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Advanced Protection of Farmland from Wild Animals using Raspberry Pi

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Abstract: Today the microprocessor and microcontroller play a vital role in automation of almost all systems. This paper reports the safeguard of farmland from wild animals. The proposed system uses Raspberry Pi controller to identify the animals by producing high frequency pulses. This is possible by producing ultrasonic sound in the frequency that irritates the animals. The experimentation is developed with Passive Infra-Red (PIR) sensor, camera, Raspberry Pi, power amplifier and high frequency ultrasonic speaker. The camera is triggered to take a picture of the animal when the PIR sensor detects the presence of an animal and the animal is identified. The Raspberry Pi is used to produce high frequency pulse related to the identified animal. The pulse produced is not enough to drive the high frequency ultrasonic speaker; as a result the pulses are amplified by power amplifier and fed to the speaker. The proposed system keeps the beasts away from the crops without hurting them and the danger of getting electrocuted can be prevented. The ultrasonic noise is indistinct to individuals and has no impact on humans.

Keywords: Farmland; PIR sensor; Raspberry Pi; power amplifier; high frequency ultrasonic speaker

1. Introduction

A lot of disputes exist in forest peripheral settlements. The majority of the communities that are now next to the forest barrier seemed formerly real forest areas. Since the British invasion of India, large areas of forestry have been chopped down and crop cultivation was promoted in order to increase earnings by means of cultivation and wood-based commodities. As a result, individuals from diverse sections of the corresponding forestry have regions relocated, resulting in the formation fresh communities. Civilian wildlife disputes, surveillance and averting beast infiltration, destruction of crops, deaths of casualties among humans, and confrontation with the forestry authority are the obstacles of the forest perimeter community. Despite the difficulties previously mentioned, the peasant's foremost concern is protecting harvests against wildlife destruction. While protecting to preserve the harvest, a certain amount of harvest is destroyed by regular raids by elephants and other animals therefore they need to request remuneration from the forestry section, yet based on their expertise, the forestry agency usually rejects their assertions. Although they provide reimbursement in certain situations, the sum compensated is little in comparison to the degree of the destruction.

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Driving beasts off fields results with person injuries and, in rare cases, mortality. Humans on barefoot becoming victims of a roaring elephant assault while moving their livestock out of the fields. Despite considerable confrontation involving communities and wildlife, the conservation service and municipality entities are evaluating their proactive measures. The basic method used by farmers to prevent this is by erecting fence around the field. These fences are provided with thorns. But this method is ineffective for large animals like elephants. So the farmers started applying electric current to the fence. An elephant, which is a cunning creature, came up with a strategy to get around such challenges by detaching the electrical wire by slicing its enclosure using a large dried woody block. Creatures additionally get killed by fences with electricity. In order to overcome these limitations, in the proposed methodology the ultrasonic sound waves are used to keep the animals at the bay. Ultrasonic sound is the sound waves with frequency above 20,000 Hz. The sounds in this frequency range is inaudible for human but other species have developed extra hearing muscle that aid them in hearing these sounds [3]. The irritating frequency for each animal differs. The raspberry pi controller is used to identify the species and produce the frequency according to the animal and prevent crop damage due to animals [9].

Damarla et. al., (2011) studied the usage of audiable, seismic and ultrasound sensors for human and animal identification [1]. Sundararaman et al., (2014) developed a prototype model in order to develop a caution particularly for dogs by producing ultrasonic sound to safeguard human beings from road accidents [2]. Dua et. al., (2015) introduced a methodology based on video camera to recognize elephants in regions where human beings intrusion are high [4]. Elephant detection using Euclidean and Manhattan distance Methodology was proposed by Sugumar and Jayaparvathy (2014) [5]. Ramesh et. al., (2017) proposed elephant detection using image processing approach [6]. Mustapha et al. (2013) revealed distance measuring using ultrasound and infrared technology towards establishing for a system to identify obstacles for those who are older and those with visual impairments [8]. Christiansen et. al., (2014) discussed a study helps to automatically identify and recognize animals based on novel feature extraction methodology [7]. Balakrishna et. al., and Venkatesh et. at., (2021) carried out their work based on internet of things to safeguard the crop from the animal entry [11], [12].

The first portion of the investigation starts by providing an overview of the existing research. The second subsection provides an overview of the intended experimental mechanism's component diagram. The third portion includes the components that were incorporated in the experimental design. The outcomes are summarized in Part IV. The final part brings it altogether to a close.

2. Contextual Information

The experimental prototype is constructed with the following blocks: Power Source, PIR Sensor, Camera, Raspberry Pi and Ultrasonic high frequency generator as shown in Figure.1 building block diagram.

Power Source: The Raspberry Pi need a power source of 5 V and 2.5 A to operate. The source can be supplied directly from the supply using a 5 V adaptor or it can be applied from a solar panel.

Motion Detector Sensor: The PIR sensor is a piece of electrical equipment that detects radiation generated by items in its field of vision. This is quite frequently used in PIR motion detectors. It is used in this research model for animal detection.

Camera: Camera v2 is the latest authorized webcam unit offered by the Pi Association. Sony IMX219 is a customized RaspberryPi Camera Module added-on board with fixed focus lenses. The camera is used to take pictures of the animal.

Raspberry Pi: It has been created by the Royal Raspberry Pi Foundation in the United Kingdom to promote fundamental education for children in the emerging nations. This is used to identify the species of the animal.

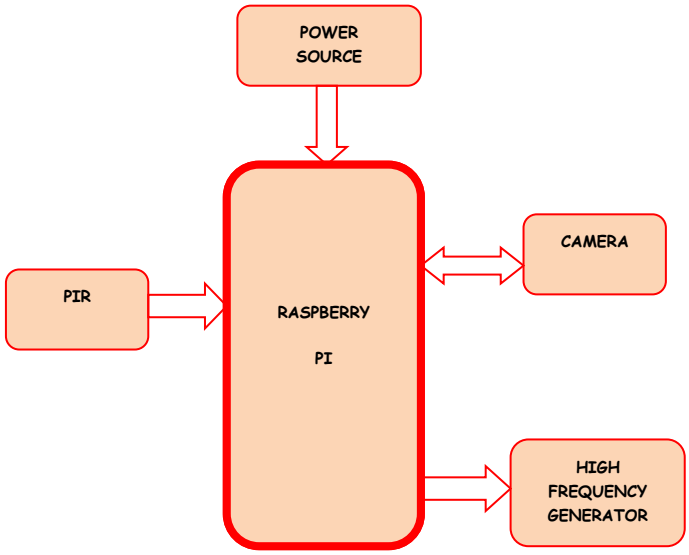

Fig.1 *Block diagram*

3. Experimentation

The proposed prototype model was constructed with the following components as shown in Figure 2.

3.1 PIR Sensor

This sensor measures the light radiations emitted by the items depicted in Figure 3. They are most widely used in motion detectors based on PIR. All artifacts above temperature emit heat in the radiation class. By fact, this radiation is not apparent to the human eye since the radiation is infrared, but it is often used electronically. The human eye cannot see it.

The word "passive" in this case refers to PIR devices not generating or radiating detection power. We entirely detect infrared (radiant heat) radiation from emitted or reflected objects. The sensor head, known as the face of the sensor, is infrared. A sensor or sensor collection of solid state, composed of pyro electric materials (materials producing energy), may be in the center of a PIR sensor when exposed to heat. It is usually produced as part of a microcircuit. These are widely used in burglar alarms and in lighting systems automatically activated. They typically are called simply "PIR" for a "passive infrared detector" or sometimes "PID." When, like an person, an object moves like a wall over the background, the temperature in the

sensor's visual field rises from cold to heat. In the input infrared, the sensor results in a change in the output voltage and activates the detection. The detector may also be activated by artifacts of similar temperature but with different surface characteristic that transfer them to the background.

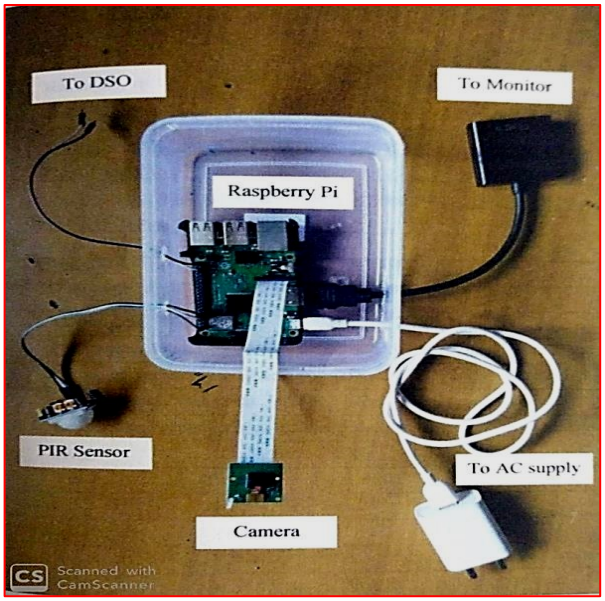

Fig. 2 *Experimental Setup*

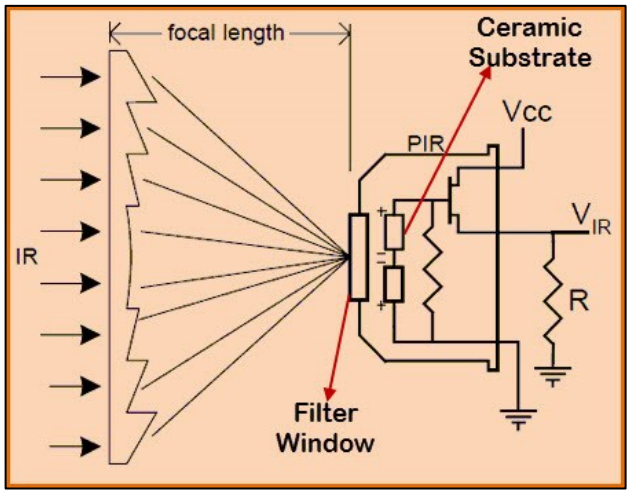

Fig. 3 *Passive Infrared Sensor*

3.2 Camera

Raspberry Pi introduces a numerous camera modules. The first version starts with a 5-pixel module and the improved version with 8-pixel module. This camera module is suitable for taking both high definition video and still images. For newbie's it is easy to use, but it provides experienced users with a lot. Raspberry Pi Camera used in the prototype development is shown in Figure. 4. The previous version employs low-pixel cameras with poor image quality. A 12-pixel module was just released, and it captures high-quality images.

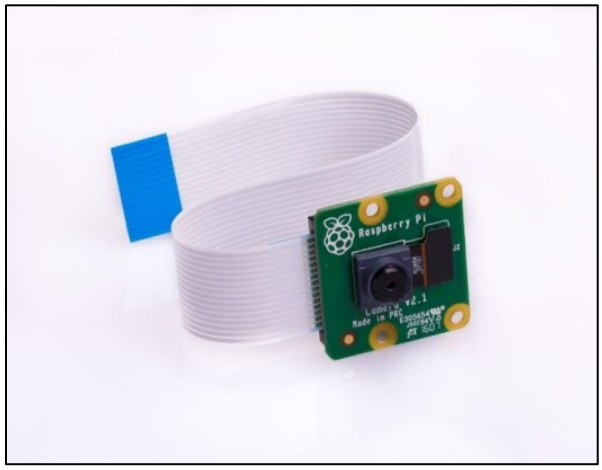

Fig. 4 *Raspberry Pi Camera*

3.3 Raspberry Pi

It [10] is a small computing device that was introduced on February 29, 2012. It incorporates a conventional keyboard as well as a mouse. It can perform every task that a computer on a desktop can do, for example accessing web pages, watching movies in high definition, engaging in video games, and word processing. Most significantly, it will allow individuals to experiment with computing and learn how to programme in languages such as Scratch and Python. The name raspberry pi was created by merging the names raspberry and pi, which relate to the programming language Python. Initially conceived for children, "Brodcom and the University of Cambridge" have since developed numerous advanced versions, and it is now widely utilised in various sectors such as weather monitoring because to its inexpensive cost.

The Raspberry Pi includes Storage and a central processing unit (CPU). A port for USB devices is provided for external connections. An Ethernet connector is provided for connecting to the internet. Power is supplied through a MICRO-USB charger, which is often used for mobile phone charging. It contains an HDMI port, which may be used to connect a monitor.

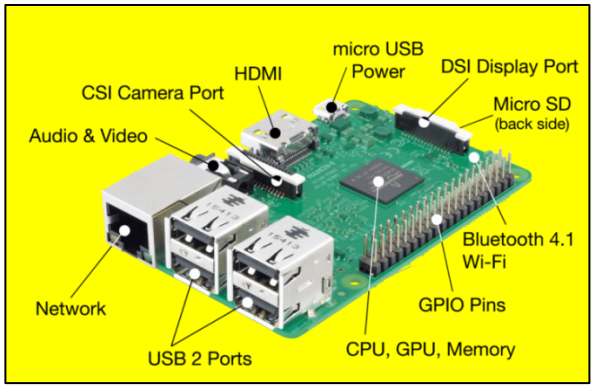

Fig. 5 *Peripherals in Raspberry Pi*

They utilize tiny SD cards as hard drives here. They mostly utilize Linux (including the Raspberry Pi operating system). This is also supported by Windows 10.However, the most common one is raspbian, while Windows 10 is usually utilized for IOT projects. The Raspberry Pi controller used for the proposed prototype model is shown in Figure. 5. People across the world use this device to acquire programming skills, build hardware projects, and conduct home automations, etc. The raspbian operating system may be obtained from the NOOBS download page. It may be downloaded into SD cards and plugged into the SD card slot. External devices such as mice and keyboards linked to a Raspberry Pi running the Raspbian operating system may form a complete computer setup.

4. Experimental Result Analysis

The program is initialized as depicted in Figure. 6 by entering the code pseudo python pir1.py. In the below result, PIR is getting initialized for detecting motion of the animal that enters into the farm land. The camera captures the picture of the detected animal and it compares with the already programmed database to detect the type of animal entering into the farm land.

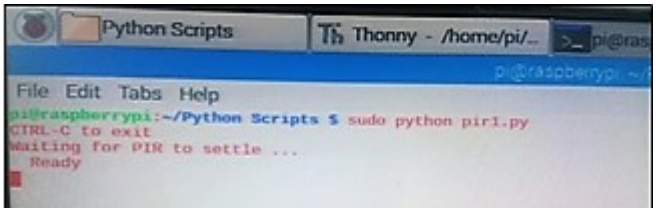

Fig. 6 *Initializing PIR*

Once the program is getting initialized by entering the code pseudo python pir1.py and it continues until the motion is detected. If an animal passes by, the PIR senses the animal and states that motion is detected as shown in Figure.7.

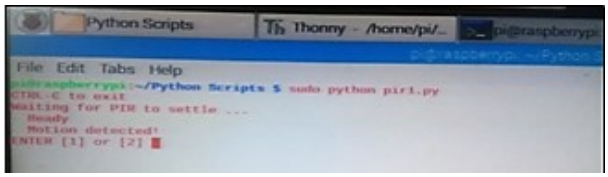

Fig. 7 *Animal Motion Detection*

For experimentation purpose, in the proposed prototype the program is built for two animals: A Elephant and B Horse. Once the motion of the animal is detected, it compares with existing database as shown in Figure 8. If the motion of the picture detected is A then the animal entering the farmland is elephant.

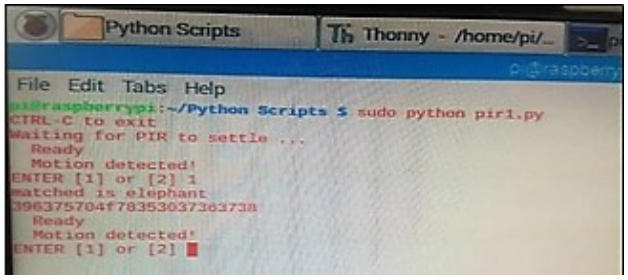

Fig. 8 *Motion detected for Animal A*

If animal A passes the farm land the camera captures the picture of that animal and compares with the pictures that already exist in the database and the sound generator produce high frequency sound related to that animal as shown in Figure 9. The same procedure is continued for animal B that passes the farm land and related high frequency is produced in same manner as depicted in Figure 10 and Figure 11.

Fig. 9 *Frequency generated for Animal A*

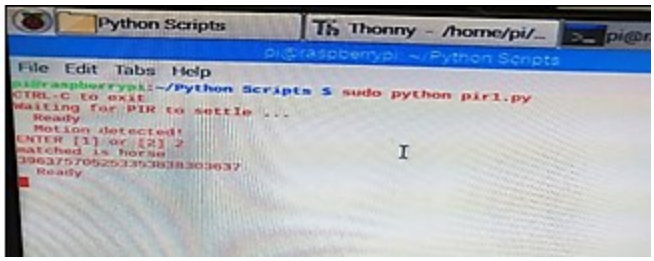

Fig.10 *Motion detected for Animal B*

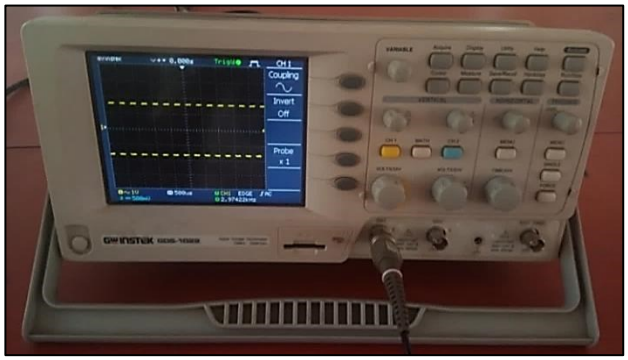

Fig.11 *Frequency generated for Animal B*

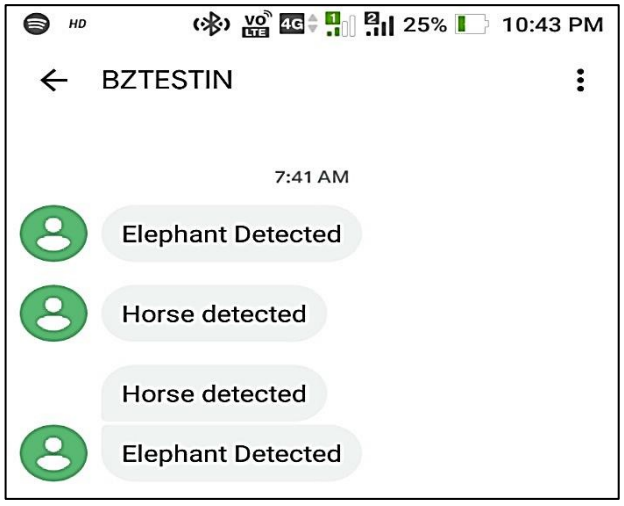

Fig.12 *SMS alert to Receiver*

In addition to the high frequency sound generation, the Raspberry Pi is programmed such a way that the farm land owner receives a message if the animals are detected as shown in Figure 12.

5. Conclusion

The farmland is protected from the animals that come in search of food. The Raspberry Pi is so effective that it does not need any external processors or memory to carry out the complex functions. It helps in identifying the species of the animal, generating the related high frequency signals and sending notification to the owner if any animal detected without the use of GSM module. The proposed system is cost effective, consumes less power, not many components are used hence the overall system is compact. In future the power source for the system can be obtained from solar panel. The overall power consumption of the sonic fence is very much less than the power consumption by electric fencing. The system can be centralized and controlled remotely through internet. Machine learning for animal identification can be achieved with the Raspberry Pi.

References:

1. T.Damarla, A.Mehmood, and J.Sabatier, (2011) *Detection of people and animals using non-imaging sensors*. 14th International Conference on Information Fusion, Chicago, Illinois ,USA.
2. V.Sundararaman, T.G.Vijayalakshmi, S.Venkatadri, (2014) *Ultrasonic sensor animal safety system*. International Conference on Recent Advances and Innovations in Engineering, 9-11 May 2014, Jaipur, India.
3. Ikuo Ihara, *Ultrasonic Sensing: Fundamentals and Its Applications to Non-destructive Evaluation*. Nagaoka University of Technology.
4. I.Dua, P.Shukla, A.Mittal, (2015) *A vision based human - elephant collision detection system.* 2015 Third International Conference on Image Information Processing (ICIIP), 21-24 Dec. 2015, Waknaghat, India.
5. S.J.Sugumar, and R.Jayaparvathy, (2014) *An Improved Real Time Image Detection System for Elephant Intrusion along the Forest Border Areas*. The Scientific World Journal, Vol. 2014, pp. 1-10, 2014.
6. G.Ramesh, M.Senthil Kumar, P.Sini Raj, V.Krishnamoorthy, and R.Gowtham, (2017) *An Automated Vision-based Method to Detect Elephants for Mitigation of Human-elephant Conflicts.* 2017 International Conference on Advances in Computing, Communications and Informatics (ICACCI), 2017.
7. P.Christiansen, K.A.Steen, R.N.Jorgensen, and H.Karstoft, (2014) *Automated Detection and Recognition of Wildlife Using Thermal Cameras.* Sensors, Vol. 14, pp. 13778-13793, 2014.
8. B.Mustapha, A.Zayegh, and R.K.Begg, (2013) *Ultrasonic and Infrared Sensors Performance in a Wireless Obstacle Detection System.* 2013 First

International Conference on Artificial Intelligence, Modelling & Simulation, pp. 439 – 444.

9. Popat, Param & Sheth, Prasham & Jain, Swati. (2019), *Animal/Object Identification Using Deep Learning on Raspberry Pi:* Proceedings of ICTIS 2018, Volume 1. 10.1007/978-981-13-1742-2_31.
10. P.Mariaraja, T.Manigandan, S.Arun, R.M.Sundaram, and K.Dhenesh, (2020) Design and Implementation of Advanced Automatic Driving System using Raspberry Pi. 2020 5th International Conference on Communication and Electronics Systems (ICCES), India, 2020, pp. 1362-1367,doi: 10.1109/ICCES48766.2020.9138082.
11. K Balakrishna, Fazil Mohammed, C.R. Ullas, C.M. Hema, and S.K. Sonakshi, (2021) *Application of IOT and machine learning in crop protection against animal intrusion*, Global Transitions Proceedings, Vol. 2, No. 2, 2021, Pages 169-174.
12. G. Venkatesh, G. Sai Suman, V. Sai Nikhilesh and S. Khaleel Ahmed, (2021) *Prevention of Animal attacks on farms with IOT System.* 2021 2nd International Conference on Smart Electronics and Communication (ICOSEC), India, 2021, pp. 1-6, doi: 10.1109/ICOSEC51865.2021.9591695.

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