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Real-time monitoring system based on integration of internet of things and global system of mobile using Raspberry Pi

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ABSTRACT

Security and safety of homes remain critical issues in all countries. The majority of individuals have to deal with significant issues like fire and theft at some point in their lives, particularly in families that spend the majority of their time and engage in most of their activities outside the house. There is a pressing need to use cutting-edge technology in order to upgrade and strengthen the security system, as well as to remotely monitor the living environment for potential mishaps. In this paper, we proposed two integrated techniques, which are the internet of things (IoT) and short message service (SMS), to monitor the home for hazards to take the necessary actions, by Raspberry Pi 4 model B as a controller and phone app to monitor. Global system of mobile (GSM) sends SMS alerts to users, and the Blynk application monitors the data of sensors. Our outcome of this demonstrates that the proposed had the capability and high efficiency to monitor and detect undesirable situations in real-time before disasters occur.

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1. INTRODUCTION

A home is considered secure if it has some kind of monitoring system or sensors installed [1]. Safety is the most vital aspect of a home for humans [2]-[4]. Especially when homeowners go on vacation and leave their homes vacant for an extended period of time, they are more likely to be victims of theft [5], [6]. Alongside the possibility of theft, there is also another risk, burning the houses due to various factors. Such as electrical zippers, and gas leaks [7]. In certain residences, security is present but less effective during security or fire disruptions. This is due to the fact that the information that is obtained is not in real-time. If information is not updated in real time, it will take longer to respond to emergencies such as security breaches and fires [8]. Therefore the utilization of internet of things (IoT) devices requires an adequate infrastructure for monitoring remotely before disaster strikes [9]. The IoT offers a wide variety of solutions that may help individuals successfully complete their everyday tasks [10].

Hence we need a system that is able to keep track of the condition of the home and immediately inform us if there has been an unobserved visitor or if any other unforeseen occurrences take place [11], [12]. This instrument makes use of the technology known as the IoT, which enables it to be operated from any a where in the world so long as there is anc internet connection availablec may also be utilised as a control and monitoring system for the house [13]. In the home, sensors may be used to monitor the use of energy and water, as well as to manage temperature, humidity, and the appliances that are located inside the home [14]. Also to monitor the door of home from theft [15].

The deployment of an IoT security system may lead to an increase in the number of arrests made for criminal activity in the house and can also reduce the risk of fire incidents occurring in the home [16]. Because home security systems only monitor for unauthorized entry from the outside, it is unable to forestall mishaps like fires C. Because of this issue, it is necessary to send a notification to the user in real time whenever there is a unique circumstance at the user's residence. For the purpose of this investigation, we intend to make use of both the IoT and global system of mobile (GSM) technology in order to notify users in real time.

Recently, a variety of home security systems have been introduced into the market; however, these systems only carry out a single function and do not provide scalability in terms of that function. In addition, the sensors are offered at a premium price despite the fact that the company only offers one or two distinct kinds of sensors and a restricted quantity of sensors. In this study, to solve this problem, will also incorporate numerous sensors, including a fire sensor, a smoke sensor (MQ2), and a digital-output relative humidity and temperature sensor (DHT22) temperature and humidity sensor. the user will receive the data of the sensors in real-time through the Blynk application and can monitor his home in addition, if there is a fire in the home the owner will receive wrong notification on the application of the phone as know Blynk. In addition, if someone uses an incorrect password or non-register card in radio frequency identification (RFID) during three times, directly the owner will be received short message service (SMS) as the wrong message through GSM network. This system is able to provide a safe environment during monitor the home in real-time and sending notifications to the user if there is interference with the house.

2. PROPOSED SYSYEM

The proposed of monitoring a home security system consisting of multi sections has been depicts in Figure 1. These are the input, controller, and output sections, respectively. In the beginning, the controller section will stay in the waiting state in order to receive a signal from the input section, which will consist of RFID, a 4×4 keypad, DHT11 sensors, gas sensors, and a fire sensor [17]. This signal will be received.

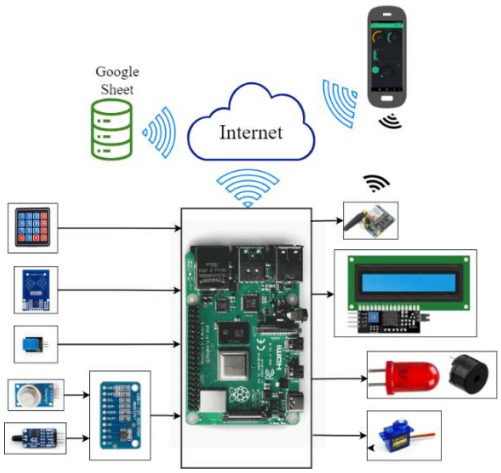


Figure 1. Block diagram of proposed monitoring home security system

In the input section, an RFID and keypad have been used for interfacing with the microcontroller to unlock the door of the system. We used the keypad in the main door and RFID for a special room in the home. If anyone tries to access the main door by using an incorrect password three times to unlock the system without authority and also use access card unregistered, a appropriate pulse is going to be sent to the controller. The controller portion makes a determination in response to the pulse that is receive from the input devices, and then it activates the output section, which consists of a liquid crystal display (LCD), GSM module, servo motor, light emitting diode (LED), and buzzer. In addition, other sensors in the input section like DHT11 sensors, gas sensors, and a fire sensor, accordingly. In the event of changes from high to low and vice versa in temperature, humidity, gas, smoke, and fire, appropriate pulses will be sent on all sensors in real-time into the microcontroller. The microcontroller makes an appropriate decision based on the received pulse from the input sensors, and then the microcontroller activates the output section by sending the data through the mobile app. However, the functionality of the devices that are output is determine by the state of the section that is input. In the event that the user enters the right password, the controller will transmit a pulse signal to the attached servo motor in order to allow the door to be opened. At the same moment, a message is show on the LCD

screen. Conversely, in case of the password incorrect, controller concurrently transmits signals to the LED, the buzzer, and the GSM module. The red LED that has been installed in the front entrance of the house serves as a warning signal in the event that anything has gone wrong inside the system. Consequently, a buzzer generates a sound signal, and a GSM module sends a message to the owner's mobile phone. Both the owner and the security guard are quite likely to be aware of such actions. As a direct consequence of this, they will be able to identify the malicious action-taking place inside the system. the dataset used here, data is stored in the cloud, through which the user can return at any time and read it. In addition, we used ADS1115 to convert from the analog input section to digital to the smoke and fire sensor. Therefore, the mission of this project has been accomplished, and it was a success in terms of making the home safer and more modern.

3. RESEARCH METHOD

The software flow chart for the proposed monitoring home security system is depicted in Figure 2, This provides an explanation the whole of the processes involved in the creation of software. The language of the program is used Python to program the microcontroller as know Raspberry Pi. The intended function is carried out in the order specified by the flowchart when the appropriate instructions are followed. At first, the software will begin the process of initialising all of the peripheral devices (WiFi, GSM module, LCD, keypad, and RFID) are operating effectively, and in the event of an error. The system will continue to verify things until it is confirmed everything is operating properly. This is a prerequisite for the peripheral devices and the microcontroller to be able to interface with one another. After the initialization process,the operations of the system are divided into two parts which are the monitoring system the environment (MSE), and the door lock system (DLS). Both of the systems operate simultaneously.

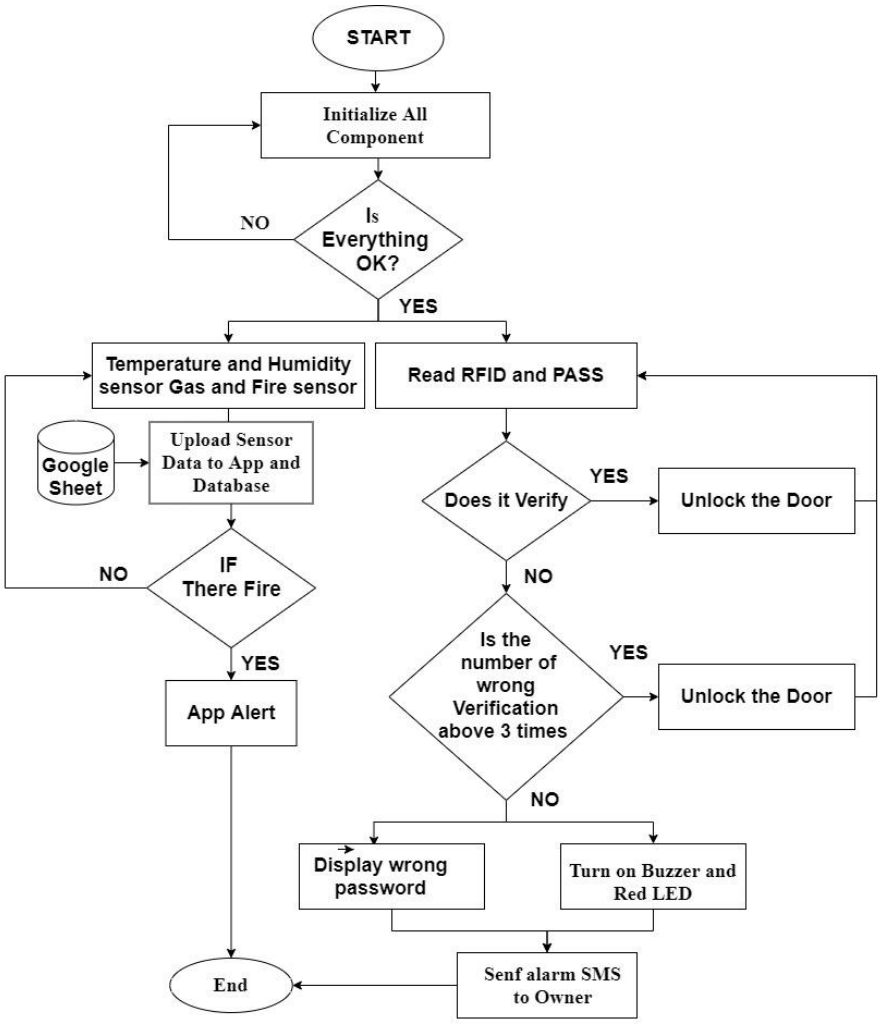


Figure 2. Flowchart for monitoring home security

In the first part is DLS system, the program examines the password, after receiving a password the application analyses the password and compares it to the door-unlocking password to ensure it is correct. If the password is correct, the program will give the authority to unlock the door, and display on the LCD that the password is correct, the door will be open by the servomotor with turn on the green light for 4 minutes and then close it automatically. As for if they entered an incorrect password or use non-registered cards for a system of RFID three times, the buzzer turns on and the LCD indicates the wrong password after that the system will send an SMS to the owner to inform him.

In the second part of the system MSE, the system checks the data of temperature, humidity, and the amount of poisonous gas and sends the data through the application Blynk application. The owner can monitor the data of the sensors in real-time. In the event of a fire that was sensed by the fire sensor, the owner of the home will be receive notification as a warning message by the app of Blynk.

3.1. Hardwere and sofwere

3.1.1. Raspberry Pi

The Raspberry Pi is depicted in Figure 3 is a credit card-sized single-board computer that can be purchased at a cheap cost and was created in the United Kingdom by the Raspberry Pi foundation. It is called a single-board computer because all of the necessary components, including the central processing unit (CPU), random access memory (RAM) [18], graphics processing unit (GPU), and other peripherals, are integrated into a single circuit board [19]. In addition to having a 64-bit ARM CPU, it runs Raspbian, which is a 32-bit operating system that is based on Linux and released by the Debian project. A computer may be created with a Raspberry Pi by connecting it to a TV or monitor, adding a keyboard, mouse, speakers, and camera, and then using it in the same manner as a traditional computer [20]. When compared to the size of a credit card, it is regarded as powerful enough for use in embedded systems, despite the fact that its processing capacity is lower than that of a typical desktop computer. There have been various iterations of the Raspberry Pi released over the years, including the Raspberry Pi 1, Raspberry Pi 2, Raspberry Pi 3, Raspberry Pi zero, Raspberry Pi 3 model B, and Raspberry Pi 4 [21].

Figure 3. Raspberry Pi 4 model B [21]

3.1.2. Global system of mobile module (SIM900A)

The technology known as the GSM communications, is implemented in a variety of different communication tools [22]. For communication with the GSM network, a computer is often used. The Figure 4 GSM module is solely capable of understanding and responding to AT instructions. The most fundamental and simple instruction is "AT," and if GSM answers with "OK," then everything is functioning normally [23]. If not, GSM will respond "ERROR". It is possible to use a number of different AT commands, such as ATA to answer the phone, ATD to make a call, AT+CMGR to read the message, AT+CMGS to send an SMS, and so on. Carriage return, sometimes known as r (0 D in hex), is the character that should follow AT instructions [24].

3.1.3. Internet of things

Blynk is a popular app, as shown by the fact that more than 100,000 people have downloaded it [25]. Blynk is a platform that allows iOS and Android applications to operate Raspberry, and a wide variety of other microcontrollers. A digital platform enables the user to construct their own visual interface for the project according to their preferences. The user just has to drag and drop the widgets that are relevant to the sort of project they are working on in order to utilise it, making it a very user-friendly and straightforward piece of software [26]. This application is use in the IoT component. Monitering home through IoT by Blynk application should be connected Raspberry Pi in WiFi. In addition, we can connected it by Ethernet cable. The owner of the home can monitor the data of sensors in real-time by smartphone. In addition, if a fire in the home, our system will send an alert notice to the house owner through Blynk application [27].

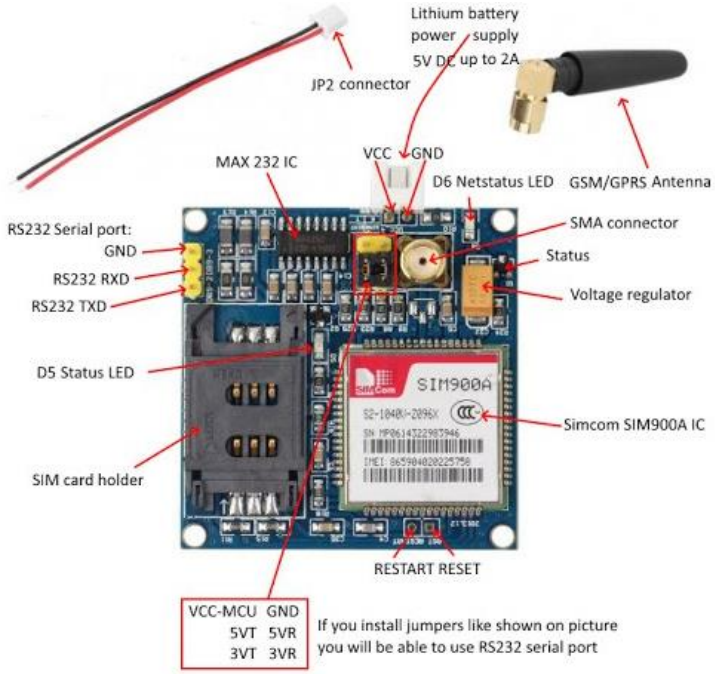


Figure 4. GSM module (SIM900A) [24]

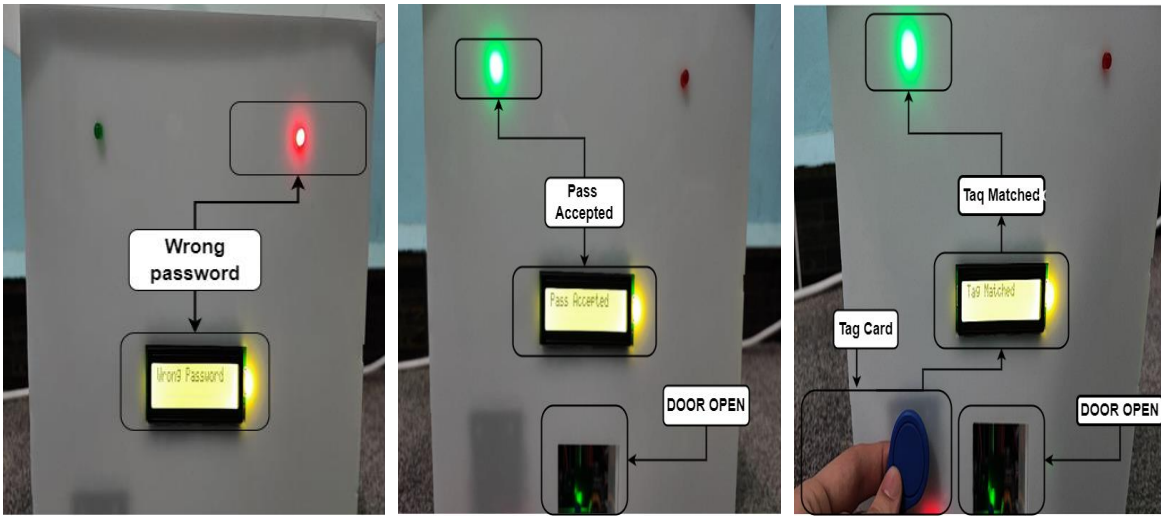
4. RESULTS AND ANALYSIS

The last stage of a monitoring home security system using Raspberry Pi based on IoT and GSM technologies as shown in Figure 5 is the implementation of the system. The first part of the door system as showen in Figure 5(a) using keypad and second part using RFID as showen in Figure 5(b). Therefore, it can be evaluated before utilization. At this phase, many several devices are used for monitoring the home system as mentioned in Figure 1. To do the experiments as explained in our proposal. We divided our work into two parts to evaluate the system. To test the first part of our proposal as we referred to it as DLS as shown in Figure 6 and Figure 7.

During testing the system, when using an incorrect password, the system sends an SMS to the owner as Figure 7(b) and non-register card the owner received SMS as shown in the result in Figure 7(a) With both a buzzer alarm. And displays alarms of the wrong pass on the LCD as showen in Figure 6(a), and the LED turns on. After that, we used the correct password as in Figure 6(b) and a correct register card in the system as Figure 6(c). The system opened the door by servo motor and displayed on the LCD, the password was accepted and that was indicated with a green LED.

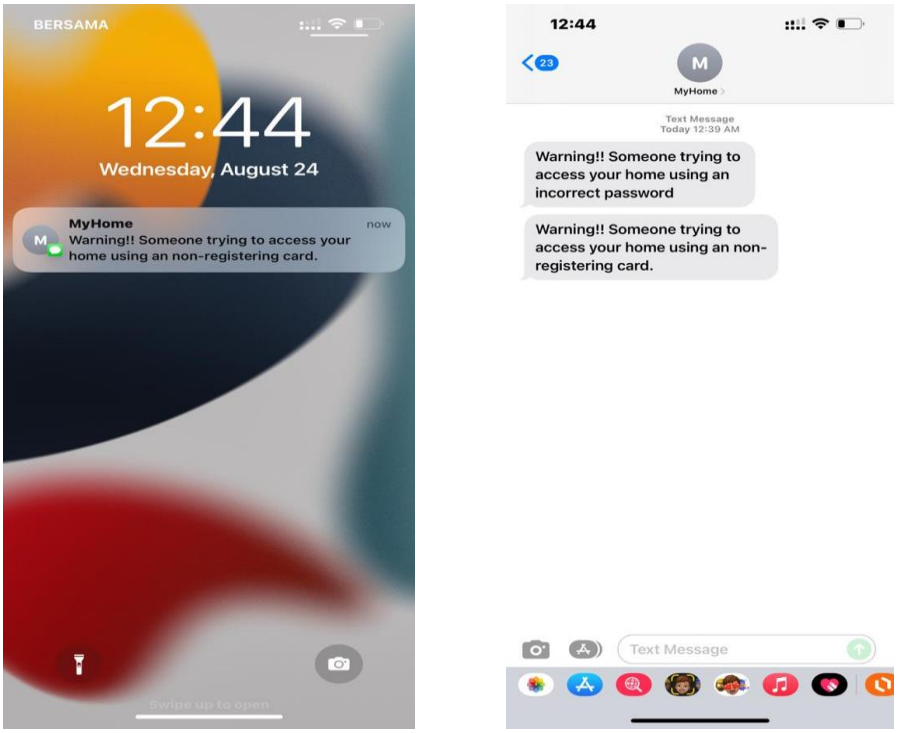
(a) (b)

Figure 5. Prototype of home security system using(a) keypad and (b) RFID



(a) (b) (c)

Figure 6 Display prototype (a) test with wrong password, (a) test with correct password and (c) test with register aceese card



(a) (b)

Figure 7. SMS Received by test from (a) RFID and (b) keypad

In order to test the last part of the project as we referred to it as MSE is depicted in Figure 8, it is consists of a group of sensors, as shown in the Figure 8(a). We used a cigarette lighter in the sensor range as meantion in Figure 8(b) the system responded by sending an alert message to the owner of the house that there is a fire inside the house. With a siren to warn of a fire inside the house to alert passersby to be careful as shown in Figure 8(d). The homeowner can also monitor the proportion of toxic gases generated by the fire in the home to take possible measures to reduce the damage caused by the fire. In addition, the homeowner can monitor the condition of the home under normal conditions at any time whether it is temperature, humidity and gases via the smartphone using the Blynk application as shown in Figure 8(c).

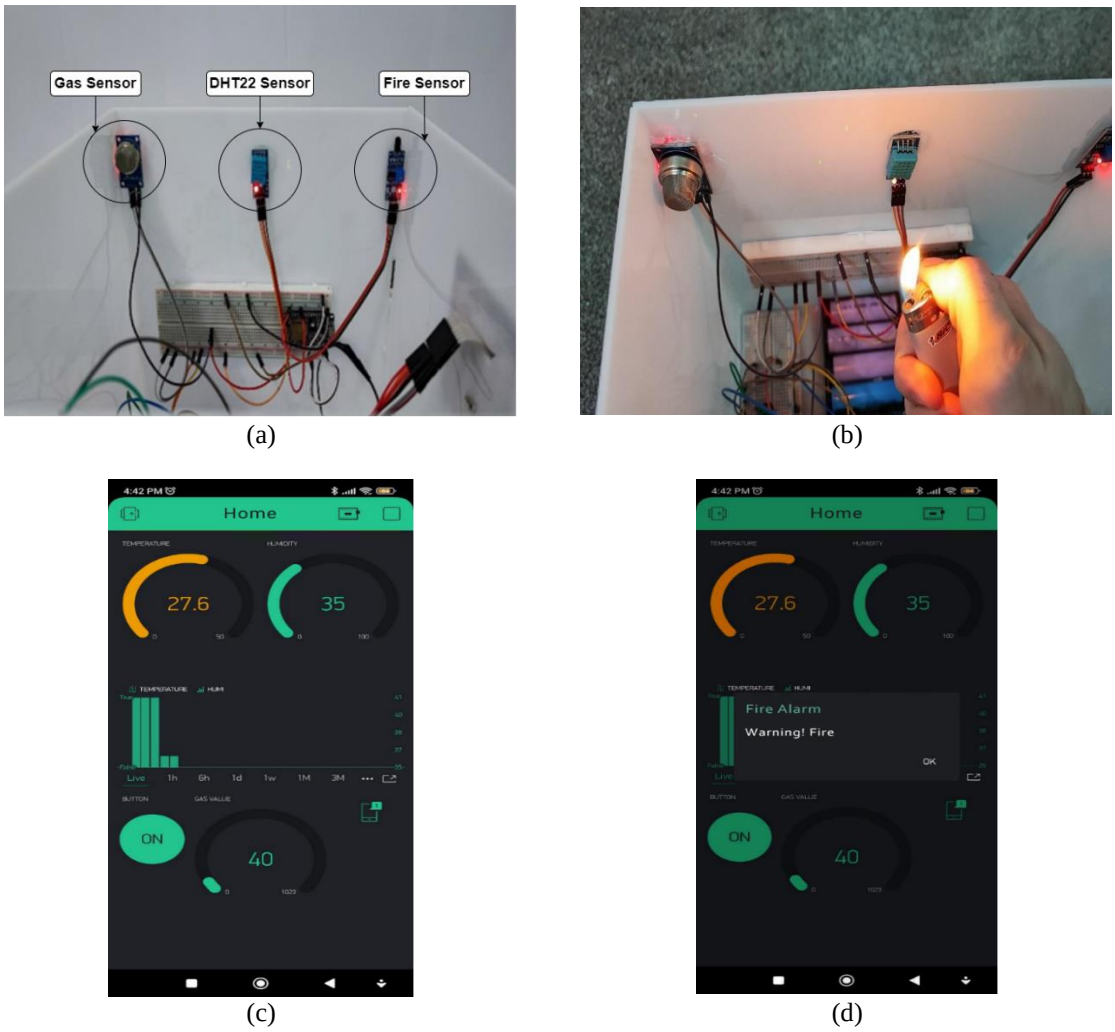


Figure 8. Display app rusalt (a) type of sensors, (b) test the system, (c) monitoring using mobile application and (d) fire alert notice

5. CONCLUSION

In this work, we have presented a monitoring home security system based on IoT and GSM. The purpose of the system is to keep an eye on the safe environment. In addition, the user is alerted about the security breach using the GSM network, which presents a unique chance whenever the user stays at a location that is quite a distance from their usual residence. However, the Blynk application is the most impressive feature available for monitoring the system using an IoT. Moreover, The technique delivers dependable results, operating at a cost that is within acceptable bounds as well as getting rid of the complicated system. The outcome of this proposed demonstrated that the system had the capability to monitor the condition of the house remotely by SMS, in addition to making use of an application on the smartphone by way of an internet connection to purpose of monitoring. It could also notify the user of the temperature inside the house and detect smoke or gas. Our future planning to devlop the home security of the system based on keyless door. This helps to facilitate entry into the house in a more secure manner without the use of any key. It also helps the elderly and the infirm to open the doors of the house and enter their homes without the need to use any physical key.

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