Research Article

Password Based Door Locking System

Doris Chasokela*[1], Lister S. Tshuma[1], Kumbulani Matshe[1], & Mandla Sibanda[1]

[1]Department of Technical and Engineering Education and Training, Faculty of Science and Technology Education, National University of Science and Technology, Zimbabwe

Abstract: In this modern world, security is the main challenging thing and crime has become ultra-modern too Motwani, (2021); Ray (2022); Rahman et al. (2018); & Vamsi, et al. (2019). In this current time a lot of incidents occur like robbery, stealing, and many more. Anyone can enter your private home at any time to steal your property. Doors serve as entrances to our homes, offices and many other kinds of enclosure; they may also provide access for strangers, criminals, and offenders. Doors are meant to be secured and to prevent intrusions from unwanted persons. Individuals and cooperate bodies are becoming more aware of the dangers associated with relying on keys and parameter fencing to provide security to exclusive areas of their apartments and organization because criminals and fraudsters can forge keys or make master keys that can be used to break into such rooms or offices. So the security does matter in this daily life. People always remain busy in their day to day work also want to ensure the safety of their beloved things. Sometimes they forget to look after their necessary things like keys, wallets and credit cards. Without these, they are unable to access their home or any place they want. To prevent such incidents many scholars came into action and tried to prohibit them. In this experimental design, a new system is designed using ARDUINO UNO which would control the door through utilizing a camera and a distance ultrasonic sensor-based technology without any complexity. A motor is fitted to the door so that door will open only when password is matched. The system keeps a picture of the visitor as evidence that would be needed if any unwanted situation occurs like stealing, and robbery. This experimental design has a known password and the information is stored in the database. When the correct pass code is entered, the microcontroller will give instruction to servo motor. Servo motor performs the action on door unlocking.

Keywords: Arduino Uno, 4*4 Keypad, Distance Ultrasonic Sensor, 16*2 LCD, Buzzer, Servo Motor.

BACKGROUND TO THE STUDY

Over the years, various control systems have been designed to prevent access to an unauthorized user. The main reason for providing locks for our buildings (home, office, church and school) is for security of our lives and property. It is therefore important to have a stress free and convenient means of achieving this purpose. In order to save the belongings most of the people employed watchdogs and security personnel. They both did well for some time. But both of them can be easily deceived. If properly planned, the burglars could easily deceive a watchman and could even kill him. A single watchman can't fight against 3 or 4 burglars. Even the watchdogs can be made unconscious with the help of chloroform.

As everyone knows old fashioned locks are heavy weight and fragile also depending on the tools therefore electronic locks are given more value than those of mechanical locks. These failures paved way for the development of intelligent door security systems, which have promised perfect protection of the assets and life. Nowadays every device's operation is based on digital technology. For example, technology based identity devices are used for automatic door unlocking or locking. These locking systems are used to control the movement of door and are functional without requiring a key to lock or unlock the door. These locking systems are controlled by a keypad and are installed at the side edge of the door. The main objective of this project is to give safety at every common place like home, public places. The solutions currently available in the market are satisfactory but high security solutions come at an expensive price. Hence an economically feasible security system has become the need of the hour.

Aim

The research seeks to design and implement password based locking system. The application will integrate a power supply, an arduino uno, a distance ultrasonic sensor, LCD, buzzer, servo motor, 4*4 keypad and a camera to capture pictures of the visitors as evidence that would be needed if any unwanted situation occurs like stealing, and robbery.

Scope of the Study

House breaking has consistently been the most common crime experienced by households, banks and institutions in Zimbabwe. Nowadays it is most important to keep our valuable things safe. The world is also growing digitally dependent, and we can even design the doors to be more secure. The aim of this project is to come out with a password based door lock system which is more secure than traditional lock system. It will be more efficient for the peoples in the field of security. It will be implemented in any places

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*Corresponding Author: Doris Chasokela

like our Houses, Institutions, Banks and any Public Places.

Relevance of the Study

As we all are facing the fear of robbery, people cannot keep their valuable things safely even at their own houses, banks or in any other places. They are always in fear of losing their valuable things. Old traditional locking system is not that safe as password based door locking system. So this project provides much more lock security as compared to traditional lock security. The old traditional lock system has been replaced with password. This project will provide efficient security to the users at low cost. It will be also easy to implement and give safety in any places like our houses, institutions, banks or any other public places. If the users forget the password, then they will have to change or reset the password, which gives the more flexibility to the users.

LITERATURE FOR OTHER SIMILAR DESIGNS

In this 21st century there are just a few digital approaches for door security locks in the current system. This contemporary smart locking system takes the place of the classic lock and key locking method. Modern living is largely reliant on technological advancements, such as opening doors, managing the air conditioning, and regulating the curtains. People want to feel safe in their own homes, offices, and stores. The primary motivation for the development of smart locks is to meet the needs of people.

Passwords aren't a novel concept when it comes to locking doors. However, as technology advances, these systems have become more sophisticated. Prabhakar *et al.* (2018) in his article shows how an ARDUINO UNO password-based door lock system is created, where the door is unlocked and the user who input the right code is authorized to enter the zone. And the common individual can bid on such a locking system for a low price in order to ensure the protection of their valuables.

A password door lock system is defined as an electronic and mechanical locking device that opens wirelessly with an authorized user's authentication, Rouse (2017). Anyone can enter your private home at any time to steal your property. In this day and age, security has become an utmost importance, be it one's home, car, offices and institutions. To protect your home from thieves one must be secured. The solutions currently available in the market are satisfactory but high security solutions come at an expensive price. Hence an economically feasible security system has become the need of the hour.

Password Based Door Lock System is designed using ARDUINO UNO, Hlaing & Lwin (2019) where in once the correct code or password is entered, the door is opened and the concerned person is allowed access to the secured area. Password Based Door Lock System using Arduino UNO is a simple project where a secure password will act as a door unlocking system. If another person arrives, it will ask to enter the password again. If the password is wrong, then door would remain locked, denying access to the person. Main idea behind this project is of a door-latch opening using a password entered through keypad. As well as turning on the Buzzer when pass code is entered wrong. User can modify this password anytime he or she wishes using a keypad. The main component in the circuit is Arduino uno. Keypad is used to enter the password. The entered password is compared with the known password. If it is correct password, the system opens the door by servo motor, Sia *et al.* (2022) and displays the status of door on LCD. If the password is wrong then door remains closed and displays "CODE INCORRECT" on liquid crystal display.

EXPERIMENTAL SET UP OF A PASSWORD BASED DOOR LOCKING SYSTEM
System Design

The experimental research design involves the development of password based door lock system for individuals to get access to restricted areas. The experiment is configured using hardware and software component. The hardware components of the system model consist of power supply**,** Arduino Uno**,** 4*4 Keypad, distance ultrasonic sensor**,** 16*2 LCD, buzzer**,** **s**ervo motor**,** **c**amera**,** **r**elay and an NPN transistor, Rahman *et al.* (2018). The Proteus software development tool is going to be used in this project. Proteus is a complete development platform from product concept to design completion. Its advantages are intelligent principle layout, hybrid circuit simulation and accurate analysis, single-chip software debugging, single-chip and peripheral circuit co-simulation, PCB automatic layout and wiring. The Software requirements include Proteus Design Suite for simulation and Arduino IDE for programming.

SYSTEM BLOCK DIAGRAM

The block diagram shows the main components that make up the system and how they are interconnected.

Figure 1: System Block Diagram

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*Corresponding Author: Doris Chasokela
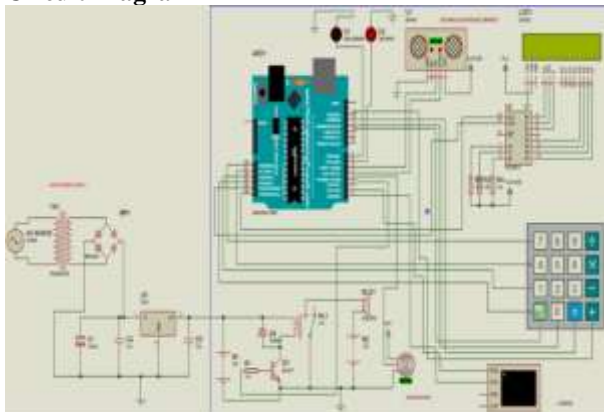
Circuit Diagram

Figure 2: System Circuit Diagram

Operation of Password Based Door Lock Security System

The password based door locking system is composed of the following block diagrams as indicated on figure 2. The power supply provides a source of power and charges the battery to cater for backup power when power cuts. The keypad which is used for entering the password, the distance ultrasonic sensor senses and measure the object at 10metres but in this case it is programmed it to measure the distance within 5metres. Liquid Crystal Display (LCD) which displays the status at different scenario, the servo motor rotes at 180 degrees to open the door. Buzzer beeps once wrong code or password is entered and the camera is for capturing and keeping pictures of visitors as evidence that would be needed if any unwanted situation occurs like stealing, and robbery, Rane (2015). Immediately after running the simulation the LED (red) turns red indicating a high voltage signal but the door is locked. All the red square dots indicate high voltage (5V) while the blue square dots indicate a low voltage or zero voltage. Since the distance on the ultrasonic sensor is above 5, the LCD displays ***Enter the code to open Door***. The camera pops up a virtual terminal displaying the distance which the sensor measure to one decimal place. Reducing the distance on the ultrasonic sensor to below 5, the LCD displays ***Enter the Code***. When the correct code or password is entered, it will match it with the password stored in the Arduino. If it is correct, then it will rotate the servo motor to 180 degree as the door is opened then the LCD displays '**Access Granted, Welcome'**. It will then give 5 seconds time for entering via the door. Once 5 seconds is completed, the door will be locked automatically. If the password is wrong, then it will show **'Code Incorrect'**, the buzzer will also beep when any key is pressed, Goswami *et al.* (2017); & Vadakkan *et al.* (2021).

HARDWARE CONNECTIONS

The power supply circuit consists of the circuit for conversion of 220 volts, 50Hz AC into 12V and 5V DC. This is achieved by the use of a step-down 12V-0-12V center-tapped transformer with a full wave rectifier. The AC ripples are eliminated using the capacitor and the LM78 voltage regulator used to regulate the output voltages. 5V DC is used to power the Microcontroller and the LCD. The 12V DC is used to power the DC motor that drives the door and also powers the relay circuits.

Arduino is an open source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting with electronics, and for good reason. Arduino board is used to program and code the action of our system's devices. It consists of a programmed circuit board and can be considered a microcontroller. The main advantage of using that board is that it can execute the program automatically, low cost and it consumes less than 12 V. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. The distance can be measured by taking into account the elapsed time between the sound wave being generated and the sound wave bouncing back to the receiver. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns. Ultrasonic sensors are suitable for close range detection up to ten meters and provide multiple range measurements per second. An ultrasonic sensor is generally used to measure the distance of an object using sound waves. The main merits of an ultrasonic sensor are that low power consumption (can be powered by battery, inexpensively) and it can operate in many environmental conditions – ultrasonic sensors work in smoke-filled environments, where other sensors would fail.

The buzzer is a sounding device that can convert audio signals into sound signals. It is usually powered by DC voltage. It is widely used in alarms, computers, printers and other electronic products as sound devices. It is mainly divided into piezoelectric buzzer and electromagnetic buzzer, represented by the letter "H" or "HA" in the circuit. According to different designs and uses, the buzzer can emit various sounds such as music, siren, buzzer, alarm, and electric bell.

The 4 X 4 keypad consists of four rows and four columns interfaced to the Arduino uno to take the input from the user. The input is then matched with the present password to check the validity of the password

if the password is valid, the door will be unlocked. If invalid, the door lock will remain locked.

The 16 * 2 Liquid Crystal Display (LCD) which I use displays alphabets along with numbers on 2 lines each containing 16 characters. I have chosen this LCD because it uses Complimentary Metal-Oxide Semiconductor (CMOS) technology which has low power requirements. It consists of 16 pins; 8 data lines, 3 control lines, 2 power lines, 1 contrast line and 2 pins for back light LED connection. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD such as commands for clearing its screen and setting the cursor position. The data register stores the data, which is ASCII value, to be displayed on the LCD.
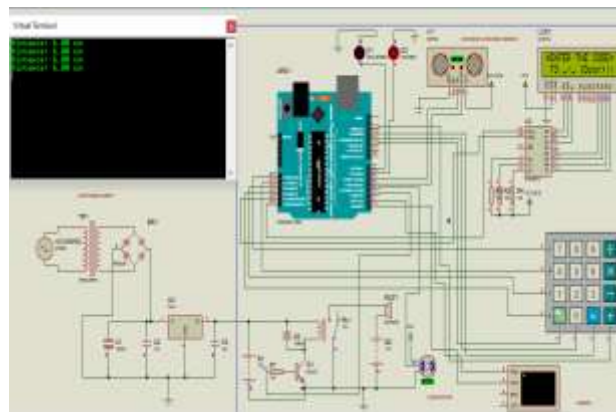
The servo motor is most commonly used for high technology devices in the industrial application like automation technology. It is a self-contained electrical device that rotates parts of a machine with high efficiency and great precision. The output shaft of this motor can be moved to a particular angle. Servo motors are mainly used in home electronics, toys, cars and airplanes.

OV7670 Camera Module is a small size, high sensitive and low voltage CMOS image Sensor module for capturing and processing the image. The OV7670 is a low cost image sensor DSP that can operate at a maximum of 30 fps and 640 x 480 ("VGA") resolutions, equivalent to 0.3 Megapixels. OV7670 camera module is the most affordable camera module that can be used with the Arduino and can be used in many projects. This module allows you to capture images in VGA format (640x480). It can perform some initial processing and transfer the images to microcontrollers, such as the Arduino, via the SCCB interface. The maximum image transfer rate (VGA) can reach 30 frames per second. The camera also performs pre-processing of images, such as exposure control, amplification, white balance, and more.

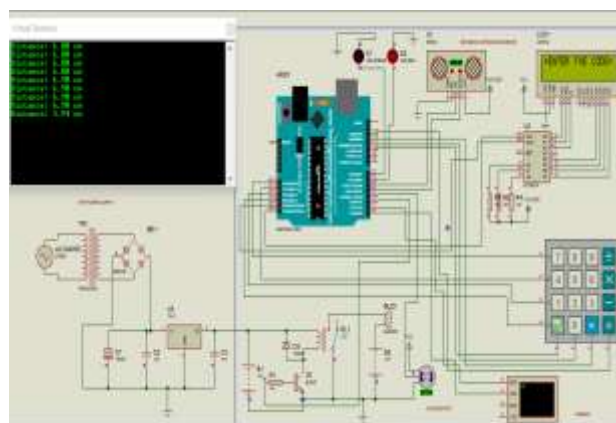## SIMULATION - MODELLING AND RESULTS PRESENTATION

Case 1:

If the simulation is run, the red light emitting diode turns ON. All the red square boxes on the circuit and the red LED indicate a high voltage signal. The blue dots resemble a low voltage. The turning on of the red LED denotes the circuit is locked. Circuit displays enter the code to open the door on the LCD and the camera is used to capture all the persons entering the secured place as well as those trying to steal. In this case because its simulation I have used a camera to capture the distance sensed by the distance ultrasonic sensor and is displayed on the virtual terminal.
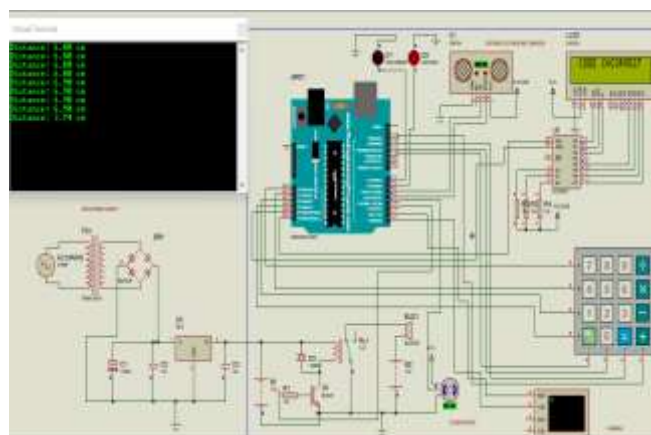

Case 2:

The ultrasonic sensors are suitable for close range detection up to ten meters. In this project wanted my ultrasonic to sense at 5 meters. Once I reduce the distance to 5 meters and below the LCD displays *ENTER THE CODE*.
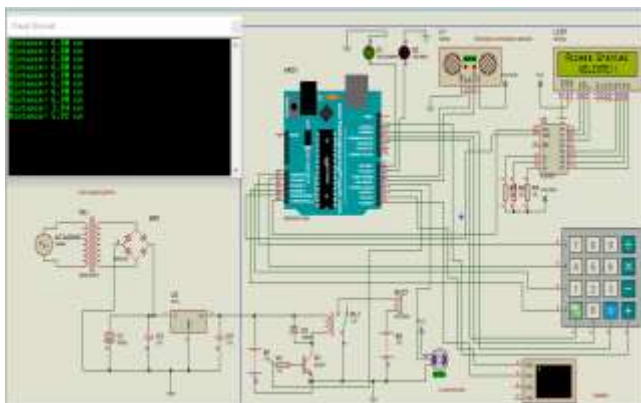

Case 3:

If the code or password entered is wrong, the LCD displays ***CODE INCORRECT***. Once the incorrect password is entered and the enter button is pressed on the keypad the relay is energized allowing base current to flow through the transistor thereby driving the relay ON and the buzzer sounds. When the buzzer stops the sound the LCD displays *** INCORRECT CODE TRY AGAIN***

*Corresponding Author: Doris Chasokela

Case 4:

When the correct code is entered the servo motor rotates to indicate its opening then the LCD displays ***ACCESS GRANTED WELCOME***.

CONCLUSION

The main purpose of this experiment was to design a security which is beneficial to each and every individual. The use of the Arduino Uno microcontroller in this project allows for design simplicity and cheap hence, the project can be achieved in lesser time compared to other techniques previously employed. Since there are many other security systems available, such as fingerprint, retina scanner, RFID card, pattern, and so on. However, the "Password based door lock system using Arduino" is very inexpensive. It is cost effective because we are using affordable component costs. Also, with the help of the library, it is extremely simple to develop code, and anyone may use this model for security purposes. Because the existing door lock system has an issue with expensive and irreplaceable components, one may use an Arduino-based door lock system to solve this problem because it is simple to install and remove. Therefore, the "Password-based door lock system using Arduino" is a time-saving programmable module that will assist us in providing excellent security.

Recommendations

This experimental design can be further implemented and used as an independent security system. Therefore, recommend all security organs to fund the project to make it a successful and implemented project for security improvement in the places which are security conscious. As long as the password is not shared with anyone, this application can provide perfect security. Users can introduce constraints to the password entry process to make it safer. Instead of using a keypad module, can employ smart cards to open doors with the same model.

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