Analysis of Impact of Repelling Sound on Animals

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Abstract

Sound has a range in time, frequency (Hz) and loudness or intensity whenever vibrating things generate changes in air pressure (decibels, sound pressure level). Comparative to humans, the ability of experimental animals to sense sound varies substantially by species. For instance, human hearing ranges from 20 Hz to 20 kHz, whereas rodent species have a far wider range of hearing ranges. We have designed a model that can generate ultrasonic frequencies to repel wild animals from crop land. We have taken observations for analyzing the impact of ultrasonic sound on animals for repelling them away from the crop-field. We have tried to find out that whether this model is sufficient enough to repel the animals or not.Therefore we have tested by increasing the frequency of ultrasonic sensor and analyze the result for predicting the impact of ultrasonic sensor on those animals.

Keywords: Crop protection, Smart farming, ultrasonic sensor, wild-animals, impact, security

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1. Introduction

Based on the minimal lasting impacts identified in the literature referenced in the Agricultural Guide (APHIS 1998), there is a higher endurance for the effects of noise on farm animals[1].24 out of 39 resources (such as TV screens, furniture, vacuums, and cage washers) have been found to produce ultrasonic sound, which can occasionally surpass 100 kHz and 122 dB in frequency and intensity. Ultrasonic sound obviously alters physiological measures (such as heart rate, blood pressure, and electroencephalographic alterations) as well as behavioural characteristics (such as seizure) and has pathological alterations on experimental animals[2][3]. The influence of sound effects also varies based on the type, strain, and age of the animal. Seeing these effects of ultrasonic sounds on animals, it can be used to scare/repel them away from crop-fields[4].

1.1 Various Techniques used to protect crops from wild Animals

a) Agricultural Fencing

An effective and long-lasting wild animal repellant is fencing. Agricultural fences are a very successful technology for protecting wild animals[5]. However, the use of fences is frequently prohibited. Certain types of fences may be prohibited or restricted by some municipal and governmental organizations[6]. Therefore, it's crucial to review local laws and ordinances prior choosing a proper fence. Various fences such as wire fence, plastic fence and electric fence.

Fig1. Agricultural Fencing

Fig2. Electrical Fencing

b) Natural repellents

Instead of employing mechanical or chemical protective methods, some farmers opt to use natural resources[7]. There are several strategies to reduce agricultural damage from wild animals, such as: smoke, fish or garlic natural emulsion, beehive fencing, chili peppers, egg-based repellant.

Fig3. Beehive Fencing (A Natural Repellant against Elephant)

2. Objective and Problem Statement

The aim of this research is to find the impact of ultrasonic frequency on wild animals to repel them away from the field[8]. We have done an experiment on the rat and cow to check whether they are being affected and repelled by the ultrasonic frequency or not. We have also observed the effect by increasing the ultrasonic frequencies on them. We have checked variations in their responses on varying the frequencies on them.The purpose of this study is to determine how ultrasonic frequency affects wild animals in order to deter them from a farm[9]. In order to determine whether or not the ultrasonic frequency affects and repels animals, we conducted an experiment on rats and cows[1]. We have also seen what happens when we raise the ultrasonic frequencies used to treat them. We have examined changes in their responses as a result of applying different frequencies to them.

3. Methodology

We have designed a model in which we have used ARDUINO UNO microcontroller, ultrasonic frequency generator with amplifier at OUTPUT pin, ultrasonic sensor at INPUT pin. This setup is used to detect the animal and as soon as the animal comes in range of ultrasonic sensor, it senses at input pin of microcontroller and then ultrasonic sound is generated from speaker at output pin[10][11]. Following is the circuit diagram of proposed system. Fig 4 shown below shows the connectivity of INPUT and OUTPUT pins to the microcontroller. Whereas Fig 5 shows the Data-sheet of the respective circuit. Table1 shows the components required in this setup.

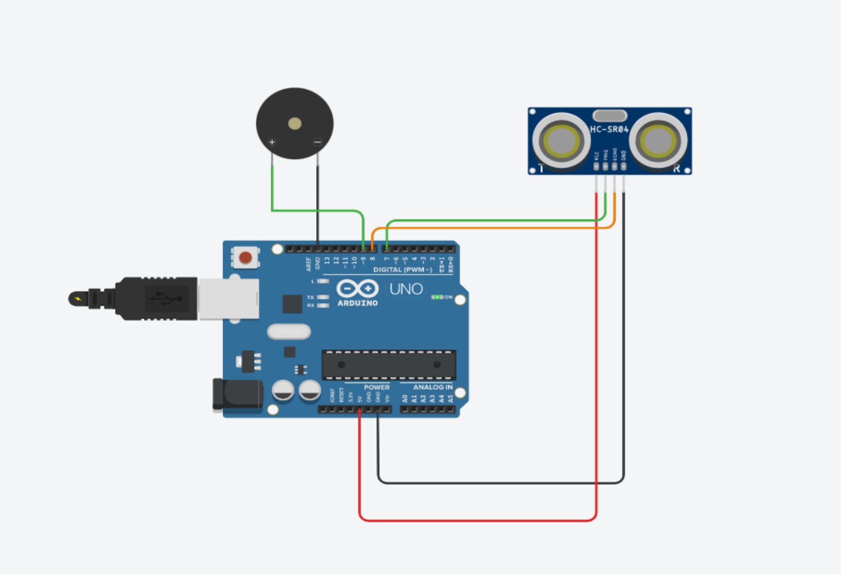

Fig 4. Circuit Diagram of the proposed system

Name	Quantity	Component
U1	1	Arduino Uno R3
DIST1	1	Ultrasonic Distance Sensor
PIEZO3	1	Piezo

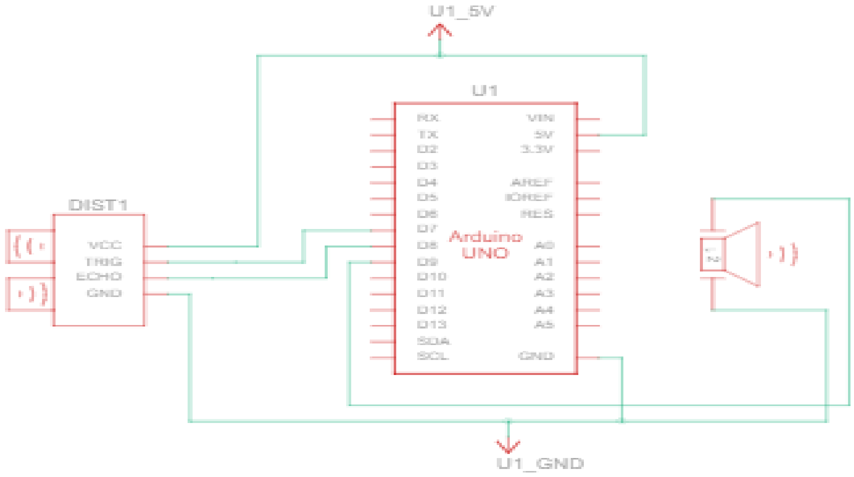

Fig 5. Data-Sheet of the circuit diagram

Using this system, we have taken observations. We allow to pass rats and cows near this system one by one. Then we took several readings for the value of ultrasonic frequency at which rat and cow started to deviate separately[12]. Initially we passed the ultrasonic frequency to 25 kHz. We took five observations. Then we amplified it to 30 kHz and then took another 5 observations. In the Results and discussion section, we have analyzed the data and discussed the results.

4. Results and Discussion

Rat hearing has a frequency range of roughly **250 Hz to 80 kHz**, with the most sensitive range being between 8 and 38 kHz, which is substantially more than that of humans[13]. Whereas Cows have greatly developed hearing, with a frequency range of **23 Hz to 37 kHz.**

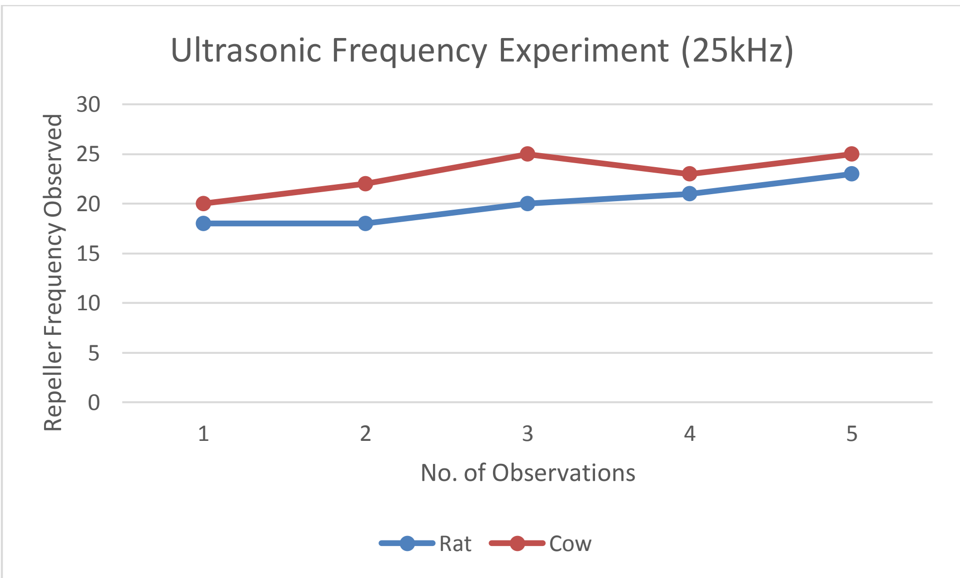

Fig 6. Data showing the range at which animals started to deviate

In **Fig 6**shown above, a chart is represented showing the frequency at which rat and cow started to deviate when a maximum 25 kHz ultrasonic sound is produced. Same process is repeated by increasing the frequency to 30 kHz. **Fig 7**shows the deviation pattern when 30kHz frequency maximum is produced.

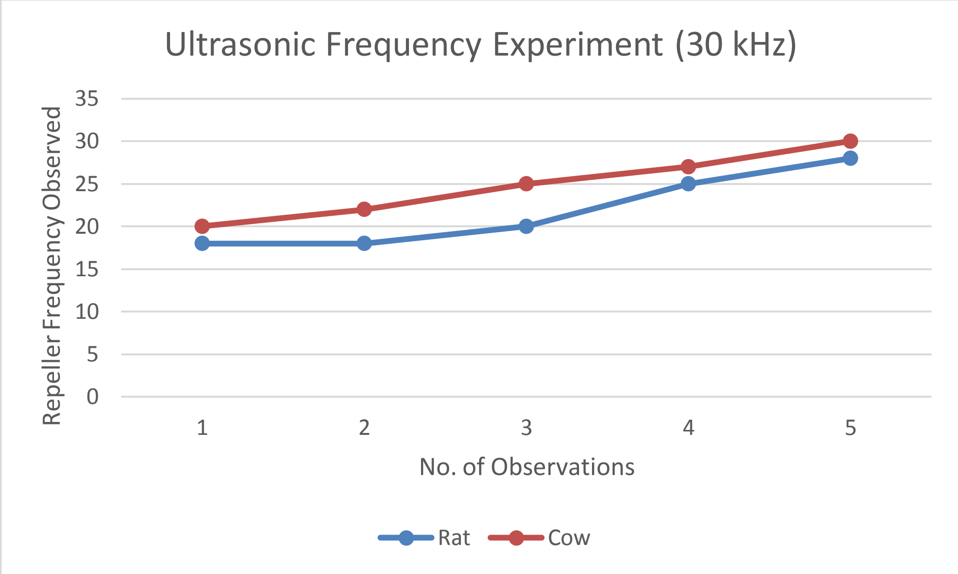

Fig 7. Data showing the deviation pattern by increasing the frequency

We have done ANOVA Analysis of both the experiments and find out whether our experiment is significant or not. Following tables namely **Table2** and **Table3**show the ANOVA analysis done on the gathered data from both the experiments.

ANOVA: SINGLE FACTOR						
SUMMARY						
GROUPS	*Count*	*Sum*	*Average*	*Variance*		
RAT	5	100	20	4.5		
COW	5	115	23	4.5		
ANOVA						
SOURCE OF VARIATION	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
BETWEEN GROUPS	22.5	1	22.5	5	0.055767	5.317655
WITHIN GROUPS	36	8	4.5			
TOTAL	58.5	9				

Table2.ANOVA analysis on the data gathered at 25 kHz maximum frequency

Here, in this table above we can observe clearly that**F-tabulatedvalue is 5.317655** and **F-calculated value is 5.** Thus, it is clear that F-calculated value is less than F-tabulated value. It depicts that the experiment done at 25 kHz ultrasonic frequency is **significant**[14]**.** Now, another ANOVA analysis at 30kHz frequency is shown below in Table3.

ANOVA: SINGLE FACTOR						
SUMMARY						
GROUPS	*Count*	*Sum*	*Average*	*Variance*		
RAT	5	109	21.8	20.2		
COW	5	124	24.8	15.7		
ANOVA						
SOURCE OF VARIATION	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
BETWEEN GROUPS	22.5	1	22.5	1.253482	0.295374	5.317655
WITHIN GROUPS	143.6	8	17.95			
TOTAL	166.1	9				

Table3. ANOVA analysis on the data gathered at 30 kHz maximum frequency

Here, in this table above we can observe clearly that **F-tabulatedvalue is 5.317655** and **F-calculated value is 1.253482.** Thus, it is clear that F-calculated value is less than F-tabulated value. It depicts that the experiment done at 30 kHz ultrasonic frequency is **significant.**

As both the experiments are significant but now, we have to find out the most significant experiment. So, for finding that, the value which is nearest to the F-tabulated will be considered as the most significant value. Thus, first experiment is more significant than second one.

5. Conclusions

Thus, we can conclude that Animals can be repelled by ultrasonic sound. We can use it for repelling them away from areas where they can do any kind of destruction. We have also seen what happens when we raise the ultrasonic frequencies used to treat them. We have examined changes in their responses as a result of applying different frequencies to them[9][15]. To prevent wild animals from visiting farms, this study aims to understand how ultrasonic frequency impacts them. We can identify the areas to put this system and this system will generate repelling sound in the form of ultrasonic sound[16]. Thus, animals can easily be repelled away at an ultrasonic frequency. If it fails to repel them away, we can increase the frequency of ultrasonic sound.

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