Arduino, Raspberry Pi, and other Microcontrollers to manage large electrical loads. In this project, we utilized a 2-channel Relay Module but only one relay. The relay module that was utilized in this project is seen below (Figure 3.6) to operate a single relay on the circuit, we must use three relay module pins: VCC, GND, and IN1.

Figure 3. 6: Relay Module.

3.8 MySQL Database

In this study, we are using two tables: Boards and Outputs (Figure 3.7).

Boards (id, board, last_request)

Outputs (id, name, board, gpio, state)

When the user wants to add a new device after they fill up all the details in the form, it is saved directory in the database. Users can also refresh the page to see the new output button that allows them to control the other device.

Our database is hosted on a University WordPress Server app.neu.edu.tr

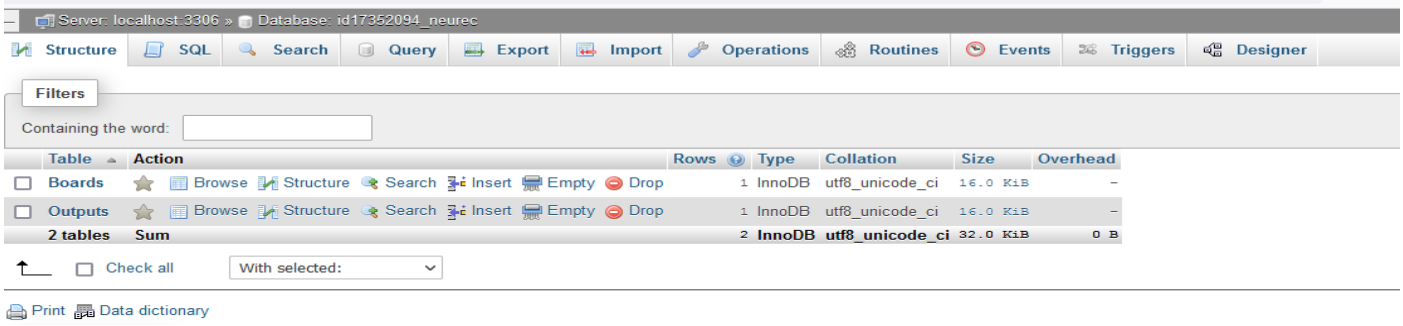

Figure 3. 7: Database Tables.

3.9 DESIGN

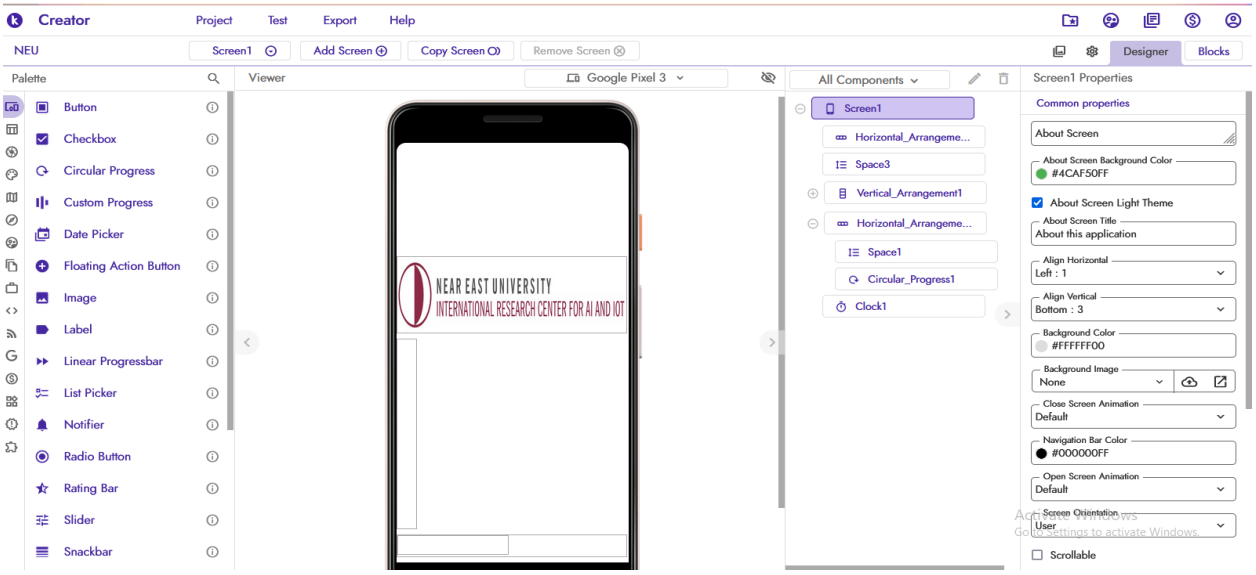

Figure 3. 8: Screen 1 Designer.

In figure 3.8, we have the first screen in the app, and this screen is a loading screen or splash screen used for the clock function and circular progress the clock function will work for five seconds and then open the main screen automatically. The circular progress it is showing a circle moving in an infinity loop. Therefore, when we open the app the first thing you will see is this screen for five seconds and then moving to another screen no need to touch anything.

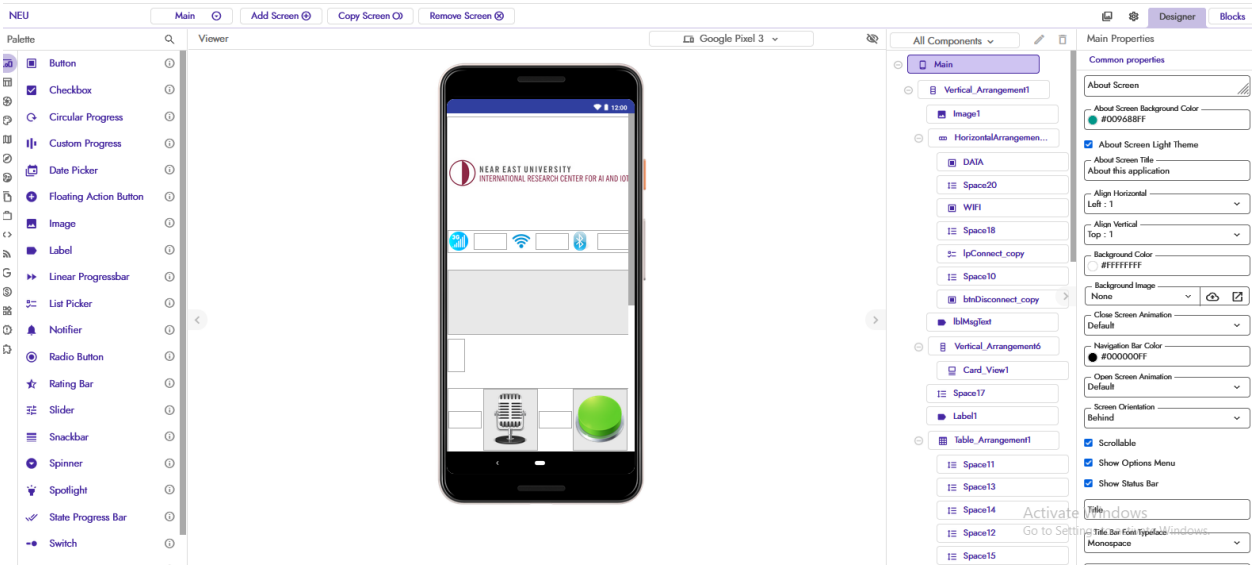

Figure 3. 9: Main Screen Designer.

On the main screen (Figure 3.9), buttons were designed and a list picker for Bluetooth and the buttons for Wi-Fi and mobile data so you have to select the way that you want to control all you want to do with just the click icon. Users can switch voice control and say “Wi-Fi” to move to another page, “connect” to connect to the Bluetooth or “data” for mobile data if they don’t have Wi-Fi, so it's flexible, also 6 buttons were designed to control the light one for switching on/off, mic button to control with voice “on/off/home”, fingerprint button to switch on if the finger is correct and off if the finger not, the camera icon. For face detection, after taking a picture the app will check if there is a face or not. In addition, the light will be on if there is more than one face and the other two buttons for control the app with a voice so that the user can control the whole app with voice, the other button to stop this function. The users can select the Bluetooth name and connect with it as well.

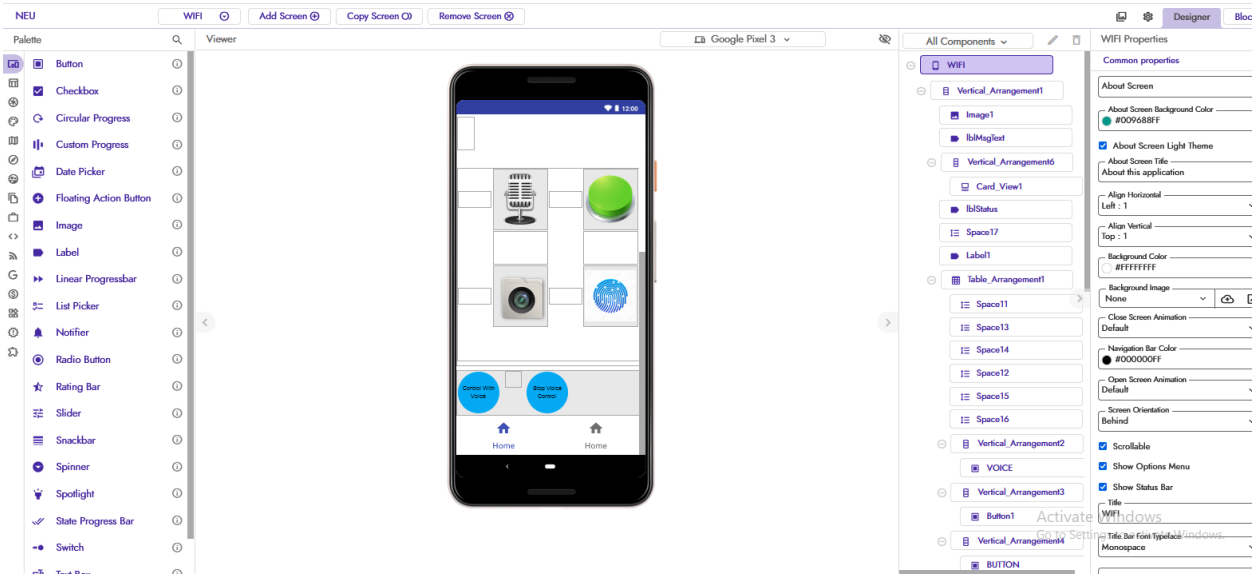

Figure 3. 10: Main Screen Button View.

From the same screen in button view (Figure 3.10), we have home icon and info icon so you can use this icon to move between pages. If the user is in switch button and need to come back to the home screen, the user will just click on the home icon, for more information clicks about icon or info icon. The green button is the switching button that allows you to control with “ON/OFF”. The mic icon to control light with the command “ON/OFF/HOME” all the user have to say is “ON” for opening light or “OFF” to switch off. Fingerprint to light with the finger that is already registered in your phone so if the finger is correct the lights will turn on. The camera button for face detection will open a camera and take a photo the app will delete if there is any face inside this image or not if yes, the light will open for 5 seconds and then switch off.

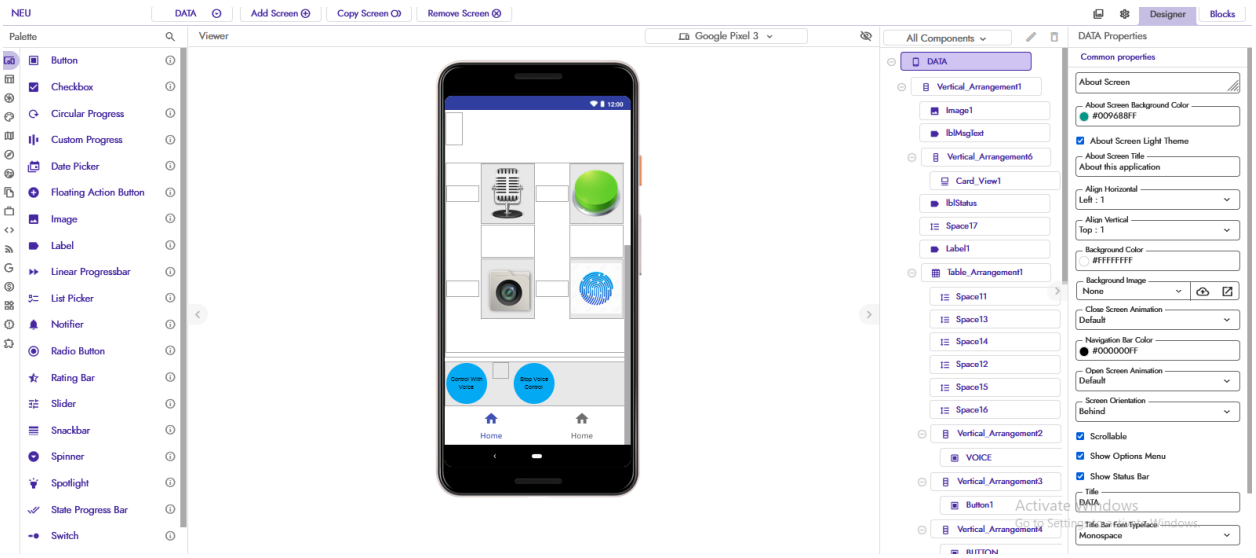

Figure 3. 11: Wi-Fi Screen Designer.

The Wi-Fi screen (Figure 3.11) is the same as the Bluetooth screen all appliances can be controlled from the screen using Wi-Fi, instead of Bluetooth. This will allow the users to use this function when they are outside the house and forget something on, so no need to come back and switching off all they have to do is open the app and click the Wi-Fi icon then will have access to appliances at home and can control everything.

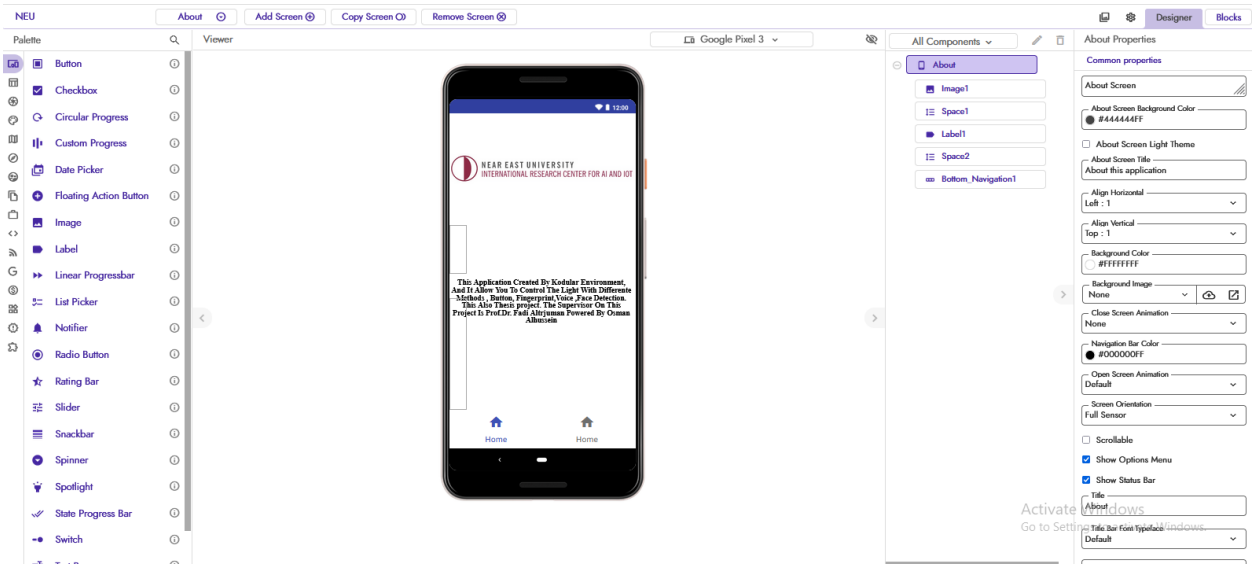

Figure 3. 12: Information Screen or About where is the Information about the App.

CHAPTER 4

RESULTS AND ANALYSIS

Our apps run on different mobile phone brands (S20s, Note9, S9+, HUAWEI Y9, HUAWEI Y8P, Tecno) and on laptop windows OS. After testing the app on those devices owned by seven different individuals. We collected response time-based data using different factors:

1. Phone Devices.
2. Network Type.
3. RAM Capacity.
4. Micro Controllers.

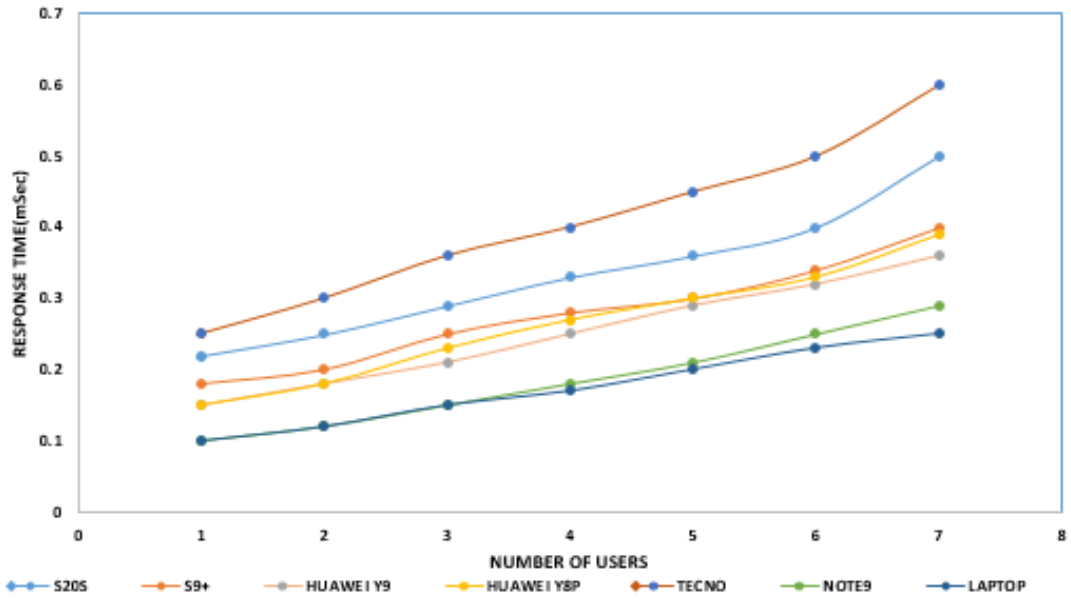

Figure 4. 1: Users and Device Responding Time.

Figure 4.1 shows that Samsung Note 9 mobile phone is the fastest among smart mobile phones. Still, using a laptop scored the best results because laptops have a big size of RAM. In the mid will see Huawei and Samsung S9+ score the second-best result. Samsung A20S came in third. Tecno mobile is the slowest among smartphones, it came in the last, and that is because of the performance of this device.

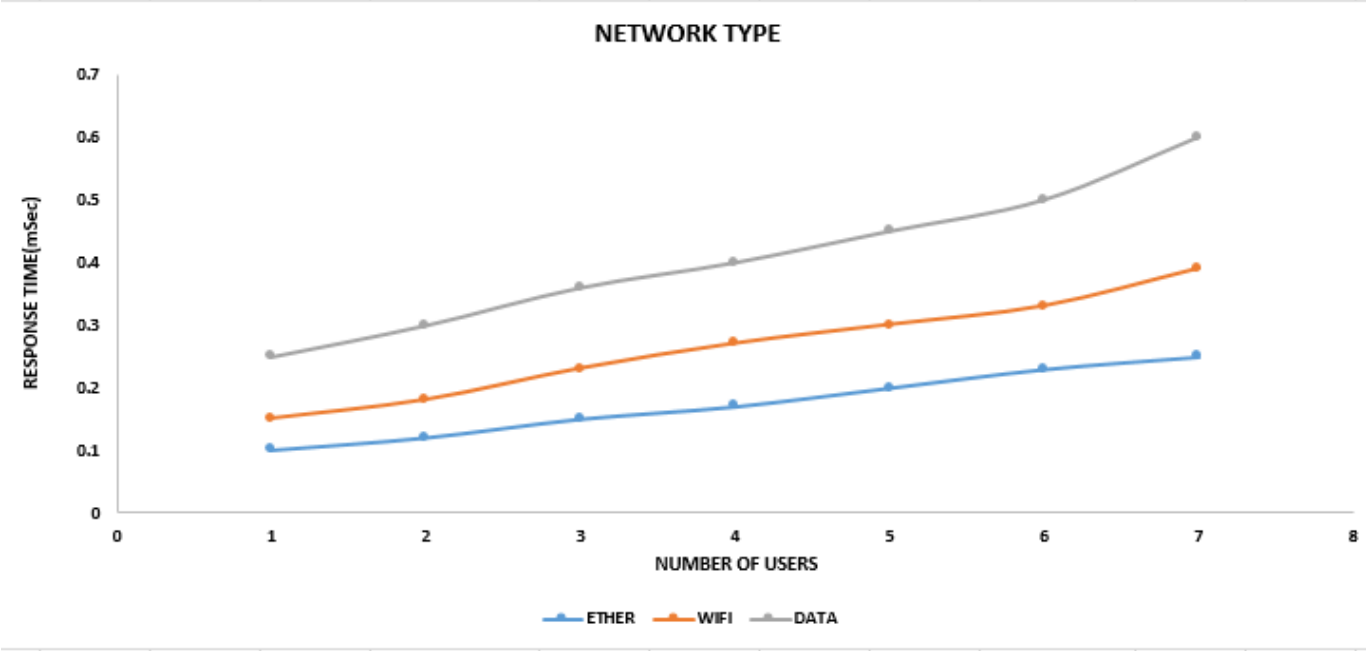

Figure 4. 2: Type of the Network.

According to figure 4.2, Ethernet is the fastest among network types. That is because the Ethernet give the full speed without sharing it with another user. Moreover, the Wi-Fi came in second because Wi-Fi shares the speed between you and other people in the same network. Then mobile data came in the last. Nevertheless, for the Wi-Fi and mobile data, it depends on the network, maybe in the other place, the mobile data is faster than Wi-Fi.

The larger RAM size is; the faster connection we have. In other words, when the size of Ram is small the time of responding will be slow. Here, we have a RAM of 8 GB and it scored the best result. The 4GB RAM scored the slowest responding time (Figure 4.3).

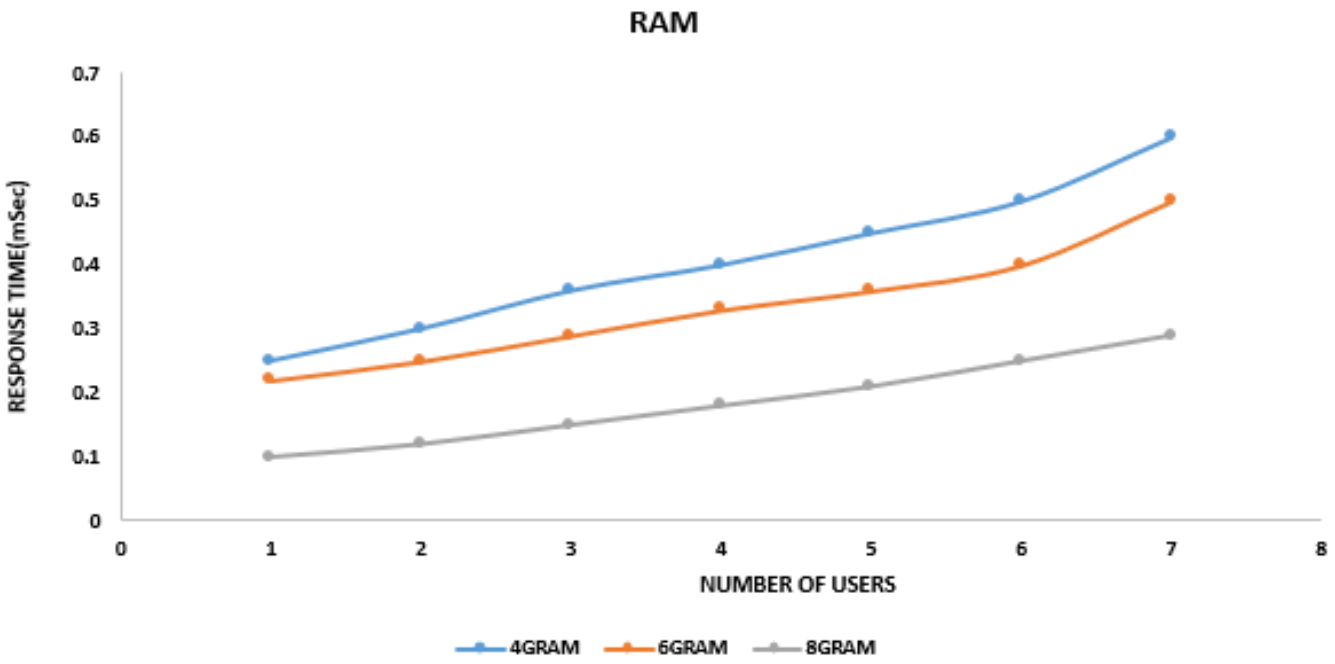

Figure 4. 3: Responding Time and RAM size.

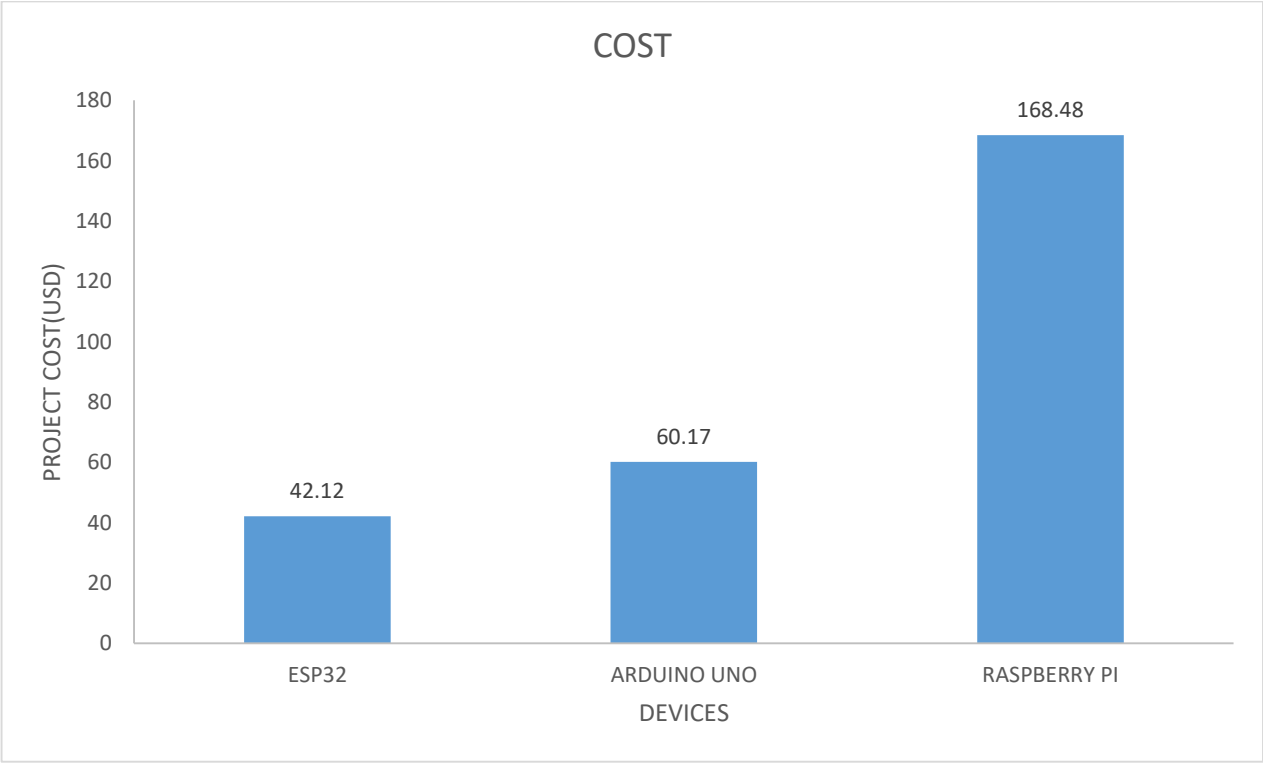

Figure 4. 4: Cost of the project with different microcontroller.

The cost of the project rises depending on the microcontroller used. Researchers can do the same project with other devices but at different costs, for example, researchers can use Arduino UNO or even raspberry pi but the cost will increase, and its same project but more expensive. That is why we use ESP32 for this project because it has built-in Bluetooth and Wi-Fi but others may need an external parts and the will increase the cost more (Figure 4.4).

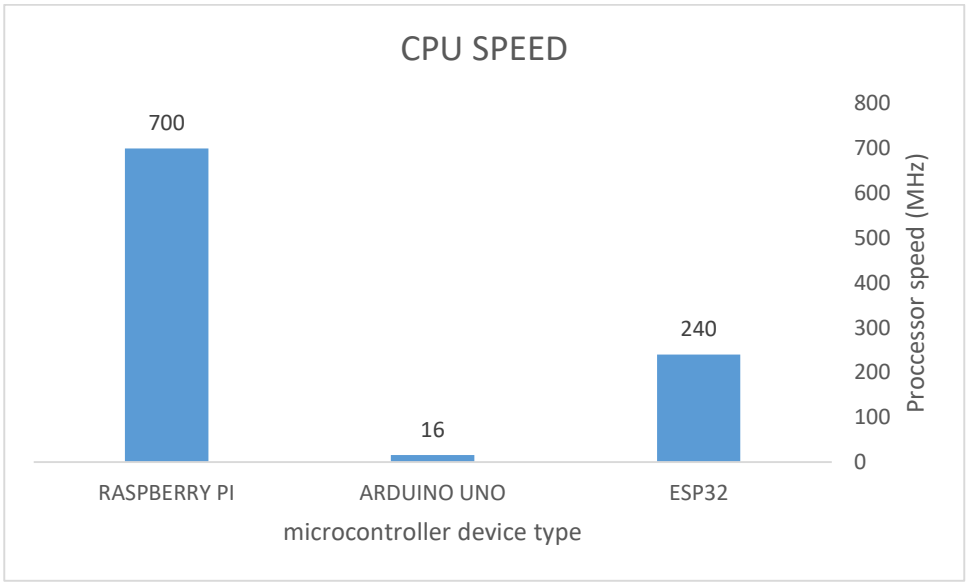

Figure 4. 5: CPU Speed for Microcontroller.

Figure 4.5 shows the speed of the microcontroller and the Raspberry Pi the fastest but the most expensive, and also you will need to buy an extra part of Wi-Fi.CPU speed changes according to the microcontroller device type. We noticed that using raspberry Pi allows faster connection but it costs the most.

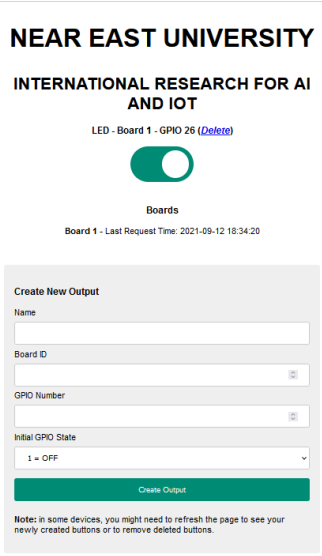

Figure 4. 6: Web Page Control.

After clicking on this link: http://app.neu.edu.tr/ESP32/esp-outputs.php will see the page in Figure 4.6 and user can control their devices from this button. Furthermore, if the user has a new device and want to connect it, all the user has to do is just fill up the field and click on create output directory will see the other button appeared and you can use it to control you're a new device. Moreover, the user can use your cell phone, so you have multiple choices you can use what is good and the user will feel comfortable with it mobile app with different controls methods or websites.

CHAPTER 5

CONCLUSION

5.1 Conclusion

Smart Home systems differ from ordinary houses that allow gadgets to communicate in the world of communication networks. Smart gadgets are used to monitor and regulate how the house works. The usage of an integrated communication system, which is available in today's modern houses, helps the residents significantly. Most homes now have air conditioners and various sorts of heating gadgets, making life easier and more flexible. The use of fire and security alarms greatly benefits security systems. In this project, a style theme for the dominant associate machine lightweight system supported the ESP32 microcontroller. The planned theme provided multi-operational modes, within which the primary machine-controlled system is employed to manage the lights supported by the device and object detection.

Good results were achieved in this study, and the app that we made allow you to control tour home with different methods and from inside your home or even outside your home even outside your country, without any media app or paid apps our app is completely free and very easy to use. There are different apps but almost all of them are paid apps or they have limited methods like Bluetooth only or Wi-Fi only, also they do not have face detection or fingerprint. That makes our app new, unique, and able to develop in the future and added more methods of control. For now, no app has this method to control with Bluetooth and Wi-Fi at the same time, and also have fingerprint or face detection that makes our app better.

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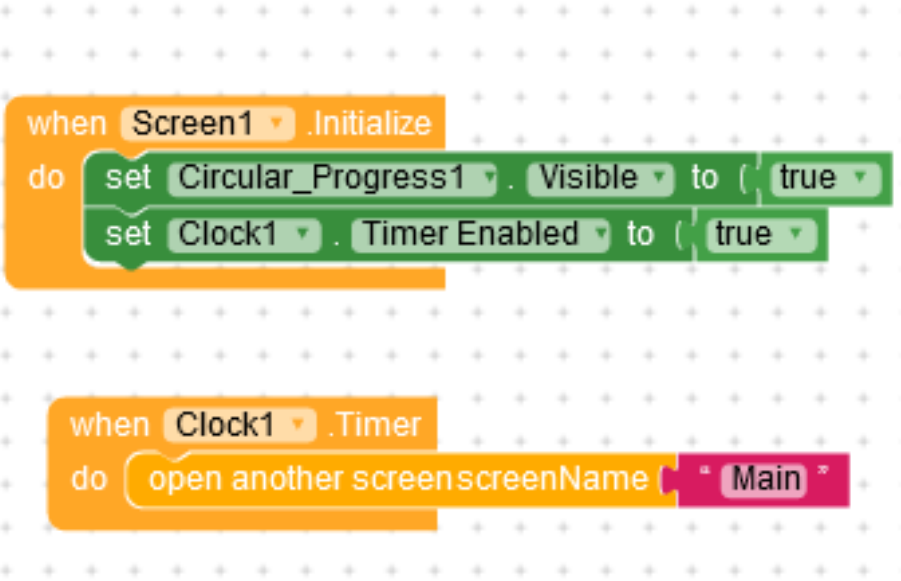
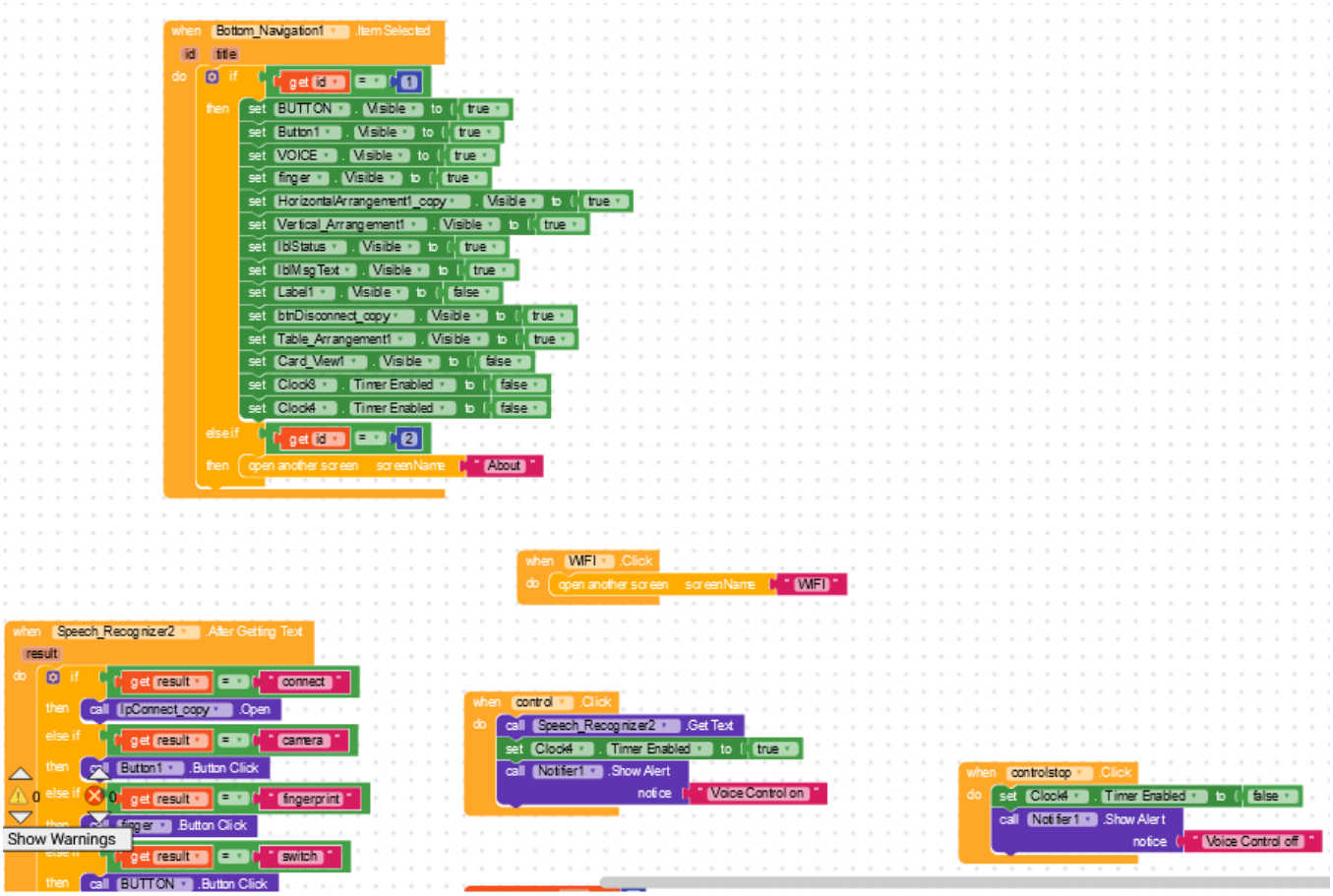
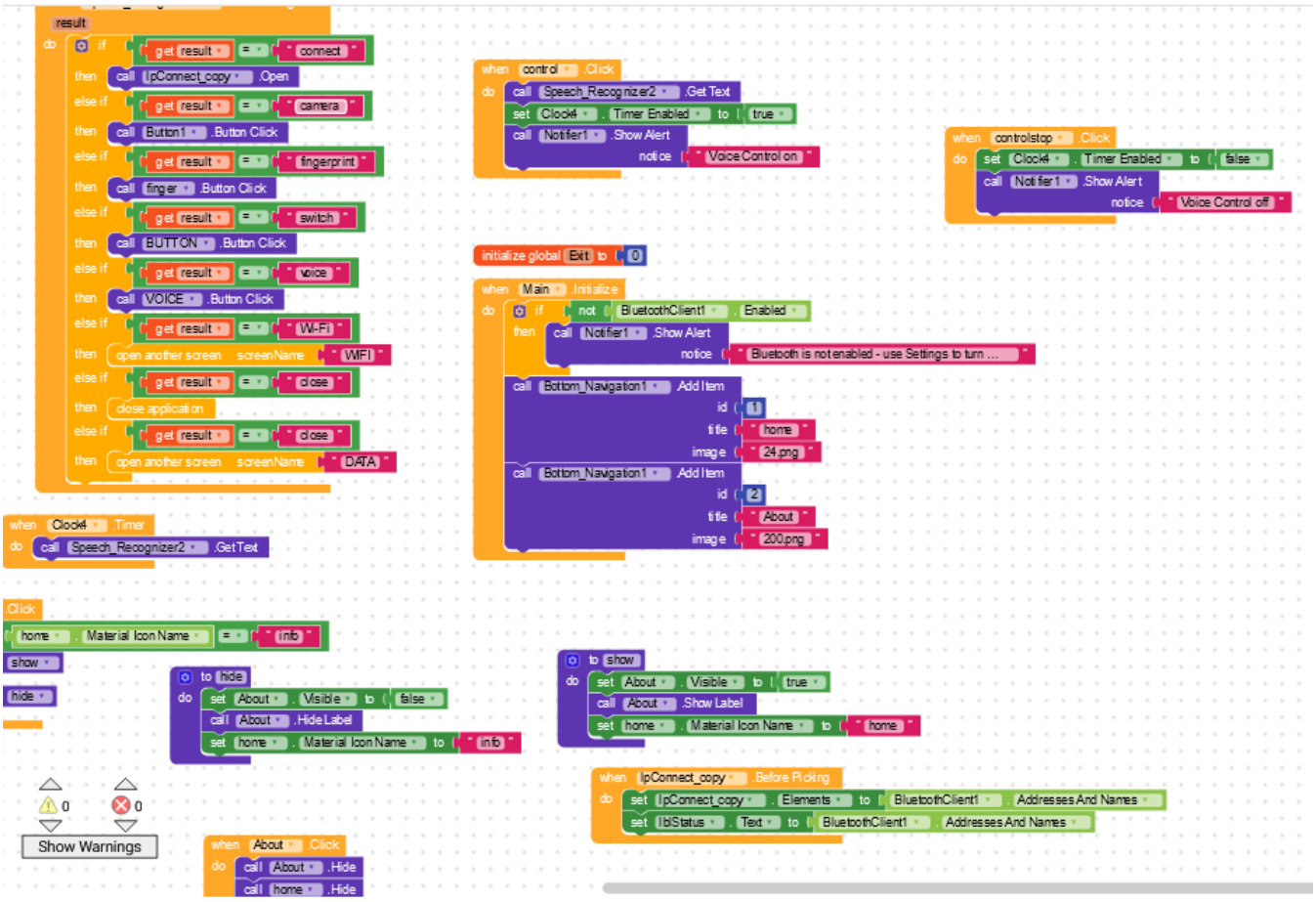
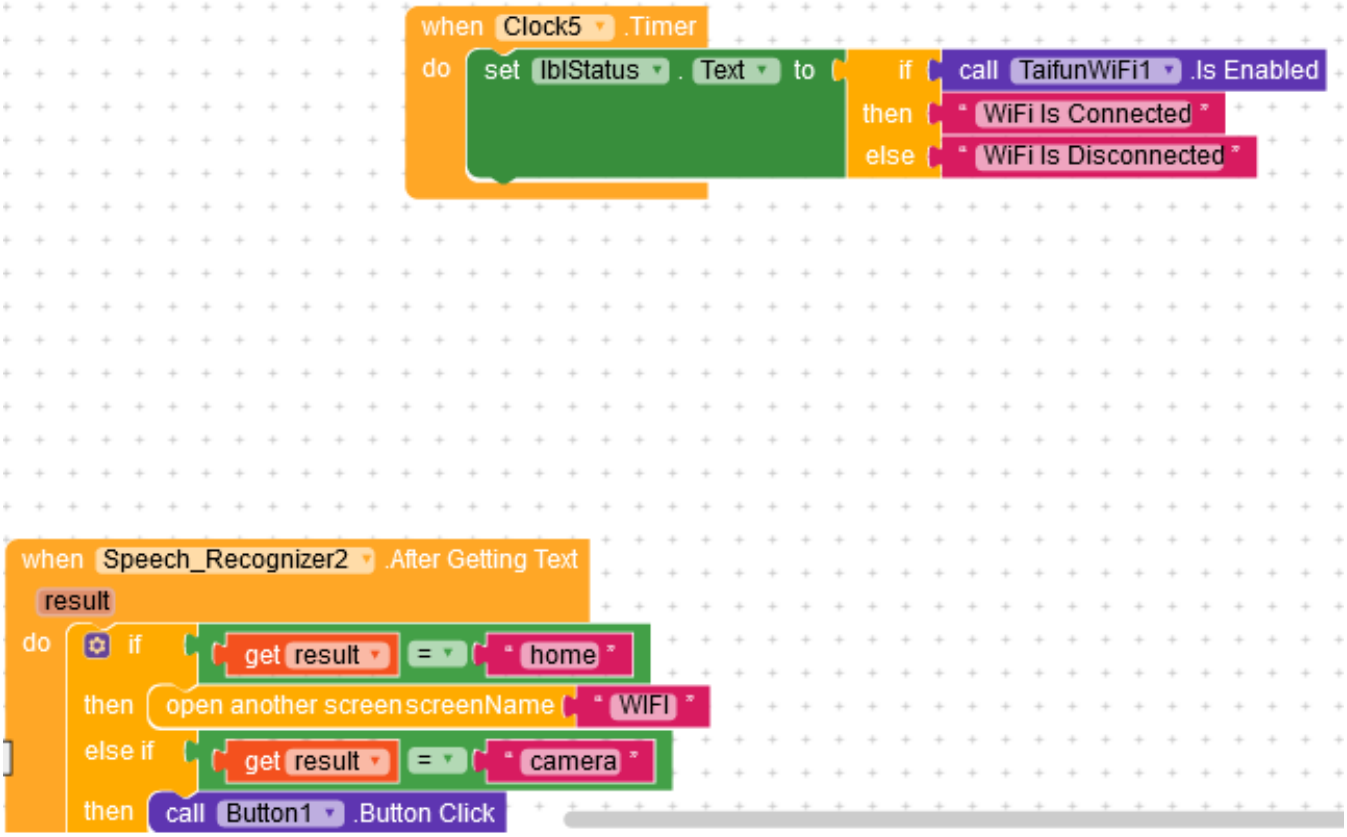
APPENDIX 1 MOBILE APP

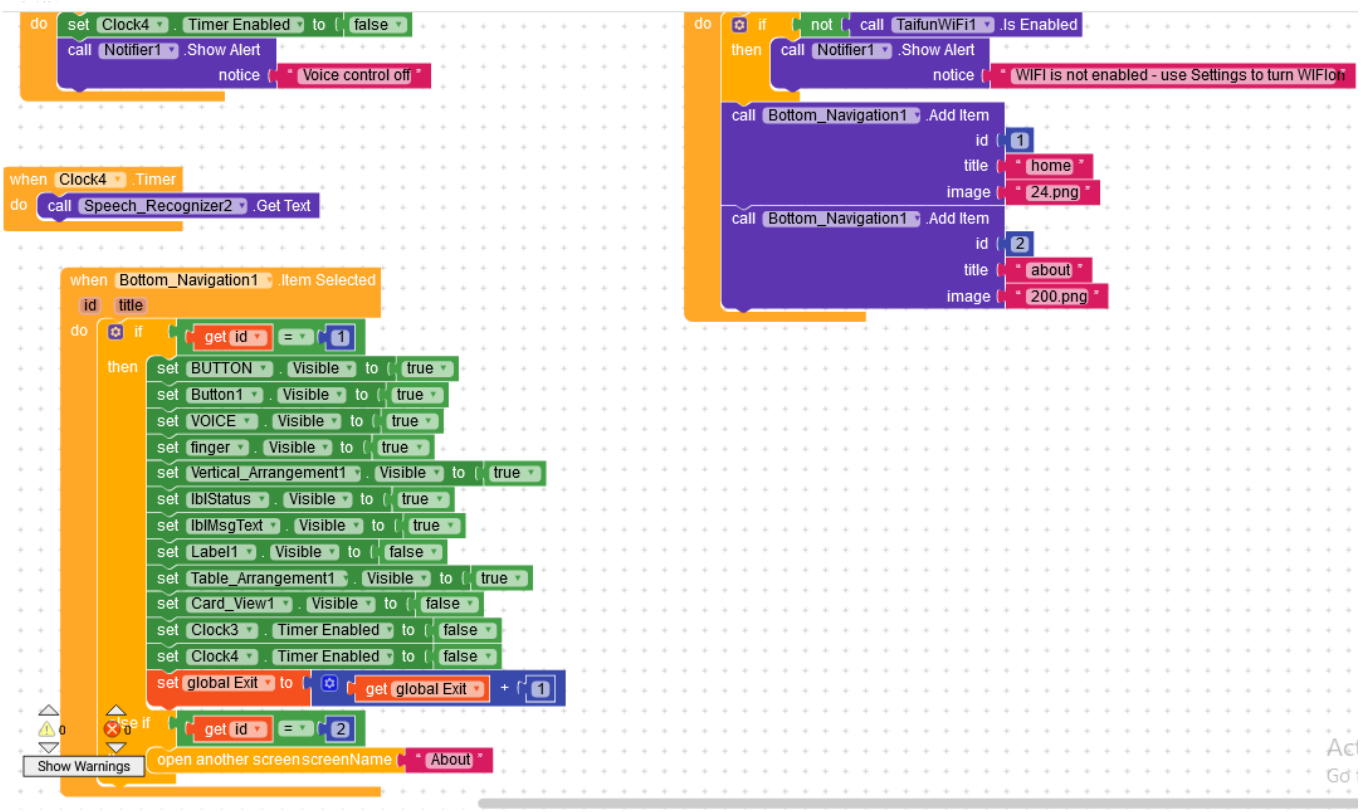


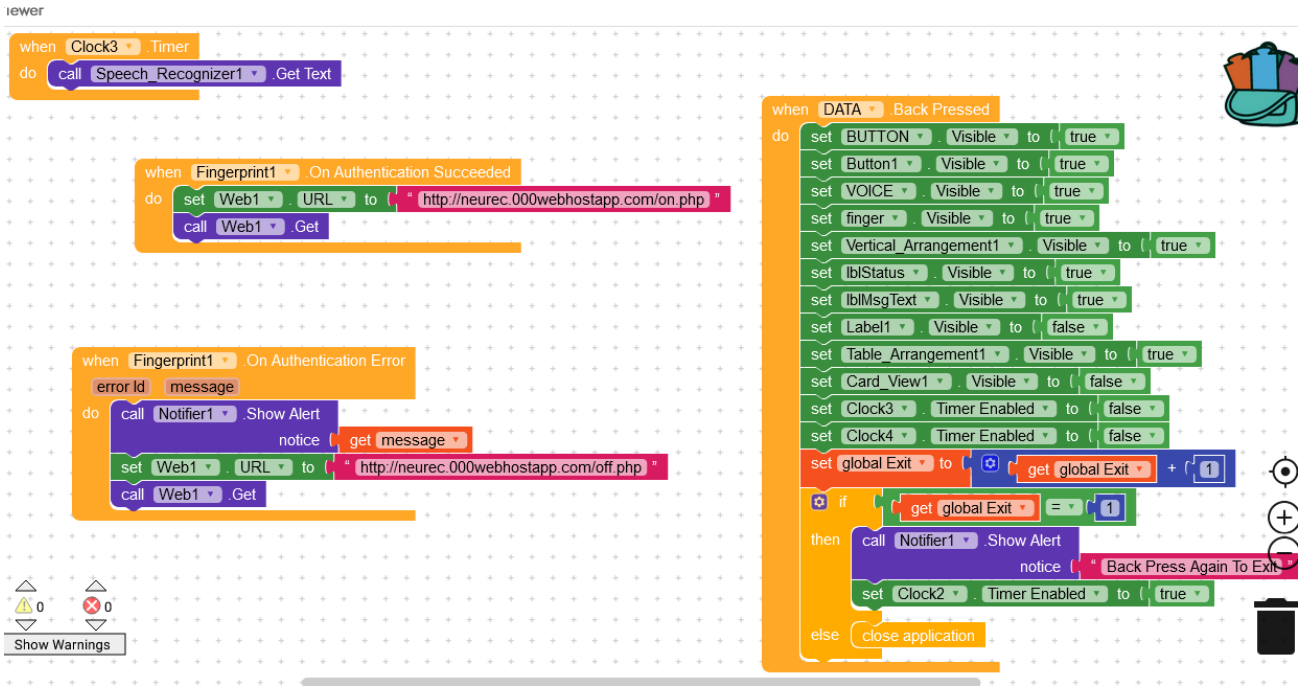

when Bottom_Navigation1 .Item Selected
id title
do if get id = 1
then set BUTTON . Visible to true
set Button1 . Visible to true
set VOICE . Visible to true
set finger . Visible to true
set HorizontalArrangement1_copy . Visible to true
set Vertical_Arrangement1 . Visible to true
set lblStatus . Visible to true
set lblMsgText . Visible to true
set Label1 . Visible to false
set btnDisconnect_copy . Visible to true
set Table_Arrangement1 . Visible to true
set Card_View1 . Visible to false
set Clock3 . Timer Enabled to false
set Clock4 . Timer Enabled to false
else if get id = 2
then open another screen screenName "About"
when WIFI .Click
do open another screen screenName "WIFI"
when Speech_Recognizer2 .After Getting Text
result
do if get result = " connect "
then call IpConnect_copy .Open
else if get result = " camera "
then call Button1 .Button Click
else if get result = " fingerprint "
then call finger .Button Click
get result = " switch "
then call BUTTON .Button Click
Show Warnings
when control .Click
do call Speech_Recognizer2 .Get Text
set Clock4 . Timer Enabled to true
call Notifier1 .Show Alert
notice " Voice Control on "
when controlstop .Click
do set Clock4 . Timer Enabled to false
call Notifier1 .Show Alert
notice " Voice Control off "

.


result
do
if
get result = connect
then call IpConnect_copy .Open
else if
get result = camera
then call Button1 .Button Click
else if
get result = fingerprint
then call finger .Button Click
else if
get result = switch
then call BUTTON .Button Click
else if
get result = voice
then call VOICE .Button Click
else if
get result = Wi-Fi
then open another screen screenName WIFI
else if
get result = close
then close application
else if
get result = close
then open another screen screenName DATA
when Clock4 .Timer
do call Speech_Recognizer2 .GetText
when control .Click
do call Speech_Recognizer2 .GetText
set Clock4 . Timer Enabled to true
call Notifier1 .Show Alert
notice Voice Control on
when controlstop .Click
do set Clock4 . Timer Enabled to false
call Notifier1 .Show Alert
notice Voice Control off
initialize global Exit to 0
when Main .Initialize
do if not BluetoothClient1 . Enabled
then call Notifier1 .Show Alert
notice Bluetooth is not enabled - use Settings to turn ...
call Bottom_Navigation1 .AddItem
id 1
title home
image 24.png
call Bottom_Navigation1 .AddItem
id 2
title About
image 200.png
.Click
home . Material Icon Name = info
show
hide
to hide
do set About . Visible to false
call About .Hide Label
set home . Material Icon Name to info
to show
do set About . Visible to true
call About .Show Label
set home . Material Icon Name to home
0
0
Show Warnings
when About .Click
do call About .Hide
call home .Hide
when IpConnect_copy .Before Picking
do set IpConnect_copy . Elements to BluetoothClient1 . Addresses And Names
set lblStatus . Text to BluetoothClient1 . Addresses And Names


when Clock5 .Timer
do set lblStatus . Text to if call TaifunWiFi1 .Is Enabled
then " WiFi Is Connected "
else " WiFi Is Disconnected "
when Speech_Recognizer2 .After Getting Text
result
do if get result = " home "
then open another screen screenName " WIFI "
else if get result = " camera "
then call Button1 .Button Click


do
set Clock4 . Timer Enabled to false
call Notifier1 .Show Alert
notice " Voice control off "
when Clock4 .Timer
do call Speech_Recognizer2 .Get Text
when Bottom_Navigation1 .Item Selected
id title
do if get id = 1
then set BUTTON . Visible to true
set Button1 . Visible to true
set VOICE . Visible to true
set finger . Visible to true
set Vertical_Arrangement1 . Visible to true
set lblStatus . Visible to true
set lblMsgText . Visible to true
set Label1 . Visible to false
set Table_Arrangement1 . Visible to true
set Card_View1 . Visible to false
set Clock3 . Timer Enabled to false
set Clock4 . Timer Enabled to false
set global Exit to get global Exit + 1
else if get id = 2
open another screen screenName " About "
Show Warnings
do if not call TaifunWiFi1 .Is Enabled
then call Notifier1 .Show Alert
notice " WIFI is not enabled - use Settings to turn WIFI on
call Bottom_Navigation1 .Add Item
id 1
title " home "
image " 24.png "
call Bottom_Navigation1 .Add Item
id 2
title " about "
image " 200.png "


when Clock3 .Timer
do call Speech_Recognizer1 .Get Text
when Fingerprint1 .On Authentication Succeeded
do set Web1 . URL to " http://neurec.000webhostapp.com/on.php "
call Web1 .Get
when Fingerprint1 .On Authentication Error
error Id message
do call Notifier1 .Show Alert
notice get message
set Web1 . URL to " http://neurec.000webhostapp.com/off.php "
call Web1 .Get
when DATA .Back Pressed
do set BUTTON . Visible to true
set Button1 . Visible to true
set VOICE . Visible to true
set finger . Visible to true
set Vertical_Arrangement1 . Visible to true
set lblStatus . Visible to true
set lblMsgText . Visible to true
set Label1 . Visible to false
set Table_Arrangement1 . Visible to true
set Card_View1 . Visible to false
set Clock3 . Timer Enabled to false
set Clock4 . Timer Enabled to false
set global Exit to get global Exit + 1
if get global Exit = 1
then call Notifier1 .Show Alert
notice " Back Press Again To Exit "
set Clock2 . Timer Enabled to true
else close application
0
0
Show Warnings

APPENDIX 2 ESP32

```
#include "BluetoothSerial.h"

#if !defined(CONFIG_BT_ENABLED) || !defined(CONFIG_BLUEDROID_ENABLED)

#error Bluetooth is not enabled! Please run `make menuconfig` to and enable it

#endif

#include "WiFiManager.h"

#include <WiFi.h>

#include <HTTPClient.h>

#include <Arduino_JSON.h>


const char* ssid = "";

const char* password = "";


//Your IP address or domain name with URL path

const char* serverName = "http://app.neu.edu.tr:9000/NEUREC/esp-outputs-
action.php?action=outputs_state&board=1";


// Update interval time set to 5 seconds

const long interval = 5000;

unsigned long previousMillis = 0;


String  outputsState;


#define SW 26
```

```
char a;

BluetoothSerial SerialBT;

void setup() {
  Serial.begin(115200);

  WiFiManager wifiManager;
 wifiManager.resetSettings();
wifiManager.autoConnect("NEUREC", "");


  WiFi.begin(ssid, password);
  Serial.println("Connecting");
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.print("Connected to WiFi network with IP Address: ");
  Serial.println(WiFi.localIP());
  pinMode(SW, OUTPUT);


  SerialBT.begin("NEUREC"); //Bluetooth device name
```

```
  Serial.println("The device started, now you can pair it with bluetooth!");
}

void loop()
{
  while (SerialBT.available()) // Read until the bluetooth client is sending.
  {
    char b = SerialBT.read();


    delay(1);




  if (b == '0')
  {

    digitalWrite(SW, LOW);
  }
  if (b == '1')
  {
    digitalWrite(SW, HIGH);
  }

  if (b == '3')
  {
    digitalWrite(SW, LOW);
```

```
 delay (5000);
  digitalWrite(SW, HIGH);

}
}

 // clearing the string.
unsigned long currentMillis = millis();

if (currentMillis - previousMillis >= interval) {
  // Check WiFi connection status
  if (WiFi.status() == WL_CONNECTED ) {
    outputsState = httpGETRequest(serverName);
    Serial.println(outputsState);
    JSONVar myObject = JSON.parse(outputsState);

    // JSON.typeof(jsonVar) can be used to get the type of the var
    if (JSON.typeof(myObject) == "undefined") {
      Serial.println("Parsing input failed!");
      return;
    }

    Serial.print("JSON object = ");
    Serial.println(myObject);

    // myObject.keys() can be used to get an array of all the keys in the object
```

```
      JSONVar keys = myObject.keys();

      for (int i = 0; i < keys.length(); i++) {
        JSONVar value = myObject[keys[i]];
        Serial.print("GPIO: ");
        Serial.print(keys[i]);
        Serial.print(" - SET to: ");
        Serial.println(value);
        pinMode(atoi(keys[i]), OUTPUT);
        digitalWrite(atoi(keys[i]), atoi(value));
      }
      // save the last HTTP GET Request
      previousMillis = currentMillis;
    }
    else {
      Serial.println("WiFi Disconnected");
    }
  }
}
String httpGETRequest(const char* serverName) {
  WiFiClient client;
  HTTPClient http;

  // Your IP address with path or Domain name with URL path
  http.begin(client, serverName);
```

```
  // Send HTTP POST request
  int httpResponseCode = http.GET();

  String payload = "{}";

  if (httpResponseCode > 0||a=='0') {
    Serial.print("HTTP Response code: ");
    Serial.println(httpResponseCode);
    payload = http.getString();
  }
  if (httpResponseCode < 0||a=='1') {
    Serial.print("Error code: ");
    Serial.println(httpResponseCode);
  }
  // Free resources
  http.end();

  return payload;
}
```