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### A Low Cost Effective Electronic System to Repel Monkeys that Damage Crop in the Dry Zone of Sri Lanka

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#### Abstract

A study was conducted to find a frequency range to repel monkeys. The first study looked at whether there was a good way to repel monkeys in the community. But there is no better way to get rid of monkeys in society. The only successful solution in society to chase away monkeys is to hunt them down using a gun. But the tester does not

consider it a good solution. If not, a study was done to find a better way to do it. There is no range of frequency of the fear within the range of listening to monkeys. The study found that monkeys were frightened away by the sound of the AK 47 gun when they studied the sound of the guns given to them using a tda2003 amplifier.

**Keywords:** Monkeys, AK 47, tda2003, Sri Lanka

#### 1. Introduction

##### 1.) Background and justification

The Monkey repellent system's main targets are protecting farmers' growth and vile Monkey life. Vile Monkey is attaching farmers' property. Monkey and Human will be attached Day today. The monkey repellent system will be protected from farmers' growth. Sri Lanka farmers use the more protecting systems to protect their growth as to never attach vile animals. But they can't give better solutions to problems.

The Sri Lanka Government has a problem that is how to reduce Monkey problems. The Monkey repellent system will be providing better service to reduce Monkey attacked. Monkeys are more intelligent animals when compare with other animals. When somebody introduces repellent for monkeys they can take an idea to escape that system. This Monkey repellent system has never bad effect on monkeys.

##### 2.) Problem statement/ study problem

Investigate how to get rid of monkeys that do not harm the lives of monkeys that harm farmers' crops.

##### 3.) Research objectives

- Protecting the crops of innocent farmers from monkeys
- Create an intelligent electrical device that can repel monkeys without endangering their lives.

##### 4.) Hypothesis (if required)

The frequency range of monkeys audible range is approximately 55 Hz-45 kHz (Pfingst *et al.*, 1978; Stebbins *et al.*, 1966), while humans can hear from 20 Hz to 20 kHz (Sivian and White, 1933; Hawkins and Stevens, 1950).

#### 2. Review of Literature

##### National scenario in the proposes area of research

Human-monkey conflicts in Sri Lanka reached crisis proportions, when the country 35-years ethnic war ended in 2018, and the pent-up desire for progress led to the extensive destruction of natural habitats for agricultural expansion and economic development. These conflicts resulted in complaints from the public with demands for Sri Lanka Department of Wildlife

Conservation (DWC) to find an immediate solution to the problem. In response, DWC attempted to do what it could with the small number of staff and annual budget available to it. Caught between political pressure and public outcry the DWC efforts to deal with the human-monkey conflict gradually fell into disarray.

Nationally never made product as reduce Human-monkey conflicts problems. Research was heled Human-monkey conflicts problems in Sri Lanka as the result of Research that was provided more idea about monkey attached farmers growth. The Research was provided how to attached monkey for farmers property and growth.

### International scenario in the proposes area of research

The monkey repellent system was made in internationally. The monkey repellent system item is more expensive. The monkey repellent system item can't use Sri Lanka farmers. All areas of Sri Lanka never provide the electricity facility. The monkey repellent system item working direct current. That facility never distributes all of country in Sri Lanka as this reason Sri Lanka farmers They can't use this item. The item distributed Ultrasonic.

### Ultrasonic Monkey Repellent



The only **high-powered ultrasonic monkey repeller** with special "Multiplex Modulated Sweeping Ultrasonic Sounds" available in India. These high intensity ultrasonic sound waves (10-65 KHz) are out of the range of hearing of humans and most household pets, except pests. These nerve-crushing sounds directly penetrate their brain and nervous systems and make them uneasy and act abnormally-such as frantic jumping, stampeding which result in the voluntary repulsion against ultrasonic wave areas and monkeys find it impossible to stay in such radiated areas. **The monkey repeller device will get rid of monkey menace and nuisance effectively.**

- Ultrasonic wave causes great pain and discomfort to monkeys but does no harm to humans.
- The ultrasonic waves emitted from **Ultrasonic Monkey Repellent** will not interfere with any electronic appliances.

### 3. Literature review

#### Local and international Item of Monkey repellent

**Wild animals** are a special challenge for farmers throughout the world. Animals such as deer, wild boars, rabbits, moles, Monkeys, and many others may cause serious **damage to crops**. They can damage the plants by **feeding on plant parts** or simply by **running over the field** and trampling over the crops. Therefore, wild animals may easily cause

significant **yield losses** and provoke additional **financial problems**. Another aspect to consider is that wild animal crop protection requires a **particularly cautious approach**. In other words, while utilizing his crop production, every farmer should be aware and take into consideration the fact that animals are living beings and need to be protected from any potential suffering.

### Top Five Strategies to Protect Crops from Wild Animals

Successful farmers always seek to determine the satisfactory level of **wild animal crop protection** using one of the following five technologies:

#### 1. Agricultural fences

Fencing is a popular wild animal protection practice for that can last for many years. Agricultural fences are quite an **effective wild animal protection technology**. However, utilizing fences as a practice is often regulated. Some local and state entities may **restrict or prevent** the use of certain types of fences. Therefore, before deciding on a suitable fence, it's important to check local law regulations.

The quality of fencing depends on the **material and structure**. Depending on how it is made and what it is made of, some **permanent fences** can last up to 30 years. Farmers usually use one of the following types of fences:

#### 2. Natural repellents

Some farmers prefer using natural protection measures instead of mechanical or chemical protective practices. There are various ways to protect crops from wild animals, including:

- **Smoke**; in some areas farmers burn Monkey dung or other materials that smolder and create heavy smoke
- **Fish or garlic natural emulsion**; repels rabbits and deer
- **Beehive fencing**; for instance, Monkeys are repelled by the sound of honey bees; this practice is beneficial as it serves as an extra source of income
- **Chili peppers**; the chemical *Capsaicin* makes chili peppers hot; an excellent repellent against Monkeys, monkeys, squirrels, and some other wild animals; farmers who plant chili peppers will also benefit from an extra source of income
- **Lavender, soybean, peas, and beans** are excellent repellents against rabbits and are also an additional source of income
- **Egg based repellent**; homemade repellent against deer
- **Castor oil**; natural repellent that keeps away burrowing animals such as moles.



Beehive fence as a natural elephant repellent

**3. Chemical repellents;** active substances such as Anthraquinone, Butanethiol, and Methyl Anthranilate can be used to keep wild animals away from crops.

**4. Biophysical barriers;** fences made of bamboo sticks, coconut tree bunches, or some other available shrubs; low-cost practice but also low efficiency in protecting crops against wild animals.

### International

#### 1. Electronic repellents;

effective, long lasting, and eco-friendly method for crop protection that repels animals without harming them. Farmers use one of the following two types of electronic repellents:

- **Ultrasonic electronic repellent;** silent to humans, high-frequency sound waves repel wild animals.
- **Sonic electronic repellent;** audible noise that scares animals.



### Quality Wild Animal Crop Protection Secures the Yield

Aside from the aforementioned strategies, some farmers rely on scarecrows, firecrackers, bright lights, fire, beating drums, and dogs.

Along with practicing certain crop protection measures, the most successful farmers will **monitor their fields as often as possible**. After all, constant monitoring is the best way to make sure that everything on the field goes as planned.



In an attempt to ensure maximum crop protection, some farmers will **combine a few crop protection strategies**. Furthermore, **modern farm technology researchers** are working on new technological solutions. These solutions involve the use of cameras, computers, and even robots to protect plants from wild animals. While waiting for advanced technology to become available, farmers can do all their best and practice some of the above mentioned strategies to protect their crops.

### 4. Methodology

#### 1.) Place and time period

**Table 1:** Place and Time

Place	Time period
At Ampara District	February of 2018 to February of 2021

### 2.) Materials

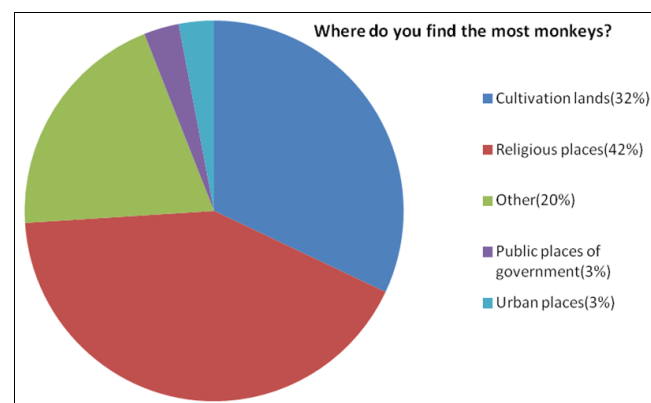
**Table 2:** List of Material

No	Material Name
01	Arduio UNO board
02	LCD Display
03	32 ohm horn
04	Controller
05	TDA2003 amplifier
06	Smart phone sound input Device
07	2.5Ah to 12Ah battery (12V)

### 3.) Experimental methods

The search process consists of two parts. The first step was to find out what kind of harm monkeys do to humans and what solutions humans provide for those harms and whether there is a more suitable solution out of those solutions. In the second phase, the design of an electronic device to repel monkeys and test its success was whitewashed. The first phase is a social studio and the second phase is an exploration of the success of the technical phase.

The materials for the for the first study consisted of 76 adult (26 Farmers at Ampara area and 50 online Google form applicant). In obtaining information from the farmers, information was obtained through the interview methodology. As The first step to look for are where do monkeys spend most of their time and what kind of trouble monkeys cause to humans. Gathered information from 50 people living in five cities (Kandy, Nuwara Eliya, Badulla, Polonnaruwa and Anuradapura) in Sri Lanka through the Google form. Information was obtained from 10 people in one city.



**Fig 1:** Pie Char One

The pie chart one illustrates where monkeys are most likely to roam. 42% say monkeys are mostly found in places of religion. According to the chart, 32% said that monkeys roam the fields. That's about 10 less than the number of people who say they roam in places of worship. 20% say that monkeys live in other areas. The chart views that the movement of monkeys in public places and cities is insignificant.



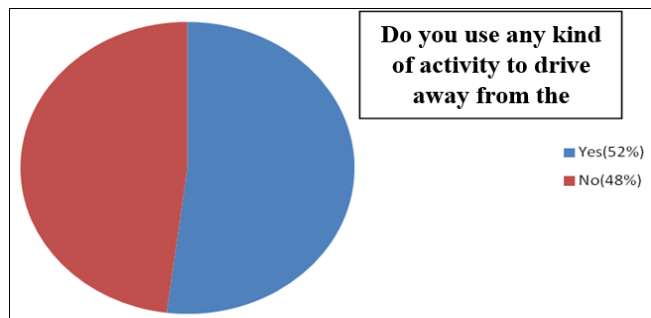


Fig 2: Pie Chart two

According to Pie Chart two, most people use any method to repel monkeys. About 52% of people use a method to repel monkeys. 48% do not use a method to repel monkeys. One of the 76 selected did not comment.

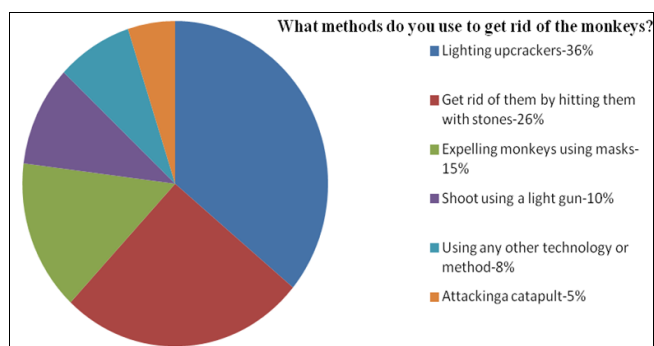


Fig 3: Pie Chart three

Of the 76 selected, only 39 use a tactic to repel monkeys. Most of those 39 studied what method they use to repel monkeys. Of those, 36% said they use lighting up crackers. 26% of people used to get rid of them by hitting them with stones. About 15% of people use Expelling monkeys using masks to repel monkeys. Fewer people use "Shoot using a light gun" than "lighting up crackers" and "get rid of them by hitting them". That group is about 10%. About 15% of people use the "Expelling monkeys using masks" tactic.

Table 3: Looking for success

Strategy	Successful		The monkeys will be harmed	
	Yes	No	Yes	No
Lighting up crackers-36%	-	100%	-	100%
Get rid of them by hitting them with stones-26%	-	100%	-	100%
Expelling monkeys using masks-15%	-	100%	-	100%
Shoot using a light gun-10%	100%	-	100%	-
Using any other technology or method-8%	-	100%	-	100%
Attacking catapult-5%	-	100%	-	100%

Only one strategy was best solution for replicate monkey. All those who use the "Lighting up crackers" method think that the method is a failure, as well as "Get rid of them by hitting them with stones", "Expelling monkeys using masks", "Using any other technology or method" and "Attacking catapult" respectively. The methodology is not successful either. Those who use "Shoot using a light gun"

say that the technique is successful, but that it kills the monkeys.

For the second study, an electronic device was developed to study the function of the sound. Here, the frequency range of monkeys was considered and their behavior was studied by emitting a sound suitable for that range. This test whitened the study into two parts. The electronic device emits a low frequency and studies the behavior of monkeys.

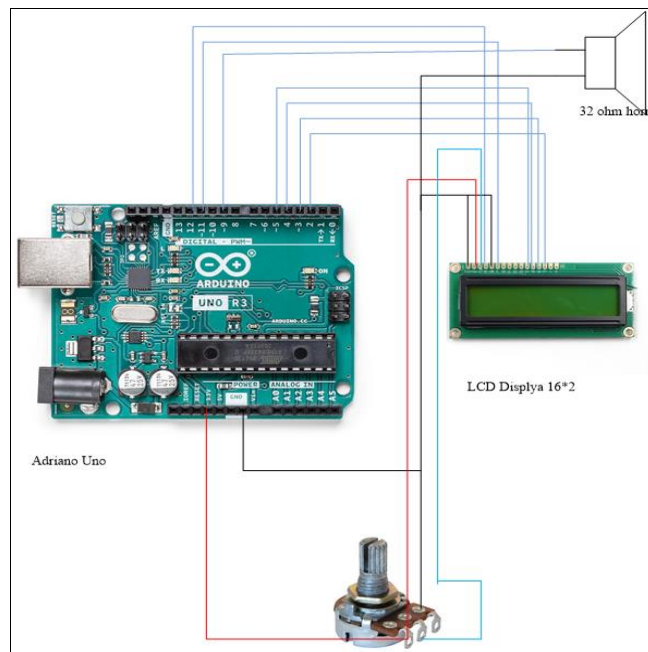


Fig 4: Circuit one

Humans and macaques have different audible frequency ranges: The macaque audible range is approximately 55 Hz-45 kHz (Pfungst *et al.*, 1978; Stebbins *et al.*, 1966), while humans can hear from 20 Hz to 20 kHz (Sivian and White, 1933; Hawkins and Stevens, 1950)

"Figure 4: Circuit one", it could be generated frequency and it providing sound. LCD display displayed frequency values that provide the circuit. "Figure 4: Circuit one". "Figure 4: Circuit one" is being used for getting frequency generation then It will be provided frequency that Increasing in order from zero.

Frequency was divided into sections and tested. The table below shows the information. The effect of the frequencies emitted on the circuit was tested using a home-grown monkey. It was monitored to see if the monkey's behavior was changing or if he was panicking.

Table 4: Frequency Test

Frequency Range	How many times was it tested?	Frequency	Did the monkey's behavior change? (Yes/No)
40hz -400hz	3 hours	6	No
400hz-800hz	3 hours	6	No
800hz-1200hz	3 hours	6	No
1200hz-1600hz	3 hours	6	No
2000hz-2400hz	3 hours	6	No
2400hz-2800hz	3 hours	6	Yes
2800hz-3200hz	3 hours	6	Yes
3200hz-3600hz	3 hours	6	No
3600hz-4000hz	3 hours	6	No
4000hz-4500hz	3 hours	6	No

Divided into frequency segments and tested as shown in Table 2. A change in the behavior of the monkey in the 40hz to 2400hz range could not be studied. Each test was performed about three hours, about six times. A change in the behavior of the monkey in the 3200hz to 4500hz range could not be studied. But it was possible to study a change in the behavior of the monkey in the range of 2400hz to 3200hz. It was therefore re-tested within those ranges. For this purpose, monkey herds roaming in different areas were inspected.

**Table 5:** Frequency Test Special Area

Frequency Range	How many times was it tested?	Frequency	Did the monkeys escape? (Yes/No)	Area
2400hz-2500hz	3 hours	3	No	Farmland
2400hz-2500hz	3 hours	3	No	In a jungle area
2500hz-2600hz	3 hours	3	No	Farmland
2500hz-2600hz	3 hours	3	No	In a jungle area
2600hz-2700hz	3 hours	3	No	Farmland
2600hz-2700hz	3 hours	3	No	In a jungle area
2700hz-2800hz	3 hours	3	No	Farmland
2700hz-2800hz	3 hours	3	No	In a jungle area
2800hz-2900hz	3 hours	3	No	Farmland
2800hz-2900hz	3 hours	3	No	In a jungle area
2900hz-3000hz	3 hours	3	No	Farmland
2900hz-3000hz	3 hours	3	No	In a jungle area
3000hz-3100hz	3 hours	3	No	Farmland
3000hz-3100hz	3 hours	3	No	In a jungle area
3100hz-3200hz	3 hours	3	No	Farmland
3100hz-3200hz	3 hours	3	No	In a jungle area

In the same frequency range, two areas were selected and examined very carefully. The same range was performed three times over a period of about three hours, changing the frequency very slowly. The frequency was tested by changing the time from the Arduino computer program to change one Hz per five minute.

The arduino computer program is as follows.

#### Program

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
int X;
int Y;

const int output_pin = 9;
int freq = 1500, duration = 30;
unsigned long delays = 0, times=0;
```

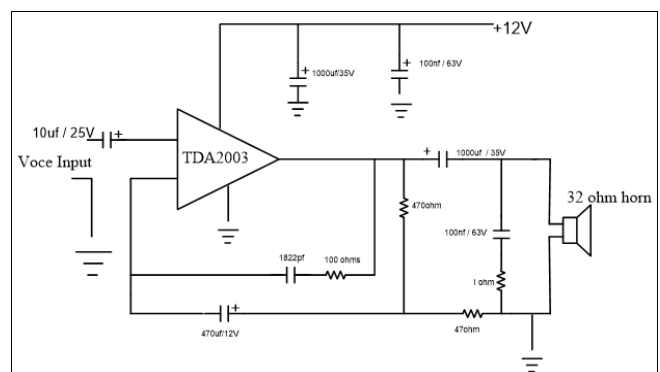
```
float Time;
float frequency;
const int input = A0;
//const int test = 9;
void setup()
{
  pinMode(input,INPUT);
  pinMode(output_pin, OUTPUT);
```

```
pinMode(output_pin, OUTPUT);
```

```
lcd.begin(16, 2);
analogWrite(output_pin,127);
}
void loop()
{

  times = millis();
  tone(output_pin, fre, duration);
  while(millis() < times + delays ){
    // Other codes to run during the 30 minutes.
```

```
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Frequency Meter");
X=pulseIn(input,HIGH);
Y=pulseIn(input,LOW);
Time = X+Y;
frequency=1000000/Time;
if(frequency<=0)
{
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Frequency Meter");
  lcd.setCursor(0,1);
  lcd.print("0.00 Hz");
}
else
{
  lcd.setCursor(0,1);
  lcd.print(frequency);
  lcd.print(" Hz");
}
delay(300);
}
```



**Fig 5:** Circuit two

According to Table 1, monkeys are afraid of guns. Therefore, it was investigated whether the sound of guns could be used to repel monkeys. For this purpose, the sound of various guns was downloaded using the internet and tested using the tda2003 amplifier circuit. The sound emitted by the tda2003 amplifier was emitted by a 32 ohm horn. At that sound the behavior of the monkeys was examined.

**Table 6:** Investigation Gun Sounds

Gun Name	Are monkeys scared? Yes/No	How far do monkeys go from the farm? Meters	Mean-value	Standard deviation	Will monkeys return to farming?	If so, after what time? minutes	Mean-value	Standard deviation
					Yes/No			
raifal	Yes	21M	13.42	6.078	Yes	60	4.928.571	14.556
		22M				45		
		10M				50		
		12M				55		
		5M				40		
		11M				70		
		13M				25		
pistol	NO							
AK-12	Yes	100M	107.14	7.559	Yes	1440	1714.28	256.57
		100M				1440		
		110M				1920		
		100M				1920		
		120M				1440		
		110M				1920		
		110M				1920		
AK-47	Yes	120M	136	24.73	Yes	7680	7611.42	431.87
		112M				8160		
		120M				7200		
		130M				7680		
		180M				8160		
		130M				7200		
		160M				7200		

The sound clip on the phone is provided to the TDA2003 Amplifier circuit. The monkey's behavior was studied and information was gathered as shown in Table 4 above in order to the circuit output sounds. The guns selected are raifal, pistol, AK 12 and AK 47. Each gun sounds were checked about seven times and the details are shown in Table 4. Approximately how far monkeys escape from the farm is recorded in a table 4. It is also noted how long it takes for the monkeys to re-enter the plantation.

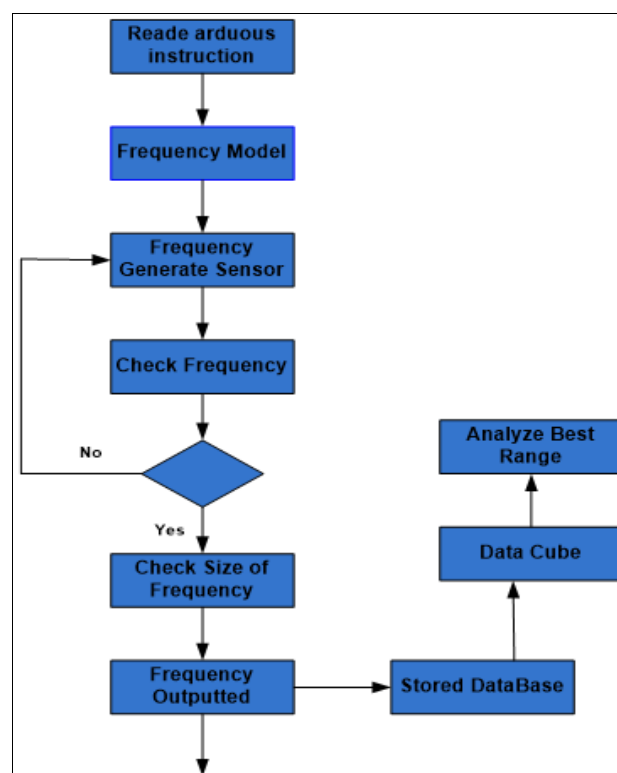
The mean value and standard deviation value of the ape

escaping distances using R Studio software are given in Table 4. The monkeys are frightened by the sounds and leave the field and the time of their return to the field is recorded in Table 4. The mean and standard deviation value for those periods is obtained by R studio and recorded in Table 4.

### 5.) Sampling techniques

Non-probability sampling methods

### 6.) Research design

**Fig 6**

## 7.) Methods of data collection

1. Obtaining information from 50 postgraduate students of the University of Peradeniya through a Google forum.
2. Gathering information from 26 farmers through interviews.
3. Observing the results obtained by the prepared technical equipment and recording those observations.

## 8.) Description of data analysis

The information provided by the Google form is analyzed by a pie chart, leading to conclusions. Analyze the information obtained from the interviews, enter the information into a Microsoft excel sheet, and analyze the data. The same information can be obtained from the pie chart.'

All the information obtained from the test results is tabulated and entered into the Microsoft Excel sheets and then the mean value and standard deviation values of the data are obtained using R Studio software.

## 5. Result & Discussion

### Result One

Shoot using a light gun is one of the best ways to chase away monkeys in society.

### Discussion

According to Table 1, it is possible to chase monkeys with a gun, but it is not a successful method. This can lead to fatal injuries to monkeys or even death to monkeys.

### Result Two

In the monkeys' auditory frequency range, there is no frequency range for monkeys to escape.

### Discussion

According to Table 2, the behavior of monkeys varies between 2400Hz-2800 Hz and 2800 Hz-3200 Hz. But according to Table 3, that change is not enough to drive away the monkeys.

### Result Three

Using the sound of an AK 47 rifle, monkeys can be chased away by emitting 32-ohm horns using the TDA2003 amplifier circuit.

### Discussion

The sound of guns scares monkeys. Rifles, pistols, AK 12, and AK 47 rifles were selected and tested. There is a fear of monkeys at every gunshot. Considering the gunshots separately, how far they have escaped has been studied. Also, a study has been conducted on how long monkeys leave the plantation and return to the plantation.

Here, the information is recorded in Table 4 about the distance the monkeys left the plantation and the time they returned to the plantation during the seven different days, emitting the same gunshots.

Considering Table 4, the mean value of the AK 47 gun sound is higher than the mean value of all other guns sounds mean value. Also, considering Table 4, the standard deviation value for the AK 47 gun sound is higher than the standard deviation value of all other guns.

## 6. Conclusions, Recommendations & Limitations

To repel monkeys, the TDA2003 amplifier circuit can be used by giving an AK 47 sound and emitting a 32-ohm horn.

To use it, the sound clip can be downloaded via <https://www.epidemicsound.com/track/znZR2Mazxr/>. It is not suitable for use in places where the noise is thought to be a hindrance, as it produces a very loud noise. This tool can be used effectively by further development. Once the monkey is identified, the device can be configured to work. YOLOv3 CNN technology can be used for this. Protecting it from water is a must.

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