# DESIGN AND IMPLEMENTATION OF TWO-WAY AUTHENTICATION SYSTEM USING RAPSBERRY PI

*Final Year Project report Submitted to Kampala International University in Partial Fulfillment of the Requirements for the Award of the Degree*

*of*

*Bachelor of Science in Telecommunications Engineering*


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**AUGUST 2019**

# DECLARATION

I ACERONGA KWOCAN hereby declare that the material submitted in this report has been compiled by me and produced to the best of my own understanding, as a prerequisite to pertain a Bachelor of Science in Telecommunication Engineering. This report has never been submitted elsewhere for any professional award in any institution of higher learning, except where due acknowledgement has been made in the text.

Signature……

Date…….

# ACKNOWLEDGEMENTS

I wish to extend my heartfelt gratitude to the Almighty God who has endowed me with the life and knowledge that has enabled me to come out with this piece of work and for having allowed me to finish these 4 years at campus. I also thank my friends and all other students with whom I have carried out this industrial training for their co-operation and mutual interaction in all the activities we engaged in during the training.

I also extend my sincere appreciation to my supervisor Mr. Ibrahim Adabara for diligently attending to me, he dedicated his time and kept in touch to see how the training was getting underway. I also thank my training officer who labored much to see that I learn all that was in store for me and benefit in a number of ways from this final year project. Not forgetting the entire board of the department of Electrical and Telecommunication Engineering of Kampala International University.

May the almighty God richly bless the above people for their genuine support rendered throughout my entire project.

# APPROVAL

This is to certify that ACERONGA KWOCAN did his Final year project from Kampala International University for a period of one year, from August 2018 to June 2019 under Mr. Ibrahim Adabara. This work has been submitted with the approval of:
Final year project.

**MR. ADABARA IBRAHIM**

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## TABLE OF CONTENTS

# ABBREVIATIONS

RFID: Radio Frequency Identity

AC: Alternating Current

DC: Direct Current

RX: Receiver

TRX: Transceiver

TX: Transmitter

# ABSTRACT

In recent years, there have been rise in the number of applications based on Radio Frequency Identification (RFID) systems and have been successfully applied to different areas such as transportation, health, education, hospitality industry and many others. RFID technology facilitates automatic wireless identification using electronic passive and active tags with suitable readers. In this project, I dealt with solving the problem of theft in our inhabitants by locking the gate and the door using RFID technology. The application of RFID as two-way authentication was designed to help people to access their gate and the door of a certain compound being identified before entering the compound to reduce on the theft in our environment and to know who enters the compound. The system will use a Raspberry Pi technology to allow it perform these tasks of identification well. In this system, once the person reaches the gate of the compound, the person has to identify him/herself by putting the tag card in front of the tag reader, this one, once identified will process the data to the Raspberry Pi and it's to the Raspberry Pi to check the given data on the tag to confirm the person's entrance and therefore the gate opens by the servo motors rotating a certain angel, then after this has happened, the gate can be opened and the person may access the gate and enter the compound, once the car has passed, the proximity sensors detects the presence of the car and after a specific amount of second, it closes the gate by reactivating the servo motors again. Similarly at the door point, when the person reaches the door he or she has entered the password and the keypad sends the code to the raspberry pi and it's the one to confirm the code whether it's to be accepted or to be ejected, and once it is allowed, the signal is sent to the servo motors controlling the door and therefore the door opens and the person may access the door and enters the house, once inside can go out by using the push button then the servo motor opens the door automatically and the person may access the door and exit the house, this is the same when you enter the house and wishes to lock the door again, all that you have to do is press the push button, and it closes automatically by activating the servo motors.

# CHAPTER ONE

# INTRODUCTION

## 1.1. Introduction

During the last few years in Uganda, the rise in theft rates has increased in great numbers. In Uganda small crimes like burglary and entering someone's compound without authorization is mostly likely ignored where as high profile crimes are highly prioritized by the law enforcement agencies. Although it's quite true that not every citizen of Uganda cannot afford to employ private security guard for their homes. Furthermore, foreigner travel in Uganda for their business purpose and other issues with a minor knowledge about Ugandan theft which has become dormant. After renting a room or a compound, these ones suffer in many ways, especially in theft. A Two-way authentication system in the residential area can secure more efficiently and aid Ugandan police to secure residents in their respective homes. However, to ensure the security of the civilian of Uganda I have the plan to design and implement a Two-way security system.

## 1.2. Background

In our real life, security system plays an important role to prevent unknown user or robbery entry secured place without authorized from owner. The security system was basically divided into two types: used normal door lock key and used electronic automatic identification system. In general, locks are very simplistic device that are employed to address very a straightforward problem. Basically, lock was easy be hacked by unwanted people allowing unauthorized people in. The lock system was not real practical used in security system and easy explores to high risk enable thieves hack this system. Therefore, there was several automatic identification technologies including barcode, keypad lock using password, magnetic stripe and Radio-frequency identification (RFID) applied in security system.

Radio-frequency identification (RFID) is an emerging technology and one of most rapidly growing segments of today's automatic identification data collection industry. RFID usage

is steadily increasing and companies across many industries are now looking at RFID to streamline operations, meet regulatory requirements and prevent the introduction of counterfeit product into the supply chain to protect both consumer safety and company profitability.

This project will implement the RFID and the Keypad technology to replace the conventional lock system to tighten the security system in our homes. The RFID system monitors the incoming and outgoing people when they entry any gate in house, while the keypad monitors all incoming and outgoing persons in the house. All of the residents will use RFID tag which is their identification cards know as smart cards and will know the password stored in the Keypad.

### 1.3. Problem statement

The main problem that this project attempts to solve is keep the house from robbery. There must be an efficient and reliable system to help the user especially resident to lock the door and the gate. Even if they are away or they are around, the system will be monitoring the entry and the exit of persons coming there.

Most residential do not think of installing an authentication system for their houses or fences and most of these people suffer from theft an authorized people enter their compound, and the most serious problem is they at times forget to lock the door because they are careless or because they are in a hurry. The two-way authentication system proposes proper system that is user easy to access. Using keypad and the RFID, user can enter and reset the password or else can use their tag to enter the compound. But in any way the system will automatically lock the gate and the door of the compound.

Employing a warden to secure the compound is difficult due to several aspects, some of these wardens are not trustworthy, they may cooperate with the thieves and therefore allow them to enter your house, or the warden may be away from the gate. This system is design to assist warden job in order to provide high security in house.

## 1.4. Objectives of the study

### 1.4.1. Main Objective

The main objective of this project is to design and implement an RFID automatic access control system which resident need to use RFID card reader to access the gate where only authentic person can be entered at their home, a password security system and an android application for accessing the door.

### 1.4.2. Specific Objective

(i) To investigate the economic benefit of using a two-way security system.

(ii) To design a two-way security system.

(iii) To validate the design system.

## 1.5. Research questions

(i) What are the economic benefits of using a two-way security system?
(ii) How to design a two-way security system?
(iii) How to validate the design of the two-way authentication system?

## 1.6. Significant of the study

Automatic door locks have become popular among homeowners, hoteliers in recent years. Although these locks were originally developed for use in cars with remote entry systems, they have been successfully modified for use in homes and hotel as well. There are a lot of reasons to consider including automatic door lock in your home and hotel. However, there are also some risks associated with this type of system, so it's important to consider all pros and cons before you install one in your home and hotel. Make sure you understand enough of the whole RFID door lock system and the password door lock. Then you'll know the model which is suitable for your situation

This is easy to maintain in case of any malfunctioning and is used to solve the problems of theft in residential of inhabitants, especially in Uganda where the theft has become worse, people are losing properties daily, but through this project, people entering the gate and even the house will all be checked automatically, and if one does not have his/her card or do not know the password of the system will not be able to access the gate or the door.

## 1.7. Scope of the Project

### 1.7.1. Context scope

This project will aim at designing a two-way automatic door lock system using keypad, RFID and android application using raspberry pi and hence to be implemented on a printed board and cased.

### 1.7.2. Geographical scope

The geographical scope of this project is home residential.

### 1.7.3. Time scope

The project started from the beginning of stage February 2019.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 Introduction

Today in most residential, there problems of theft which is arising daily, for this reason, this issue of theft need to be solved by design a system capable of monitoring our both gates and door for entry and exit. This project is to prevent unknown people to enter the gate by using RFID and prevent unknown person to access the door using password system. Radio frequency identification (RFID) refers to the use of radio frequency wave to identify and track the tag apply into an object or a living thing. It is a wireless means of communication that use electromagnetic and electrostatic coupling in radio frequency portion of the spectrum to communicate between reader and tag through a variety of modulation and encoding scheme. At their simplest, RFID systems use tiny chips called tags that contain and transmit some piece of identifying information to an RFID reader, a device that in turn can interface with computers. It operates at frequency of 125 kHz and 5V power supply. The users only need to place their RFID tag on the RFID reader to access the gate. In recent years, RFID is one of the automatic identification technologies. There is a wide research and development in this area trying to take maximum advantage of this technology, and in coming years many new applications and research areas will continue to appear. RFID system has been successfully applied to different areas as diverse as transportation, health-care, agriculture, and hospitality industry to name a few. RFID systems have been widely used in many application areas such as inventory control, product tracking through manufacturing and assembly, parking lot access and control, Automatic Toll Collection System (ATCS), Bank Locker Security System, Library Management system (LMS), Attendance Management System etc.

## 2.1 Literature Review

| Names | Work done | Year | Technology used |
|---|---|---|---|
| **Charlie Fine et. al** | RFID system can be broken down into two key dimensions. The technical infrastructure includes the actual data capture technology comprised of tags, readers, and transmission medium. | **2006** | Arduino |
| **Ahuja Sanjay and Potti Pavan** | RFID tags embedded in uniforms can be used to know the number of hours an employee spends to complete a particular task. | **2010** | Arduino |
| **Matija Bumbak** | Securing data related to the serial number on a tag, which may be stored in a network database. | **2005** | Network of a thing |
| **Kamaran Ahsan et. al** | Security of items which shouldn't leave the area, equipment tracking in engineering firms, hospital filing systems. | **2010** | Network of a thing |
| **Srivastav Nandita** | Understanding the RFID systems | **2006** | Arduino |

| | | | |
|---|---|---|---|
| **Daniel M Dobkin et. al** | Understanding the RFID systems as a communication device | **2005** | Network of a thing |
| **Juels Ari** | clandestine tracking and inventorying using RFID | **2005** | Network of a thing |
| **Jihoon Myung and Wonjun Lee** | A study on when more than one answer sends their IDs and the system does not respond to any | **2006** | Raspberry Pi |
| **Kong Wa Chiang et. al** | Prefix Randomized Query Tree protocol builds a binary search tree according to the prefixes chosen randomly by tags rather than using their ID-based prefixes | **2008** | Arduino |
| **Yang H et. al** | Static broadcast tree protocols have been proposed to optimize the querying procedure in sensor networks | **2006** | Arduino |
| **Bhandari Naval et. al** | An Intelligent Query Tree (IQT) Protocol for tag identification that exploits specific prefix patterns in the tags and make the identification process more efficient | **2004** | Network of a thing |

| | | | |
|---|---|---|---|
| **TZAY –FARN SHIN and WEN-LI HSU** | Solve the collision problem occurred in RFID system and consequently improve the efficacy of RFID | **2002** | Matlab |
| **M. V. Bueno – Delgado** | The time subdivided into the frame which occurs in the RFID | **2000** | Matlab |
| **Dahiya Ritu and Dahiya Ravindra** | Authentication protocol with proxy system | **2012** | Network of a thing |
| **Tao Li et. Al** | Design of a series of missing-tag identification protocols that employ novel techniques to reduce the execution time is created | **2010** | Network of a thing |
| **Cheng Jin and Sung Ho Cho** | Enabling fast and accurate CD by detecting the number of pulses transmitted by tags | **2012** | Raspberry pi |
| **Young-Long Chen and Xiao-Zhu Shi** | The system we have designed provides a method to help facilitate health management through an associated smart phone with Radio Frequency Identification (RFID), which is a new type of application. | **2012** | Arduino |
| **Kochar Barjesh and Chhillar Rajender** | Manufacturing, the logistics distribution and various stages of supply chains, retail store | **2012** | Arduino |

| | | | |
|---|---|---|---|
| | and quality management applications are involved in the RFID technology in business | | |
| **Widad Ismail and Khadijah Kamarulazizi** | The proposed RFID system uses tags that are mounted on the windshields of vehicles, through which information embedded on the tags are read by RFID readers; The proposed system eliminates the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively | **2010** | Network of a thing |
| **Hsi-Wen Wang et. al** | Public key encryption, embedded computation, and wireless communication technologies integrated into the active RFID system. | **2010** | Network of a thing |
| **Paul Golding and Venessa Tennanta** | A Reader orientation sensitivity, read distance, and metal and other possible sources of electromagnetic interference | **2008** | Network of a thing |
| **Thomas Plos et. al** | How the developed semi-passive RFID tags can help implementing and attacking | **2012** | Arduino |

| | | | |
|---|---|---|---|
| | security-enhanced RFID systems | | |
| **Singh Sanjay et. al** | Implementing RFID in Library Methodology system | **2010** | Network of a thing |
| **Cristina Turcu et. al** | This paper proposes an RFID-based system (named SIMOPAC) that integrates RFID and multi-agent technologies in health care in order to make patient emergency care as efficient and risk-free as possible, by providing doctors with as much information about a patient as quickly as possible. | **2009** | Network of a thing |
| **Mulla and Chandrashekara** | RFID technology provides an automated method to collect product or transaction information. | **2006** | Raspberry Pi |
| **Kamaran Ahsan** | Library security system using RFID | **2010** | Raspberry Pi |
| **Nainan Sumita et. al** | RFID system in the industries | **2013** | Network of a thing |
| **Das Sidipto et. al** | Scalable database management systems (DBMS) using RFID | **2005** | Arduino |

| | | | |
|---|---|---|---|
| **Bhanti Prateek et. al** | The implementation of cloud computing system using RFID university case | **2011** | Arduino |
| **Vouk Mladen** | The implementation of cloud computing system using RFID building case | **2008** | Arduino |
| **Sangroya Amit et. al** | Data security of service consumers using RFID | **2010** | Arduino |

## 2.2 Radio Frequency Identification

RFID stands for Radio Frequency Identification. RFID is a means of identifying a person or object using Radio Frequency Transmission. RFID is used to collect information automatically by radio frequency data communication between a mobile object and an RFID reader to identify and track them. They are most commonly referred to as reader and tag respectively. There are Tags and Reader in the system. A typical reader is a device that has one or more antennas that emit radio waves and receive signals back from the tag. To retrieve the data stored on an RFID tag, a reader is needed. RFID is used to read or write information on a tag and passing that information to a system for storage and processing. Generally, RFID system consists of 2 parts Interrogator and Transponders. Interrogator and Transponder are also known as RFID Reader and RFID Tag respectively.

### A. RFID Reader

RFID Reader is a scanning device that uses the antenna to realize the tags that are in its contiguity. It transmits signals at certain frequencies. RFID readers are usually ON,

continuously transmitting radio energy and awaiting any tags that enter their field of operation. RC 522 RFID Reader is shown below. RC 522 RFID reader is the device capable of reading and recalling information stored inside the RFID tags. There are two types of RFID readers, the active and the passive RFID readers.

**Figure 1. RFID reader**

Active RFID reader can detect an active RFID tag at few meters to line of Sight while passive RFID reader can only detect passive RFID tag at a few centimeters away from the reader. It operates at frequency of 125 kHz and 5V power supply. The effective detection range of the reader is around 10 millimeters from the antenna. The RFID reader used in the system is a low cost reader for reading passive RFID tags.

### B. RFID Tags

RFID Tag is an IC chip that has unique hexadecimal or electronic product code (EPC) contained in it. Here UNIQUE refers to each and every code word of the tag and is independent of other code word. The tag acts as a Key that is capable of opening a particular lock. So, it is also named as RFID key.

The sequence is a numeric serial, which is stored in the RFID memory. The microchip is available inside RFID tag which is shown in below. The microchips contain minute circuitry and an embedded silicon chip. Each tag can store a maximum of 2KB of information in the microchips. The tag memory can be permanent or re-writable, which can be reprogrammed electronically by the reader multiple times.

There are three types of RFID tags which are active, passive, and semi-passive. Active tags are active in nature i.e. they do not require any external source; they have their own in-built battery. Passive tags are passive in nature i.e. they do not have any battery source

built in them. They draw their power from the electromagnetic field generated by the RFID reader. They have no active transmitter and rely on altering the RF field from the transceiver in a way that the reader can detect.

**Figure 2. RFID Tags**

They transmit low frequencies so that can be detected up to few meters of distance. Tags are available in various shapes and sizes which are shown in table 1. A Semi-Passive tag exists, which has the features of both Active and Passive tags. Semi-Passive Tags have their own power source that powers the microchip only. They have no transmitter and as with Passive tags they rely on altering the RF field from the Transceiver to transmit their data. The different types of RFID Tags are shown in table.

| Feature | Passive | Active | Semi-Passive |
|---|---|---|---|
| Read Range | Short (Up to10cm) | Long (Up to100m) | Long (Up to100m) |
| Battery | No | Yes | Yes |
| Life validity | Up to 20 years | Between 5-10 Years | Up to 10 Years |
| Storage | 128 bytes read/write | 128 Kbytes read/write | 128 Kbytes read/write |
| Cost | Cheap | Very Expensive | Expensive |
| Application | Attendance Management System | Monitor the condition of fresh produce | Measurement of temperature periodically |

**Table 1.**

Tags operate on Low frequency (LF) (30 KHz-300 KHz), High frequency (HF) (3MHz-30MHz), Ultra high
frequency (UHF) (300MHz-3GHz) and Microwave (2.4 GHz-5GHz).

## 2.3 Related work done

In the previous work done by Dhrubajyoti Adak, Manoj Kumar Pain, Uttam Kumar Dey, these people have done a RFID based security system using Arduino. In this system, they were solving still the problem of non-authorized persons entering a building and hence, they went forward and made a security system such that everyone who enters the building must be controlled at the entrance before accessing the building for better security in the building as shown in the **figure 3**.

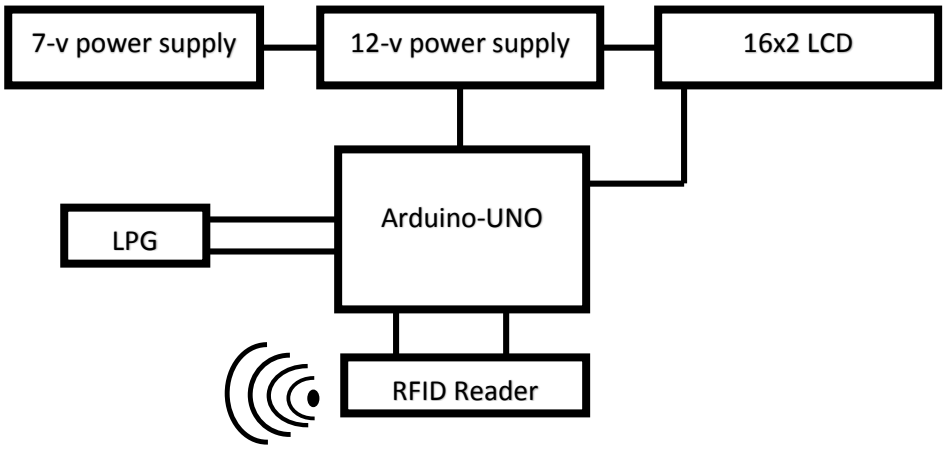


**Figure 3. RFID based security system**

Therefor in my own project I to look forward solving the problem of theft by using the same technology of the RFID but then, instead of using Arduino microcontroller I preferred using Raspberry Pi to solve the issue of theft in the country, especially in the rural areas of Uganda. The illustration of this project is shown in the **figure 4** of this report. However, some suggestions and recommendations mentioned on the **pages 30** and **31** of this report to allow the next person who would like to improve on this project to continue from.

# CHAPTER THREE

# METHODOLOGY

## 3.0 Introduction

This project is based on providing security for the household through two different ways of identifications which are all embedded in the system by the use of a microcontroller called raspberry pi. The system comprises of hardware and software application program for the raspberry pi which was developed using mikroC programming language. The hardware units is composed of the following units: RFID tag, RFID reader, a push button, a display unit, raspberry pi and a Keypad. The other hardware systems such as the power units are on the diagram of the circuitry.

**Block diagram of the circuit.**

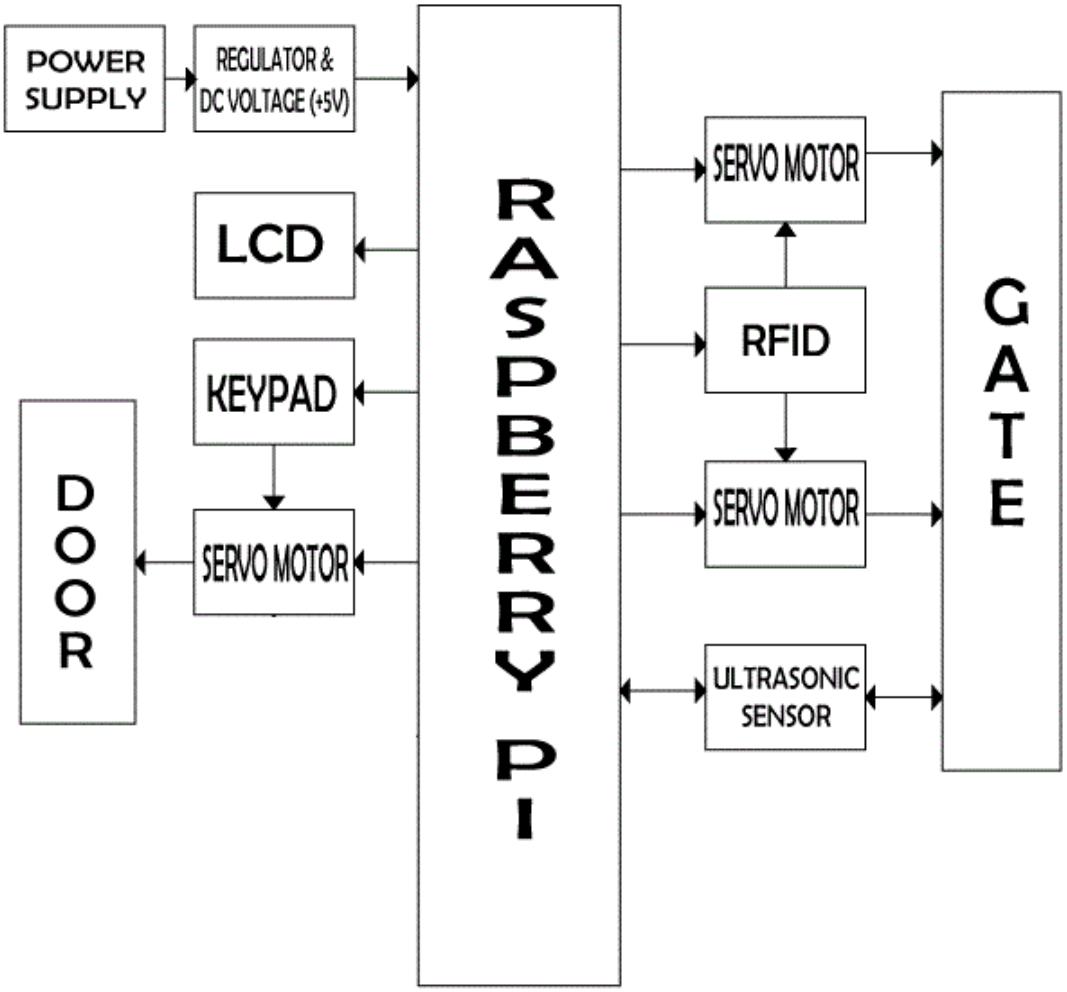


**Fig. 4 Block diagram of Two-Way Authentication System**

**Circuit diagram of the circuit.**

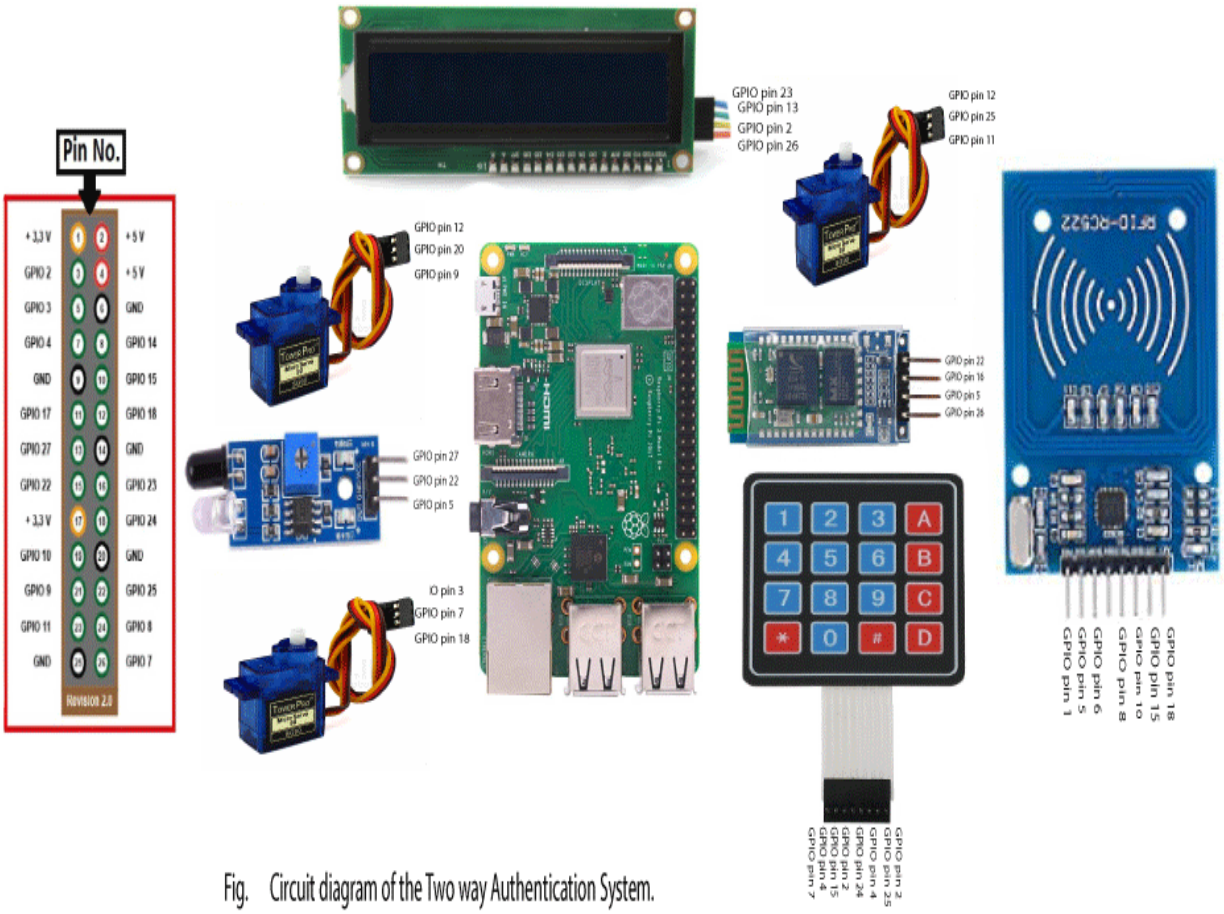


Fig. Circuit diagram of the Two way Authentication System.

**Flowchart of the circuit**

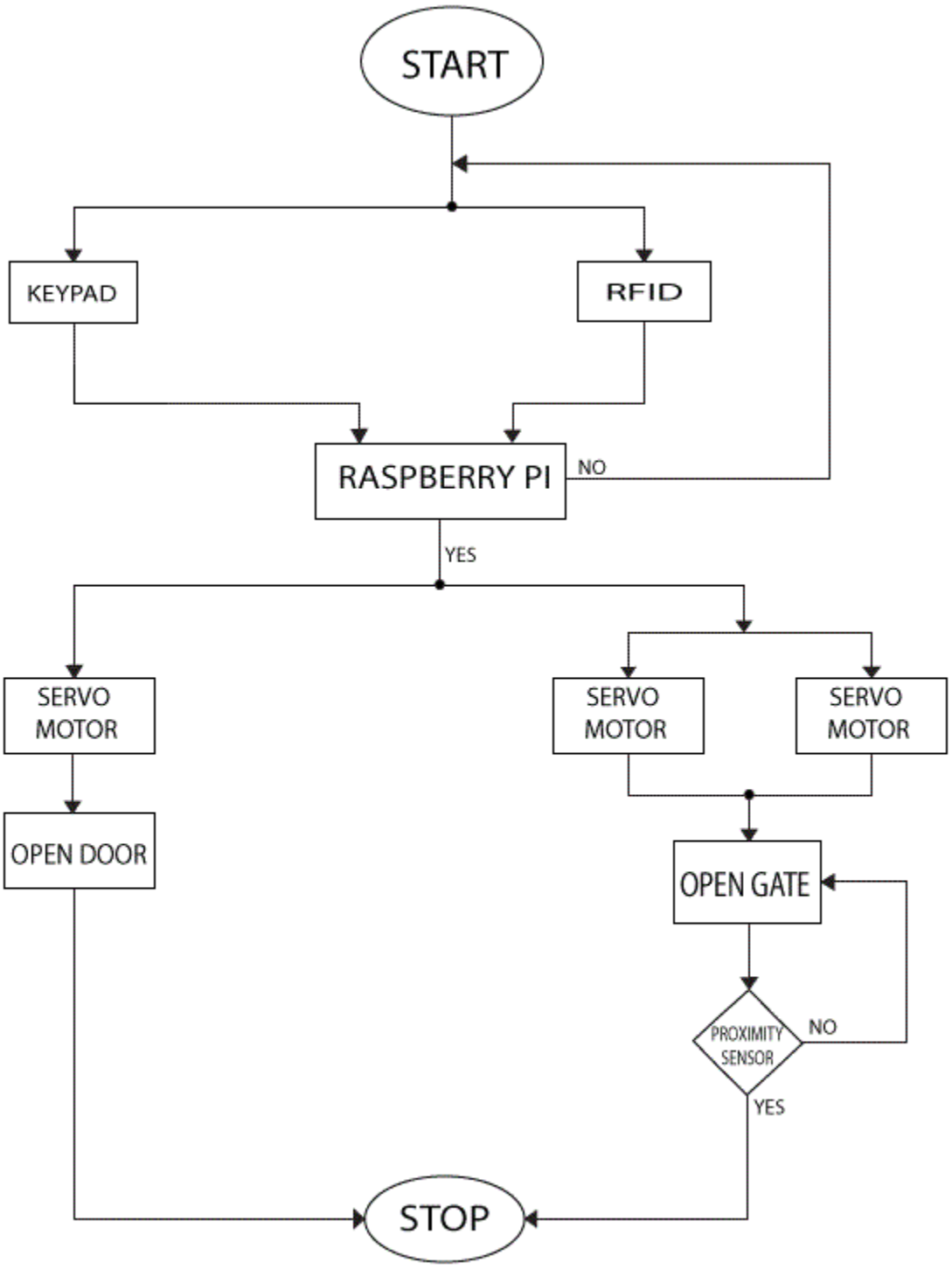


Fig. Flowchart of the Two way Authentication System

In this project, as shown above there are presence of several electronic components used, there is a proximity sensor in the diagram, there are servo motors there is also a digital display, RFID reader there is also a Keypad, Raspberry Pi B+3 all these components are used in the circuit. The input devices (Keypad and the RFID reader) detects the signals coming from either a password or from a RFID tag then send these signals to the Raspberry Pi which in its turn controls these signals and sends the answers to the output devices which are the Servo Motors, and once these output devices receive the signals from the Raspberry Pi, the open the gate or the door and hence the system closes the circuit, and the proximity sensor is there to send back the signal to the Raspberry Pi in case of any detection of the passage and therefore the servo motors of the gate close the gate. The push button is made for opening and closing the door in case of emergency or to allow a person inside the house to come out of the house.

## 3.1 Components used

### 3.1.1 RFID Reader

RFID Reader IP10 proximity card reader with operating frequency of 125KHz and reading distance up to 4 inches is used. The reader can be easily installed on metal doors, provides the tag information serially in RS232 format and is suitable for indoor as well as outdoor operations [11]. Three such readers are installed for hostel security: hostel entrance gate, hostel exit gate and mess entrance gate.

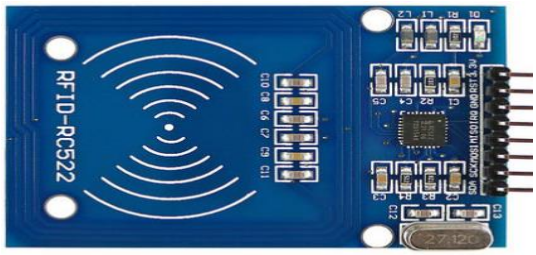


**Figure 7. RFID Reader**

### 3.1.2 RFID tag

RFID Tag IPC80 passive RFID tag operating at a frequency of 125KHz is issued to the user. The tag transmits information to the reader in ASK format.

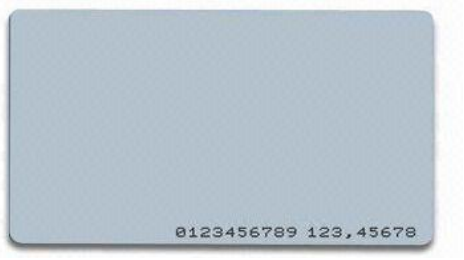


**Figure 8. RFID tag**

### 3.1.3 Liquid crystal display

IC/I2C Interface Adapter Module is used for 16×2 LCD Display. It uses the PCF8574T IC chip which converts I2C serial data to parallel data for the LCD display. Also this interface module simplifies connecting an Arduino to a 16×2 Liquid Crystal display using only 4 wires.

**Figure 9. LCD screen**

**Specifications:**

Supply Voltage: 5V

- Interface: I2C
- Compatible for 16×2 LCD
- Brightness and Contrast can be adjusted by the Potentiometer

**Hardware connections:**

First connect the I2C LCD adapter to LCD display by simply soldering the I2C adapter as shown in the image. Now connect the adapter to Uno as follows:

- Vcc to 5V
- Gnd to Gnd
- SDA to A4
- SCL to A5

### 3.1.4 Raspberry Pi-3 Model B

Raspberry Pi-3Model is the third generation Raspberry Pi. It replaced with Raspberry Pi 2 Model B in February 2016. As of January 2017, Raspberry Pi-3 Model B is the newest version of Raspberry Pi. It is as small as credit card size. Also it is open source therefore changes can be made to it as and when required. Compared to the Raspberry Pi 2, it has 802.11n Wireless LAN as well as Bluetooth 4.1 and Bluetooth Low Energy (BLE). For the Raspberry Pi-3 Model B, CPU speed ranges from 700 MHz to 1.2 GHz and on board memory range from 256 MB to 1 GB RAM.

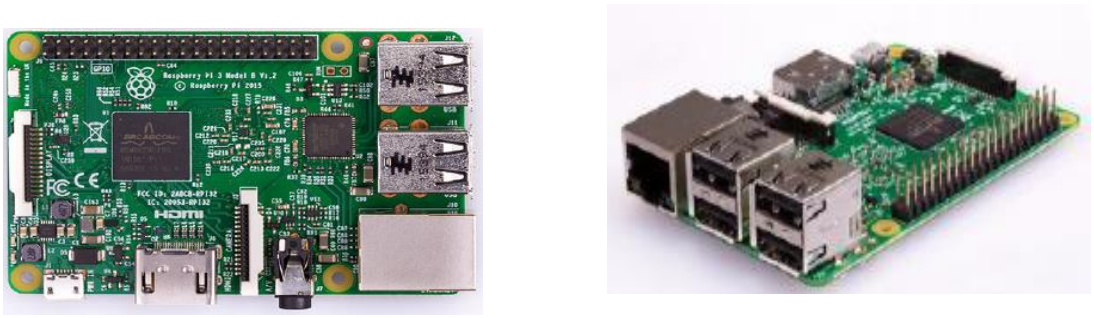

**Figure 10. Raspberry Pi-3**

Raspberry Pi-3Model B which uses system on chip (Soc) BCM2835. It does not have storage drive but one can use SD card for storing operating system as well as for booting and long term process. The Raspberry Pi-3Model B runs on Raspbian OS and it is programmed using python 2.7.6. Also one can install various different type of software's for different purposes. Four USB ports for external storage, 40 GPIO pins for interfacing with hardware and full HDMI port are available on Raspberry Pi- 3Model B board.

The Broadcom BCM2835 SoC used in the first generation Raspberry Pi is somewhat equivalent to the chip used in first generation smartphones (its CPU is an older ARMv6

architecture), [14] which includes a 700 MHz ARM1176JZF-S processor, VideoCore IV graphics processing unit (GPU),[15] and RAM. It has a level 1 (L1) cache of 16 KB and a level 2 (L2) cache of 128 KB. The level 2 cache is used primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its edge is visible. The Raspberry Pi 2 uses a Broadcom BCM2836 SoC with a 900 MHz 32-bit quad-core ARM Cortex-A7 processor (as do many current smartphones), with 256 KB shared L2 cache. The Raspberry Pi 3 uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache

### 3.1.5 Servo motor

The **servo motor** is most commonly used for high technology devices in the industrial application like automation technology. **Servo motors** have three wires: power, ground, and signal. **The** power wire is typically red, and should be connected to **the** 5V **pin** on **the** Arduino board. ... **The** signal **pin** is typically yellow, orange or white and should be connected to a digital **pin** on **the** Arduino board.

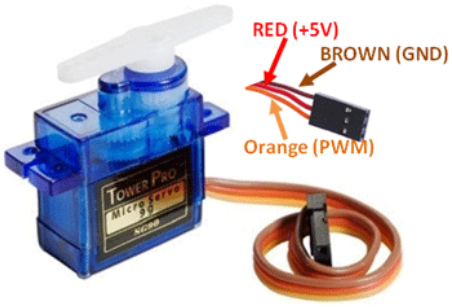


**Figure 11. Servo Motor**

### 3.1.6 Proximity sensor

This IR Proximity Sensor is a multipurpose infrared sensor which can be used for obstacle sensing, color detection, fire detection, line sensing, etc and also as an encoder sensor. The sensor provides a digital output.

The sensor outputs a logic one(+5V) at the digital output when an object is placed in front of the sensor and a logic zero(0V), when there is no object in front of the sensor. An onboard LED is used to indicate the presence of an object. This digital output can be directly connected to an Arduino, Raspberry Pi, AVR, PIC, 8051 or any other microcontroller to read the sensor output.

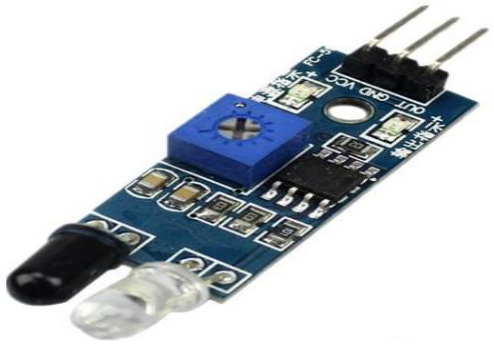


**Figure 11. Proximity Sensor**

**Specification:**

- Operational Voltage: 5V
- Ambient Light & RGB Color Sensing
- Proximity Sensing
- Gesture Detection
- Operating Range: 4-8in (10-20cm)
- I2C Interface (I2C Address: 0x39)

## 3.2 Design of the System

At the beginning of this project, I proposed a two-way security system using keypad and RFID. Later on the system was implemented in two stages, the hardware stages and the software stage. These stages are the ones used in this project to come up with project and to implement it on the board as illustrated in the above figures of the circuitry. The components used both software and hardware were already explained in the introduction of this chapter, therefore I can still explain the details of the proposed and the implemented project in form of stages as follow:

**Stage 1. The input devices (RFID reader and the Keypad)** this device finds the saved information about the person allowed to pass in the RFID tags which is always in form of electromagnetic signals from a range of some few millimeters from the tag. Similarly, the keypad after receives the password inserted to it.

**Stage 2.** after receiving the information, the reader sends it to the Raspberry Pi for further identification of the person. Same way, the keypad does, it sends the signal to the Raspberry Pi for verification of the password.

**Stage 3.** The Raspberry Pi verifies the information, if its correct or incorrect.

**Stage 4.** If the information is correct, it allows the signal to pass and to go to the Servo Motor for opening of the gate. Otherwise it sends back to the LCD screen the message encored "Wrong password, try again" and for the case of the RFID, it sends back to the reader.

**Stage 5.** The proximity Sensor is therefore activated by the passage of the gate over it, and waits for the car of the person to pass over it or in its range of action then time some seconds to act.

**Stage 6.** The proximity Sensor after receiving a signal of a passage, sends the signal to the Servo Motor which closes the gate of the fence.

**Stage 7.** The door being open can be closed by pressing on button "F" of the keypad or else by the emergency push button.

RFID reader was connected to the system through USB port to provide communication between system and RFID reader. The output control signal is generated by system through parallel port which controls the opening and closing of door by means of steeper motor. The technical specifications of the RFID are as follows:

- ✓ Power: DC6V, 4 standard AA alkaline batteries

- ✓ Read speed: 0.5 ~ 1.0 second
- ✓ Capacity: 100 different cards
- ✓ Maximum reading rang: RFID card: less than 30mm
- ✓ Card format: For ID card EM.125K
- ✓ Door Lock: Motor driven locks and unlock
- ✓ Battery life: More than 4,000 times open/close of door
- ✓ Low voltage warning: When CPU working voltage is less 4.8V, the lock can still be opened 200 times before the batteries are replaced
- ✓ Door thickness request: 32mm ~ 45mm

**Python Scripting Language**

Python is a widely used general-purpose, high-level programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C++ or Java. The language provides constructs intended to enable clear programs on both a small and large scale.

Python supports multiple paradigms, including oriented, imperative and functional programming or procedural styles. It features a dynamic system and automatic memory management and has a large and comprehensive standard library. Python interpreters are available for installation on many operating systems, allowing Python code execution on a wide variety of systems. Using third party tools, such as Py2exe or Pyinstaller, Python code can be packaged into stand-alone executable programs for some of the most popular operating systems, allowing for the distribution of Pythonbased software for use on those environments without requiring the installation of a Python interpreter.

CPython, the reference implementation of Python, is free and open-source software and has a community-based development model, as do nearly all of its alternative implementations. CPython is managed by the non-profit Python Software Foundation.

Python is a multi-paradigm programming language: object-oriented programming and structured programming are fully supported, and there are a number of language features

which support functional programming and aspect-oriented programming (including by metaprogramming and by magic methods). Many other paradigms are supported using extensions, including design by contract and logic programming. Python uses dynamic typing and a combination of reference countinG and a cycle-detecting garbage collector for memory management. An important feature of Python is dynamic name resolution (late binding), which binds method and variable names during program execution.
The design of Python offers only limited support for functional programming in the Lisp tradition. The language has map (), reduce () and filter() functions; comprehensions for lists, dictionaries, and sets; as well as generator expressions. The standard library has two modules (itertools and functools) that implement functional tools borrowed from Haskell and Standard ML.

## 3.3 Working of the system

A new user is once registered with the system, the system stores all the information necessary about the user and the corresponding information is saved in RFID tag. This RFID tag will be accessible through the system. When a registered user comes to the gate, and put the tag before the reader, the system checks whether it is registered or it's an imposter.
If the user is registered, and the tab information is matched with the user information stored in system. The door is open for the entry of the user after successful authentication and close automatically after a specified time due to the proximity Sensor installed in the system.

The password is also stored in the system, once the password is saved in the system, the person coming to access the door must be in possession of the password, once he or she insert the password, the door opens and if the password is incorrect, it sends you the notice "Wrong password, try again" and once it's correct, it opens the door and therefore you can access the door and enter the house.

# CHAPTER FOUR

# DISCUSSION AND RESULT OF THE SYSTEM

## 4.0 Results of the system

After the system is plugged on power +5v dc, the whole of the system will be powered, and therefore, before someone comes with the tag or comes to input the password the system will be stable at its normal state, everything will be closed though there will be power and the whole system will be powered just as illustrated in the picture below.

**Figure 12. The system at work 1**

Then after the tag is showed to the tag reader and its validated, the gate opens and the person may access the gate and therefore the car may now enter the gate as shown in the figure below.

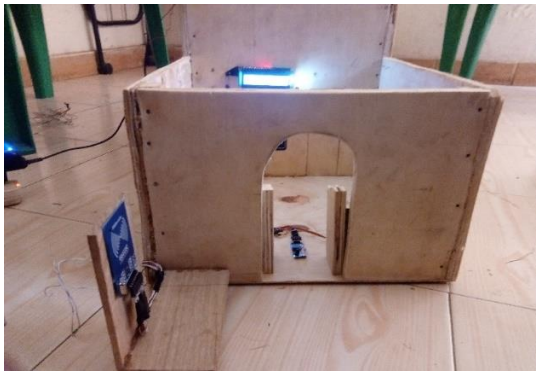

**Figure 13. System at work 2**

And once the car has entered the gate and has bypassed the proximity Sensor, hence it sends signals to the Servo Motor and closes the gate immediately as shown in the figure below.

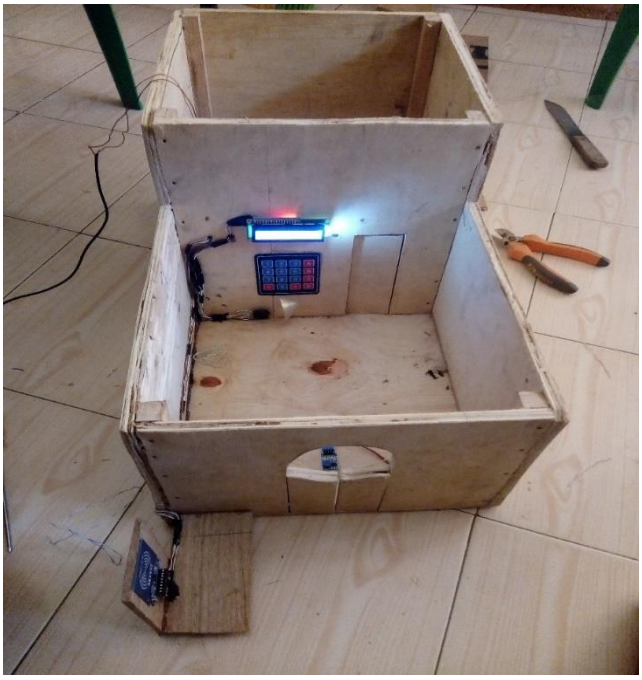

**Figure 14. System at work 3**

The same scenario applies for the keypad, if u enter the password and it is not correct, it rejects the password and asks u to put again the password. As shown below.

**Figure 15. System at work 4**

Once your password is confirmed and validated, it opens the door automatically and therefor you can access the door and enter the house. Just as illustrated in the image below.


**Figure 16. System at work 5**

Then lastly the emergency button helps in closing the door, after entering it or in case you're inside the door and want to leave. The emergency button is shown in the figure below.

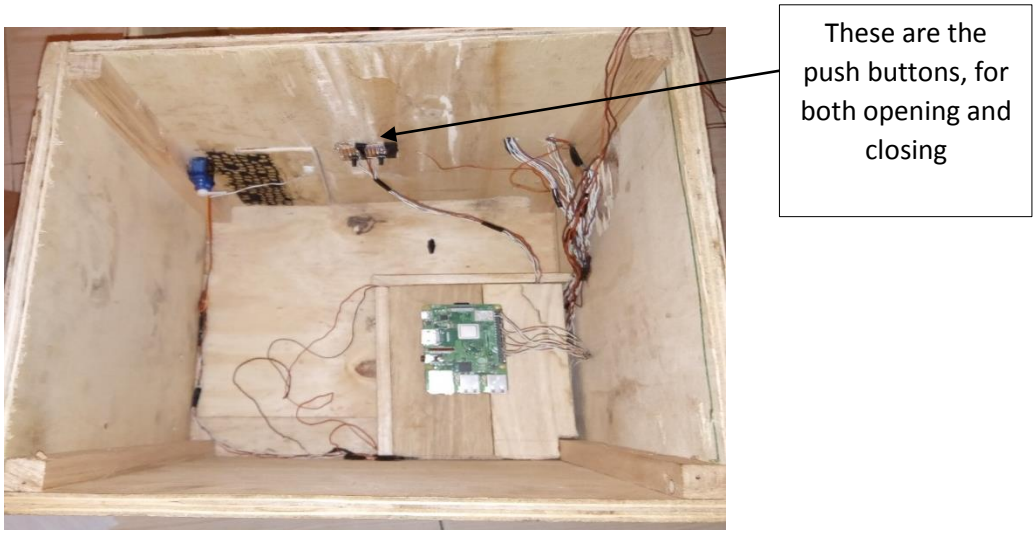


**Figure 17. System at work 6**

# CHAPTER FIVE

# CONCLUSIONS AND RECOMMENDATIONS

## 5.0 Conclusions

This project is the design and implementation of a two-way security system using Raspberry Pi. This system is generally made for the security of residence in a certain compound, it was designed due to the level of theft which is daily increasing in the rural area of the world especially in Kampala Uganda where people are complaining of theft daily. By doing this project there are numbers of advantages offered to the users of this system. This system is small and does not cost much money to implement, similarly the system can be implemented in any of the gate or door of any residential, banks, hospitals, labs and other sophisticated automated systems, which dramatically reduce the hazard of unauthorized entry.

As the RFID technology evolves, more sophisticated applications will use the capability of RFID to receive, store and forward data to a remote sink source. RFID has many applications as can be imagined. In this project, I have utilized the versatility of RFID in gate and door security system of a residential, similarly the Raspberry Pi possesses several function, kit can perform a number of things but for this case, I only used it for monitoring the entrance and exit of a residential.

## 5.1 Recommendations

Every good engineering design innovation has limitations. This two-way security system is not without limitation as well. Hence, the limitation of this design would be improved upon in future by considering the following recommendations:

- ✓ By incorporating a facial recognition application that would serve to further increase the biometric security of the system against unknown persons.

- ✓ Usage of High Frequency (HF) active RFID tags against passive Low frequency (LF) RFID tags for better performance and flexibility of users

- ✓ Performance evaluation of combination of thumbprint, facial recognition and RFID technology to secure the system mostly

- ✓ Designing a system able to recognize the person using the machine and to provoke an alarm in case of unrecognized person trying to login the system or trying to enter the gate/door.

# Chapter Six

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# APPENDICES