



Design and implementation of multilevel security based Home Management System

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ABSTRACT

The safety and security-based systems have taken a wide size in our everyday life because of their significance in protecting homes, companies, gold shops, or other institutions and properties from disasters such as exposure to fire or gas leakage and even being robbed by burglars. In recent years, such systems have get huge attention by many researchers and begun to evolve with the development of technology and the emergence of various types of smart microcontrollers and intelligent electronics. In this paper, a multilevel home management security and safety system has been proposed by using the Arduino microcontroller board. Such management would be carried remotely or locally. The result obtained from the proposed system has showed reliability in the performance manner that can take place in IoT based applications. In addition, the system showed independence on single failure point. Furthermore, such a system could be considered as an inexpensive system that can be applied in several places to achieve higher security levels and protection against different types of disasters.

Key words: Security system, Management, IoT, Safety System.

1. INTRODUCTION

Smart homes could be considered as a one of the most popular aspects related with the introduction of Internet of Things (IoT) [1]. In the 21st century, security was one of the most important requirements for the preservation of people's lives and personal and public property. Security methods evolved with the development of human life and technology. With the rapid development of technology, automatic control has become the highlight of the possibility of managing the protection and remote alarm systems, thus reducing our material cost and human effort. [2]. Hence, the home security system can be defined as a device that detect the unauthorized

people or unwanted events and do a specific job about this situation like alert the owner, call police, run the fire extinguisher [3].

Home Automation is more prevalent, quickly makes a better position in market, and gives a major scope to work and research for the engineers. It is the expected that within 2020 the market rate of Home Automation become more than 10 billion US\$. Several types of wireless network technology like an internet, WI-FI, GSM makes the Home Automation system more efficacious [4]. A security system is defined to disclose obstructions, unauthorized access to a building or a protected area and to decline such illicit access to personal and property protection from damages or harms. The security systems are used in the defence against theft or property damage, as well as personal protection against meddlers in commercial, residential, military and industrial properties [5]. Home management suffered from several serious challenges in the security/privacy manner and in efficient management of the smart home. An example for such challenges are the limited hardware resources and the consumption of both power and memory. As a result, it is very difficult or even impossible to propose complex algorithms [6]. Another challenge is the increasing in the number of smart home systems use the cloud-based platform [7]. Because, this means that the interface would be exist on the Internet, which may allow unauthorized access persons [6]. Meanwhile, wireless based communication protocols used in IoT are not fully protected against attacks [8]. Other significant challenges related with the configuration and lack of a programming uniform interface. As a result, all these mentioned above challenges have make the home management based systems complicated and expensive and in many cases unprofitable. In this work, it has been proposed and implemented a multilevel-based security and safety system for home management. The proposed system has been carried out based on the use of low cost Arduino board. Hyper Text Transfer Protocol (HTTP) has been used for packet traveling. The system considered both level of security and safety with wide range of utilized sensors. The results of the proposed system showed significant reliability and flexibility in controlling the management of such system. The rest of the paper is formed

as follow: in section 2 the related work is presented, while section 3 proposed the design, methodology of our home management system. In section 4 the implementation of our system would be discussed. Finally, section 5 presents the conclusion.

2. RELATED WORKS

Several researchers have proposed methods, algorithms, systems for handling the home management issues. For example in [9], the researchers suggested and proposed methodology stated that the microcontroller handling the management should be built on an automatic system that offers strong protection against fracture or physical interference by sending a message directly to the law - enforcement group. The system consists of a microcontroller with a passive infrared radiation system, a shock sensor and a display panel keyboard. Meanwhile, in [10] researchers proposed a system to collect the information from two PIR sensors to identify obstacles, treat the data and transfer SMS to GSM mobile phone equivalent number with GSM modem, and serial camera, module of the SD card, to reserve this image. However, such methodology was very complex and expensive to be applied in multilevel applications. In addition to that, in [11] the researchers proposed Arduino based surveillance increase the detecting capability of theft by vibration, PIR and password pedant. Arduino microcontroller is connected to USB and transfers a photograph analog to a digital signal, and stores images on the cloud server to save the impact of the person who was involved in the steal. Photos are transmitted to android users as a warning against mistresses. In [12] authors proposed innovative low cost design and automated weather device and home security control. The design has been carried out by using the Android app to enable the smart phone to send orders and get warning via the server-based system. Recently, several researchers proposed novel methods. For instance, in [13] they proposed a module that uses the PIR motion detector sensor, TICC3200 Launch-Pad, Energia as a software. The prototype in their work is simple and inexpensive. However, the sensitivity of the PIR was an issue that has not been highlighted properly. Additionally, in [14] researchers proposed system for home management based on the use of Microcontroller and by using the Bluetooth remote, Mobile app which supports both android and IOS and PIR sensors. Data gathered from the Bluetooth remote goes to the microcontroller. In this work it has been uses a timing system such as to control light by providing fixed time. In [15] it has been designed and implements a smart home security system based on the use of GSM/GPRS (Global System for Mobile Communication /General Packet Radio Service). It has been proposed a two-module system for security issues, which would increase the computational complexities of the system. However, the system has not been tested for real-time processing procedures to consider its reliability. Furthermore, researchers in [16,17,18,19,20,21,22] proposed an efficient model for home management system; the system has been utilized by using the PIR and Pizo buzzer, which has been connected to the Node MCU. The later has been considered as a microcontroller. However, the proposed system has only

considered single sensor approach, which has been reported as inefficient method [23,24,25].

3.METHODOLOGY AND DESIGN OF SMART HOME MANAGEMENT SYSTEM (SHMS)

In this implemented system, an integrated house management system with safety and security system has been designed based on Arduino Microcontroller and several of available sensors. The system is divided into two main parts the first part is responsible for security. Figure 1 presents the block diagram of the security part of the proposed SHMS. This part is based on two levels of security. The first level is the use of the motion detection sensor (PIR sensor), which senses the movement through the change of the infrared radiation emitted from the human body. The second level of security is the use of laser beamline and optical resistance (LDR sensor), which in turn will be the reader(receiver) of the laser beam, when the thief tries to pass from the front of PIR sensor or cutting the laser beam the Arduino NANO will be turning ON the alarm buzzer, and in the same time through the programmed GUI the NodeMCU will send a message also to alert the house owner, the user can access to the GUI by a local IP address granted by the NodeMCU microcontroller. Additionally, a temperature sensor is used to monitor the weather temperature in order to choose a perfect potion to install the system.

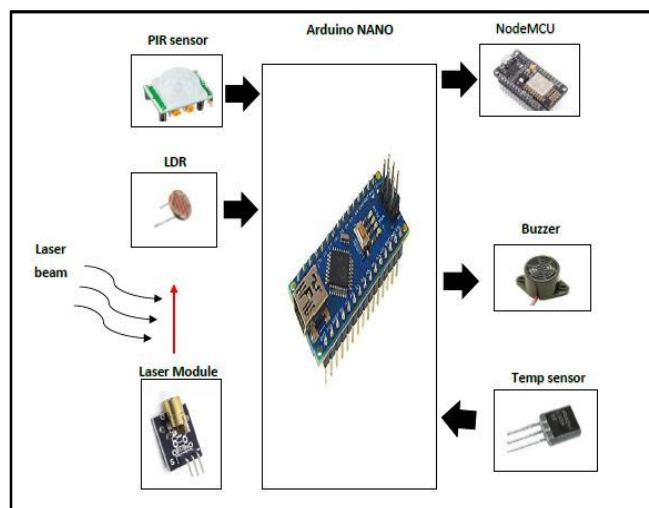


Figure 1:The Block Diagram of Security System Including the Utilized Sensors

The second part of the system is responsible for ensuring safety, such as the detection of the leakage of cooking gas by the MQ-04 gas sensor and detection of the fire by the flame sensor. Figure 2 clarifies the block diagram of the safety part of our proposed system. In the case of fire detection, when the flame sensor detects the fire the owner of the house will be alerted by turning on the alarm and turning on the water dispenser to extinguish the fire and at the same time the system will send a message to the GUI. In case of a gas leak, the gas sensor detects the gas leak and the homeowner also alerted by a message on the GUI. The soil sensor is used to measure the soil humidity, if the soil is dry the water pump

will be turning on and send a message to the GUI. Also, a water level sensor is used to monitor the tank water level and in the same previous procedure will turn on the water pump and send the message to the GUI. All status of the house is monitored remotely via IoT technology which is supported by the NodeMCU microcontroller where all the alarm messages will appear on the special GUI programmed inside the Arduino environment, the NodeMCU grant to the user a local IP allows him to monitor his house wirelessly. Additionally, the user can convert this local IP into public IP by some algorithms or by using some websites that are powered by network companies, the public IP allows the user to monitor his home from anywhere in the world. Additionally, the homeowner can be turned ON/OFF the outdoor light through the GUI to provide comfort to the homeowner. To clarify these two parts in much proper manner the structure described in figure 3 illustrate it.

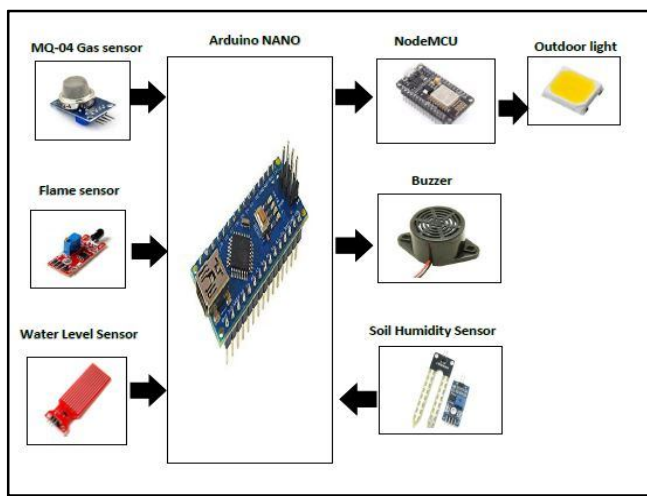


Figure 2: The Block Diagram of Safety System Including the Utilized Sensors

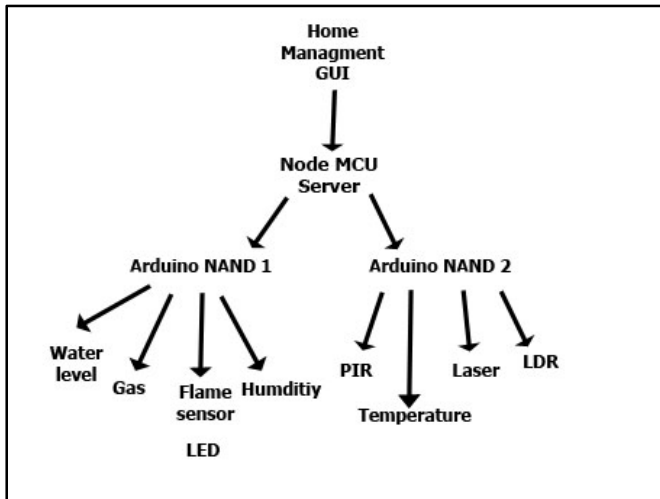


Figure 3: Structure describe our proposed SHMS

4. RESULT AND DISCUSSION

The implemented system that has been clarified in the previous section would be discussed in this section. In

addition, the Hardware design for our proposed system can be seen in figure 4 with all attached and utilized sensors within our multilevel system. Additionally, the flowchart describing the workflow of our proposed system can be clarified as indicate in figure 5.

In order to get accessing to our SHMS it has been designed a GUI window for accessing process based on the use of NodeMCU, which would formed as a webservice as can be seen in figure 6. Hence, by placing the selected IP address on the browser of laptop or any smartphone to obtain the GUI for our home management system.

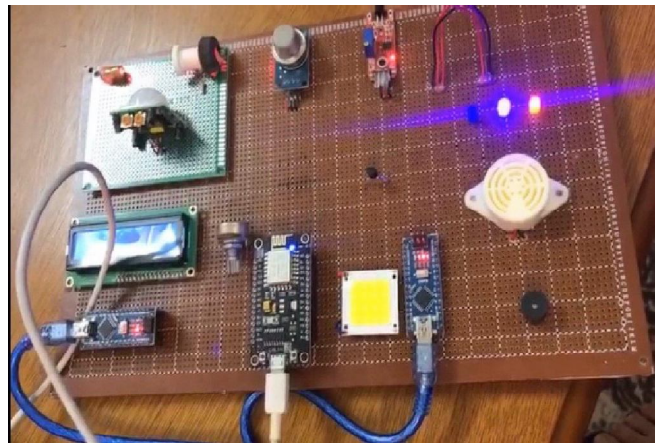


Figure 4: The Hardware Implementation of Our SHMS

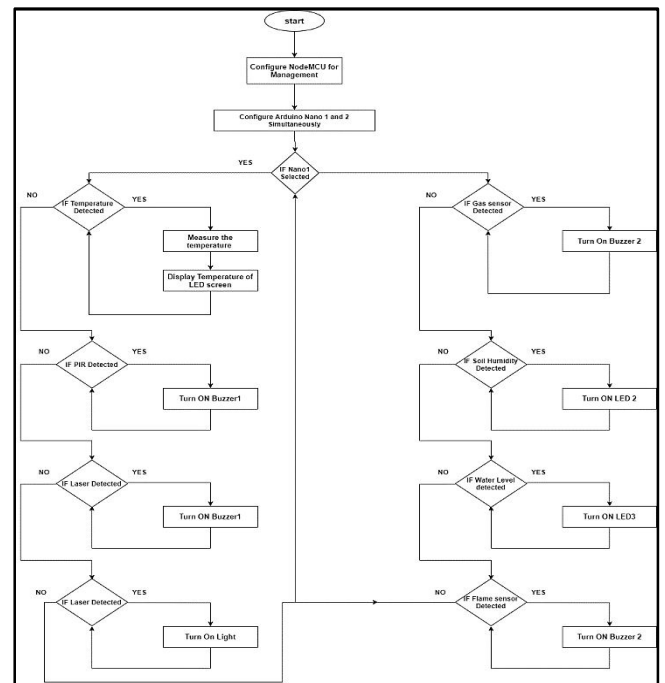


Figure 5: The flowchart describing our proposed SHMS.

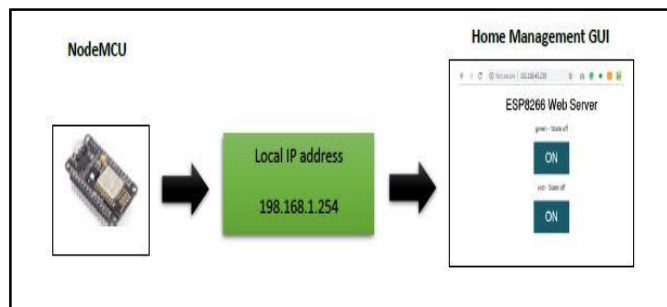


Figure 6: GUI accessing operation for our proposed SHMS

Finally, an alerting message would be showed when there is any type of detection that faces each sensor operation. An example for this message can be seen in figure 7.

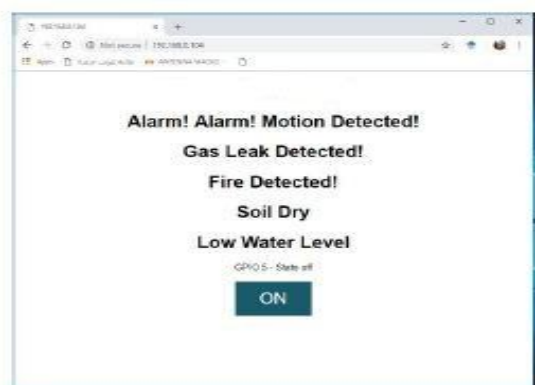


Figure 7: Example of Alerting Message from Our SHMS

5. CONCLUSION

In this work it has been explores the concept of smart home management for the security and safety system. A smart system for handling the control over wide range of different function sensors have been designed. The system was working based on the use of both Arduino Nano and NodeMCU as controllers in order to increase the reliability and make the system independent on single failure point. The security concern with our proposed system was based on the two level in order to increase the secure level of such systems. the uses of IoT technology in this work to facilitate the system accessing by the user and gives alternative way to alerting the house owner, where the owner can monitor his home wirelessly through the special programmed GUI in the various cases in motion detection, gas leak detection, fire detection and all cases that mentioned previously. For future, we would connect our proposed system to the cloud based platform to handle the data gathering, processing in a much proper manner.

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