

Development of Multiple Cell Phone attuned Intruder Detection Security Device

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ABSTRACT:Security has become a concern everywhere. Home, industries and vehicle security is necessary nowadays as the possibilities of intrusion are increasing daily. The frequent and widespread cases of burglary in homes, offices, and factories are on the increase. In the past few decades up till today, security peoples are hired to guard the important facilities. Government and house owners invest huge amount in order to provide security. The human security guards do the work at great risk sometimes resulting in loss of lives. However, as technology develops, electronic security systems gained popularity being fast and assuredly the easiest method of security while rendering better security capable of covering larger coverage areas. The advancement in technology has intensified such that movement can be detected by electronic device that detects burglars through doors and windows with the use of sensor devices that are mounted at designated places. This work designed and developed a security device that is armed and disarmed from any location using a hand set. ATmega8 microcontroller is connected to a GSM (Global System for Mobile Communication) module, GPS (Global Positioning System) module with SIM (subscriber identification module) from MTN network provider. Reeds contact switches are connected to a microcontroller unit of the electronic device. This detects any intruder in a classified area and then activates the alarm system and sends out text message notifications to the administrator, specifying the location (longitude and latitude) and time of intrusion to the authorized phone number. The design is expected to work in real-time in an area with good GSM network coverage as expected.

Keywords: Security, Home, Intruder, Device, GPS, GSM, SIM

I. INTRODUCTION

Security has become a concern everywhere. Home, industries and vehicle security is necessary nowadays as the possibilities of intrusion are increasing daily. The frequent and widespread cases of burglary in homes, offices, factories etcetera, is on the increase. In the past few decades, security personnel were hired to guard the areas. House owners invested descent amount in order to provide security. Though humans perform creditably, sometimes the surveillance provided by humans during the nights have a momentary lapse as the humans tend to fall asleep. Security is a very challenging area in the modern world. It consists of policies and provisions implemented by the administrator to stop unwanted access, alteration or misuse of the available assets. While it is good to trust people, sometimes trust can be exploited. That is why security technology is so important, as it minimizes risks by removing human judgment[1].However, as technology increasingly develops, electronic security systems gained popularity among the people because of various factors like fastness and ease ensuring better security and large coverage [2].Conventional intruder detection systems were designed to scare, deter and to give notice of the appearance of an unwanted guest or that trespass has been made. Hence, the advancement in technology has intensified such that movement can be detected by electronic devices through doors and windows with the use of sensor devices that are mounted at designated places. Thus, when alarm is triggered by the intruder, the exert location and burgled part of the vicinity can be identified by cross examining the entire building. Conventional detectors are discussed hereunder:

Electric fence: The electricity flows through conducting wire as a result of electrical pressure which is measured in volts that are

generated by the energizer. Plate 1 depicts conventional electric fence.



Plate 1. Electric fence

The energizer produces brief, high voltage pulses of electricity which are passed to the conducting wire, while the circuit closes to the ground when in contact. The Electric Fence Energizer converts the electrical energy, which normally comes from the electrical utility, batteries or solar PVs in an electric impulse with limited energy associated according to safety limits [3]. This type of conventional security system cannot be used for domestic home security device such as the doors and windows due to its complexity and cost of installation. Also, users and their pets exposed to danger of being electrocuted. In addition, it cannot be used for detecting an intruder and tactically be apprehended without deterring the intruder from the scene. However, they are best used in farms and zoos, whereas animals standing on the ground touching the electrified wire completes the circuit and receives intermittent but regular shocks to deter them away from the fence in order to keep them within the perimeter. The pulsed nature of the electricity enables animals to move away from the fence, which prevents them from electrocution [4].

Closed-Circuit Television System CCTV: The CCTV's are commonly used in places such as the banks, shopping malls, sensitive data facilities, as well as military installments to continuously record activities being carried out. However, they do not absolutely detect any moving object. Although, they are designed real time security system using human motion detection devices to monitor the area via web camera installed at restricted locations in order to capture live images and stores them for further evaluation [5], any intruder that knows the camera location can find ways to evade the view. Detecting an intruder using this system requires more human involvements to keep watch on the screen as to identify any suspicious activities or any approach made by unauthorized persons in the restricted areas. Meanwhile, advancements were made, whereby, an alarm alert system is added to CCTV

image and video record of the security system in a farm [6]. However, CCTV camera cannot be used as domestic intruder detection security system due to the expenses as result of the use of computer and human effort to detect unauthorized activity [7].

On the other hand, sensors may be placed at the perimeter of the protected area, within it, or both. Sensors can detect intruders by a variety of methods, such as monitoring doors and windows for opening, or by monitoring unoccupied interiors for motions, sound, vibration, or other disturbances. The function of a sensor in security detection system responds to a signal for which it is compatible. That is, the sensor is capable of detecting the source that produced the signal, complying with the application of the detector. The commonly used sensors are the Passive Infrared sensor (PIR). Usually, a low-amplitude signal is received by the sensor in a detector, and so it is necessary to increase the level of signal through an amplifier. The signal-to-noise ratio (SNR) is increased by the amplifier to detect a change in the signal strength from the presence of a person. The effect of the amplifier is to increase the sensitivity of the detection function so that it may detect subtle changes in intrusion within the system's field of view. Depending on the type and style of sensors used in the security technology, the amplifier will possess functions to increase the signal strength [8]. **Magnetic reed switches:** Recently, houses are been installed with a well-protected break proof doors and windows. However, it is necessary to monitor the conditions of the door, while it can be done by installing small magnetic switches inside the frame. Thus, when disturbed, the alarm will be activated. The alarm system in Plate 2 is operated by 3pcs of 1.5V LR44 / AG 13 button cell which requires periodic replacement. It cannot be an effective intruder detection device as it can be easily noticed and reached by the intruder, which can be destroyed and disarmed even when the alarm may turn on.



Plate 2. Wireless Door Burglar Alarm

Breaking glass detector: Plate 3 shows a glass break detector. The glass break detectors has a small microphone which is connected to a sound processor. The audio received by the microphone are analyzed by the processor to recognize the frequency of breaking glass as tuned. Additionally, they also have shock sensors that detect the tiny shock wave which passes as a result of the impact suffered by the window. Therefore, they are only activated by the sound of breaking glass and a shock wave. Thus, they are tremendously immune to environmental noise which might cause a false alarm. Although, heavy window treatments can significantly reduce the breaking glass detecting effectiveness as it tends to reduce breaking glass sound frequency. Similar to the Magnetic reed switch intruder detection system, the intruder may avoid every means of activating the alarm system since they can be easily noticed, neither would the intruder want to make a suspicious noise. Thus, they cannot be recommended for an effective intruder detection device for utmost security practice.

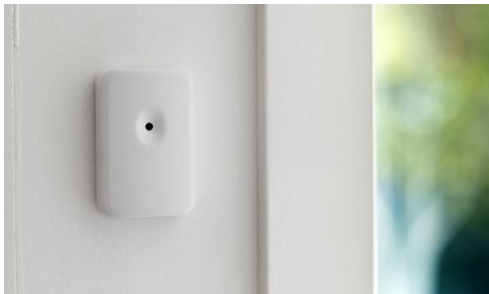


Plate 3. Glass Break Detector

Passive infrared detectors PIR: The passive infrared (PIR) motion detector is one of the most common sensors found in household and small business environments. Passive infrared sensor (Plate. 4) is an electronic device that measures infrared (IR) light radiating from objects in its field of view. PIR sensors are often used in the construction of PIR-based motion detectors (Plate 5). Strictly speaking, PIR sensors do not detect motion; rather, they detect abrupt changes in temperature at a given point. As an intruder walks in front of the sensor, the temperature at that point will rise from room temperature to body temperature, and then back again. This quick change in temperature triggers the detection. The DSC WS8904W (Plate 5), is a wireless pet-immune passive infrared detector based on the Bravo 3D hardwire motion detector. It features pet immunity up to 27 kg and reliable 868 MHz technology. However, they are usually placed a bit lower the ceiling top of the room it's

monitoring. Whereby, the user is required to climb up to check on the power supply. Thus, making it stressful to maintain. Additionally, there is always a false alarm when users gain access to the area after a long time and also fails to raise alarm when an intruder tries to again access to the area while the user is steal within the environment.



Plate 4. PIR motion sensor [9]



Plate 5. DSC WS8904W wireless pet-immune passive infrared detector

Radar: The security radar shown in Plate 6 operates on 24 GHz radar chip for 24/7 all-weather high-accuracy detection in the range of 450 m/90°. It supports radar-PTZ smart tracking, compatible with common Dahua speed domes. With radar detection and intelligent algorithms, ultra-low false alarms and zero missed alarms are achieved around the clock. Additionally, multiple PTZ cameras can be linked to one radar, thus, a wide range detection and detail tracking can be achieved simultaneously. However, the system requires high capital, moreover, will require data storage device to store all tracking information for review. This also cannot be handy for every individual as an intruder detection system to help deal with the immediate security challenges.



Plate 6. Dahua PFR4K-D450 450 m Security Radar for Area Protection

II. STATEMENT OF THE PROBLEM

Intruders always want to swiftly get away with their acts without being caught. Thus, they can harm anyone who tends to stop or apprehend them. When an intruder detection system detects an intruder and the alarm is triggered, the intruder at that point becomes dangerous and may lay ambush, thus, exposing anyone against them in greater danger of be hunt. The electricity energized fence can be maneuvered whereby the intruder may avoid being in contact with the energized wires. In some cases, the intruder can go as far as terminating power supply into the building in order to de-energize the wires. In addition, tough and harden criminals can cut or destroy the fence, even endure the shock in order to gain access into the facility. Moreover, the intruders may do whatever they want and get away with it before the owner gets to know. Thus, the system cannot be used for an intruder detection system for apprehending intruders that are right in their acts. The CCTV intruder detection system provides a real time record of intruders trying to burgle in restricted areas. However, they are expensive and require 100% of human efforts to keep a watch on the display monitor to detect an intruder. Hence, they cannot be used for detecting intruders promptly before or during the act unless humans are stationed all the time monitoring the system.

Furthermore, the conventional intruder detection systems such as the passive infrared detector, wireless door burglar alarm, glass break detector and radar intruder detector do not immediately communicate with the users when they are absent. The users get to know about an intruder trying to gain access only when they are within the audible distance from the device. Thus, these types of conventional devices cannot be effective for apprehending an intruder, in a manner that the users can be safe. In addition, since the conventional intruder detection systems are

manually armed and disarmed, the users will have to be constantly reminded to arm the device before leaving the facility and disarmed when not in use to avoid frequent false alarm as though the intruders may study and take advantage of the false alarm. Therefore, it is important to develop a device that is 100% independent of human watch to detect, report an intruder with the exact location before the intruder becomes aware of being notice.

It is important that both the intruder detection systems and their users be smarter than the intruder to ensure the protection of the lives and property of the users. This invention can be connected to all types of sensors and gives the user utmost control, wirelessly within the country, either to arm or disarm the system by the use of GSM system. Thus, the users can arm the system when they forget to arm it before leaving the facility. Additionally, actuation is made inbuilt so that the device cannot be easily rendered inactive by interrupting main power supply. Meanwhile, the invention allows users to arm the device in a manner that it will detect an intruder without turning on the alarm. Also, the users will be notified of an unauthorized access in the facility via SMS. In addition, a GPS module is attached to the device which generates coordinates in order to get actual location of the facility. The coordinates are processed and arranged as a web link so that the facility can be easily located with the aid of google maps. Thus, the users can immediately forward the information to security personnel for easy description and locating the facility. Furthermore, the invention employs the use of a backup power pack which is capable of providing power for 2days conveniently and recharges when the mains is restored. Additionally, all components of the invention are locally outsourced, thus, making it readily available for mass production and accessible for individuals for both domestic and industrial use.

III. EQUIPMENT DESCRIPTION

The invention is displayed in an isometric view shown in Figure 1 and a total size of the invention as shown in an orthographic view in Figure 2, is 90 x 200 x 270 mm (LxBxH). All other components are mounted inside, while the front has a transparent cover for the LED bulbs to be seen, in order to indicate power supplied and armed. As shown in Exploded view (Figure 3) below, the intruder detection security device consists of the Case (3), Case Cover (2), Case Cover-2 (1), 12v Battery (4), LED Bulb (5), LED Bulb 2 (6), Switch (7), GPS Module (8), Microcontroller Device (9),

SIM900-B GSM Module (10) and 12v Battery Charger (11).

The intruder detection security device components are enclosed in a locally outsourced adaptable box of size 90 x 200 x 270 mm (L x B x H), comprising of Case Cover-2 (1), Case Cover (2) and Case (3). Whereby, 12v Battery (4) is fastened on the Case (3) which serves as the supplementary power supply to keep the system running for the period of 2 days uninterruptedly even when the mains is interrupted. A 12v Battery Charger (11) is also mounted close to the 12v Battery (4) in order to continuously keep the Battery Charged in order to avoid complete power lost when main power supply is interrupted.

Energy supplied to the entire circuit is controlled using a Switch (7). Thus, the device may not drain the battery energy after production and when not in use. The Switch (7) is made inbuilt, in order to be turned on during installation and cannot not be easily reached by the intruder or accidentally turned off by the users. The user can be consciously informed of the last status of the device and if tampered with during investigation. However, a LED Bulb-2 (5) indicates power supply from the mains to the entire device and currently charging the 12v Battery (4), while the LED Bulb (6) indicates the device is switched on and active. Thus, the user may not have to dismantle the device in order to know either the switch is turned on/off, or the availability of the mains power supply.

The Microcontroller Device (9) and SIM900-B GSM Module (10) operate on 5 volt power supply. However, they have a voltage regulator that accepts voltage ranging from 6 – 18 volts and steps down to 5volt safe for use for the chips embedded. The Microcontroller Device (9) is equipped with ATmega 328P chip which has an EEPROM of 512B, Internal SRAM of 1KB, In-System Flash program memory of 16KB, 8-bit Microcontroller, RISC Architecture, 32 × 8 General Purpose Working Registers and 32 Programmable I/O Lines. Also, the SIM900-B GSM Module (10) comes with a GPRS features that can be utilized for coordinates retrieving. However, the coordinates are always usually of the nearest network mast which the SIM900-B GSM Module (10) communicates with. Thus, in order to obtain a more accurate coordinates from the device, a GPS Module (8) is connected to the device. The GPS Module (8) is made up of a SiRF3 chip from Sparkfun, which has 20 Channel Receiver with Built-in antenna, Sensitivity of -159dBm, accuracy of 5m, with a Baud Rate of 4800. However, a registered and active Subscriber Identity Module (SIM) card has to be inserted into the SIM900-B

GSM Module (10) in order to receive command from the user. In addition, the LED Bulb-3 indicates the availability of GSM/GPRS and GPS networks are available.

The Microcontroller Device (9) being the central processing unit can be programmed using both C/C++ and assembly programming languages. The Microcontroller is used to read and analyze the activities of the device as well as assignment tasks to be carried out by other components connected to it. When SMS is sent to the SIM card, it is then transferred to the Microcontroller Device (9) through data communication lines from the SIM900-B GSM Module (10).

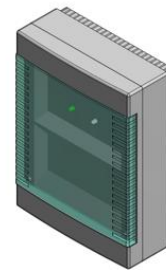


Figure 1. Isometric View of Intruder Detection Security Device

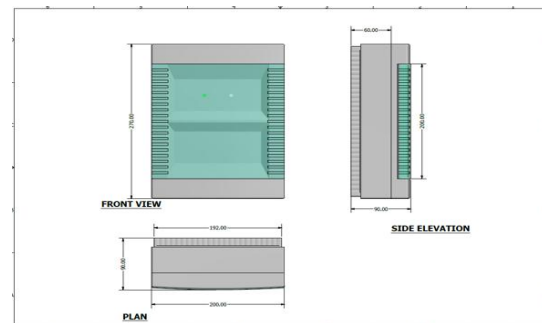


Figure 2. Orthographic View of Intruder Detection Security Device

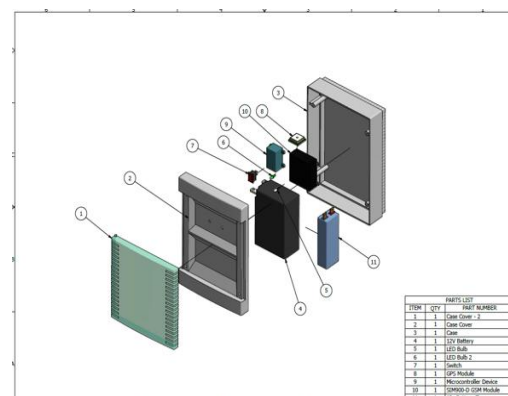


Figure 3. Exploded View of Intruder Detection Security Device

The device only accepts commands from authorized personnel (admin). Therefore, the admin is automatically registered by the device following a certain command line, whereby, the device can register the maximum of ten admin cell phone numbers which it can receive instructions from. The device is initialized simply by sending "Begin+ Password" to the SIM card number in the device, in which the device replies with an SMS "Begin OK". Then, the device SIM card number is called up ten times with the authorized personnel phone number, after which, the device will automatically register the number as an authorized admin who can arm and disarm the device, as well as, to be notified when an intruder is detected.

Similarly, the device is armed through the activation code written and sent to it from the authorized administrator handset. The SIM card in the device receives the information and communicates to the micro-controller which in turn sends signals to the respective sensors connected in parallel and mounted at the doors and windows of the secured building as the case may be. These sensors are therefore either activated or deactivated. This is followed by an alarm sound for a second. To arm the device, the admin sends "arm xxxxxx", and the device will reply "device armed", while the admin sends "disarm xxxxxx", and the device will reply "device disarmed". If by any chance a sensor is not closed (vis a vis door/window), the device will fail to arm. Thus, the admin can control the device from any part of the country and track the last state of the device. When the device is armed and eventually detects an intruder triggered by any of the sensors, an SMS is generated by the device as programmed, forming a google map link which includes the coordinates decoded from the GPS Module, and the ID of the sensor triggered to easily revile the area that was burgled. Plate 7, Plate 8 and Plate 9 are the pictures of the gadget during construction, the picture when completed and the buzzer actuated and the picture during operation respectively.



Plate 7. Pictorial View of the device during Construction



Plate 8. Pictorial View of the device with the buzzer



Plate 9. Pictorial View of the device during operational state

IV. CONCLUSION

Security is a very challenging area in the modern world. It consists of policies and provisions implemented by the administrator to stop unwanted access, alteration or misuse of the available assets. Such a need is driven in part by burglary. This work proves very useful for all those who want to start to plan and install intruder detection security systems in their homes, shops, large buildings and industrial facilities, or for any other protected areas. Intruder detection security systems (IDS), should be always designed and used to protect first people and then properties and assets. This invention is designed and developed to detect and signal the presence, entry or attempted entry of an intrusion into an alarmed area. It is a set of interconnected devices that is aimed to protect an object, usually a facility, against intruders and to notify the owner or a monitoring station/center of any violation of the protected zones. The most basic feature of simplest model consists of at least one sensor to detect trespassers and an alerting device to indicate the intrusion. It also offers a monitoring service. In the event of an alarm, the premises control unit

contacts a central monitoring station. Operators at the station see the signal and take appropriate action, such as contacting property owners, notifying police, or dispatching private security forces. Such alerts are transmitted through dedicated alarm circuits or telephone lines as the case may be. This innovation is a strong, robust and light-weighted solution to intruder detection especially with the increase in the internet of things (IoT) application and the security vulnerability it possesses.

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