

Microcontroller-Based Automatic Bat Pest-Repellent Device

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ABSTRACT

Bat habitats often coexist with human life, especially in homes, these mammals usually perch on the roofs of rooms or warehouses. In general, bats are parasites and pests for human life, therefore researchers have designed an automatic bat pest-repellent tool based on a microcontroller. This study aimed to create an automatic bat pest-repellent tool based on a microcontroller and electronic components as support for the circuit. This research method used three parts, namely input, output, and control. Where Arduino functioned as a controller for the entire circuit, while the ultrasonic sensor functioned as input while the Df player and speaker functioned as output. In this study, the researcher conducted 10 tests to determine the performance of the designed tool. After conducting 10 tests, the speaker produced a sound to repel bats, and the ultrasonic sensor was used as a detector of bat movements, in this test the distance of the ultrasonic sensor detected bats has been programmed, it was 5 cm to 50 cm.

INTRODUCTION

In general, bats are parasites and pests for human life, especially for farmers. These animals eat and damage fruits and plants which can harm farmers' income. Behind the disadvantages, there are benefits, namely helping pollination and bats function as predators of agricultural pests, one of which is the main pest eater of rice.

Bats are small mammals with the second largest species diversity after rodents. Bats have an important role in the ecosystem. Fruit bats play a role in seed dispersal in various types of plants. Bats fly far from their previous location, where the seeds of the trees they eat can fall. Fruit bats play a role in the forest ecosystem as flower pollinators and soil fertilizers (from droppings). One type of fruit bat is *Penthetor lucasii* which is spread in Kalimantan. In addition to the vital role of bats in the ecosystem, some types of bats are also included as pests. The type of bat in question is the fruit bat. Fruit bats often use farmers' fruit as food. Because of the actions of these bats, fruit farmers and people who have fruit trees experience losses because the harvest yields decrease (Sumarni, 2019).

Bat habitats often coexist with human life, especially in homes, these mammals often perch on the roof of rooms or warehouses, therefore this is very disturbing to the lives of individuals or groups of humans because bats defecate on the floor so that the dirt produces odor and is difficult to clean. Based on the background above, I made a tool to repel bats automatically using a Microcontroller.

LITERATURE REVIEW

Research That Has Been Conducted By Previous Researchers Related To Technology And Similar Cases Includes The Development And Preliminary Testing Of An Electronic Pest Repeller With Automatic Frequency Variation (Simeon et al., 2013). Prototype Of Rat Pest Repellent Device For Corn Plants Using Microcontroller (Qomariah & Santoso, 2023). Design Of Pest Detection And Repellent Device Based On Arduino Uno Using Pir (Passive Infrared Receiver) Sensor (Prasetyo et al., 2024). Automatic Plant Pest Extermination Device Based On Microcontroller Using Electric Shock Voltage (Marcos, 2023). Perakus (Insect And Rat Pest Control) Automatic Appropriate Device Based On Microcontroller As A Food Solution Without Chemical Pesticides (Fatahullah et al., 2020). Application Of Rice Pest Repellent Using Esp32 Microcontroller And Internet Of Things-Based Sound Wave (Puryono & Pangestu, 2023). Design Of A Bat-Repellent Device Using The Ultrasonic Sound Wave Method (Widiarko et al., 2024). Prototype Of Rice-Eating Bird Pest Repellent Device In Fields Based On Arduino Uno (Adhitya, 2018). Benefits And Effectiveness Of Automatic Farmer Pest Repellent (Nurikhsani & Mupita, 2022). Design And Construction Of Electronic Pest Repellent For Use In Homes And Farmland (Abdulrahman et al., 2019). Utilization Of Ultrasonic Waves To Improve Fruit Harvest Yield (Sukarno et al., 2024). Evanesco-An Ultrasonic Repeller Using Uav (Raghuhandan et al., 2020). Design And Construction Of Bat Repellent Device Using Android Based Microcontroller (Musaddiq, 2021). A Novel Approach To Bat Protection Iot-Based Ultrasound System Of Smart Farming (Rahman et al., 2023).



METHOD

Tools and materials

Hardware

Table 1. Hardware

No	Tool name	Tool Function
1	Arduino Uno	As a controller of components in the design of the Bat Pest Repeller.
2	Ultrasonic Sensor	As a Motion Detector
3	Speakers	As a Loudspeaker
4	Df Player	As a connector between the speaker and the Arduino
5	Jumper Cables	As a connector between one component and another.
6	Adapter	As a conductor of electric current
7	Soldering	As a heating tool used to connect a circuit or component to electronic equipment.

Software

Table 2. Software

No	Tool name	Tool Function
1	Arduino IDE	Used to record and fill the program to the Arduino board.
2	Windows 10	Manage the preparation process, scheduling, and monitoring of the program being run.
3	Fritzing	Used to create a sketch of the design of an automatic bat-repellent tool

Research Stages

1. Preparation Stage
At this stage, prepare the tools and materials needed to make this final project such as PC, Arduino Uno, Jumper Cable, Ultrasonic Sensor, Df Player, and Solder
2. Design stage
At this stage, what must be done is to connect one tool to another so that it becomes a unit.
3. Program Writing Stage
This stage is done by writing the program syntax into the Arduino IDE software.
4. Testing Stage
After the previous stages are done correctly, at this stage, what must be done is to connect the laptop to the device that has been assembled, and upload the program.
5. Testing Place
The testing of this tool was carried out on the terrace of the house ceiling, namely in the rented house that I currently occupy on Jl. T.B.en Mahmud, Lhok Keutapang, this tool can anticipate bats so that they do not enter the house.

Design Chart



Figure 1. Design Chart

1. Arduino uno As a controller of components in the design of the Bat Pest Repeller.
2. Ultrasonic Sensor As a distance detector
3. Df Player functions as a connector between the speaker and the Arduino
4. Speaker as a loudspeaker

Flowchart Design

When the device is turned on, the sensor starts reading the movement, if the sensor detects movement, the speaker will automatically emit a sound. If not, the sensor will read the movement again. In general, Ultrasonic sensors

have an effective reading range of 3cm – 3 meters, but Ultrasonic sensors have a range of distances and reading angles that vary, depending on the characteristics of the sensor.

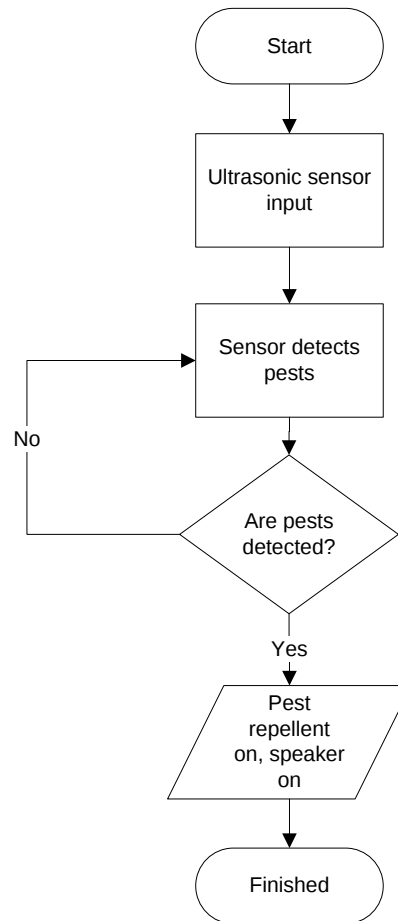


Figure 2. Flowchart

RESULT AND DISCUSSION

Automatic Bat Pest Repellent Device Circuit

The following are the stages in designing an automatic bat pest-repellent device circuit.

Ultrasonic Sensor Circuit Connected to Arduino

The Vcc Pin on the Ultrasonic Sensor is connected to the 5v Pin on the Arduino, the Tring Pin on the Ultrasonic Sensor is connected to the -6 Pin on the Arduino, the Echo Pin on the Ultrasonic Sensor is connected to the -5 Pin on the Arduino, the GND Pin on the Ultrasonic Sensor is connected to the GND Pin on the Arduino.



Figure 1. Ultrasonic Sensor Circuit Connected to Arduino

Df Player circuit connected to Arduino.

The Df Player's Vcc pin is connected to the Arduino's 5v pin, the Rx pin is connected to the Arduino's -11 pin, and the Tx pin is connected to the Arduino's -10 pin.

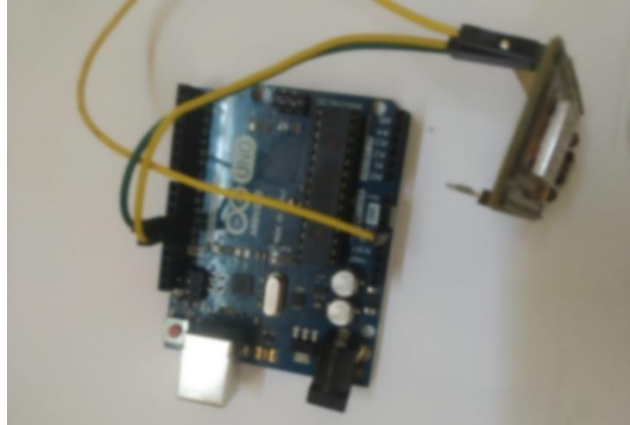


Figure 2. Df Player circuit connected to Arduino

Speaker circuit connected to Df Player.

Pin + on the Speaker is connected to Pin Spk1 on the Df Player, and Pin - on the Speaker is connected to Pin Spk2 on the Df Player.

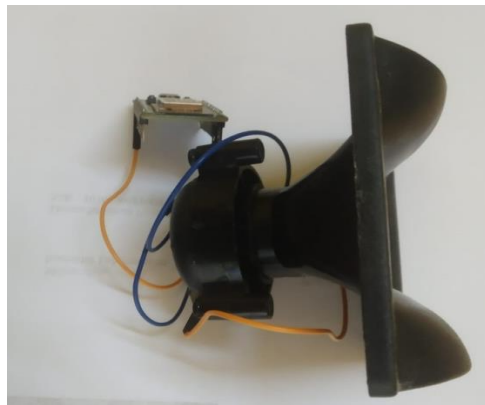


Figure 3. Speaker circuit connected to Df Player

Complete Tool Assembly

All components are connected, and the Ultrasonic Sensor will detect objects or movements of bat pests.

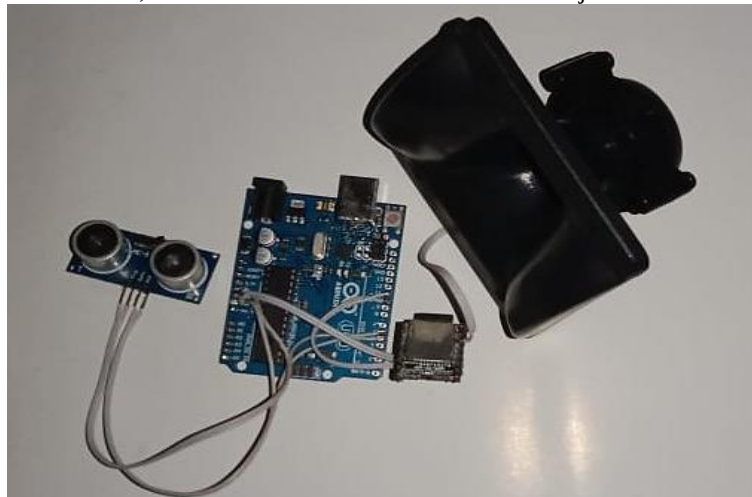


Figure 4. Complete Tool Set

Tool Testing Procedure

After the system is finished, it is necessary to test the system. When the Arduino Uno starts running, the Ultrasonic Sensor starts reading the movement, if the sensor detects movement, the speaker will automatically emit a sound. This test was carried out 15 times to determine the performance of the tool that has been designed.

Table 1. Tool testing

Testing	Sensor Detecting	Df Player	Speaker Status	Status
1.	5 Cm	On	On	Banished
2.	10 Cm	On	On	Banished
3.	15 Cm	On	On	Banished
4.	20 Cm	On	On	Banished
5.	25 Cm	On	On	Banished
6.	30 Cm	On	On	Banished
7.	35 Cm	On	On	Banished
8.	40 Cm	On	On	Banished
9.	45 Cm	On	On	Banished
10.	50 Cm	On	On	Banished

After conducting 10 tests, the results were that 5 cm to 50 cm of the ultrasonic sensor successfully detected movement. So this tool can repel noise from the speaker.

Tool Testing Results

After the system is finished, it is necessary to test the system. When the Arduino Uno starts running, the Ultrasonic Sensor starts reading movement, if the sensor detects movement, the speaker will automatically emit a sound.

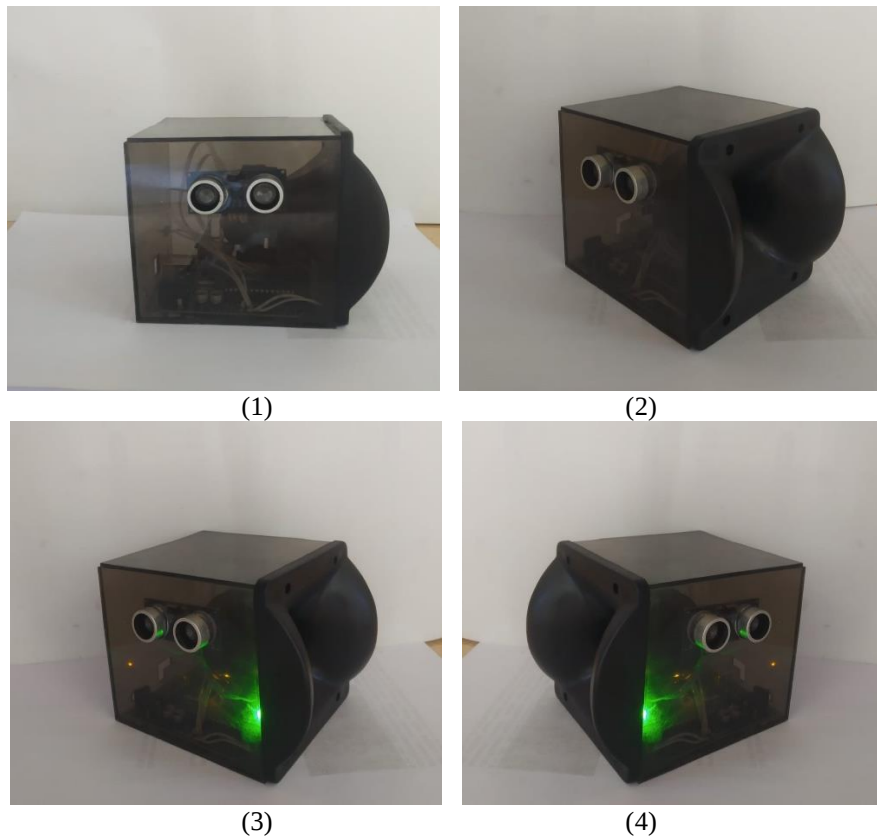


Figure 5. Tool Test Results

CONCLUSION

After designing and testing the Automatic Bat Pest Repellent Tool Based on a Microcontroller and then testing the tool, both testing each circuit and overall sensor readings. Then the following conclusions can be drawn:

1. Bats have a hearing frequency of 10,000 Hz to 15,000 Hz so that this tool can repel / repel bats because the sound frequency output is 20,000 Hz.
2. Using an Ultrasonic Sensor as a detector of bat movements, in this test the distance the ultrasonic sensor detects bats has been programmed, namely 5 cm to 50 cm.
3. Using a Df player and speaker that produces output in the form of sound that disturbs bats.

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