

Guardino: GSM Based Home Embedded Surveillance System Utilizing Pyroelectric Infrared Sensor

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Abstract— For the earlier years, wireless sensor networks (WSNs) and their applicability for a wide number of situations have been the center of research worldwide. Security was a prior concern to the researchers since the beginning of this sensor networks. This research aims to present an embedded system that prevents or at least lessen the chances of home robbery and other related crimes to happen inside the house or other private establishments. The system was developed using open source programming language, a microcontroller, and an open source IDE that also serves as a big help in constructing the logic of the project. The results of the software evaluation show that the functionality, reliability, usability, efficiency, and maintainability of the project earned a rating of highly acceptable among the appellants of the research. Thus, the system itself can show the need of people for the safety of their family. Practical and research implications are discussed.

Keywords— theft, risk evaluation, security, embedded system, sensor networks.

I. INTRODUCTION

A home security system has become popular to avoid home robbery or theft. Automated security surveillance systems play a major role in providing extra security to the existing monitoring system. Modern advances in technologies of safety have led to miniaturization and improvement of the performances of computers, sensors, and networking. In the Philippines for the past three years, the crime rate is about 40%. However, the main concern here is the percentage of the homes broken, and things were stolen, it is about 43% which is pretty high knowing that we are already in the year 2016 with a lot of CCTV around [1].

To date, almost all of the places here in the Philippines are operated with CCTVs. It is located on crime prone and populated areas. However, the chances of the crimes happening are still alarming. Yes, of course, the moment that the CCTVs are installed mostly in the streets, the crimes are decreased. However, it cannot completely stop the criminals to do their disgraceful intentions [2]. Most of these cases, the criminals walked away with thousands of worth of belongings even though they already got a CCTV and it did not help in preventing these things from happening.

Thus, there is a need to produce a system that can enhance

the safety of the people in their private premises primarily in their houses. At this point, this project aims to present a prototype that can lessen the chances of home robbery and other crime related things to happen.

II. RELATED WORKS

Remote sensor systems or the Wireless Sensor Networks (WSNs) are turning out to be progressively spreading and both industry and the scholarly world are centering their research endeavors with a specific end goal to enhance their applications and other existing applications [3]. Currently, the pacing on the advancement of the Wireless Sensor Networks is fast, and it cannot be long until the world is covered by WSNs since it has a very broad usage. It can be used for medical, security, military, crisis management, smart spaces, and homeland defense [4]. As for Chan, E., security systems are not only for homes. It can also be used in establishments like hotels because again, security and safety are very important factors for the guests [5]. The emerging of the new concepts of security systems should offer convenience, comfort and of course a very safe environment for the occupants [6].

Even before, security is a very important thing for every people especially today that there are some smart home applications available [7]. When it comes to this things, there is also a similar area where WSNs are used. It can be deployed to monitor the concentration of harmful gas components that are present in the air that can affect people [8]. The concept of smart homes has been one of the interest in the past years [9]. Smart homes contain various, associated gadgets, such as home entertainment appliances, security systems, and surveillance. Intelligent home automation framework is consolidated into smart homes to give convenience, comfort, and security to property holders [10, 11, 12].

There are other systems used not only for security, but also as a fireproof device that can emit a loud sound when the sensor that is attached to the system receives a very significant amount of heat. [13]. It is an excellent example of real-time security system that can provide immediate output from the device. And of course the advantage of this kind of security system offers a great contribution to safety since this kind of device is part of real-time dependable that accepts input from the user and outputs some result immediately [14].

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Home automation systems basically describe and state the status of the connected devices in an interface permitting the users, and clients to control different devices with the touch of a few buttons. Some of these communication technologies include Bluetooth, the Wireless LAN (Wi-Fi), and the Global System for Mobile Communication (GSM) [15, 16]. Regarding with the GSM Module that the research relies on, Global System for Mobile (GSM) is a second-era cell framework system standard. It is the first cell framework to determine computerized adjustment and system-level models and administrations. The first significant set or arrangement of Radio Frequency (RF-ICS) for GSM standard began at 1900, and it was first presented in Europe in 1991, and today it is the most basic cell standard. GSM is the world's first cell framework to indicate computerized regulation and system lever structures and administrations. It is presently the world's most well-known standard for new cell radio and individual interchanges hardware all through the world. Safety is a huge test everywhere because crimes are increasing every day. Some well-known technologies are accessible to protect the properties safe from thieves. However, common smart home security systems do work on wireless communication [17, 18].

Since the research is about security, there is also much technology that can be applied and added to the said project, with the quick advancement of the biometric recognition innovation, more multi-modular biometric recognition frameworks have been proposed for the accompanying three reasons. Firstly, multi-modal biometric recognition systems use multi-source components, for example, iris, face, unique finger prints, palm, and voice and so forth [19]. Personal identification or authentication using biometrics applies pattern recognition techniques to measurable physiological or behavioral characteristics. Biometric techniques can be distributed into physiological and behavioral [20]. The present development identifies with a framework for biometric input, examination, and verification and, all the more especially, to a framework and technique for securing one or more documents, including information records and applications, by confining accessible authorized people using a biometric input device [21].

III. METHODOLOGY

This project used agile software development method because it provides an exclusive opportunity for clients and users to be involved throughout the making of the project until it is done, from prioritizing its features to planning to frequent software builds for changes. This research used C++ programming language, hardware modules, and related application programming interfaces to help build the system. The research also involved a different group of users covering homeowners, students, and other professionals. This research used a software evaluation following ISO9126 criteria and distributed to the users during the testing stage. The Likert's scale with the interpretation of Highly Acceptable, Acceptable, Moderately Acceptable, Slightly Acceptable and

Not Acceptable were used to specify the users' level of agreement or disagreement on the software evaluation items. The results of software evaluation are presented in the succeeding sections of this paper.

IV. RESULTS AND DISCUSSION

This section presents the Guarduino: GSM Based Home Embedded Surveillance System Utilizing Pyroelectric Sensor.

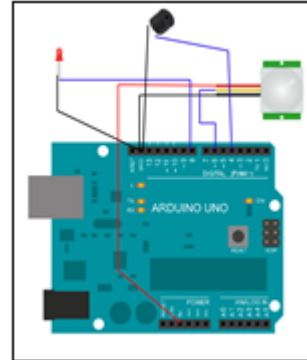


Fig. 1 Schematic Diagram

Figure 1 shows the Schematic Diagram of the Guarduino, on how it looks without the case. All the components and modules are attached to the Arduino that is programmable. It sends instructions to the hardware components on how would they act and how would they work to be able to secure the house, and the families inside it. The GSM Module serves as the shield for the Arduino as it is attached to the Arduino itself. After it is attached, the Pyroelectric Infrared Sensor, the buzzer, and the LED light should now be connected.

The Pyroelectric Infrared Sensors detects motion through body heat via infrared. The buzzer serves as an added notification when someone was detected by the sensor and the LED light serves as an indication if the Guarduino is activated or not. We used the parallel connection for the GND (Ground) pins of the buzzer, the PIR Sensor and the LED light to save spaces for other pins. The GND pins serve as the negative pins of the components. With the positive pins, it is called VCC or the IC power-supply. For the sensor, it has three pins. First, the GND pin, followed by the VCC that is connected to the 5v pin since it can hold up to 5v of power. The last is the Digital pin which is the blue wire on the figure. It is the pin where the codes or instructions go through. There are also Digital pins for LED light and the buzzer, and it is connected to pin eight and four respectively.

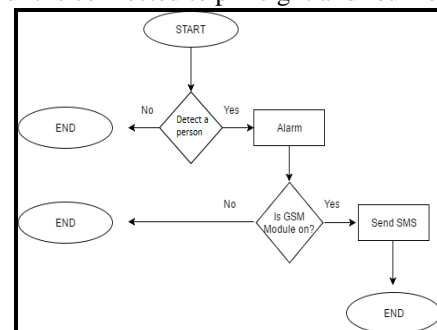


Fig. 2 System Flowchart

Figure 2 shows the flow on how the Guarduino works. It shows the step by step process of the logic that was inputted in the system. As soon as Guarduino detected motion, it can alarm notifying the owner and at the same time, if the GSM Module is on, it can send SMS for added notifications.



Fig. 3 Pyroelectric Infrared Sensors

Figure 3 focuses on the sensors of the Guarduino. It was designed to have two sensors since most of the single-detached houses here in the Philippines has their doors and windows close to each other. It can be attached to the wall that can improve the security of the house since the Guarduino can secure at least two entry ways at the same time. The maximum range of the sensor is up to 10 meters or 32 feet. However, depending on how the system is installed inside the house, it is not going to be maximized.



Fig. 4 Buzzer module 0

Figure 4 focuses on the buzzer of the Guarduino. It emits a loud noise after either of the sensors detected the motion. It can give a real-time notification for the system to alert the homeowner if the Guarduino detected something or someone. With this, it can help them to be more alert and vigilant to the security of their family and their house. However, there is a delay time before the Guarduino can detect someone again. Based on the trial sessions, 8 to 10 seconds after the buzzer ended, that is the time the Pyroelectric Infrared Sensor is ready again to receive inputs from its Field of View (FOV).



Fig. 5 GSM Module

Figure 5 shows the GSM Module which is the main component of the Guarduino. It can send an SMS to the owner as the sensors detect something. No matter where the owner is in the Philippines, the homeowner can receive the

message. However, if the homeowner is not in the country anymore, Guarduino can still send SMS to the designated number, but it is not going to be received by the homeowner anymore.

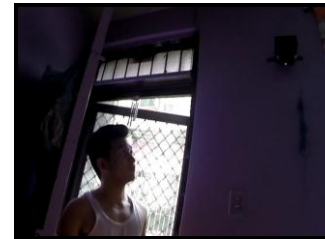


Fig. 6 Trial Sessions

Figure 6 shows if the Guarduino actually works the way it should be. This is to test how the system can really improve the security of the house. The distance of the sensor was also tested if it detects someone as soon as the person passes its field of view (FOV). And how fast the GSM Module sends the SMS to the designated phone number after the motion was detected.

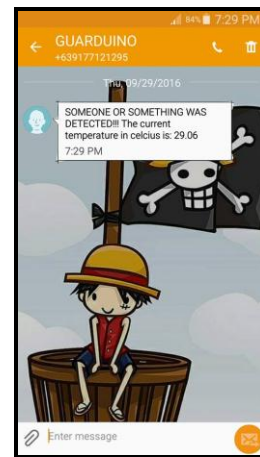


Fig. 7 SMS Notification

Figure 7 shows that the system detected something and immediately sends a notification to the homeowner via SMS within the country through the GSM Module. With this, the homeowner can immediately report it to the barangay to check if there is an intruder in their house.

TABLE I
SUMMARY OF SOFTWARE EVALUATION RESULTS

Criteria	Mean	Interpretation
Functionality	4.64	Highly Acceptable
Relilability	4.66	Highly Acceptable
Usability	4.54	Highly Acceptable
Efficiency	4.78	Highly Acceptable
Maintainability	4.58	Highly Acceptable
Portability	4.69	Highly Acceptable
Overall	4.64	Highly Acceptable
Weighted Mean		

In summary, the software evaluation indicates a strong perception among the respondents that the Guarduino is highly functional (4.64), reliable (4.66), usable (4.54),

efficient (4.78), maintainable (4.58), and portable (4.69). Hence, the software evaluation receives an overall rating of 4.64 with an interpretation of Highly Acceptable. These results indicated that the Guarduino can be used to lessen the cases of the home robbery at the same time it can be a useful tool to notify the owner if someone entered their home without his or her knowledge. Moreover, the research was able to use available hardware components offering real-time notifications, outputs for the homeowners.

V. CONCLUSION

This research aims to: (a) provide a system that can provide additional safety and awareness to the people about what is happening in their private premises in their absence and especially at night; (b) secure at least two entry points at the same time with the help of two sensors; (c) to develop a low cost security system compared to others. The evaluation also indicates the relevance of the features provided for homeowners to ensure that real-time outputs and information are being executed efficiently. However, this research has also some recommendations to enhance the findings of the research including (a) develop a version that can have a camera to capture the intruder; (b) adding an eco-friendly power source like solar panels rather than batteries; (c) improvement of the design of the prototype to make it more presentable and easy to operate; (d) the use of power banks to power the system via USB port of the Arduino; (e) instead of sending SMS, it should generate calls for the homeowners for better notifications.

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