

Implementation of Security System and Its Interconnection with Lighting



K. M. Akshay, Rahul Hebbar, R. Harshavardan, Roshan,
and P. S. Manjunath

Abstract Nowadays like home security, building security is also becoming prominent since the possibilities of intrusion and other kinds of security threats are growing day by day. For an organization, safeguarding their assets is of utmost importance. Thus, with the help of latest technology, our project aims to design and implement the highest level of security that an organization can have in order to protect and control the assets of the organization. The work focuses on constructing a state-of-the-art security for buildings which includes integrating four different types of securities which are access control, surveillance, geofencing, intrusion detection and asset management. This system can alert the authorized persons by sending SMS/email to their mobile phones. An alarm is also raised if required. The advantage of using this system over the existing ones is that the current security systems are all stand-alone systems. The surveillance, intrusion detection, access control, and asset management are not integrated into the existing system. Our work focuses on integrating these into a single microcontroller. First stage of the work consists of building a prototype by using different sensors such as ultrasonic sensor, IR sensor, radio frequency identification card reader, GSM module, etc. The main controller used for the prototype is ATmega 2560. Second stage consists of implementing it in real time. According to the company's requirement different brands such as DSC, Bluvision, and Zavio were used. These stand-alone systems were integrated into Vantage lighting system, which is the main controller used for real-time implementation. Both in prototype and real-time implementation of the work, the security system is completely automatic and it will enable the authorized persons to remotely control and monitor the areas of the building from any place. The result of the project shows that whether there is an intrusion and security breach from one's own employees of an organization, they are all monitored and controlled automatically through different systems which in turn are integrated into a single system so that immediate action can be taken to prevent such breaches.

Keywords Automatic security · Integration · Lighting · Foolproof system

K. M. Akshay · R. Hebbar · R. Harshavardan · Roshan · P. S. Manjunath (✉)
Department of Telecommunication Engineering, B.M.S College of Engineering, Bengaluru, India
e-mail: manjunathps.tce@bmsce.ac.in

1 Introduction

In this twenty-first century, the crime rates are ever increasing; everybody wants to safeguard one's own assets. Thus, the security system plays an important role. Suppose a CEO of an organization is away from the building and he/she needs to ensure that the building is secured. The CEO can use anyone of the stand-alone security systems in the market. But in today's world everything is becoming automatic. Hence, it is important to have an automatic security system which inculcates various categories of security like intrusion, access control, asset management, surveillance, etc. All these types of security need to be integrated into one stand-alone system from which it can be monitored and controlled. An automated security system which integrates different types of security into a single system provides an additional layer of security. The security might comprise of user verification to prevent break-ins at entry points and also to track unwanted activities or illegal intrusions within the locality of the building.

The stand-alone system that is used in the real-time implementation of the project includes DSC, Bluvison, and Zavio. These systems are integrated into a microcontroller, which is the lighting system of the building. The provision to send alert message to security guard during security breaches is also built into this system. Also if the employees of the organization are deceptive in nature, they can be monitored and controlled through this system. Thus, the building security system proposed in the project provides the state of security for the CEO and the employees of an organization. The rest of the paper is organized as follows. The literature survey of this paper is described in Sect. 2. Section 3 lists the architecture design for security. Sections 4 and 5 describe prototype and real-time implementation of the work, respectively. The conclusion and future work of this project is described in Sects. 6 and 7, respectively.

2 Related Work

Office or building security is one of the important issues where crime rates are increasing day by day and due to this the organization faces a huge loss. In order to have a sustainable growth in the organization, proper security measures have to be incorporated. The security system should be able to identify the intruder and not an employee of an organization. And if there is attempt for breaking in, the owner or the required person should be alerted so that he/she can take immediate action. Also, there should be a device for recording in order to trace what is happening, and this can be used as an evidence to help the police to identify the intruder and to be able to search the misplaced or stolen object [1].

Earlier research about building security was conducted by Aditya Shankar where the security system included fingerprint activation for access control and a camera for surveillance [2]. Another study that was conducted about building security systems included using LabVIEW for face detection. Their technology uses histogram as a

feature for face detection [3]. One more study by Alvin Kabir, where he designed a system which could send the alerts to a cellular device like a portable mobile phone of the required person. GSM technology was used in this system so that an SMS was used to alert the individual. This setup used three components: a GSM module, PIC microcontroller, and one or more sensors to detect the intrusion [4]. This method which uses portable mobile handsets to receive warning or alert messages is very helpful since the user need not hold any additional piece of equipment to receive the warning messages, because most of the people already have a handset that supports GSM technology. But this system does not include surveillance and measures to monitor the assets. The prototype of the automatic security system was designed and developed using Arduino mega [5]. This included using different sensors for motion, intrusion detection, etc. A motor was used to integrate the camera into the existing system. Alert messages are sent to the owner via SMS using GSM technology. The main idea of using wireless technology was to send alerts and to make sure that the owner is alerted even if he is away from the office. There were different types of wireless technologies such as Bluetooth, CDMA, etc. but we choose GSM since we compared it with other techniques and found out that it is more efficient and cheaper and also we were more familiar with it than other technologies [6].

The microcontroller that we use to build the prototype was ATmega 2560 [7]. We used this since it simplifies the amount of software and hardware development needed to get the system working and also in the hardware platform reset and power circuit setup are readily available. It also supports circuits through which we can directly program and communicate with the microcontroller using USB. On the software end, Arduino Mega 2560 provides a number of different libraries so that the microcontroller can be programmed effortlessly [8]. The prototype design of the security system consisted of using Radio Frequency Identification (RFID) cards and reader for access control. It is basically a wireless technology which works on radio waves. The tags and the RFID reader will be emitting these waves and are picked up by the reader when these cards come near it. The tags/cards consist of microchip ID data, which stores the UID of different employees of the organization [9]. The electronic circuits of RFID Tags have memory and because of this they can store data. This memory is divided into different cells. Some cells can store only read-only data, such as UID number, rest can store UID, major and minor together [10]. These IDs are generated at the time when the tag is produced.

3 Architecture Design

Security is a strategy by which something is secured through an arrangement of inter-working components and gadgets. All security systems deal with a similar essential guideline of securing entry points, like the main building door and windows, and in addition inside space of an office/building containing assets. The building/office security system consists of networks of integrated devices which are all working together with a central controller in order to protect against intruders and burglars

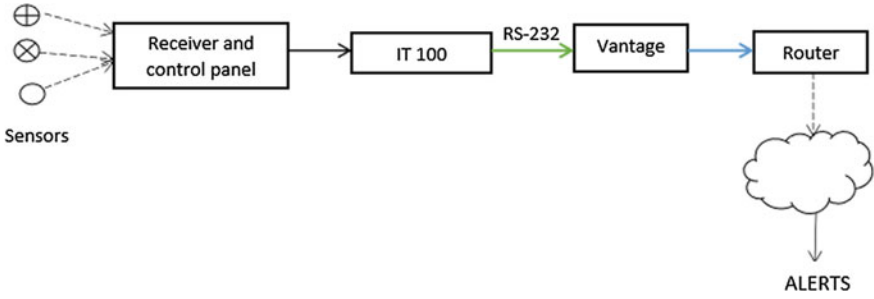


Fig. 1 Architecture of intrusion detection

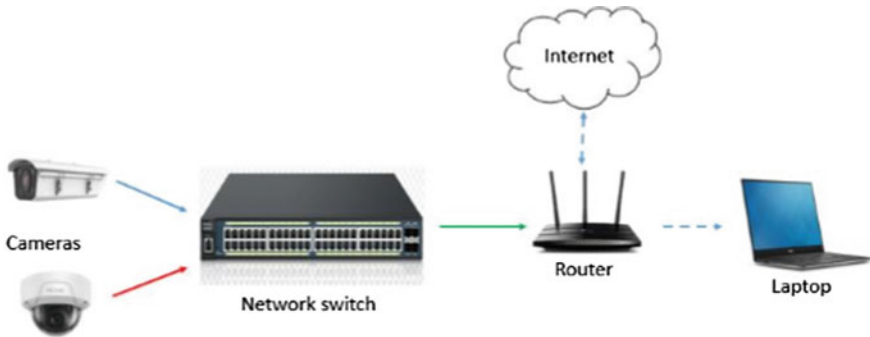


Fig. 2 Architecture of surveillance

and other potential threats. Mainly a security system has four domains: surveillance, intrusion detection, access control and geofencing and asset management.

A simple architecture was designed for each part of the security system as shown in Figs. 1 and 2.

3.1 Intrusion Detection Surveillance

See Figs. 1 and 2.

4 Prototype Implementation

The block diagram of the prototype is shown in Fig. 3. The main controller used for the prototype is ATmega 2560. In this prototype, ultrasonic sensors are used to detect any motion or intrusion and RFID-based access control to provide access to

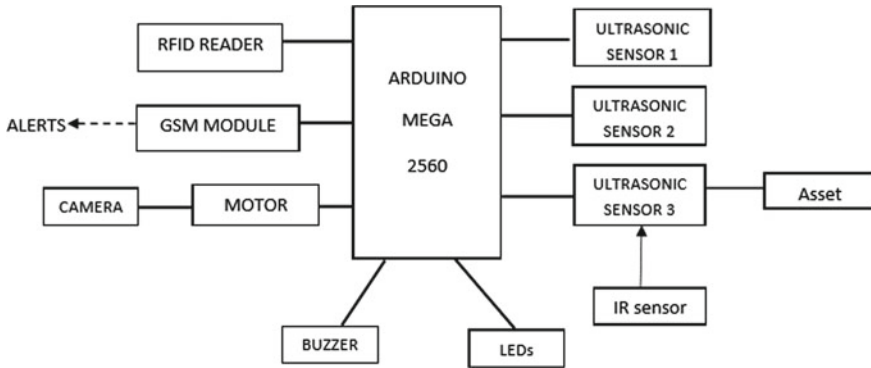


Fig. 3 General block diagram of prototype

authorized users. IR sensor is used to detect if the asset is moved or not. The control of camera is done through a motor. There is a main door through which a person can enter by scanning the RFID cards. Each room consists of LED's to which the security system is integrated.

The implemented circuit is shown in Fig. 4. The prototype requires a power supply of 12 V. There are two modes defined for the prototype, Intrusion ON mode and Intrusion OFF mode. When a supply of 12 V is given to the Arduino Mega controller, the prototype will start with Intrusion ON mode. This mode is to detect any unwanted or unauthorized entry. If any movement or presence is detected in this mode, alarm will go on and an alert text is sent to authorized mobile phones via a GSM module. Along with this, a camera model, which is controlled by a motor, tracks the intrusion. Also if an asset is moved which is kept in the asset room, alarm and text message are sent to the authorized person.

The Intrusion OFF mode is activated by scanning an authorized RFID card on the RFID reader near the door. Any unauthorized card is rejected by the controller and an authorized card is accepted and acknowledged with a short beep sound. As soon as an authorized card is accepted, the door automatically opens and closes with a slight

Fig. 4 Implementation setup

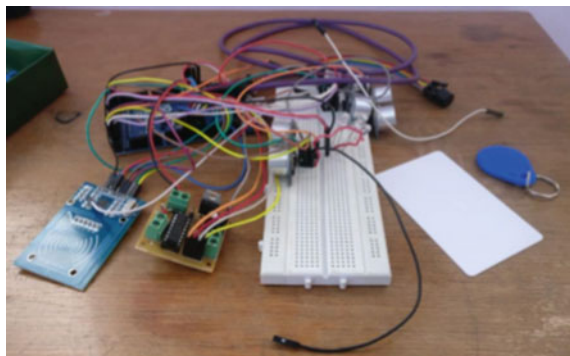


Fig. 5 Layout of prototype

delay to allow a person to enter. The opening and closing of a door are controlled by a motor. Once an authorized person enters any cabin, the LED in that cabin will turn on by detecting the presence of that person. Later, the LED automatically turns off when there is no one present in the cabin. When there is no movement or presence of anyone in any of the cabins, then the prototype switches to Intrusion ON mode. Then any movement before scanning an authorized card will be treated as an intrusion. The layout for the prototype is shown in Fig. 5 (Fig. 6).

The brand selected for intrusion detection system is DSC which is shown in Fig. 7. Different sensors that were used are motion sensor to detect motion, glass break sensor to detect breaking of a glass, contact sensor to detect opening and closing of a door or window, flood sensor to detect any water leakage, and smoke sensor to detect smoke caused by fire in the building. These sensors are wireless sensors and communicate with a DSC control panel, PC-1864, at 433 MHz; the DSC panel PC-1864 is a hybrid panel which supports both wired and wireless sensors. This stand-alone system is integrated into Vantage controller through an interface module, IT-100, via RS-232 cable. Interfacing module IT100 converts the signals of the DSC control panel to a format which is compatible with Vantage and vice versa. So one can arm or disarm the intrusion system through mobile phone.

5 Conclusion

The designed automatic building security system was tested a number of times and it can be certified as a completely foolproof system. The chief executive officer can remotely monitor how each employee is spending their time in office as well as control certain restricted areas to manage assets. The Vantage system to which we have integrated provides both security and building automation. Finally, the work was designed and implemented in such a manner so as to make it user-friendly and also

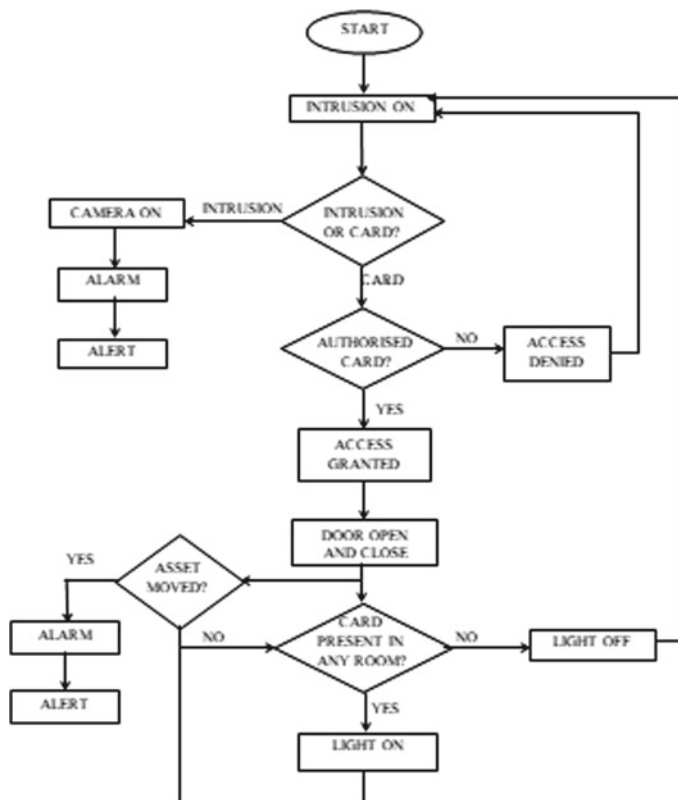
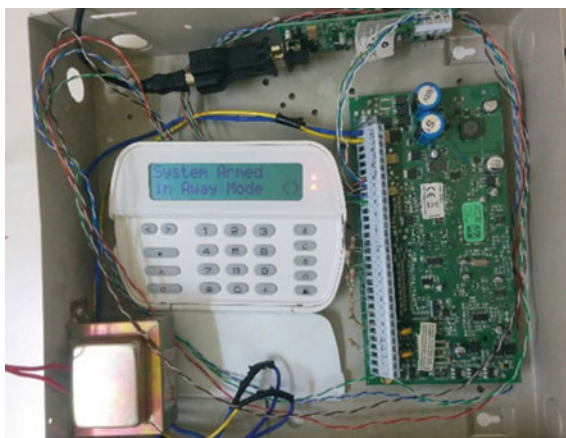


Fig. 6 Working flowchart

Fig. 7 DSC intrusion detection system



to set it up in different offices with ease and convince. Thus, the required objectives and goals of our work have been accomplished.

As of now, the system is dependent on the employees of the building. As soon as the employees leave the building the system will be in “armed” mode. If a guest wants to visit the building, it will lead to security breach. This can be improved by having a camera which can send pictures of the person who wish to enter the building to the CEO and he/she can remotely disable the security system to welcome the guest.

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