Security System for Bank Cash Safe

Ahmad Al-Fandi, Ahmad Toma, Basim Alsayid, Samer Alsadi, Tareq Foqha, Ali Elrashidi, and Mohammad Rasmi Al-Mousa

Abstract This project solves the problems of hacking bank vaults. Through a programmed security system integrated with weight sensors, and through specific programming, this system operates the alarm system or not. It measures the weight of the safe every second and checks whether the value of the weight taken matches the stored value. As for entering the safe, there are 3 stages that the user goes through to be able to enter the door of the safe. When the user wants to log in, there are several requirements for entry that must be completed and matched for the user to be able to log in, which are: pressing the activation button for the system to prepare to receive the user's information, after which the user enters his password, and the system matches it and if it matches the system asks the user to enter his fingerprint and when it matches the door is opened. From activating the user information reception system to opening the door. A magnetic lock will be used in this safe that works on a voltage of 12 V and consists of two pieces to ensure more protection for the safe.

Keywords Programmed security · Bank cash · Fingerprint

A. Al-Fandi · A. Toma · B. Alsayid · S. Alsadi · T. Foqha
Electrical Engineering Department, Faculty of Engineering and Technology, Palestine Technical University-Kadoorie, Tulkarm, Palestine

A. Elrashidi (✉)
University of Business and Technology, Jeddah 23435, Saudi Arabia
e-mail: a.elrashidi@ubt.edu.sa

M. R. Al-Mousa
Departments of Software Engineering, Faculty of Science, Zarqa University, Zarqa, Jordan
e-mail: mmousa@zu.edu.jo

R. E. Khoury and N. Nasrallah (eds.), *Intelligent Systems, Business, and Innovation Research*, Studies in Systems, Decision and Control 489,
https://doi.org/10.1007/978-3-031-36895-0_57

1 Introduction

In this project, we are working to increase the safety of bank safes from theft, as it is the safest place to save people's money. Through the events that occurred over the past years for the incidents of breaching safes, there was a certain security loophole in each system that helped to penetrate with ease. Putting the safe on an electronic scale that measures the weight of the safe and what is inside it and connects the scale with a microcontroller, where the value of the required weight is entered into the programming of the microcontroller, where the microcontroller works to check this weight constantly, and when there is a change in weight with the conditions not being met, the microcontroller By operates the alarm system, but when the weight changes and the conditions have been met, the alarm system is not activated. These conditions are as follow [1]:

1. Pressing a button that is connected to the microcontroller, when it is pressed, the data receiving system of the microcontroller is activated.
2. When the data reception system is activated in the microcontroller, the user is asked to enter a specific password that is entered in the programming code of the microcontroller. If this password entered with the user matches the password entered in the code, the second procedure is requested If it does not match, the alarm system will be activated.
3. After matching the entered password, the user is asked to enter his fingerprint. If it matches the entered fingerprint, the door is opened, and if the alarm system does not activate.

After fulfilling these conditions, if the weight of the safe changes, the alarm system will not be activated until after the door is closed. Where the Mission Critical YouTube channel presented its project, which is like our existing project, except that their project contained one security system, which is (entering the password) and without weighing. Where the user in their project was required to enter the password only. However, in our project, you need to enter the password and fingerprint. And the weight is checked every certain time to make sure that there is any intentional penetration [2].

2 Used Hardware

There are many components are used in the proposed system which illustrated as follow.

2.1 Arduino Mega

It is an open source microcomputer that is programmed using C++, where sensors and several components are connected to it, which helps in forming a system that performs the required function. This controller contains 54 PIN Digital, 16 PIN Analogue, 3 PIN 5 V, and have the stronger and faster CPU between all of other controllers [3].

2.2 Wires

The wires will be used to connect the pieces with the controller [3].

2.3 Electronic Scale

It is an electronic piece that measures weight. As it is pressed, it generates small electrical impulses and sends them to the controller, where it works on translating these impulses and converting them using a software code. Where the controller reads these pulses and converts them into a number measured in a unit of weight. When this sensor is pressed, the resistance value inside it changes and works to convert the resistance value into a volt signal for output via TTL RS232. And they can be measured up to 10 kg [4].

The overall specifications are as follow:

- Differential input voltage: ± 40 mV (Full-scale differential input voltage is ± 40 mV).
- Data accuracy: 24 bits (24-bit A/D converter chip).
- Refresh frequency: 80 Hz.
- Operating Voltage: 5 V DC.
- Operating current: < 10 mA.

2.4 System Keypad

An electronic board that is connected to the controller and contains numbers. When one of the buttons is pressed, it delivers an electrical pulse to the controller, and the controller translates this pulse and converts it according to a code [4].

2.5 Fingerprint

It is a sensor that reads the fingerprint and converts it into electrical impulses and sends them to the controller [5].

2.6 Monitor

This screen displays texts and numbers that are entered in the code entered into the controller [1].

2.7 Buzzer

An electric buzzer is given by the controller to turn on the signal [5].

2.8 Safe Figurine

An iron model that will be designed during the implementation period of the project, as its shape will be like the shape of the safe.

2.9 Relay

The relay consists of a magnetic coil and a contact, and when this coil is activated, the contact position is changed, as this relay will be used to control the disconnection and connection of electricity to the magnetic lock.

2.10 Magnetic Lock

This lock consists of two pieces, the first being a piece of iron, and the second being a strong magnet where this magnet works when delivering electricity to it and when a piece of iron approaches it, it catches it, but when the electricity is separated from it, it releases the piece of iron due to the lack of magnetic force [6].

2.11 Adapter 12 V

Converter from 220 V AC to volts DC. It will be used to supply electricity to the magnetic lock.

2.12 Limit Switch

There is a switch have a 3 points (COM, NO, NC). There is in normally mode they connect the COM point with NC point and when pressed the connect the COM point with NO point. We want to use the limit switch in system for know if the door closed or open [7].

3 Circuit Connection

Electronic Scale with Arduino is illustrated in Fig. 1 and illustrated as, the red wire is VCC, the black wire is GND. The yellow wire is SCK, which is responsible for sending the signal to the controller. The purple wire is DT, He is responsible for receiving the return from the signal.

On the other hand, the keypad with Arduino is connected when we press the button, we connect the two wire tighter and these two wires is sending a signal for controller, and this signal are phrasing the pulse.

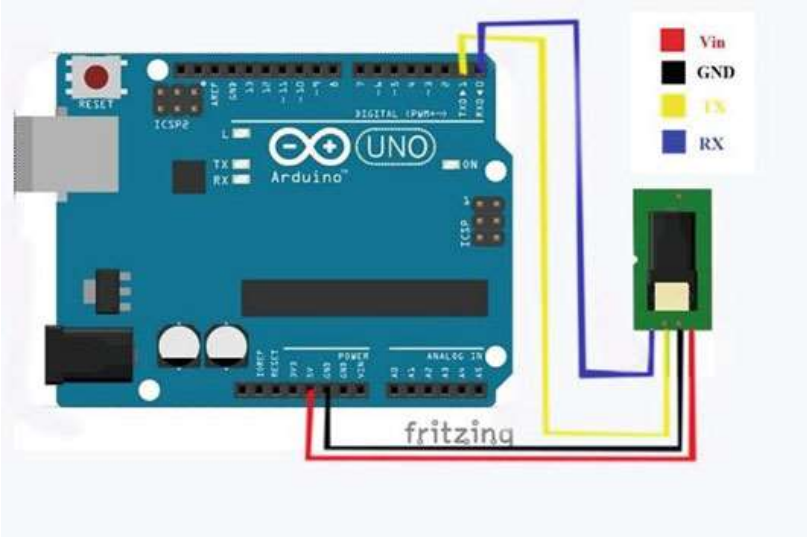

Fig. 1 The proposed circuit connection

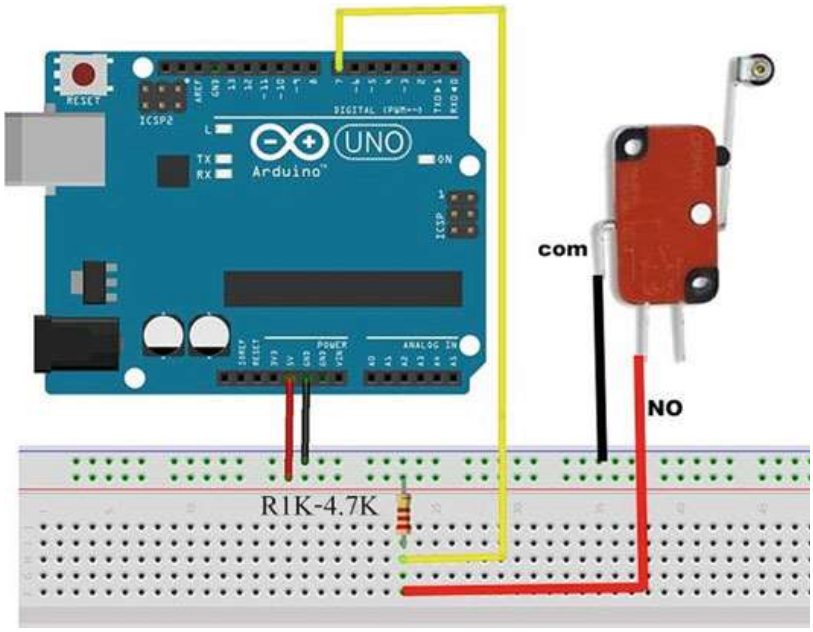

Fig. 2 The proposed circuit connection with buzzer

Fingerprint with Arduino connection is the red wire is VCC, the black wire is GND. The yellow wire is a transmitter signal. The blue wire is a receiver signal, as illustrated in Fig. 1.

The connection of the LCD I2C with Arduino is as follow: the red wire is VCC, the black wire is GND. The blue wire is SDA and the green wire is SCL. In this connection we used the i2c protocol between Arduino and LCD. This protocol abbreviation helps No. of pins from 16 to 4 pins.

The Buzzer with Arduino connection is; the red wire is the SIGNAL, and his signal is digital and we can to run by PWM PIN. The black wire is the GND.

Relay and magnetic lock with Arduino connection is the red wire is VCC and the black wire is GND. The yellow wire is the signal.

Relay and magnetic lock with Arduino connection is the Black wire is connecting the COM point with GND. The Red wire is connect the NO point and The Pin in controller. When the sensor is pressed, the connection is made between the VCC and GND, where it is connected to the GND, a resistance that absorbs most of the current passing through, and a simple current remains that goes to the controller, and it crosses the signal, the circuit diagram connection is shown below in Fig. 2.

4 Overall Cost Analysis

Table 1 illustrates the overall project cost analysis.

Table 1 Overall cost analysis

No.	Name	Price	No. of pieces	Full price
1	Arduino mega	75	1	75
2	Wires	0.1	100	10
3	Electronic Scale	45	1	45
4	Keypad	20	1	20
5	Fingerprint	65	1	65
6	LCD 16 * 2 i2c	35	1	35
7	Safe figurine	1	100	100
8	Relay	10	1	10
9	Magnetic lock	150	1	150
10	Adapter 12v	40	1	40
11	Buzzer	10	1	10
Total			560 NIS	

5 Faced Problems

Among the problems that we faced in building the security system is a weight sensitive place, which is the most important element in the system. Through many experiments, we discovered that the location of the sensor is an important factor in building the system. We discovered through experiments that the best place for the sensor is on the tip of the stereo. As any pressure that occurs or any effect of weight that occurs inside the body is located on the side of the body. The best place for the sensor was on the side of the stereo, which helped to obtain the best results through experiments.

6 Development Outlook

Vibration Sensor is added to the to the security system helps reduce intrusion incidents. When a person tries to dig from outside the body, vibrations are generated in the body. The weight sensor senses these vibrations resulting from the excavation work and sends an alarm, which helps prevent the penetration accident before it occurs [8].

The Hand Sensor is helping in reading all hand information from fingerprints, finger size and hand size. And it works on reading the lines in the hand, and as we know that no person has a hand like the other, it is 100% identical. This sensor helps to increase the percentage of security and safety inside the system and reduces accidents of penetration. The hardware connection is illustrated in Fig. 3 [9, 10].

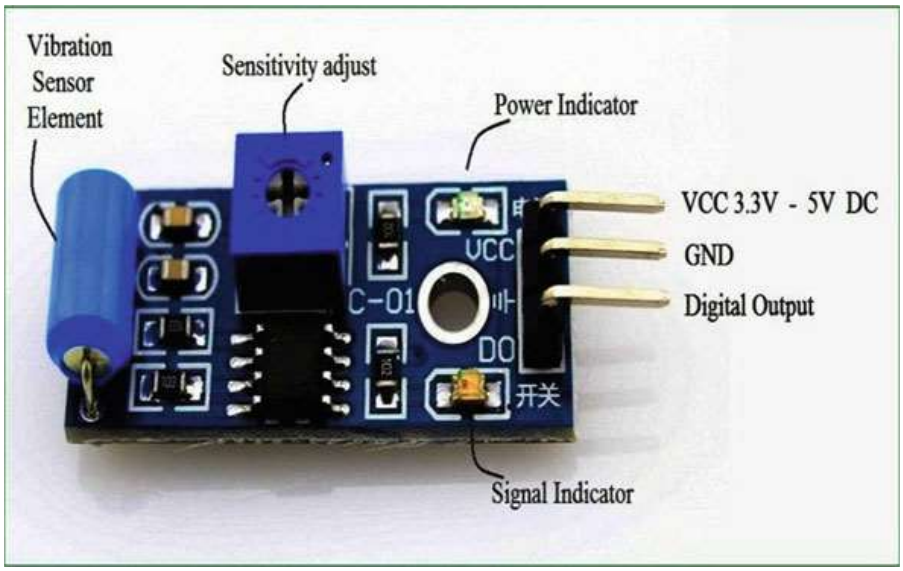

Fig. 3 The hardware connection using vibration sensor and hand sensor

7 Conclusion

The main problem of any back account is the hacking vaults is solved in this work. A secured program is introduced using C++ program which reduced the incidents of hacking bank vaults. Three level of security entering increases the complicity of hacking ability. In addition, several requirements for entry for each user that must be completed and matched for the user to be able to log in. The level of security are: pressing the activation button for the system to prepare to receive the user's information, then the user enters his password, and finally the system matches it and if it matches the system asks the user to enter his fingerprint and when it matches the door is opened. From activating the user information reception system to opening the door. A magnetic lock will be used in this safe that works on a voltage of 12 V and consists of two pieces to ensure more protection for the safe.

References

1. Monk, S.: Programming Arduino: Getting Started with Sketches, 2nd edn. McGraw Hill TAB (2016)
2. Bill, P.: The Complete Book of Locks and Locksmithing, 4th edn. McGraw Hill Inc. (1995)
3. Random Nerd Tutorials Homepage. https://randomnerdtutorials.com/esp32-relay-module-ac-web-server. Last accessed 21 Nov 2022
4. Arduino Homepage. https://www.arduino.cc/reference/en/. Last accessed 5 Dec 2022
5. Tutorialspoint Homepage. https://www.tutorialspoint.com/arduino/index.htm. Last accessed 12 Dec 2022
6. Java T point Homepage. https://www.javatpoint.com/arduino-coding-basics. Last accessed 27 Nov 2022

7. Microcontrollerslab Homepage. https://microcontrollerslab.com/. Last accessed 29 Nov 2022
8. Nassar, Y.F., Alsadi, S.Y.: Assessment of solar energy potential in Gaza Strip-Palestine. Sustain. Energy Technol. Assess. **31**, 318–328 (2019)
9. Foqha, T., Alsadi, S., Refaat, S.S., Abdulmawjood, K.: Experimental validation of a mitigation method of Ferranti effect in transmission line. IEEE Access **11**, 15878–15895 (2023)
10. Nassar, Y.F., Alsadi, S.Y., Miskeen, G.M., El-Khozondar, H.J., Abuhamoud,N.M.: Mapping of PV solar module technologies across Libyan Territory. In: 2022 Iraqi International Conference on Communication and Information Technologies (IICCIT), pp. 227–232 (2022)