Ensuring Important Household Item Security by Designing LDR Sensor and GSM Technology based Cost-Effective Smart Protection Box

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ABSTRACT - Security is regarded as a key concern of home automation systems since it ensures the resident's comfort and well-being. As crime is piling up rapidly in today's culture, home defense devices are very important. With the advent of innovative technology in recent years, homeowners can go outside the home with relief as modern home security systems offer ample protection against burglars, fire, smoke, etc. This article implements a smart protection box for legitimate personnel that can help to notify when an unapproved user tries to infringe the security of necessary materials inside the box for taking immediate actions. Two other main aspects of this smart security box, along with the upgraded security features are affordability and accessibility. This low-priced, low-power enabled the smart security box based on empirical research, is found to be durable and reliable in detecting and providing legal customers with security violation notifications. This forthcoming smart security box can detect security breaches with the highest accuracy of 100% if proper light facilities can be arranged along with the warning SMS transmission within 800 milliseconds. This low-cost device has been built for only 62.5$ and can be commercially exploited for smart security technologies in the local and foreign markets.

 Keywords — *GSM Technology, Smart Home Security, Security Box, Arduino, SMS, LDR Sensor.*

I. INTRODUCTION

The security dilemma is one of the interesting problems in the advanced era of computerized creativity. The level of defense against injury, danger, damage and wrong-doing is implied by security. It is a type of growth and strategy for the betterment of daily life. A protection device is a tool for raising the quality of living in the home or office by simplifying a pliable, comfortable and secure environment [1]. When the owners are at home or out of the building, a wellness scheme offers a kind of assurance that ensures the protection and security of the properties. In new home projects, the trending culture is home automation. This is being undertaken to promote the current homeowners' versatile and relaxed living experience. An advanced home monitoring system is part of home automation. Although people work hard and spend a lot in furnishing their homes and maintaining valuable hard-won in their homes, some devil-minded people opt for the shorter path of burglary. Instead of going outside the home for recreation, homeowners sometimes stay at their house because of their valuable products' safety.

The majority of the current safety systems are costly, complicated, and voluminous. Moreover, they require complex wiring [2]. To fill up such loopholes, a simple, low-cost, less spacious and transportable system needs to be devised. Effectual energy consumption and limited-cost occupied authentication for Smart Home Security and Remote Monitoring [3] by motion discernment are imperative for a wide variety of commercial and security applications. Till now, smart home protection control systems are being increasingly implemented by several nations. Countless home and office gadgets with which communications are made today have microprocessors. Many of these appliances carry explicit user interfaces, but the complexity of using these complicated features frustrates many people. This paper presents a smart security box that provides the above-mentioned concerns with an inexpensive solution.

In today's world, the introduction of home security systems is paramount as the need for security and defence from different forms of threats and vulnerabilities is continuously mounting. Because of the ease of use and low

cost, our device provides the customer with a decent level of security and is easy to run and install. There are still some outdated systems; some of them are either too costly or not convenient to use and install. Before getting access to the device, certain applications need to be installed by users and many of them are third-party apps. In our proposed security box, a simple, automated text message system is introduced which can inform the user about the security violence based on Light-Dependent Resistor (LDR) data. This SMS is dispatched to the registered cell number saved by the user at the time of installation.

In the past, different apparatus is used in home-based authentication systems; e.g. sensor-based, keypad-based, fingerprint, palm print and so on [4]. In this article, the GSM technology is utilized for the development of a smart protection box. There are several explanations for using GSM technology. First of all, GSM technology uses the SMS technique which delivers short messages easily, reliably and at low cost. Secondly, the GSM-based Wireless Sensor Network (WSN) is employed, which ensures network stability and adaptability for any change; it adapts at any time to new network devices, saves costs by saving a lot of wiring costs in complicated wired topological connections [5]. Thirdly, considering Gu et al. [6] and Mingming et al. [7], GSM is one of the world's most commonly deployed cellular technologies. Felix et al. [8], Peijiang et al. [9] and Rao et al. [10] also clarified that GSM implementation is fully operational in any work with the increase within the range of GSM subscribers, research and growth. Finally, nearly everyone uses mobile-phones today. It can facilitate the text sending module to be widely exerted.

Previously, various systems were introduced by researchers and developers for smoothing daily activities and to provide security of home appliances. Both Arduino and Raspberry Pi were utilized in the smart home scheme by Kumar and Pati [11]. Arduino was used for monitoring of home appliances such as lamps, ventilators, heaters, washing machines, taps, etc. and Raspberry Pi was occupied for voice recording and video capturing via the graphical user interface (GUI) on smartphone applications. This system was developed for continuous monitoring of home necessaries. It is applicable to the general purpose only.

Besides, a study in [12] was also carried out to secure homes using the sensor, for instance, ATmega microcontroller, buzzer and relay to monitor the system. In this study, when the IR sensor senses an intruder at home, a signal was sent to the microcontroller that reads the sensor status and flips the keyboard and LCD panel accordingly. The LCD monitor displays the feedback of staff with the right password to open the door and the message sent to the cell phone of the customer via GSM. This work was also focused on home appliances and the system cannot be transported to other places if necessary. Research [13] was carried out on Home Automation, Protection and Defence using the Arduino ATmega microcontroller, where Android phones were considered for receiving warnings. Sensors such as MQ2 and MQ7 were availed for gas and smoke perception. The ultrasonic sensor was used for intruder presence detection and notification was sent to the user's phone for warning via GSM. Here, ultrasonic sensors were taken for detection purposes which can make the use-case of the prototype questionable. If an authenticated person comes in front of the system, it might detect it as a faulty intrusion and might send the warning.

Moreover, Shawki et al. [14] suggested a protection device in which temperature, heat, smoke etc. are detected by various sensors. In this work, the sensors transfer the data to the microcontroller and the microcontroller takes more measures at that stage. It also operates while the owner is far away from the building. When the consumer goes outside the home and the display sensor is triggered, the device detects some activity and provides a signal to the microcontroller. Via the GSM module, the microcontroller sends a message to the proprietor. Unfortunately, this device also lacks transport capability and unauthentic intervention detection module is not implemented here.

Hasan et al. [15] created a mechanism when someone except the proprietor, tries to open the system, the pressure sensors are triggered at that moment and pulses are also obtained by the controller. At that point, according to the pulse outcome, the controller unit takes choices and actions. Instead of using low-cost and effective LDR sensors, it emphasizes pressure sensors.

Khan et al. proposed a home safety device that controls the barrier's touch, heat, smoke and sound [16]. It collects information from the sensors and uses the GSM module to send an SMS to the corresponding number. Zaman et al. [17] devised low-cost home automation and protection using motion sensors and GSM where Arduino can cause alarm and warning notifications and deliver them via smartphone to the corresponding customer. Sriskanthan et al. [18] built a home automation system based on wireless Bluetooth technology enables the user to monitor multiple Bluetooth-connected devices in the home environment. These solutions are difficult for extended use and have some drawbacks that do not include a comprehensive home safeguarding solution.

Annapurna et al. developed a password-based automated lock system [19] where an access control system allows approved persons to access restricted areas and RF wireless communication that transmits signals to neighbouring houses for robbery indicator. Huang et al. [20] developed a home security alarm system based on a wireless sensor network and GSM technologies. The system's operation consists of a single central node module and a large number of node data collection modules operate at the point of multipoint communication. This method overcomes spatial limits, thereby raising operating costs.

Remote control of household appliances was mentioned in [21–24] for Internet usage. In [18], a home automation control based on Bluetooth was defined. Voice commands for controlling home automation relying upon GSM system was designed in [25]. Speech commands for home automation have been illustrated in [26].

However, none of the above devices have created a system of having a repertoire of particular elements in a shield box where it cannot be handled without legitimated users. Moreover, a real-time auto-lock system was also unavailable in the aforementioned well-established systems. The key vision of this work is to develop an automated home security box to store important products of a house that alert the homeowner in real-time if an intruder tries to demolish the box or if they want to steal the box contents by using several cost-effective modules. Three unique goals have been established to add cumulatively to the ultimate accomplishment of the main objective. Those particular targets include:

1. In terms of their cost and performance, to study and test current home security systems and to come up with a precise, low-priced solution.

2. To determine how a mobile-based device - GSM, can be accompanied into a protection framework to generate real-time information of a homeowner.

3. Planning, development and testing of a solution prototype.

Although comparable systems can currently exist in the market, these are not user-friendly, quite costly and not seamless. This study aims to reinvent such a device using locally accessible materials and streamlined programming that makes it user-friendly and low-priced. The merits are outlined as follows:

1. The use of LDRs to check the status of the box door (either the box is locked or unlocked) is a very easy and inexpensive way of testing this kind of conditions. The use of GSM is a basic and effective method of communicating information and reaches all areas of the globe due to technical innovation, so the homeowner is not restricted to receive warnings from his position away from the building.

2. The concept produced in this article is a prototype, compact in scale and light in weight. Hence, carrying this box is easier and it can be mount anywhere at home where the homeowner might think it will can be placed.

3. The prototype consists of basic, readily available electronic components and the microcontroller employed is also cost effective. The result is that the total expense of the project is minimized and made comparatively cheap, making the prototype feasible for many households.

II. PROPOSED METHODOLOGY

Our proposed framework accumulates different hardware and the coding was made in Arduino software for setting simultaneous logical statements for activation of the sensors and actuators. The hardware used in the framework consists of the Arduino Microcontroller, GSM assembly, Servo Motor, Buzzer, LDR sensors, Light-Emitting Diode (LCD) and 9V Direct Current (DC) Battery. In the following two sub-sections the proposed system i.e., the system diagram and the functional diagram are discussed.

A. System Diagram

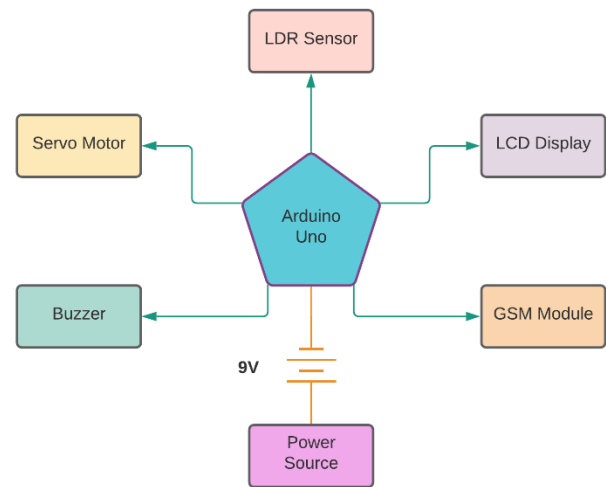The system diagram for the proposed protection box based is shown in Fig. 1.

Fig. 1 System Diagram

It normally consists of three essential parts. Segments of input data, power and transmission, and performance. LDR sensors work as the source of input data to the system. LDR is an extremely advantageous tool for calculating light intensity. 9V batteries can easily provide the required energy for turning on the microcontroller device. The Arduino Uno is an open-source control unit. The microcontroller available on the Arduino relies on the ATmega3288. LCD is a display module that is available for visualization purposes. The message sending option is established using the GSM module. A servo motor is one type of actuator that can rotate up to 180 degrees. The box opens automatically using this feature. The magnetic pulse is excelled by the Piezo Buzzer. This will create a disturbing sound when box security is broken. In our protection scheme, the LDR sensor, LCD, Buzzer, GSM module and Servo motor are connected with the microcontroller which starts its activity after getting the power from the battery or other power sources.

B. Functional Diagram

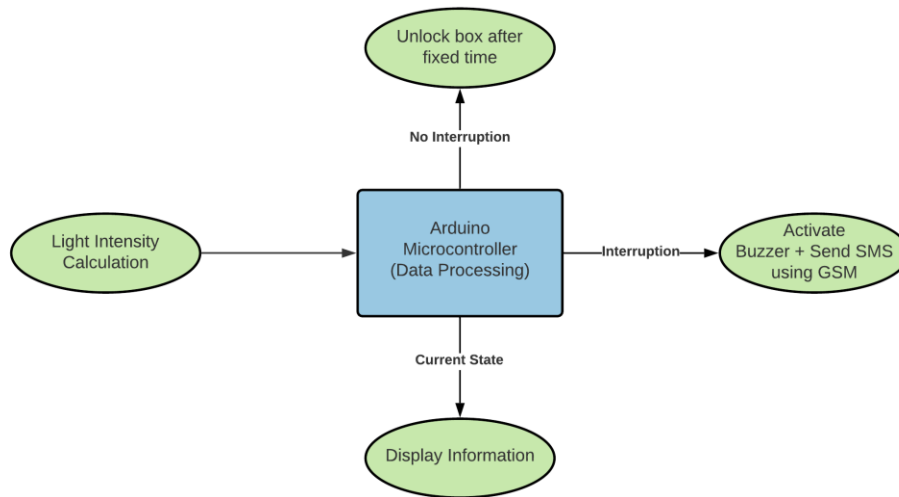The utility diagram of the proposed security device is illustrated in Fig. 2.

Fig. 2 Functional Diagram

The designed smart box holds a space where important documents and essential materials can be stored. The modules are placed feasibly so that the purpose of the protection box is not interrupted. The user sets a fixed time and the box cannot be opened before that. The current state and the remaining time can be seen on the LCD. A servo motor is utilized to handle the locking of the box. After completion of the remaining time, the user can see a thread on the digital interface, "Now you can open the box" and the servo motor rotates 90 degrees for unlocking the box. To detect whether the box is opened before the remaining time or not, LDR sensors are arranged in the box to measure the light intensity fluctuation. If someone opens the carton before the fastened time, the sensors measure the light fluctuation and transfer the processed data to the Arduino to carry the next steps. Arduino triggers the buzzer with this information and makes an alarming sound before the device switches off so that if the consumer is near the box, he can come quickly to check the current condition of the box. Meanwhile, Arduino also sends an SMS to the owner's cell phone using the SIM 900A GSM GPRS module and unveils a conscious message on the LCD monitor as well. Thus, the system can notify the consumer whether the box safety is destroyed or not.

C. System Architecture

This section presents a brief description of the hardware elements that are taken to build the smart protection box, steps that are involved in the operation of the prototype box and the overall flow chart along with the circuit diagram.

1) Hardware Components

The hardware components that are needed for the total functionality of the safety system are described in this paragraph.

- *Arduino:* Arduino has been used for monitoring the signals incorporated from different sensors and modules. Arduino is a forum for controlling and handling electronics in physical computing. It has an independent IDE, which helps programmers to process and monitor the electronic signals from the connected units. Arduino Uno's most common Arduino board consists of the 8-bit Atmel AVR 16 MHz clock speed microcontroller. Additionally, the board is not costly, freeware and has a very vigorous group of developers. Another important feature of this device is its ability to work just by getting little power. In our system, we have tried to operate our protection framework by maintaining the only 5V to 9V power sources.

- *SIM 900A GPRS/GSM Module:* By different technical approaches such as wireless networking, Ethernet, GSM cell network, the warning message may be transmitted to the remote location. The most viable and open of all these network innovations for all consumers today is the GSM module since everybody has a smartphone phone. These GSM modules enable the cell carrier's Subscriber Identification Module (SIM) to send a notification. AT Commands are also used in the Arduino IDE, as specified in GSM standards, to monitor the module and process

these short messages. SIM 900A was included in the device to transmit SMS to the client's cell phone.

It is also small in scale, low power consumption, quick and cost-effective. It will fit into nearly all the software currently used by consumers. Many advantages underlie with the telecommunication GSM module as described by [27]. These include:

- It increases the performance of the spectrum.

- Universal roaming; is worldwide and this ensures that every portion of the globe can be roamed with one phone.

- This enables other services other than just voice, such as text messages and internet services, to be incorporated (data services).

- *LCD Monitor:* A liquid crystal display (LCD) is a level surfaced display that incorporates the liquid display's light modulating properties. Market devices such as game cameras, entertainment devices, watches, telephones, printers, calculators, etc. are widely used. The LCD uses the characteristics of light monitoring to display alphanumeric symbols. Sixteen columns and two lines are open. Up to 16 characters in 2 lines can be shown. In this system, the remaining time before the opening of the box and the current status of the security box are appeared on the screen of the LCD.

- *Piezo Buzzer:* Piezo buzzers are basic instruments that are able to generate radical beeps and tones. They act by using a piezo crystal, a special substance that changes shape based on the applied voltage. If the crystal, like a tiny speaker cone, presses into a diaphragm, a pressure wave will be produced by it which can be picked up as a sound by the human. It also shows proficiency in producing audio from 2 to 4 kHz. In this system, when anyone opens the box before the scheduled time, it makes the sound. This sound helps the surrounding people to make immediate action if any outsider attacks the box before the scheduled time.

- *LDR Sensor:* Photo-resistors, also regarded as Light-Dependent Resistors (LDR), are the most commonly considered light-delicate devices to sense the presence or shortage of light or to recognize the dominance of light. Their resistance is very high in the dark, often up to 1M, but when the LDR sensors are open

to light, depending on the light level, the resistance decreases significantly, even down to a few ohms. In this security device, the harmful physical attacks to the box are measured based on the processed data submitted to the microcontroller by the LDRs calculating the fluctuation of light intensity.

- Servo Motor: An electrical system that can drive or rotate an object with great accuracy is a servo motor. If an object needs to be rotated at some particular lengths or angles, the servo motor can be availed. It is essentially composed of a basic motor operating via a servo system. It is a self-contained computer for electronics. It is 23mm $\times$ 12.2mm $\times$ 29mm in height and 9g in weight. The servo engine is capable of spinning from 0 to 180 degrees. In our proposed prototype, this motor effectively performs the locking of the box door by moving from 0 to 90 degrees. This spinning cannot be performed before the time which has been fixed by the legal authority.

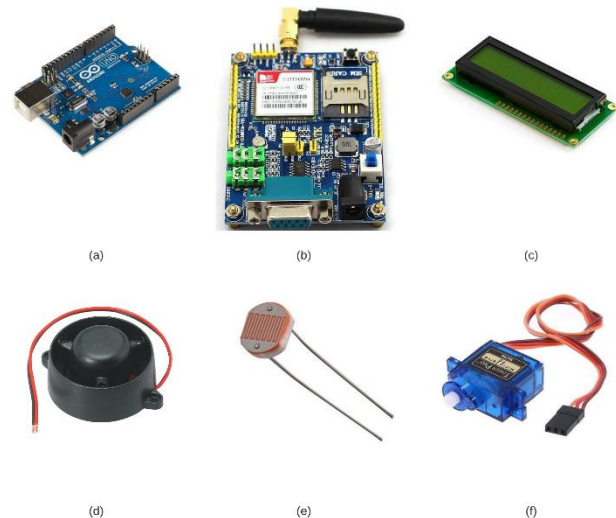All the hardware components considered in our system is illustrated in Fig. 3.

Fig. 3 Hardware Equipment (a) Arduino Microcontroller, (b) GSM Module, (c) LCD Monitor, (d) Piezo Bazar, (e) LDR Sensor, (f) Servo Motor

D. Procedure Phase wise

The prototype works by following the consecutive phases:

1. Insert something and bolt the package into the box.

2. In order to open the package after a certain moment, set a timetable.

3. Is the box open prior to time?

4. If Phase 3 is NO, the box opens immediately after the time you have reserved.

5. Display a warning message if Phase 3 is YES.

6. Give an SMS message to the owner of the Box.

7. Trigger the noise alarm.

E. The Proposed System Flow Chart and Diagram

Fig. 4 displays the complete system's flow map. The diagram explicitly portrays, step by step, how the overall structure and the security mechanism can work. Fig. 5 depicts the proposed device's circuit map. Every element is connected to the Arduino micro controller within the circuit. The 9V DC battery is the power source here.
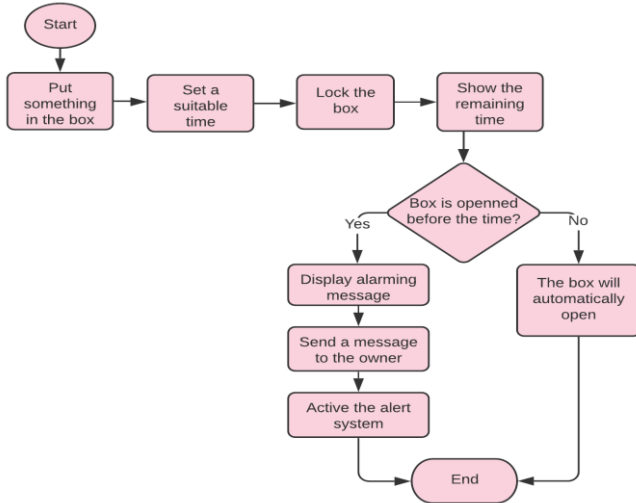

Fig. 4 Overall System Flow Chart

III. EXPERIMENTAL RESULTS AND DISCUSSION

The protection box model for home security based on SMS can be easily scheduled and enforced. The machine has been tested many times and provided correct output every time. When the package opens before the programmed time, the system collects the sensor data quickly with a good response and sends SMS to the legitimate user.

A lock and a LCD monitor are situated in front of the box. The enduring time for the packet to expose, as well as a conscious message, is designed to be visible on the LCD screen. After opening the envelope, the consumer places something inside the box and determines an acceptable fixed duration to make the materials protected inside the box. Next, the client closes the box and locks the box. The lock will automatically activate after the stated time is up and the message "Now you can open the box" will also be displayed on the LCD screen. After that, the package's owner can open the box safely. Fig. 6 displays the front view and the automatic lock and LCD.
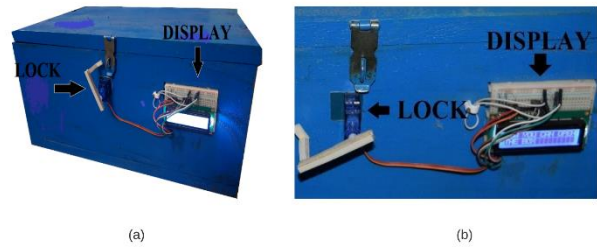

Fig. 6 (a) Front View of the Protection Box, (b) Automatic Lock and LCD Display

If a user attempts to expose the carton before the occupied time, the LDR sensor will be triggered. Simultaneously, the Arduino will receive a signal from the LDR sensor. Then the warning system as well as the GSM module will also be activated by the Arduino. On the LCD, a warning message will be shown. Also, an alarm will start to ring.

A note is often sent to the proprietor of the box when the shipment opens past the planned time. The contact number of the proprietor is registered on the computer. Whenever required, a customer can alter the number. No external electronic equipment is needed to transmit SMS because of the use of a GSM module in the system. Sending and receiving SMS prices are rather intangible and are continually declining. Time depends on the spectrum of signal intensity across the mobile tower to get the SMS to the owner. If the network signal is not strong enough, SMS transmission can be difficult in that case. Fig. 7 reveals the notification in the proprietor's registered mobile number and the warning which can be visible in the display if the invader attacks the box. Based on the text message received via SMS, the owner knows about the security violation and can perform further needed activities.
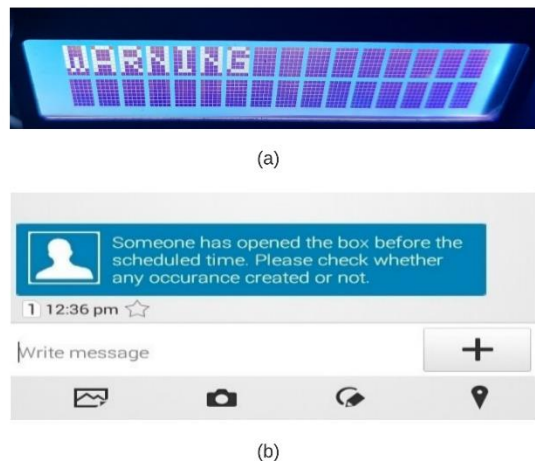

Fig. 7 (a) The Warning in the LCD Display, (b) SMS in the Box Proprietor's Cell Phone
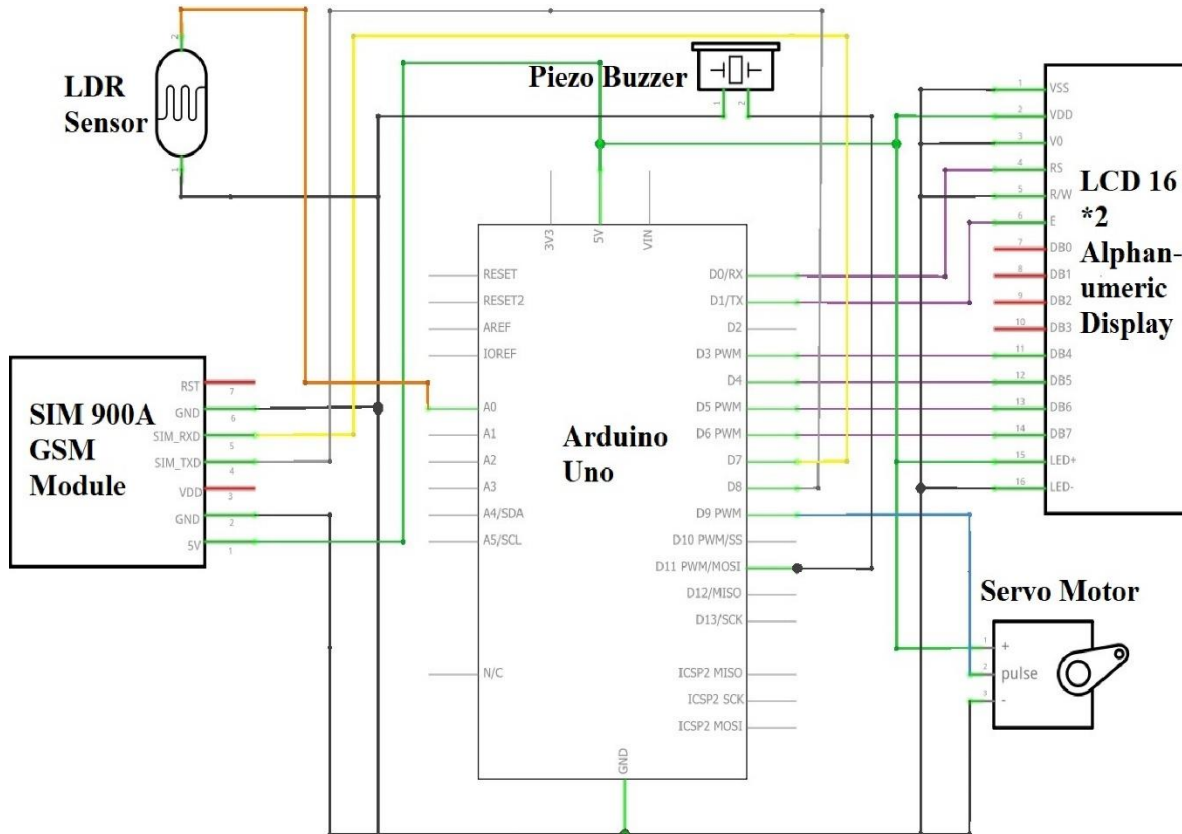
Fig. 5 Circuit Diagram of the Proposed System

A. *Features of the System*

This autonomous smart protective box has some salient features.

- *Low Cost:* The ATmega28 microcontroller is used at a very low cost within the Arduino Uno. The prices are also fair for the LCD panel, LDR sensors, Buzzer, Servo Motor and GSM module. Table 1 shows the system's overall cost.

- *Compact in size:* The protection box exerted in the designed system is delicate and dense in size. Changing from one location to another is really easy to do.

- *User-Friendly:* It is exceptionally quick to grasp the method. The devices can also be used appropriately by someone who does not have any experience with Arduino or additional components used in this scheme. The customer primarily has to push the control button and set the desired time to use it when required.

- *Rapid Response Time:* Guarantees proper protection by alarming the owner in a flash. Within a second, the device sends an SMS to the recipient. Additionally, it plays a loud alarm briefly when the box is opened before the due time so that if the proprietor is near the device, he or she can check the condition quickly.

- *Broad Area Coverage:* The use of the GSM network means that the regional areas of the system are served thoroughly.

As LDR has been deployed in our system to measure light intensity for initiating the necessary tasks by the microcontroller, the proper recognition of light intensity under varying situations is necessary. Generally, LDR resistors hold reluctance to lights. As long as the light intensity increases, their resistance tends to decrease. The resistance is calculated as mentioned in (1).

$$R_{Light} = \frac{500}{Lux} \qquad (1)$$

Here, Lux is the amount of light which can be fall into the

LDR.

Table 1 Total Expense of the System

Name of the Components	Quantity	Expense per product ($)	Overall ($)
Arduino Uno	1	7	7
SIM 900A GSM	1	28	28
LCD Display	1	3	3
LDR Sensor	4	0.3	1.2
Piezo Buzzer	1	0.3	0.3
Servo Motor	1	4	4
9V DC battery	2	3.5	7
Wooden Box	1	6	6
Others			6
Total Cost			62.5

In our work, whenever the resistance value of the LDR decreases in the range from 5kΩ to 15kΩ, at that moment, the Arduino recognizes the event as a violation of the security and performs necessary steps accordingly. The system performance has been computed for four lighting conditions – full day light, medium day light, dim light and full dark environment. The protection box has been opened several times before the schedule to check whether the device can provide successful warning to the proprietor or not. The Table 2 shows the system performance for various lighting conditions.

From Table 2 it can be observed that the Smart Security Box works perfectly when there is enough light available in the environment at the time of breaching the security of the box. Around 800 milliseconds are required for the device to send text messages to the registered mobile at that time. When the device has been tested in full, medium and dim light with the external light source, we have supplied one tube light, one 25Watt energy bulb and one 5Watt bulb in the room respectively. But the system does not work considerably when there is no light in the surroundings. Although there has been no light, 20% accuracy has been achieved because of little light reflection from other living rooms. Unfortunately, it took a larger amount of time to send text messages to the owner of the box in a full dark environment. The performance increases with the dispense of the extraneous light source. Fig. 8 illustrates the speediness of sending message to the consumer for different resistance values of the LDRs.

From Fig. 8 it can be easily interpretable that the time needs to send a text increases abruptly if the intensity of light is not enough. The LDRs work better when the resistance is less than 10kΩ. Thus we have selected the range of resistance from 5kΩ to 15kΩ to ensure the system efficacy in low lights.

In our work, we have selected an Arduino microcontroller which entails little power to operate. The recommended voltage requirement for this device is only from 7.5V to 12V [28]. To build this model, we have connected two 12V DC Energizer batteries serially for providing a power supply to our device. Table 3 shows the battery backup of our device for using it for a particular period.

Table 3 Battery Backup Summary for Smart Security Box

Daily Device Running Time (Hours)	No. of Warnings Send (Daily)	Backup Duration (Days)
24	40	21
	30	22
	20	**24**
12	40	40
	30s	40
	20	41
6	40	58
	30	**59**
	20	**59**

Table 3 provides the information that if the device runs for 24 hours constantly, we may get the highest 24 days backup with just 2 batteries. However, the backup time depends solely on the quality of the batteries customers use for the system. If the consumer uses this security box only for 6 hours per day, the backup duration drives up to 59 days which can be a good deal with the device cost. The duration will get increased more if the number of battery cells is extended. AC power supply can also be used to build this system. But as it is a security purpose box, constant running of the device is necessary. We have employed DC batteries by considering that in different developing countries, people face a load-shedding issue that can breach the device feasibility. Nevertheless, external backup batteries can be connected to minimize the electricity problem in AC batteries, but the price will be higher too.

The system holds few limitations. Because the LDR inside the box is the main driver to detect security violations of the system by sensing light intensity, more LDR sensors are required to be employed inside the box. Moreover, if the network support is not good enough in a place for example in remote areas, in those cases, SMS transmission via GSM is troublesome. Apart from these, the system functions in a robust way to fulfil the goal.

IV. CONCLUSIONS

Home Security is a major concern worldwide. To secure our homes from criminal attacks, numerous home-based security devices are designed and built because of today's advanced technology.

Table 2 Performance Estimation of the Smart Protection Box in varying Lighting Condition

| Lighting Condition	External Light Source	LDR Resistance (kΩ)	No. of Tests	No. of Successful Attempts	Average Time to Send SMS (milliseconds)	Proposed System Accuracy (%)
Full Day-Light	No	5 to 10	20	20	880.55	**100**
	Yes	5 to 7	20	20	**798.64**	**100**
Medium Day-Light	No	10 to 17	20	18	885.92	90
	Yes	9 to 16	20	19	884.73	95
Dim Light	No	10 to 20	20	17	920.25	85
	Yes	10 to 16	20	18	903.83	90
Full Dark	No	13 to 55	20	4	1501.77	20
	Yes	10 to 30	20	14	1063.66	70
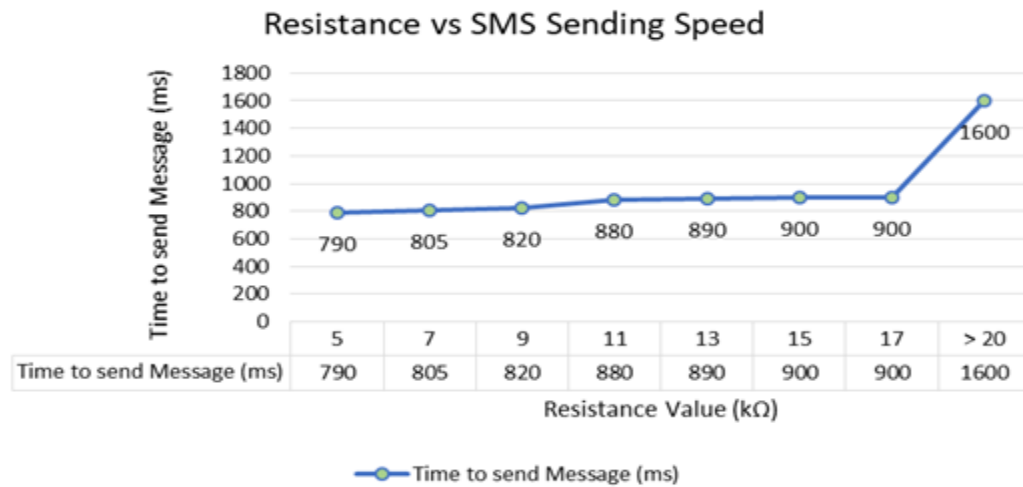
Fig. 8 Speed Measurement of Texts for various resistance values of LDRs

A revolutionary technological solution to safeguard the proprietor's precious home assets is presented in this article. This paper will allow us to have a deeper understanding of future events and the need to establish a safe community in such a manner that there will be a crime-free society. It can be underscored in the conclusion section that if anything worse happens, a simple method of getting an SMS can easily trace the house security and an immediate or inevitable reaction can be possible thereby. This product provides security, which is regarded as one of the intrinsic requirements for home automation systems. It is integrated and thus works excluding human intervention. In this work, we have designed a prototype of the system and the module has been designed in a low-cost manner for the usage of the middle class and less educated people also. Thus, an automatic system with simple functions is contemplated in this box. Still, we have obtained 70% accuracy in the dark lights for this device in detecting intruders. So LED lights and pressure sensors can be adjusted near the LDR sensors for more bringing stronger security. In the future, the Internet of Things (IoT) can be augmented with this system for cloud storage and internet-based control for industrial operation. This smart safety box is ultimately a low-cost, environmentally sustainable and user-friendly product that can be used both for residential and commercial purposes.

REFERENCES

[1] G. M. S. Mahmud Rana, A. A. Mamun Khan, M. N. Hoque and A. F. Mitul, "Design and Implementation of a GSM Based Remote Home Security and Appliance Control System," 2013 2nd International Conference on Advances in Electrical Engineering (ICAEE), pp. 291-295, December 2013.

[2] M. H. Jusoh, M. F. B. Jamali, A. F. B. Z. Abidin, A. A. Sulaiman and M. F. Hussin, "Wi-Fi and GSM Based Motion Sensor for Home Security System Apllication," IOP Conference Series: Materials Science and Engineering, vol. 99, no. 1, pp. 012010, 2015.

[3] J. Han, C. Choi and I. Lee, "More Efficient Home Energy Management System Based on ZigBee Communication and Infrared Remote Controls," in IEEE Trans. on Consumer Electronics, vol. 57, no. 1, pp. 85-89, February 2011.

[4] A. S. Parab and A. Joglekar, "Implementation of Home Security System using GSM module and Microcontroller," International Journal of Computer Science and Information Technologies, vol. 6, no. 3, pp. 2950-2953, 2015.

[5] W. Chengdong, Z. Jungang, L. Daren and X. Kun, "Study on Smart Home Network Technology Based on Wireless Sensor Network," Academic Journal of Shenyang Jianzhu University, vol. 21, no. 6, pp. 753-756, 2005.

[6] G. Gu and G. Peng, "The Survey of GSM Wireless Communication System," 2010 International Conference on Computer and Information Application, pp. 121-124, December 2010.

[7] G. Mingming, S. Liangshan, H. Xiaowei and S. Qingwei, "The System of Wireless Smart House Based on GSM and ZigBee," 2010 International Conference on Intelligent Computation Technology and Automation, pp. 1017-1020, May 2010.

[8] C. Felix and I. Jacob Raglend, "Home Automation using GSM," 2011 International Conference on Signal Processing, Communication, Computing and Networking Technologies, pp. 15-19, July 2011.

[9] C. Peijiang and J. Xuehua, "Design and Implementation of Remote Monitoring System Based on GSM," 2008 IEEE Pacific-Asia Workshop on Computational Intelligence and Industrial Application, pp. 678-681, December 2008.

[10] B. S. Rao, S. D. V. Prasad and R. M. Mohan, "A Proto-type for Home Automation using GSM technology," 2010 International Conference on Power, Control and Embedded Systems, pp. 1-4, November-December 2010.

[11] P. Kumar and U. C. Pati, "IoT Based Monitoring and Control of Appliances for Smart Home," 2016 IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), pp. 1145-1150, May 2016.

[12] R. Teymourzadeh, Salah Addin Ahmed, Kok Wai Chan and Mok Vee Hoong, "Smart GSM Based Home Automation System," 2013 IEEE Conference on Systems, Process & Control (ICSPC), pp. 306-309, December 2013.

[13] A. Singh, A. Pal and B. Rai, "GSM Based Home Automation, Safety and Security System using Android Mobile Phone," International Journal of Engineering Research & Technology (IJERT), vol. 4, no. 5, pp. 490-494, 2015.

[14] F. Shawki, M. E-S. Dessoukiand, A. I. Elbasiouny, A. N. Almazroui and F. M. R. Albeladi, "Microcontroller Based Smart Home with Security using Gsm Technology," IJRET: International Journal of Research in Engineering and Technology, vol. 4, no. 6, pp. 20-28, 2015.

[15] R. Hasan, M. M. Khan, A. Ashek and I. J. Rumpa, "Microcontroller Based Home Security System with GSM Technology," Open Journal of Safety Science and Technology, vol. 5, no. 2, pp. 55, 2015.

[16] S. R. Khan, A. A. Mansur, A. Kabir, S. Jaman and N. Chowdhury, "Design and Implementation of Low Cost Home Security System using GSM Network," International Journal of Scientific & Engineering Research, vol. 3, no. 3, pp. 1-6, 2012.

[17] H. U. Zaman, T. E. Tabassum, T. Islam and N. Mohammad, "Low Cost Multi-Level Home Security System for Developing Countries," 2017 International Conference on Intelligent Computing and Control Systems (ICICCS), pp. 549-554, June 2017.

[18] N. Sriskanthan, F. Tan and A. Karande, "Bluetooth Based Home Automation System," Microprocessors and microsystems, vol. 26, no. 6, pp. 281-289, 2002.

[19] L. B. Annapurna, K. Mounika, K. C. Chary and R. Afroz, "Smart Security System using Arduino and Wireless Communication," International Journal of Engineering Innovation & Research, vo 4, no. 2, pp. 326-331, 2015.

[20] H. Huang, S. Xiao, X. Meng and Y. Xiong, "A Remote Home Security System Based on Wireless Sensor Network and GSM Technology," 2010 Second International Conference on Networks Security, Wireless Communications and Trusted Computing, pp. 535-538, April 2010.

[21] R. J. C. Nunes and J. C. M. Delgado, "An Internet Application for Home Automation," 2000 10th Mediterranean Electrotechnical Conference. Information Technology and Electrotechnology for the Mediterranean Countries, Proc. MeleCon 2000 (Cat. No.00CH37099), vol. 1, pp. 298-301, May 2000.

[22] Neng-Shiang Liang, Li-Chen Fu and Chao-Lin Wu, "An Integrated, Flexible, and Internet-Based Control Architecture for Home Automation System in the Internet Era," Proc. 2002 IEEE International Conference on Robotics and Automation (Cat. No.02CH37292), vol. 2, pp. 1101-1106, May 2002.

[23] A. Z. Alkar and U. Buhur, "An Internet Based Wireless Home Automation System for Multifunctional Devices," in IEEE Trans. on Consumer Electronics, vol. 51, no. 4, pp. 1169-1174, November 2005.

[24] R. Shahriyar, E. Hoque, S. M. Sohan, I. Naim, M. M. Akbar and M. K. Khan, "Remote Controlling of Home Appliances using Mobile Telephony," International Journal of Smart Home, vol. 2, no. 3, pp. 37-54, 2008.

[25] B. Yuksekkaya, A. A. Kayalar, M. B. Tosun, M. K. Ozcan and A. Z. Alkar, "A GSM, Internet and Speech Controlled Wireless Interactive Home Automation System," in IEEE Trans. on Consumer Electronics, vol. 52, no. 3, pp. 837-843, August 2006.

[26] J. Wang, H. Lee, J. Wang and C. Lin, "Robust Environmental Sound Recognition for Home Automation," in IEEE Trans. on Automation Science and Engineering, vol. 5, no. 1, pp. 25-31, January 2008.

[27] J. Bangali and A. Shaligram, "Design and Implementation of Security Systems for Smart Home based on GSM technology," International Journal of Smart Home, vol. 7, no. 6, pp. 201-208, 2013.

[28] RoboticsBD, "Arduino Uno R3," [Online], https://store.roboticsbd.com/arduino-bangladesh/94-8-arduino-uno-bangladesh.html, Accessed: 2021.