

DEVELOPMENT OF ULTRASONIC SECURITY SYSTEM WITH A BUZZER NOTIFIER

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Abstract- The Akyat-Bahay scheme is the most common type of robbery (BURGLARY) in the Philippines. Three to five people are usually involved in the planning of this crime. These thieves target unoccupied homes, particularly during the holiday season (i.e., Christmas, Holy Week, and Summer Vacation) or during severe weather conditions (i.e., typhoons) when members of the household are oblivious to break-ins. The gang also hires children who can quickly enter homes illegally through tiny openings.

Keeping this in mind, the researchers devised the Ultrasonic Security System with a Buzzer Notifier. The controller module accepts data from the ultrasonic sensor module, and this sensor acts as an intruder detector. The Arduino Uno is linked to the LED indicators, LCD, and buzzer. The green LED serves as an indicator, and the LCDs the message "No intruder detected. When the sensor detects the opening of a door or an intruder walking within range, the red LED serves as an indicator, and the LCDs the message security alert, and the buzzer serves as a notifier to make a noise that wakes the homeowner.

Following various tests on the system's accuracy, it is logical to argue that the prototype was successfully designed and meets the study's objectives.

Key Words- Akyat-Bahay Gang, Ultrasonic Security System, Buzzer, Micro-controller, Sensor Module

I. INTRODUCTION

Theft is the most well-known and prevalent crime in the Philippines. It can happen anywhere: at home, in stores, in business structures, on roads and streets, and in other public places. Every year, hundreds, if not thousands, of scams are reported to authorities, and the number continues to rise.

The Akyat-Bahay scheme is the most common type of robbery (BURGLARY) in the Philippines. Three to five people are usually involved in the planning of this crime. These thieves target

unoccupied homes, particularly during the holiday season (i.e., Christmas, Holy Week, and Summer Vacation) or during severe weather conditions (i.e., typhoons) when members of the household are oblivious to break-ins. The gang also hires children who can quickly enter homes illegally through tiny openings.

Based on the statistical report on an article "Philippine National Office: AKYAT-BAHAY INFOGRAPHIC" by RPCRD. Based on the current authors, "from 2010 to 2015, there were eight akyat-bahay incidents per month. However, from 2016 to 2020, it more than doubles the previous data [1]." Because of their plan, the akyat-bahay gang is challenging to find; some of them serve as hideouts, while others serve as collectors of the material they obtain.

According to the National Capital Region Police Office, "most of the neighborhood does not recognize if there is a thief happening because they are sleeping or they do not hear any noise from the suspect." They realize there is a thief when the thief has already accomplished his or her work or when the victim has already returned home." The authors added, "the victim is unaware that an akyat-bahay gang is already in their home, and they are unable to make a sound due to the suspect threat [2]."

Keeping this in mind, the researchers devised the Ultrasonic Security System with a Buzzer Notifier. Based on the implemented distance, it alerts the household if there is an intruder in their home. When an intruder approaches the door and opens it, the buzzer sounds, and the red LED inside the house blinks and the LCD display displays a security alert that homeowners and neighbors can hear.

The study focused on the design and development of an Ultrasonic Security System with a Buzzer Notifier. The researchers will create the prototype to provide a simple solution to community problems and reduce thief occurrences. Take, for example, the akyat-bahay gang. The prototype is comprised of hardware and system software. The hardware component of an ultrasonic security system is composed of the following components: a

microcontroller unit, LED lights, an LCD, and an Ultrasonic Sensor Distance Measuring Module. In terms of system software, the Arduino programming will tell all of the hardware components. However, the project is only intended for a single door for prototyping and testing.

II. METHODOLOGY

The research focuses on the prototype's design, development, and testing. The steps provides to make this research possible are as follows. For this study, a prototyping technique was used, which required the fabrication of a working model of the product. This is done to ensure that the proposed design functions correctly. A flowchart is used to represent the system's step-by-step operation graphically. The software is developed based on the flowchart and the existing programming language for the microcontroller unit.

Prototyping. During this phase, the final appearance of the device's architectural layout design is created. The installation of the device is depicted in the figure below. The design of the prototype to be attached to the door is demonstrated in Figure 1.

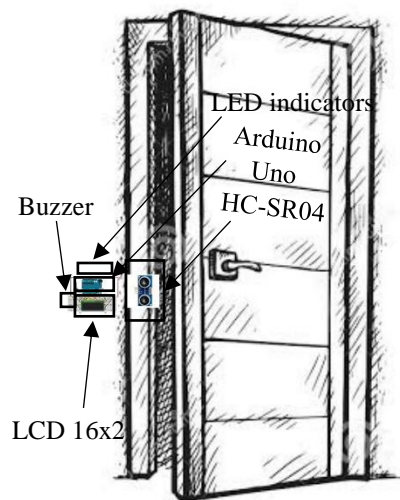


Figure 1. *Perspective view of the System.*

The system block diagram is shown in Figure 2. It represents the main components and their functionality. The door-mounted system includes a controller, ultrasonic sensor module, led indicators, and a buzzer. The ultrasonic sensor module is linked to the controller and detects any object within 10 meters.

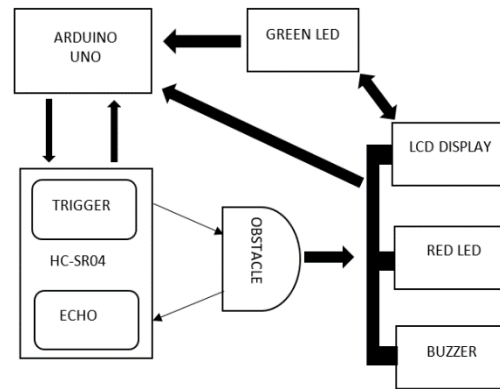


Figure 2. *System Block Diagram.*

Project Development. The project is divided into two parts: hardware development and firmware development. Hardware development is made up of various electronic components, whereas firmware development is made up of coding and testing.

1. **Hardware Development.** The prototype is placed within the door's closing entry. The ultrasonic sensor module is affixed to the door's edge. The controller module accepts data from the ultrasonic sensor module, and this sensor acts as an intruder detector. The Arduino Uno is linked to the LED indicators, LCD, and buzzer. The green LED serves as an indicator, and the LCDs the message "No intruder detected". When the sensor detects the opening of a door or an intruder walking within range, the red LED serves as an indicator, and the LCDs the message security alert, and the buzzer serves as a notifier to make a noise that wakes the homeowner.
2. **Firmware Development.** This is for the development of firmware for the microcontroller, which will control the entire security system's. A system flowchart is created as a guide for developing the device's program.

III. RESULTS AND DISCUSSION

After assembling all the system components and checking them on the serial monitor of the Arduino IDE, several experiments were performed. This section provides the actual structure and developmental stage of the study and its results during experimentation and testing. Each result is carefully examined and serves as a guide for successfully developing an ultrasonic security system with a buzzer notifier to address society's akyat bahay gang problem. *Hardware Circuit Design and Testing.* Several experiments were carried out in order to validate the system's functionality. The system was first assembled on a breadboard for debugging purposes, as shown in Figure 3. It consists of the Arduino Uno, Ultrasonic Sensor Module, LED, LCD Display, and Buzzer. This has the following advantages: 1. The ability to add and remove components and modules as needed. 2. Ease of troubleshooting and debugging. There is a testing phase to ensure that it performs as intended.

Test Phase 1. During this phase, the hardware components were assembled and the final code was loaded onto the microcontroller board. The code is then validated and compiled for use with the Arduino IDE. Various tests were performed on the developed device in order to validate its functionality. It was then temporarily installed on the door's edge for hardware and software debugging. During those tests, a few errors in object detection were discovered due to the placement of the ultrasonic sensor module, which were immediately corrected.

Test Phase 2. During this phase, researchers examine whether the system functions properly. When there is no detected object in the sensor, the Green LED illuminates and the LCD displays No Intruder which is shown in figure 3; when the sensor module detects an object within the range, the Red LED and Buzzer illuminate and the LCD displays Security Alert which is shown in figure 4.

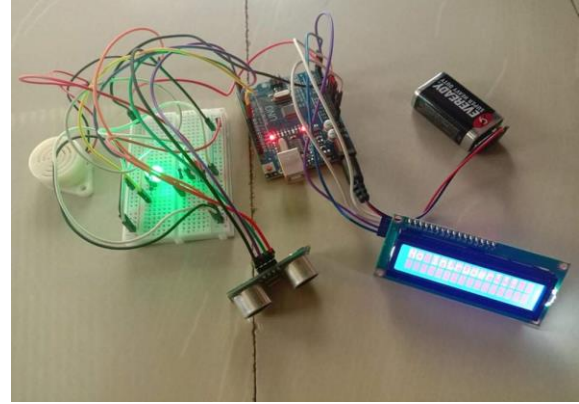


Figure 3. Breadboard implementation and Green LED

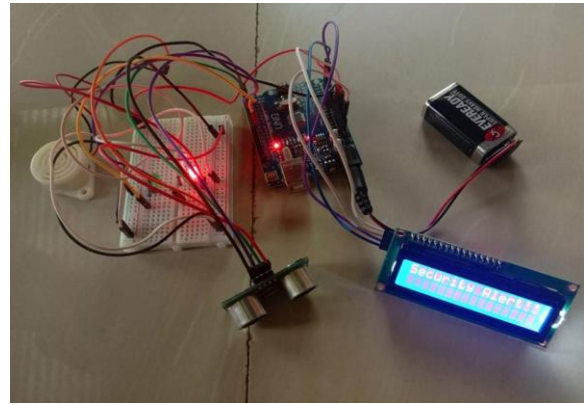


Figure 4. Breadboard implementation and Red LED

On July 10, 2021, the experiment was carried out in San Pablo City, Laguna, with the researchers testing it at 1-hour intervals for accuracy. Table 1 shows that it works properly when an object is detected, the Red LED blinks as an indicator, the buzzer notifier makes a noise, and the LCD will display the security alert, and when no object is detected, the Green LED is ON, and the LCD Display the no intruder found.

Attempt	Function Properly
1	Yes
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	Yes
9	Yes
10	Yes

Table 1. Trial on breadboard implementation.

As previously stated, the researchers tested the system on the edge of the door to see if it worked, as illustrated in Figure 5. And perform the trial to ensure that it functions properly, as shown in Figure 6.

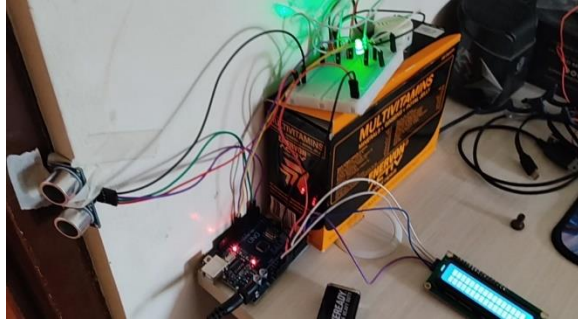


Figure 5. *System's implementation on the door*



Figure 6. *Performing Trials*

Table 2 displays the trial results; the first attempt failed, and the researchers discovered that the placement of the ultrasonic sensor module was the reason for the detection delay. The findings show that the range of the sensor module should be taken into account.

Attempt	Function Properly
1	No
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	Yes
9	Yes
10	Yes

Table 2. *Trials on door implementation.*

IV. CONCLUSION

Based on the findings and discussions, it is reasonable to conclude that the prototype was successfully designed, tested, and meets the study's objectives. Using the ultrasonic sensor module and Arduino UNO, the device was able to 1.) detect the object. 2.) The Green LED is always illuminated, and the LCD displays "No Intruder Found." 3.) When the sensor module detects an object, the red LED blinks, the LCD displays a security alert, and the buzzer notifier makes a noise.

However, minor issues that researchers encountered during the initial testing; when it was implemented on the door, the first trial attempt failed, but researchers discovered that the placement of the ultrasonic sensor module was required to the factor to be considered. Following the error correction, the device was tested to ensure that it functions correctly and that the homeowners are notified if an intruder wishes to enter.

Further, during the prototype's development stage, these errors are widely accepted and the testing of the device, it was also determined that it functions properly and can reduce the akyat bahay gang's report on police, and the homeowners can reduce their fear. The researchers' study has many opportunities to improve so that future researchers can use it as a guidelines and stepping stone.

REFERENCES

- [1] N. Magpantay, "Philippine National Office: AKYAT-BAHAY INFOGRAPHIC," *Philippine National Police*. [Online]. Available: <https://pro9.pnp.gov.ph/index.php/public-relations/crime-prevention/tips/1771-akyat-bahay-infographic> [Accessed: 08-Jul-2021].
- [2] C. Santos, "AKYAT BAHAY CRIME GROUP," *Philippine National Police*. [Online]. Available: <https://ncrpo.pnp.gov.ph/leader-of-bianong-robbery-akyat-bahay-crime-group-captured-in-quezon-city/>