

Design Security System based on Arduino

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Abstract:

Advanced technologies make life easier where people can protect their properties from burglars even if they exist in different locations. This paper presents a security system that uses Arduino with a mobile phone for remote protection. The proposed system has an infrared sensor that sends a signal to the microcontroller after detecting a motion. After processing the signal, the mobile takes a picture and sends warning messages to the stored phone numbers of the property owner. This can reduce the risk of having a burglar threat. The proposed design has advantages of low cost and flexible security.

Keywords: Security system, Arduino, Mobile phone

I. INTRODUCTION

Security can currently be considered as a very important issue in our lives. There are different security systems with various techniques and various performances [1,2]. For example, the system that uses Zigbee technology employed the processor of the personal computer. This limits the work area to about 10-20 meter around the system [3]. However, there is a chance to improve that by using a system which depends on the properties of the mobile phone that can be controlled by the Arduino technology [4]. Arduino, which consists of both physical programmable circuit board and software program such as Integrate Development Environment (IDE), is used by writing codes in a computer and then sending them to the Arduino's physical board [5].

In the literature, various work can be found regarding establishing a security surveillance system. In 2000, Moore *et al.* suggested a real time direction movement detection system. This work is specifically designed for airport securities [6]. In 2008, Watada and Musa and built a multiple camera tracking system for a security purpose.

The designed system can track several individual movements at a time [7]. In 2013, Tuscano *et al.* proposed a surveillance system based on the smart web cam motion detection [8]. In 2016, Win *et al.* used the internet of things to propose a smart security system in the case of home appliances control [9]. In 2017, Abduelhadi and Elnour suggested a smart motion detection. This study is mainly concentrated on enhancing the motion detection [10]. In 2018, Chikezie *et al.* suggested a security system for indoor geo-location. The authors considered the development of a microcontroller by utilizing the motion detector [11]. In the same year, Surantha and Wicaksono designed a smart home security system by exploiting a PIR sensor and object recognition [12].

The aim of this study is to design a security system by exploiting the Arduino technology. This security system has the ability to detect a burglar motion.

The remaining sections after the introduction will be organized as follows: Section 2 clarifies the proposed security system, Section 3

demonstrates results and discussions, and Section 4 clarifies the conclusion.

II. THE PROPOSED SECURITY SYSTEM:

As mentioned, the proposed security system aims to detect a burglar motion. The Arduino technology is suggested to be exploited in this

suggested system. Fig.1 shows the main block diagram of the proposed security system.

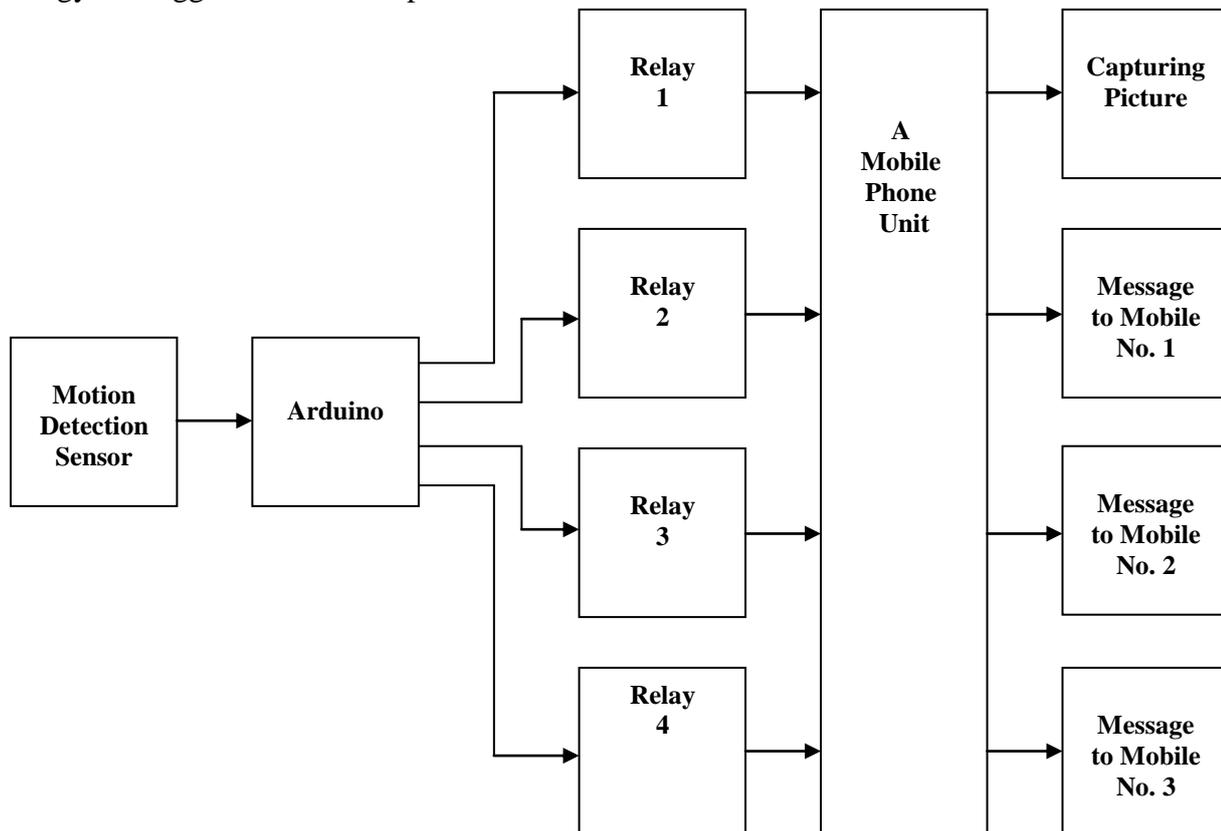


Figure 1. The main block diagram of the proposed security system

In this proposed design, the mobile phone is connected to the output port of the Arduino through relays. Whereas, an infrared sensor is connected to the input port of the Arduino. The sensor sends a motion sensitive signal to the Arduino, when someone passes through. Subsequently, as a response to the received signal the programmed software makes the following two operations:

- 1- Snapshotting a picture for the unauthorized person by utilizing the mobile phone camera.
- 2- Sending messages to three mobile phone numbers that are determined by the homeowner (or security staff).

The hardware circuit includes all components that are required for the designed security system, as shown in Fig. 2. The microcontroller of the Arduino here can be considered as the heart of this system. It is used to process all the signals that are used in this system. Basically, the Arduino receives signals from the motion; three mobile phone numbers which are specified by the home owner (or any allowed person). That is, a photo for the burglar in the observed place and warning messages are generated and sent to specific mobile phone numbers. Fig. 3 shows the electronic hardware of the employed Arduino Printed Circuit Board (PCB). It is of type UNO.

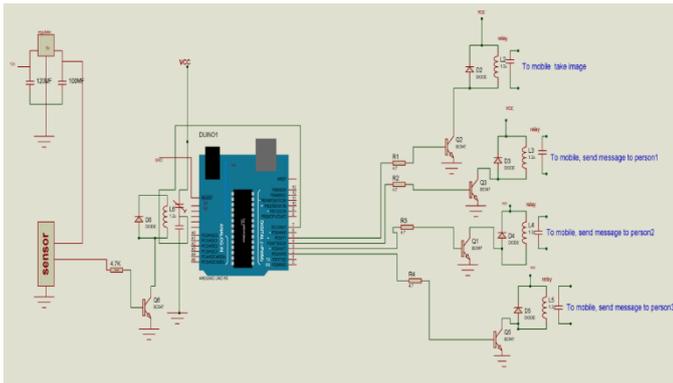


Figure 2. The proposed hardware circuit

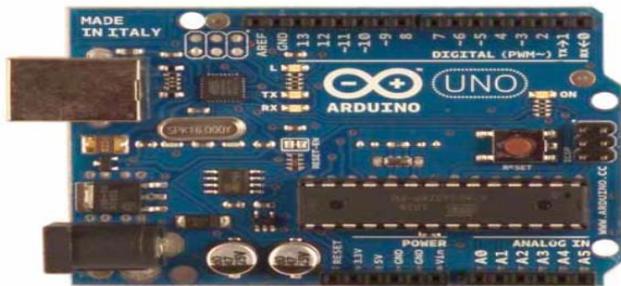


Figure 3. The hardware of the Arduino (type UNO)

Four essential hardware components are suggested to be used in our proposed security system. These are the motion detection sensor, controller circuits based on the Arduino, relays and mobile phone.

Firstly, the motion detection sensor is an electronic device that works according to a combination of two parts. The first one is the Infrared Light (IR) of a Light Emitting Diode (LED). It operates as a transmitter. This part emits the IR light to a determined area. The second part is the photodiode. It operates as a receiver. The photodiode is sensitive to the same wavelength of the transmitted signal. Crossing the IR light by someone would affect the received signal by the second part [13]. So, a suspected motion can be detected.

Secondly, the control unit is built by using the Arduino of type UNO. It makes the design easy and effective. The hardware of the Arduino is simple. It consists of open source board that contains 32-bits or 8-bits for the AVR microcontroller type. Its software uses a programming language compiler, where the

program that is stored in the microcontroller can be executed [14].

Thirdly, relays are electrically operated switches. They pass currents through their coils. Thus, magnetic fields are created to change the switches' contacts [15]. Relays are used in our proposed system as switches to control stopping or passing the warning signals.

Fourthly, a mobile phone of type Nokia 6120 is employed in the proposed security system. It requires using several buttons to capture a picture for the suspected scene and send warning messages. Three warning messages are suggested to be sent, each for one responsible person. So, total of three individuals can receive the warning messages. Intuitively, the phone numbers of the three individuals have to be stored inside the memory of the mobile phone. These phone numbers can carefully be assigned during the security installation to receive the warning messages.

III. RESULTS AND DISCUSSIONS

The proposed design was implemented by using the Arduino of type UNO, relays, infrared sensor and a mobile phone of type Nokia 6120. These parts are available in local markets.

First of all, the motion detection sensor sends a signal to the microcontroller of Arduino after identifying a burglar's thread. Fig. 4 shows the electronic circuit of the motion detection sensor.

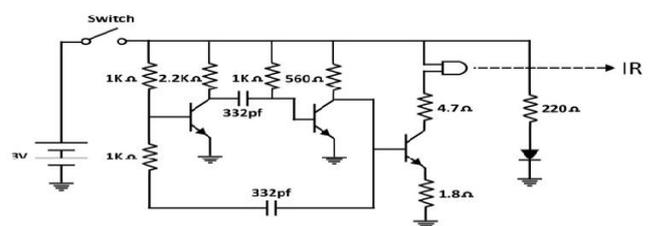


Figure 4. The electronic circuit of the motion detection sensor

In this figure, it can be seen that there is a Light Emitting Diode (LED). It transmits an Infra-Red (IR) signal. This signal can detect a motion of the moving object(s). The photodiode, which is provided within the same electronic circuit of the motion detection sensor, is sensitive to the same

wavelength of the IR light. This important part works as a detector. Basically, it can detect the moving object(s).

When the controller of the Arduino receives the motion detection signal, it immediately sends warning signals via a set of relays. The relays are connected to a selective group of pins within the mobile unit. One pin can be influenced to take a picture for the suspected place. Other pins are used to sequentially send warning messages to three responsible persons.

Relay coil can be on or off. So, they are able to control stopping or passing the warning signals. The utilized relays can have double throw (changeover) switch contacts, as shown in Fig.5.

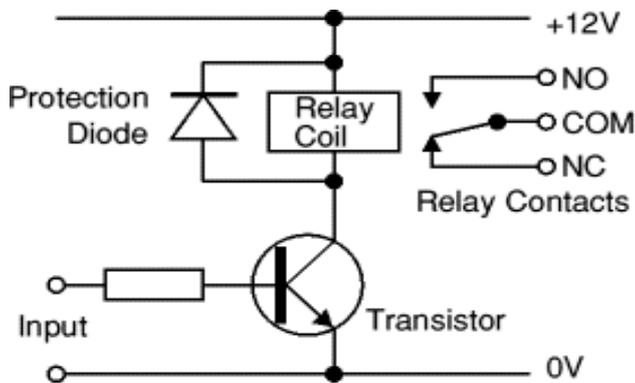
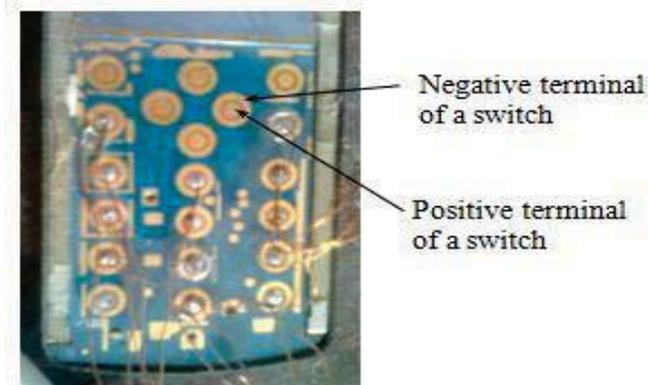


Figure 5. Electronic circuit of a controlled relay

Consequently, a mobile phone of type Nokia 6120 is used in the proposed system. It only requires pressing two buttons several times in a certain order to send the warning messages and capture a picture for the scene place. Therefore, Arduino is programmed to electronically achieve these tasks. Fig. 6 shows the utilized hardware



part in a Nokia mobile phone. It demonstrates the

negative and positive terminals of each button in this device.

Figure 6. The utilized hardware part in a Nokia mobilephone

As it can be seen from Fig.6, the outer circle of each button works as negative terminal and the inner circle of each button works as positive terminal. The negative terminals of all the buttons are shorted to the common. Copper wires are soldered with the keypad buttons. They are also connected to the relays. When the positive and negative terminals of any button are shorted the corresponding number in the mobile phone is generated. Fundamentally, the mobile phone buttons are generally distributed in rows and columns of a matrix. Hence, the buttons of 1,4,7 and *, which organized at the left column, are used for sending a warning message to the first person. The buttons of 2,5,8 and 0, which ordered at the middle column, are utilized for sending a warning message to the second person. The buttons of 3,6,9 and #, which distributed at the right column, are exploited for sending a warning message to the third person. Similarly, the picture taken button is used for capturing a picture of the determined or suspected place. The Arduino is accordingly programmed by the IDE software.

Fig.7 shows the main flowchart of the flow system security stages. The related software codes are uploaded to the microcontroller in order to do the required tasks. To illustrate, the Arduino is programmed for:

- Observing the motion detection sensor. Consequently, detecting a threaded signal of any burglar.
- Utilizing pins 3, 4 and 5 to send the warning messages to the three mobile phones numbers, respectively.
- Exploiting pin 2 to take a picture for the suspected scene.

It is worth mentioning that the suggested security system is successfully implemented. This system has the following advantages:

- Effective design.
- Costless.

- Consider a high level of security (by warning different persons and capturing a burglar's picture).
- Because of using a mobile phone, the system is able to send the warning messages for long distances.
- The taken picture can be utilized as a strong evidence against the burglar(s).

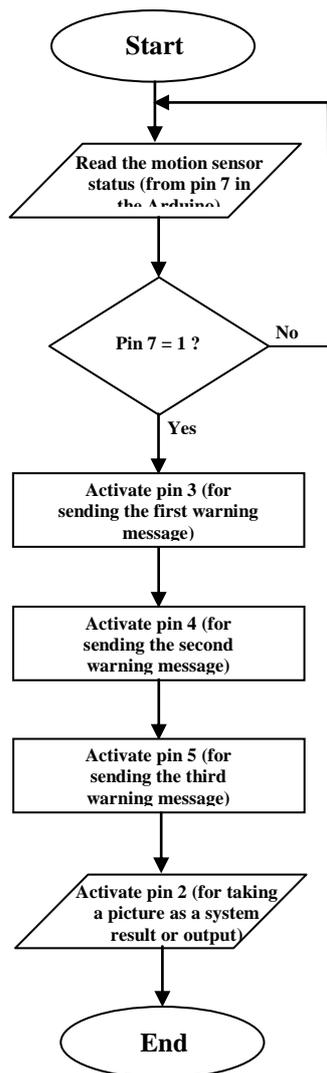


Figure 7. The main flowchart of the flow system security stages

IV. CONCLUSION

In this work, a security system based on Arduino technology is designed. This system can detect the movements of a burglar or burglars. In addition, it can immediately send many warning messages and snapshot a picture for the suspected

area. Both hardware and software elements are gathered in this study. The following benefits are observed for proposed system:

- (1) It has applicable design.
- (2) Its components are cheap and available.
- (3) It provides a high level of security.
- (4) Warning messages can be sent for long distances.
- (5) Capturing a picture for the burglar(s) can later be used as a strong evidence.

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