

Design and Develop Smart door by using IOT to sense the body afflicted with infectious diseases in Ministry of Defense.

Mohammed Said AL Shaaili¹, Ali Abbas¹ and Raza Hasan¹

¹Department of Computing, Middle East College, Muscat, Oman.

ABSTRACT

The Internet of Things (IoT) is a system consisting of computing devices featuring devices connected to the Internet with each other, digital and mechanical machines, things, and people who provide distinct identifiers and the ability to transfer data across the network without the need. For people, they interact with the PC. This system consists of several devices that can be said to be security, safety and health of the Ministry's employees from the infectious diseases spreading in the world recently. The system contains many devices, a face detection camera, temperature sensor, mask detection," a camera, a digital screen, and an additional sterilizer. How the systems work In short, the employee or visitor is standing in front of the system. The temperature sensor will read the body temperature, and if it is above (38.5), the device will send a signal to the system not to open the gate because the body temperature is high and is considered a threat, and a message will appear on the digital screen "Please stay away. You cannot enter." Your temperature is high. " At the same time, the camera capture the person face, identifies the person whether he is an employee of the ministry or not. Also check the mask if he does not wear the mask, a message will appear on the digital screen, "Please wear a muzzle upon entering", in order to enter, you must be an employee in the ministry and your body temperature is normal while you wear the mask.

1. Aim and objectives:

The primary aim of this study is to examine and develop smart door authentication mechanism which ensure high security without physical intervention and guarantee easy access for all the users entering to ministry.

The main aim of this project is summarized as below:

- I. Establishing a reliable IoT based smart authentication mechanism to determine whether if a guest is having coronavirus symptoms or not.
- II. Open the door for the users after identifying and recognizing the user temperature.
- III. Overview the architecture of IoT for providing functions and support.

2. Introduction:

2.1 Internet of Things

The Internet of Things is such a big bias that it is possible to connect a large number of devices and sensors to the Internet and interact with the cloud. The Internet of Things is growing rapidly, and the number of connected devices in 2022 is estimated to be 18 billion.

2.2 : IoT Architecture

Providing a functional system architecture requires an understanding of the basic principles of the Internet of Things. Common systems for Internet systems consist of a three-layer architecture (application layer, edge layer, and sensor layer).

- The sensor layer: This layer is considered the lowest of the three layers as it is implemented at the bottom of the IoT architecture. Also, through smart devices such as actuators and sensors, it can communicate with physical sectors and devices, and this in turn makes it linked to controlling the physical world and collecting data.
- Edge Layer (Grid Layer): This is the middle section of the structure. This layer is used to receive the processed information that is presented by the sensor layer, as it limits directions in order to transfer data to embedded applications and devices in the Internet of things system. It is also considered the most important layer in the Internet of things system.
- Application layer: As for this layer, it is located at the top. It is used to interpret, store, and analyze the data collected. (Hafdi, 2019)

2.3 Overview of Project Case / Business case

The Internet of Things plays an important role in our time in facilitating people's lives in general. As it enhances the project that I am undertaking, which is the smart door that enhances the security of the ministry, as it is not allowed to enter a person whose temperature exceeds 37 degrees Celsius and whoever does not wear a muzzle, this increases the safety of the workers in the ministry. At the present time, and about what we lived in 2020, the world has been greatly affected by the Corona Covid-19 pandemic, as this epidemic has spread significantly and significantly. Therefore, the main objective of this project is to identify organisms affected by infectious diseases. The Internet of Things (IoT) is a system consisting of computing devices that are characterized by internet connected devices with each other, digital and mechanical machines, things, and people that provide distinct identifiers and the ability to transfer data through the network without the need for people, but rather interacting with PC.

The Internet of Things (IoT) describes the network of physical objects, which are often included with other sensors, technologies, and programs so that data can be connected and exchanged with other systems and devices via the Internet.

The definition of the Internet of Things has also evolved as a result of the convergence that occurs between many analyzes and technologies at the present time, embedded systems, commodity sensors, and machine learning. To enable the Internet of things, there are several areas that contribute to this matter, including control and automation systems, wireless sensor networks, and the traditional fields of embedded systems. Internet of things technology in the consumer market is synonymous with products related to the concept of "smart door", an example of devices (thermostats, sensor systems, and security systems) that in turn support the most widespread and common systems and can be controlled through the devices associated with this. the system.

There are also many serious concerns regarding risks in terms of the growth of the Internet of things, and in the areas of security and privacy. Government and industrial moves have begun to address these concerns.

In the twenty-first century, the wireless sensor network is one of the best emerging technologies, in terms of its development in the past ten years at an exponential rate. They have also conducted many different studies with the aim of improving it in several aspects, node operating systems, data consolidation and collection, routing protocols, positioning mechanism, etc. However, with all this, there are many problems with the wireless sensor network.

Door sensors are an essential component of a place's safety, as they help you to know if the next person has an infectious disease or has symptoms that you mentioned previously. Also, these devices consist of two parts, and that when a person goes to the door, either it opens in the absence of symptoms or the door remains closed and that causes symptoms that may cause infection to the rest of the staff.

The system is placed at the main entrance gate, so that no person can enter unless he meets the conditions, including wearing the muzzle, and that the body temperature is normal, and also that the person is affiliated with an employee in the ministry. How the systems work In short, the employee or visitor is standing in front of the system. The temperature sensor will read the body temperature, and if it is above (37.9), the device will send a signal to the system not to open the gate because the body temperature is high and is considered a threat, and a message will appear on the digital screen "Please stay away. You cannot enter." Your temperature is high. " At the same time, the fingerprint reader identifies the person, whether he is an employee in the ministry or not, as it will be compared to the database that was previously stored for all the ministry's employees, and if the person is not an employee, a message will appear on the digital screen for the portal's employees in the presence of a visitor or a stranger who wants Entry must be verified, and in this case the gate will not open unless the person is an employee and the smart camera will make sure that the person wears the mask, and if he does not wear the mask, a message will appear on the digital screen, "Please wear the muzzle when entering", in order to be able to enter, you must be Employees in the ministry, your body temperature is normal while you wear the mask.

2.4 Project background

I will do this project for Ministry of Defense in Sultanate of Oman, because of the great importance of the Ministry within the Sultanate, as it is the Ministry responsible for the security and stability of the country. It is likely that the ministry will implement this project in all the entrances and exits of the ministry, so that this system will limit the spread of infectious diseases, by measuring the temperature of the affiliated employees before entering the ministry's buildings, and in case the employee's temperature is high, it gives a signal to the door to It will not open, and also the door will contain an eye-print reader, so that the fingerprint of all employees is recorded in a database connected to the door system, and this sensor reads the fingerprint and also gives a signal to the door to open to the employees only, and the door contains a smart camera that can read the face of the person who wears Mask or not, and in turn, employees are prohibited from entering without a mask.

The Ministry of Defense is responsible for implementing the defense policies of the country. It is considered the most important sovereign ministry and has its own considerations from the government and the Sultan. The Ministry of defense was established at the beginning of the reign of Sultan Qaboos - may God have mercy on him

- in 1970. The ministry's name changed to several names until it settled with this name since 1987. During the reign of Sultan Haitham bin Tariq, he appointed his brother Sayyid Shihab bin Tariq as Minister of Defense Affairs. The Ministry of Defense is divided into three main departments (Army, Navy and Air Force) in addition to the Royal Guard of Oman. There are many sites of the Ministry of Defense in the various governorates of the Sultanate, and each site and building of the Ministry has its own peculiarities and considerations, and only employees are allowed to enter the Ministry's sites. It is the ministry that includes the most subsidiaries and employees, with more than 635,000 employees.

This project will be used in various location and buildings of Ministry of Defense that are concerned with the safety and security of their employees during the period of the spread of infectious diseases, as the current situation is spreading the Coronavirus Covid 19, and many have placed one of the employees in front of the entrance door of the organization to measure the temperature of employees and auditors before they enter the organization And obliging them to wear a mask before entering

3. Literature Review

3.1: Introduction

In this chapter, the two most important aspects that I will discuss in this chapter are the feasibility of the project and the discussion of the literature. As for literature review, it is about searching for previous projects or articles that have been worked on with the same project that I am doing and the Internet of Things. In addition, As for the feasibility of the project, it is through discussion of technological and economic feasibility, cost, ethical, operational and benefit.

3.2: Outline of Literature Review and Feasibility Analysis

In this chapter I will talk about the literature devoted to the Smart Door project and major similar projects. Second, I will work on a feasibility analysis of the project.

3.3: Similar Work

This article explains the development of an IOT app based on a smart door so that it is online and also identifies the employees at work. This topic places great emphasis on the security aspect by highlighting the most important and typical security challenges in IoT systems, then these challenges are summarized so that a more secure functional product is developed from the start. In this project, a very fine microcontroller is selected and also working on creating a testing environment for developing and testing security breaches. Architectural designs are chosen for the API being developed and for the Android application. Thus, a detailed description of the database that Azure Active Directory represents is provided, along with its importance in terms of achieving a fundamental security breach. Eddystone is a new technology that was introduced in the project with the aim of the transmission protocol, with Bluetooth signals in place. The final stage of this project is to finalize Android application development and work to ensure all developed subsystems communicate with each other, so as to provide more secure flow and functionality of the IoT system. (Song and Nam, 2017)

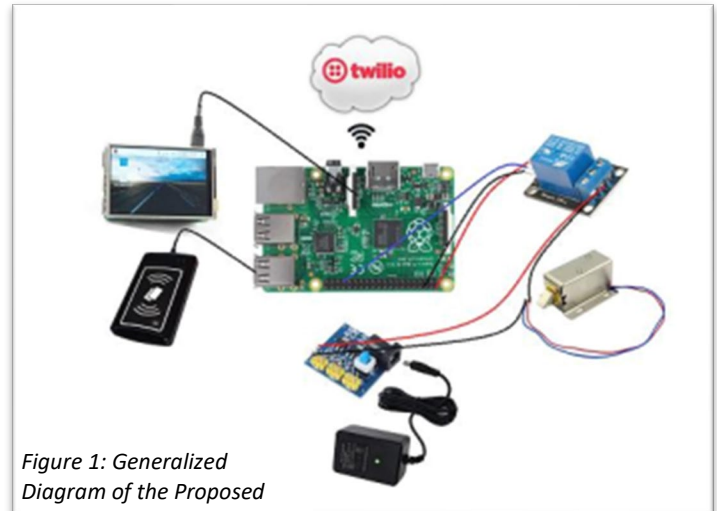


Figure 1: Generalized
Diagram of the Proposed

This article talks about the world of technology and innovation, as it has become a source of inventions, as security is one of the sources of great concern to a group of sectors such as (banks, public and private resources). Weak access points and predominant access mechanisms can negatively affect both the security and integrity of the system. This model aims to develop a highly secure lock that adapts to the needs of the desired system. A three-factor authentication model is also published (and the third factor is also configurable). This aims to make the system more secure. Three-factor authentication also adds an extra layer of security to the second collision that already exists, after which it is difficult to crack or bypass the system. Also, today people are very focused on product safety. The Internet of Things is of great importance because the security consequences found in IoT devices can be devastating. Breaking the door lock can create frightening situations. (Celestine, 2020)

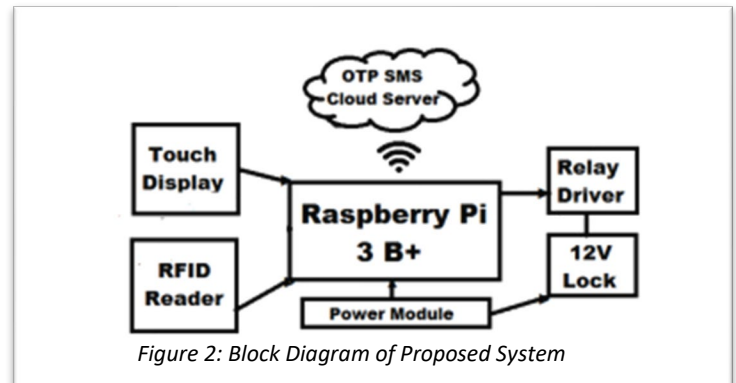


Figure 2: Block Diagram of Proposed System

Security and privacy are universal rights, and to ensure our safety in our daily life, a group of researchers spoke about the most important safety measures, and the Internet of things is considered a turning point in the industry, where everyday things are linked and shared with data so that it can be improved. Facial recognition is one of the well-

established processes through which a face is detected and recognized by the image. The aim of this study is to create a smart door through which we can secure the gate based on identity. With our proof of smart door concept, we used a high-resolution live camera on the front side of the setup. It is also connected to a display and is connected to a camera so that it appears who is standing in front of the door, and the system is able to give the output and this is done through word processing on the Raspberry Pi ARM processor, after which the answers appear on the screen. We also use a set of electromagnets that can be controlled through a microcontroller, which can be locked. Anyone can unlock the smart door through facial recognition and is able to interact with it. Microsoft Face API is used for facial recognition, but the application that is run through the Microsoft Visual Studio IDE on the desktop reduces the time by detecting the face and then it is presented as an output to the Microsoft Face API, and it can also be hosted by Microsoft Azure Cloud support. (Deshwal, 2019)

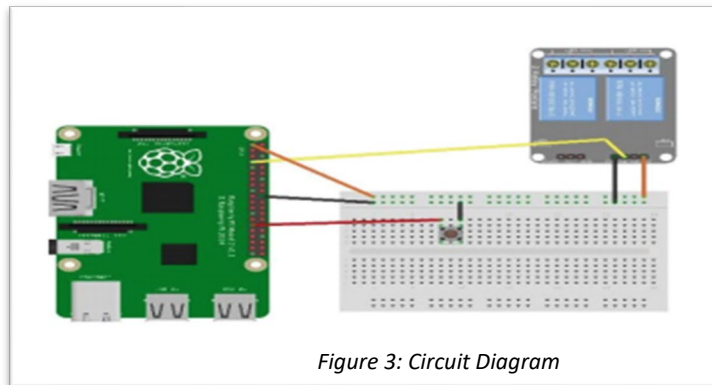


Figure 3: Circuit Diagram

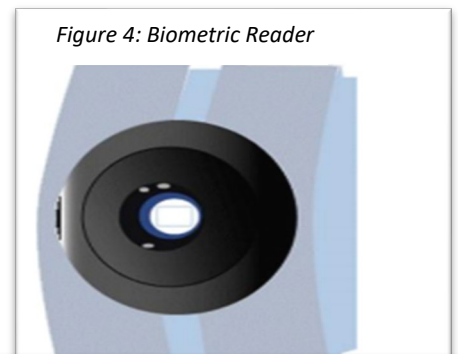


Figure 4: Biometric Reader

Nowadays, many control systems are designed for the purpose of securing the home and also to prevent unauthorized user access. The main goal of our life control systems is that they provide security for our private property, offices, and more. Therefore, it is very important that you have smart technology to achieve this goal. Automatic door system has become a very important feature of many buildings. Also, owning an electronic device is now popular, as it offers high security. Previously, home security was one of the many problems that occurred, and this was done so that only authorized persons could enter. Home automation is needed in order for the user to take advantage of IoT technology. Therefore, this project aims to develop a prototype of door security code system using smart Bluetooth device as interface and key with internet of things so that the system is monitored. This project is considered one of the successful projects. (Dabhade, 2017)

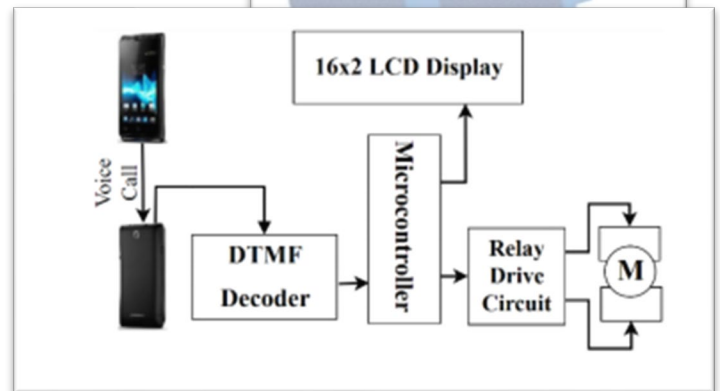


Figure 5: Password Protected Door Locking System based on Cell Phone

The Internet of Things is the connection of something to another. The door is an important thing for home security. Therefore, the provision of door system becomes safer for homes. The aim of the study is to implement a home safety system by integrating the Internet of Things with smartphones. The remote use of IOT is to display the activity and also to obtain notification in case there is an object nearby. The Raspberry Pi, camera, etc. is used until an alarm system is provided, provided it has the ability to notify the owner. Home insurance is now a matter of concern. Also, homes are now considered more vulnerable to threats, so home security is required. So, it is suggested

to work with a smart door lock system. It is also considered one of the most secure systems, and through this system it is only allowed for authorized persons to enter. (Viraja2018)

4. Methodology

4.1. Agile method

Agile methodology is one of the types of project management processes, this methodology is intended to be used for software development, as solutions and requests are developed through the collaborative effort of multi-functional and self-organizing teams.

Agile software development methodology is considered one of the easiest and most effective operations in order to transform the vision of business needs into programming solutions. Agile is a term used to describe approaches to program development that use learning, continuous planning, team collaboration, improvement, developmental development, group collaboration, and early delivery. It also encourages flexible responses to grasp. (Shankarmani, Pawar, S. Mantha and Babu, 2012)

1. The Agile methodology proposes an iterative and phased approach to software design.
2. The lean process is broken down into individual models for designers to work on.
3. The customer has frequent and early opportunities to make a decision and consider product and project changes.
4. The error can be fixed in the middle of the project.
5. Small projects can be implemented quickly, unlike large projects it is very difficult to estimate the time to develop it.



Figure 7: Agile method

4.2. Agile SWOT:

<p>Strengths</p> <ul style="list-style-type: none"> - Welcoming the requirements of change, even if there is a delay in the development time. - For the satisfaction of users and stakeholders. - Iterative-Incremental Development 	<p>Weaknesses</p> <ul style="list-style-type: none"> - Limitations in matters of distributed and global developments. - Lack of efficiency in methods of communication and interaction. - The need to provide the customer when developing.
<p>Opportunities</p> <ul style="list-style-type: none"> - Methodology engineering - Light design and analysis - Professional advice - Techniques and strategies for developing distributed software 	<p>Threats</p> <ul style="list-style-type: none"> - Lack of interest in using agile methodologies and this in traditional organization.

4.3. Advantages and Disadvantages of use Agile methods:

<p>- Advantages</p>	<p>- Disadvantages</p>
<ul style="list-style-type: none"> - It is characterized by ease in making changes, due to short repetition and communication, and there are multi-functional teams, and this helps in implementing and modifying changes to the project. - One of its advantages is that it handles tasks quickly and that by using repetition, it is possible for teams to work on small parts and then synchronize with other teams. It also facilitates problem solving more legitimately. - Clients can add notes and entries to the workflow. 	<ul style="list-style-type: none"> - Priorities are constantly being renamed because planning is less realistic. This makes it very difficult to set the deadline for delivery. - Turning away or reducing customer familiarity, and this aids in change as required. - It is very easy for a project to go off course, so the end result is clear.

4.4. Justifying Methodology:

I chose the Agile methodology because it is an advantage in that it helps me enable the preparation of the project, as it allows others to express their opinions freely, and it also allows the project to be modified while working on it without anything being affected by the project.

Continuous delivery methodologies and flexibility are also good features of the methodology, as it meets all IoT requirements. And other features that help it in new updates to the device and continuously. The user needs a suitable device in the market to allow it to be used

5. Proposed Network Design and Implementation:

5.1 Initial design:

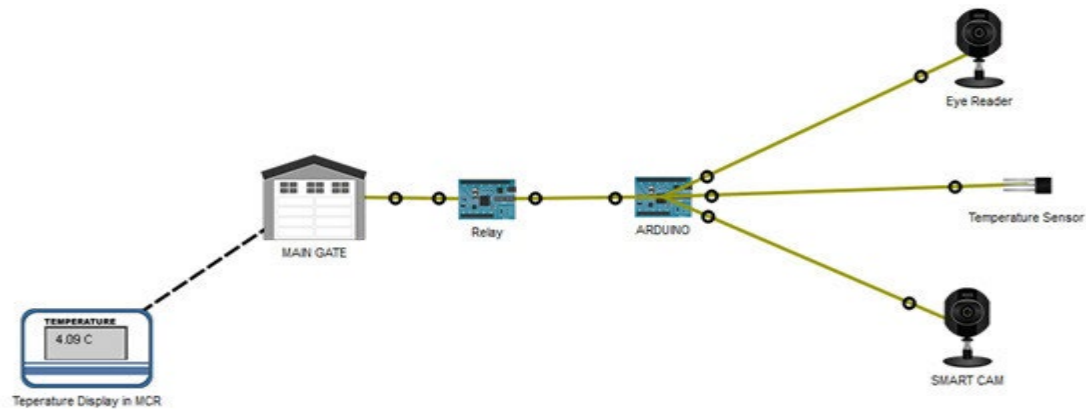


Figure 35: Initial design

Temperature Display in MCR.

Relay

It is an electrically operated switch. It also consists of a set of input terminals for multiple and single control signals, also known as a set of working communication terminals. Any key can contain a number of contacts in multiple contact forms, such as (separating contacts or creating other contacts or groups).

Arduino

It is an electronic board that contains an open-source electronic circuit with a microcontroller that is programmed and done by computer, designed to facilitate the use of interactive electronics in multidisciplinary projects.

Eye Reader

Temperature sensor

It is an electronic device that measures the temperature of its environment as it works to convert the input data into electronic data to record, refer to or monitor temperature changes.

Smart Cam

The smart camera keeps track of the events as you use your Wi-Fi network, and the data is stored in the cloud archive storage.

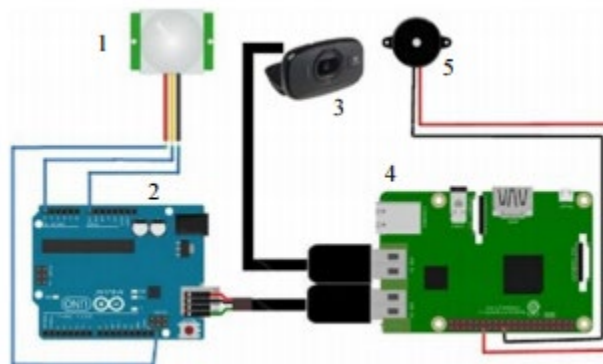


Figure 36: Hardware architecture

This section explains hardware design. Hardware design includes selection of electronic equipment and connection of all components. This figure shows the design of devices for safety monitoring. Raspberry Pi 3 model we use for processing unit. This board is equipped with a wireless LAN unit for communication. The Arduino is even used to collect the signal from the PIR sensor via the USB webcam on the Raspberry Pi 3 via the USB cable. The doorbell module also connects to the Raspberry Pi 3 via the port. Raspberry Pi 3. GPIO is also connected to the internet so that the system has the ability to send an email notification.

5.2: Physical Design:

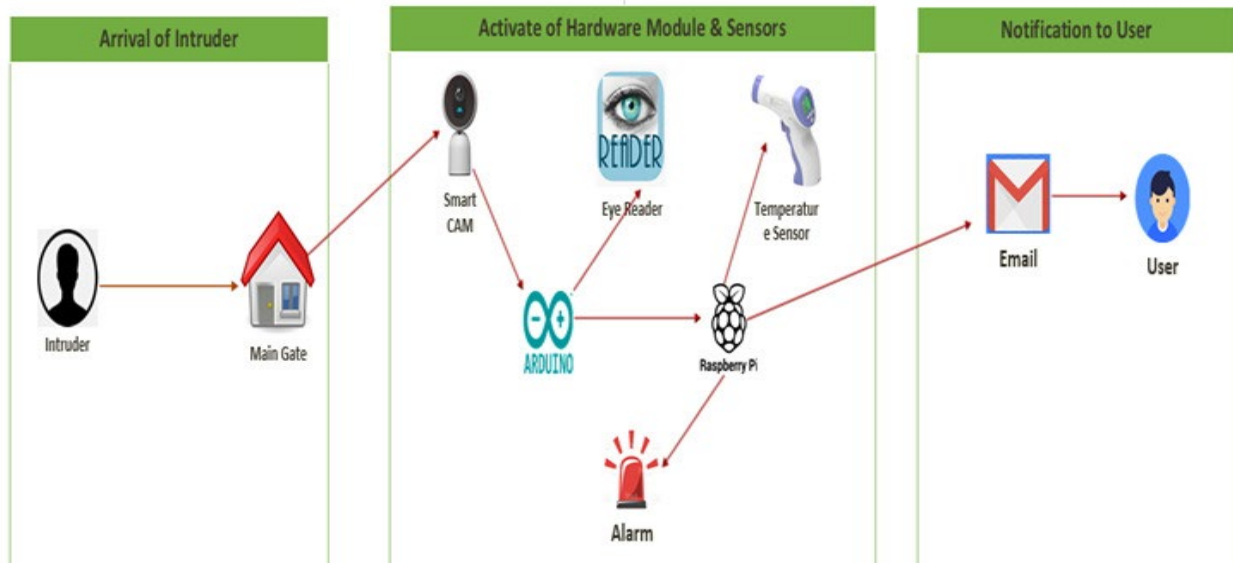


Figure 17: Physical diagram

The PIR sensor on the Arduino

Motion detection programming is implemented by using the PIR sensor in the Arduino IDE application. Then the source code in the Arduino is included. This is by connecting the Arduino to a computer using a USB cable, and then the programs are downloaded to the Arduino.

Raspberry Pi 3

Raspbian Stretching. OpenCV and Python:

Motion detection programming is implemented through the use of a PIR sensor in the Arduino IDE app. Then, the source code is embedded in the Arduino by connecting it to a computer through the use of a USB cable, and then the programs are loaded onto the Arduino.

Camera: The webcam uses the fswebcam library. Then a file is created. And that with the text. The image produced is 640 x 480 pixels and has an FPS of 15. The purpose of setting the lower resolution is to make the image faster, less than 1 second.

Alarm: The alarm function of the Raspberry Pi 3 has a gpiozero pin interface. So, it is possible to use the alarm immediately.

E-mail: Email configuration is configured by viewing it as recipient and sender email. Configuration is also done on recipient and sender's Gmail account to allow less secure apps, after which email can be sent automatically.

3.8 Logical Design

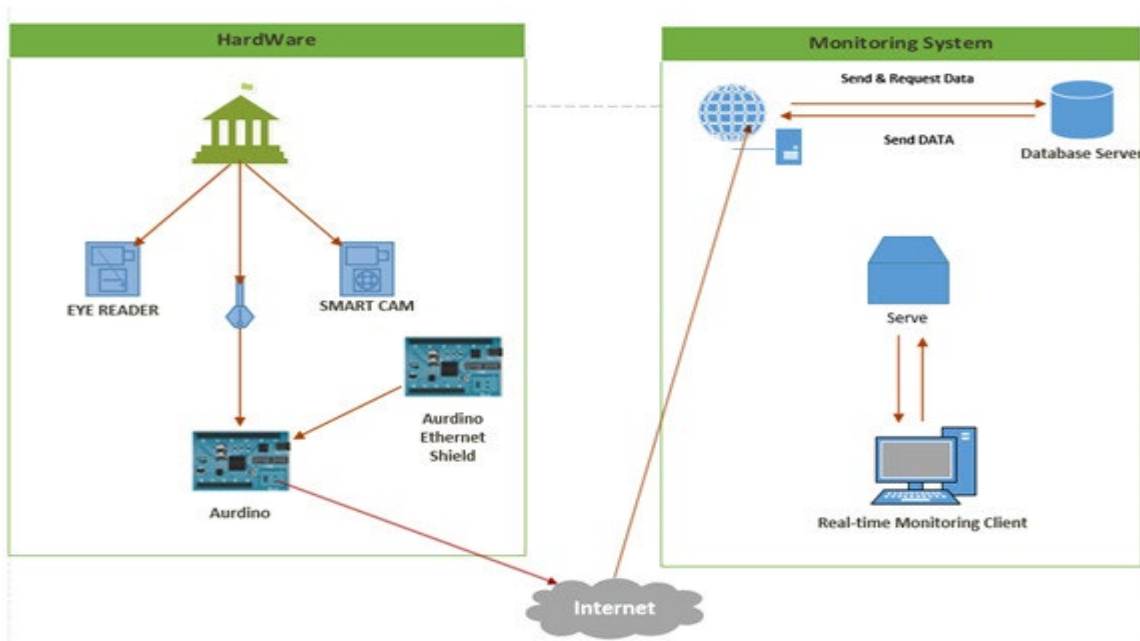
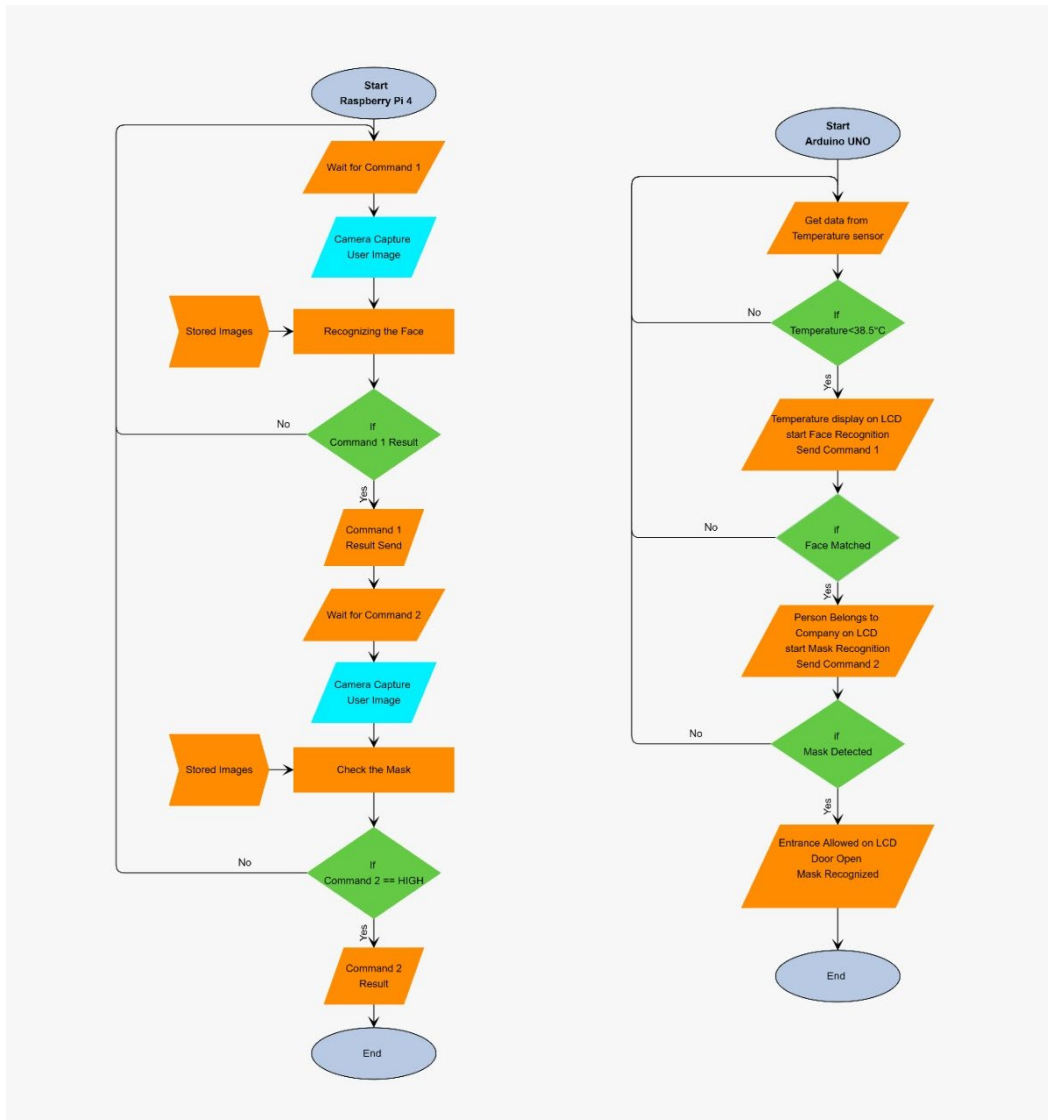


Figure 28: Logical diagram

General system engineering devices, the data retrieved by the sensor is displayed and then transmitted to the monitoring application system through the Arduino using the monitoring application using the Arduino Ethernet shield. The process begins with the employee and then passes through the temperature sensor, eye reader, and camera located in the building door. Next, the sensors collect data from the employee and send it to the Arduino. The Arduino has pinned that act as a data input and power processor. A sensor that sends data to the Arduino as a power source. Then the data obtained is stored on the server on the local PC of PC, and then immediately sent to the monitoring application. The data from the Arduino is stored on the localhost server and on the computer via Ethernet.



There are two main modules here:

One is microcontroller Arduino Uno and other is Raspberry pi 4 for processing the data for face detection and mask detection. The raspberry flow diagram is depended on the Arduino's flow diagram. First Arduino will get data from the no contact temperature sensor. if the temperature is greater the 38.5 the person will not allowed to move in the results will be displayed on the LCD screen. If the person has temperature less then 38.7. next stage will be start.

The Arduino send a trigger to raspberry pi 4 to capture the image using the camera and compare the result with the data base. If the results are matched the system send a feedback to Arduino and wait for next signal from Arduino for mask detection. the Arduino will show the result on LCD that mask detected or person belong to company. If not, the cursor move back to first condition which is checking the temperature.

6: References

- [1] Dabhade, J., Javare, A., Ghayal, T., Shelar, A. and Gupta, A. (2017) "Smart Door Lock System: Improving Home Security Using Bluetooth Technology". *International Journal Of Computer Applications* 160 (8), 19-22
- [2] Prihandani, K. and Susilo Yuda Irawan, A. (2019) "Door Lock Berbasis Internet Of Things". *SYSTEMATICS* 1 (1), 22
- [3] Mahindra.P. Shinde, Siddha Mehta, Ishaan Shanbhag and Varad Lele, Atharva Bhise (2020) "Android Based Smart Door Locking System". *International Journal Of Engineering Research And V9* (01)
- [4] Karimi, K. (2020) "Secure Smart Door Lock System Based On Arduino And Smartphone App". *Journal Of Advanced Research In Dynamical And Control Systems* 12 (01-Special Issue), 407-414
- [5] Celestine, D. (2020) "Smart Lock Systems: An Overview". *International Journal Of Computer Applications* 177 (37), 40-43
- [6] Vaničková, R., 2017. Application of PRINCE2 Project Management Methodology. *Studia Commercialia Bratislavensia*, 10(38), pp.227-238.
- [7] Shankarmani, R., Pawar, R., S. Mantha, S. and Babu, V., 2012. Agile Methodology Adoption: Benefits and Constraints. *International Journal of Computer Applications*, 58(15), pp.31-37.
- [8] Karimi, K., 2020. Secure Smart Door Lock System based on Arduino and Smartphone App. *Journal of Advanced Research in Dynamical and Control Systems*, 12(01-Special Issue), pp.407-414.
- [9] Hafdi, K., 2019. Overview on Internet of Things (IoT) Architectures, Enabling Technologies and Challenges. *Journal of Computers*, 14(9), pp.557-570.
- [10] Benn, S., Abratt, R. and O'Leary, B., 2016. Defining and identifying stakeholders: Views from management and stakeholders. *South African Journal of Business Management*, 47(2), pp.1-11.
- [11] Anoop Sharma, A., 2019. A Comparative Analysis of Agile Methods for Core Banking Software, XP Versus DSDM. *International Journal of Communication and Media Studies*, 9(3), pp.85-90.
- [12] Ward, C. and Legorreta, L., 2009. Beyond Waterfall and Agile Methods: Towards a New Contingency Model for IT Project Management. *SSRN Electronic Journal*,