PROFOBAT (Protection From Bats) Microcontroller-BasedBat RepellentSystem in Fruit Bearing Trees

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ABSTRACT

Bats are nocturnal animals who feast on fruits bearing trees like lansones, rambutan, papaya, etc. As the time goes by farmers have generated few deterrent systems for bats, like putting nets around the trees, but by doing this thing some bats gets caught and can be killed meaning it is harmful to the species and putting net is also expensive and must be changed every often because it is easily broken. This study demonstrates the effect of an alternative way to deter bats by developing a device that can detect bats and other nocturnal animals near its effective range. It uses PIR (passive infrared sensor) as the detector, 12v LED light and ultrasonic speaker as the deterrent. The PROFOBAT detects body heat in motion and emits frequency that range from 10 KHz to 42 KHz. This frequency is not audible to human ears but is effective as a deterrent for animals, meaning that it can detect bats that flies in its effective range that is 10- 12 meters at 180 degrees. This device is powered by twelve 12 batteries and is controlled by an Arduino mega microcontroller. The device was developed using the following steps namely; problem identification, research requirements specification, concept generation, design prototype, system testing and evaluation. The device was tested for its functionality in a local farm, and was the evaluated for reliability, ease of use, portability, and accuracy.

Index Terms—Bats, flashing lights, PIR (passive infrared sensor); tropical fruit bearing trees; ultrasonic Speaker

INTRODUCTION

Due to its tropical weather, Philippine is known for its tropical fruits like rambutan, lansones, papaya, mango, Tar fruit (caimito) and many more fruits of minor importance but very well known. Over a considerable period, these fruits have developed enormous acceptance as a seasonally available fruit in many countries in Asia, and it is widely planted in both backyard gardens and commercial plantation. It has been cultivated in some South East Asian countries.

With the abundance of fruits even birds and bats prefer to eat, however, by developing a microcontroller-based bat repellent system using PIR (passive infrared sensor) sensor that can move these birds and bats away that has the intention of destroying these fruits.

In many of today's industries, the need for an active bird deterrent is significant. There have been many attempts in the past to build a successful system with few being able to achieve satisfactory performance. This project aimed at developing and designing a deterrent system that creates minimal disturbance while being effective in bird and bat deterrence. An initial investigation and analysis of the existing types of bird and bat deterrent systems were undertaken and chosen for the designed system from this method of deterrence. The electrical, digital and computer parts of the conceptual design have been completed system will have designed in detail and partially constructed to discover the effectiveness of the system. the main objective of this study is to develop a microcontroller-based Bat deterrent system in Papaya Plantation using PIR (passive infrared sensor).

This study would help farmers to expand the fruits farm in country and is easy to set up for those farmers who have these fruits. Many farmers use the net to cover their entire tree so that it cannot be entered or be eaten by bats or any other bird species that will eventually break the fruit, to this day it continues the tradition of farmers in their trees but the net they put in the tree is usually destroyed because it is bitten by bats to break the barrier and enter and eat the fruits this is also why the bats are dying because it is caught in the net placed on the tree.

It is merciless and lethal whilst the used of skinny nylon netting sold by some hardware stores and isaccountable for the killing of hundreds of flying birds and other flying animals yearly. The proponents are suggestting people who unintentionally caught wildlife in this type of material, to find and use a safer options. By developing a microcontroller-based bat detection using PIR (passive infrared sensor) it will detect approaching birds and bat in the tree and thereby drive the bats and birds away from the assigned tree. This will contribute to the development of the population of tropical fruit bearing trees in the Philippines. It will also help future researchers in the world to assess the impact of lights and acoustic sound in deterring bats.

REVIEW OF EXISTING WORKS

This paper introduces the concept of an ultrasonic insect detector consisting of an ultrasonic sensor, an infrared sensor and a GSM module where the sound is detected by an ultrasonic sensor of insects by detecting ultrasonic signals produced by the insect feeding events in crops. After that the presence of bugs is indicated by the warmth heat radiated by the body of the insect by an infrared sensor. If all sensors indicate the existence of insects, a message will be sent using the GSM module to warn the farmer about the existence of insects after the farmer will use pesticides or insecticides according to their crops. According to the author, it will not only helps the farmers but also increase the agriculture productivity[1].

The author[2] addresses the development and preliminaryassessment of an advanced electronic repeller for pests with automated frequency variation. The study aims to develop a tool that is capable of emitting varied frequencies of ultrasonic energy. Such frequencies influence pest's auditory senses such as rats, bats and birds by making them nervous at home. However these high level frequencies have no effect on human ear and hearing.

A similar kind of work was shown by Jason W. Horn, Edward B. Arnett, Mark Jensen and Thomas H. Kunz where the researchers conducted an experiment on how to deter bats away from wind turbines and to test the effect of acoustic sounds on the bats[3].

In another study,the researchers found out why the bats are attracted to wind farms and how to deter them away and they concluded that the bats was being deter using differentrandom ultrasonic frequency. [4].

METHODOLOGY

PROPOSED MODEL

The design of this project was inspired and used previous research as references. This study incorporates new ideas and techniques, and considering some important matter like the distance and the span of the detection field, delay time and response of the sensor the developers used the proposed design for the system. The device is composed of PIR sensor (passive infrared sensor), Ultrasonic speaker that has 10-42khz frequency range, 12v Led Lights, Arduino mega, jumpers' wires 12v battery supply and ply wood for the enclosure.

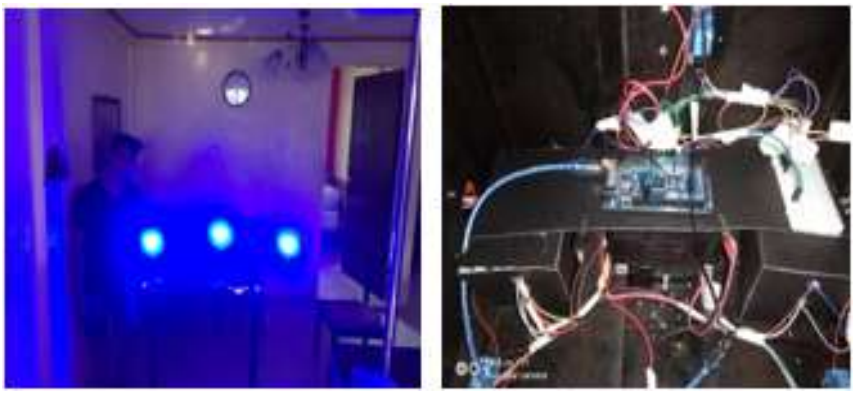


Figure 1. Prototype of the Proposed Model
Figure 1 shows the prototype design of the proposed PROBAT.

SCHEMATIC DIAGRAM

Figure 2: Schematic Diagram of the Device

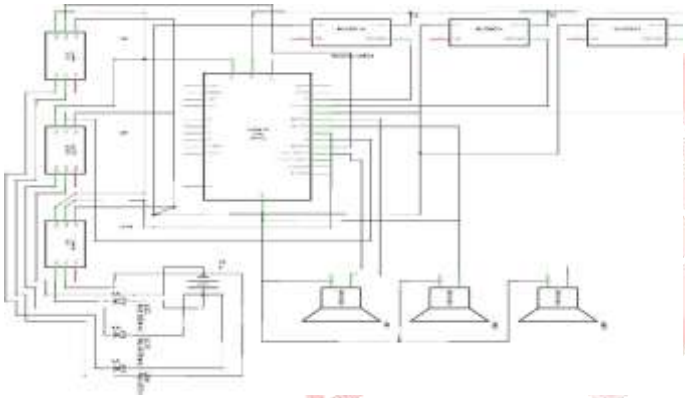


Figure 2 shows the connections of sensors the input and output of the system, the sensor and output were group into three. The first group is composed of one PIR sensor, one Ultrasonic speaker and a 12v LED light these are the output of the device. The connection of first group are digital pin 2,5,7 respectively to PIR sensor, Ultrasonic Speaker, and 12v LED light. The second group of sensors and output are connected to digital pins 3,6,8 respectively, and the last group is connected to pins 4,10,9 respectively. The schematic diagram also shows the connection of the power supply.

MATERIALS AND REQUIREMENTS

ARDUINO MICROCONTROLLER

The Arduino Super 2560 is a board focused on the ATmega2560 (datasheet) Microcontroller. This has 54 optical input / output pins (including 14 as PWM outputs), 16 physical inputs, 4 UARTs (hardware serial ports), 16 MHz quartz. oscillator, a USB interface, a power jack, an ICSP header, and a reset key. It provides everything required to help the microcontroller; simply attach it to a device with a USB cord, or power it to get going with an AC-to-DC converter or battery. The Super is compatible with most arduino Duemilanove or Diecimila shields.

Figure 3: Arduino mega

Figure 3 shows the microcontroller system on which the prototype will be designed.

PIR (passive infrared sensor)

Figure 4: PIR sensor

Figure 4 is the PIR sensor. It is an electronic device to detect body heat in motion it has a maximum range of 10-12 meters. PIR devices are widely used in fire warnings and automated lighting. PIR sensor detects every heat in motion but does not give data about the detected object.

Ultrasonic Speaker

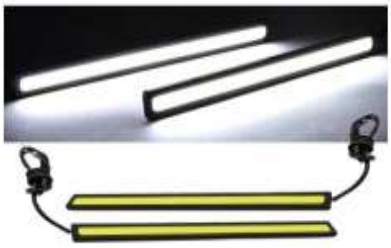
Figure 5: Ultrasonic speaker

Figure 5 is an Ultrasonic speaker. It is a speaker that emits ultrasonic sound ranging from 20 khz above. The said frequency is not audible in human ears but is suitable and has been tested to be capable for deterring animals.

12v led lights

LED LIGHTS

Figure 6. LED lights



In Figure 6, Flashing lights were incorporated to the device as primary deterrents as other study has proven that it can be good deterrent for nocturnal animals.

RESULTS AND DISCUSSION

In this part, the components of the device were assembled and tested. The assembly was organized in a process in which the components would fit in the enclosure and in that will work efficient.

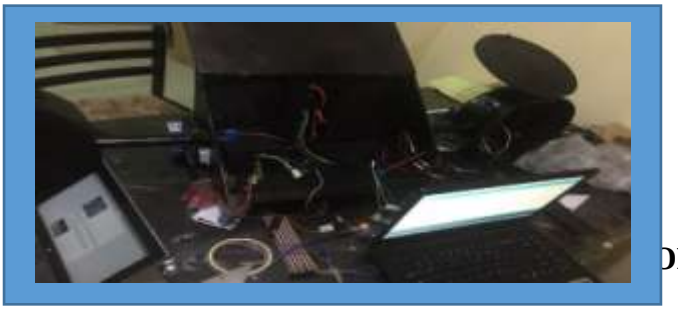


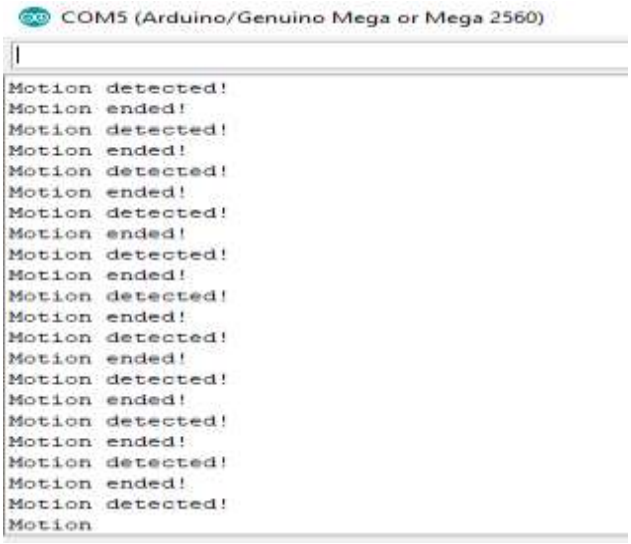
Figure 7: Construction of the circuitry, wirings and arrangement of each component.

Figure 7 shows the materials and testing procedures in the development of the system

OFOBAT

For the program of the system Arduino IDE was used. Figure 8 shows the result of PIR testing, if the PIR sensor detects motion the serial monitor in arduino IDE prints the results.

Figure 8: Testing of the the program in the device



BLOCK DIAGRAM

The microcontroller controls all the circuit. It has to be programmed. It directs the sensor to collect radiated heat from an object or a living being, When the PIR senses an animal with specific heat level, the microcontroller processes the information and produce an output.

If there is an obstruction, it triggers a speaker (ultrasonic speaker) to emit frequency ranging from 10khz to 40khz; which is proven to be a good sound to deter animals. It will also trigger the LED to flash light, both the flashing of lights and noise produce by the speaker will not end until the there is no body heat in motion in the sensors field of view. It then continues this process for eternity before the device is turned off.

Figure 9: Circuit Block Diagram

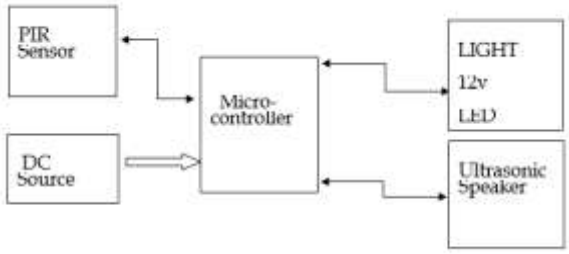
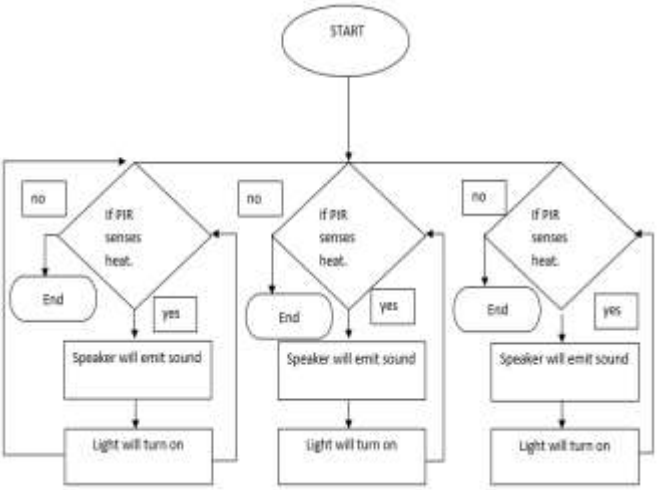


Figure 9 shows the circuit diagram of the proposed system.

FLOW CHART DIAGRAM

Figure 10shows the closed-looped pattern in the system, when-ever the sensor senses an object it will trigger the LED and the ultrasonic speaker to emit their respective output. Until there is no detected body heat in motion both the light and noise will con-tenue. But if the device has not detected object the output will stay off.

Figure 10: Flowchart of the Program



EVALUATION AND TESTING

After finishing the real device, the researchers conducted a system testing in a local fruit farm.

For the functionality of the device the researchers conducted an experiment in a local farm. And after the experiment was conducted, an evaluation to the land owner was done. For the remaining criteria, they used questionnaire and was evaluated by the teachers and students of John Paul College located at MGM Andaya compound Odiong Roxas Oriental Mindoro.

Duing the day 1-10 of the testing for the functionality of the device, the researchers first search the farm for the right tree to where they will put the device. The selected tree must have fruit and must be visited by bats occasionally to feed on its fruits. To observe wether the bats did visit and eat on the tree the researcher counted the fruits before and after. The result was tabulated and is shown below.

Table 1: Experiment results

Days of testing	Total number of fruits(A)	Number of fruits eaten by bats(A)	Number of days/hours of the experiment	Functionality(x)
1	10	0	12hours	100%
2	10	0	12hours	100%
3	10	0	12hours	100%
4	10	0	12hours	100%
5	10	0	12hours	100%
6	10	0	12hours	100%
7	10	0	12hours	100%
8	10	1	12hours	99%
9	10	0	12hours	100%
10	10	0	12hours	100%

Formula =

$$X=\frac{A}{B}$$

Where:

A = is total number of fruits put in the tree
B = is t
the total number of fruits eaten by bats
X = functionality of the device

Table 1 shows the expirement results. This experiment was conducted in a farm located in Kaligtsan Oriental Mindoro, where we ask a local farm owner for help in accumulating this statistic. This experiment was done by selecting a right tree and fruit to where to test the device and counting the fruit on the tree every night and will be checked in the morning for defects caused by bats. The fruits that was used was a guyabano,papaya, and caimito (tar apple) .

This experiment shows the functionality of the device in small scale by putting the device near trees it seems that the bats was already discourage to feed on its fruits because of unfamiliarity to the device and when they go near the tree the device acted and deter them away.

This test also concluded that some bats get past the deterrent for some reason, this reasons include the limit of the device the quality of the sensor and the false alarm cause by the sensors.

EVALUATION OF THE SYSTEM

After the functionality test the researchers conducted an evaulation according to the criteria stated below.

Table 2: Result of the Evaluation of the System

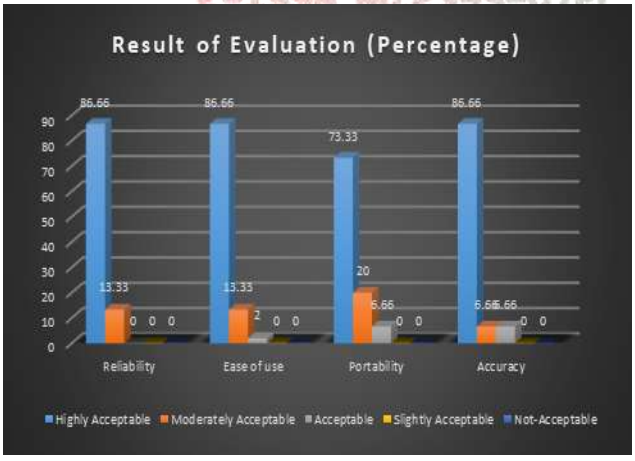


Table 2. shows that the result of the evaluation for Realaibilty, Ease of use, Portablity, Accuracy.All of the result was highly acceptable.

CONCLUSION AND RECOMMENDATION

Profobat was developed using a microcontroller, the device uses PIR sensors and was calibrated to its most effective sensitivity thus it can detect moving bats(animals) up to 10 meters, the device used ultrasonic speaker

that emits a frequency of 10 khz to 40 khz, this frequency range is not perceptible to most human ears but is effective on deterring nocturnal animals, the device incorporate light that flash when triggered by the sensors. the device can be used as a bat deterrence system in fruit bearing trees. the device is evaluated based on reliability ease of use, portability and accuracy.

For further development of the project, the following recommendations were drawn: To use other alternative power supply like solar panels etc. to make the device more compact and easy to install, to make the device more durable to withstand heat, rain and other exposure to the elements. To make the device more efficient so that it could be use not just on one tree.

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