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IOT Influenced Automatic Elephant Repelling System for Enhancing Safety of Public and Plantations

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Abstract

Majority of the forest areas are getting destroyed, due to human population explosion and deforestation thereby causing Human- Animal Conflict. This has also resulted in tremendous agricultural losses. The proposed will be focusing mainly upon elephants rather than other animals in the wilderness. Currently Elephant identification are being done using CCTV, LVDT, etc. But these methods are very expensive and less accurate. The work in hand is an automated system for the identification of wild elephants and repel them back into their forest. The sensors are placed in two layers so as to track the presence of animals with greater accuracy. The first primary layer senses the movement of the animal in the vicinity. This is aided by InfraRed sensors/PIR sensors/ Sharp IR sensors. The next layer senses and confirms the vibrations of the elephant with the help of piezoelectric vibration sensor/seismic sensors and also helps in repelling the wild elephants back into the forest. As soon as the second layer confirms the intrusion of wild elephants, it sends alert signals to the base station using a GSM Module thereby alerting the concerned authorities to take necessary actions*.* © 2020VDGOOD Professional Association. All rights reserved

Keywords: InfraRed sensors; Piezoelectric sensor; Arduino microcontroller; Layering; Repellant systems;

1. Introduction

In India , a survey reports that farmers suffer crop losses about 10,000 to 30,000 each year. Elephants by nature roam from one area to the other in search of food , water or even shelter. In some instances their presence may be a beneficiary one , yet there are times where its presence may be destructive and undesirable. Various types of ideas and methods are presently being used to protect human habitation. But the sad fact is the resulting discouragement of animals. This problem is becoming an important wildlife management issue. When the demands of growing human populations overlap with established wildlife territory, there is a reduction of resources. This thereby leads to human-animal conflict. As a result, people start losing their crops, livestock, property, and sometimes their lives. In most cases Human-animal conflicts are dealt in a wrong way by

the humans further leading to **extinction**. To prevent all these unfortunate happenings, we have proposed an automated system which senses the presence of an animal (Elephant) and sends out sounds to scare them. In our model we have used two layers of sensing and sound repelling so that if it escapes the first it gets diverted by the next strong layer. Also a warning system to inform the human populations about the chance of the animal to harm them is set up.

2. Literature Survey

The datasets used here are from a national news source (The Times Of India).Last year, in Vellore district of Tamilnadu herd of seven wild elephants that strayed into Chinnavarigam and surroundings near Ambur in Tamilnadu destroyed harvested paddy crop and banana plants in the early hours of Tuesday.Villagers, panicked over recent elephant attacks, demanded that the forest department drive away the wild jumbos back into the forest. Officials attached to the forest department said that usually wild elephants from neighbouring Andhra Pradesh raid the crops during the sugarcane and paddy harvesting season of December and January in villages surrounding Pernambut. But, for the first time the elephants raided the agricultural lands surrounding Ambur. The seven wild elephants, which strayed into Vengamoolai, destroyed paddy crop of a farmer named Murali. Later, the herd raided the tomato and banana farms of a villager named Dinesh and finally damaged the coconut farm of another villager, Krishnan. On information, Ambur MLA A C Vilwanathan visited the villages and directed revenue and forest officials to step up measures to disburse appropriate compensation to the farmers for their loss and to chase away the elephants.

Ambur divisional forest officer Murugan said, "A team of forest personnel has been posted to safely chase the elephants back into the forest. They are now hiding in an unidentified. Similarly, there are 10000-30000 crop losses due to wild elephant intrusion being reported each year.

3. Existing Approaches

3.1. Differentiate between Human and Animal by detecting their motion.

It is a very simple method in which several Infrared sensors are placed near the origin of destruction or near a place where the existence of wild elephants is imminent. The sensors are fixed into a tower. This system can only detect an intrusion and cannot take any automatic action. The main objective of their invention is to monitor the area and find any kind of intrusion into that area.In addition, if you closely look at its output, we can clearly see that it can't differentiate the obstacle that is detected. i.e, it does not confirm the intrusion of an elephant, neither does it confirm the identity of any kind of species that's intruding, because its only capable of detecting an obstacle and not confirming it. Another disadvantage is that the output must be monitored continuously by a human else its considered inefficient because detecting an intrusion without taking any necessary actions is purely useless. Hence this system is not feasible at its best.

3.2. Using GPS Device

In this method, it's proposed to fix a GPS device upon the leader of wild elephants that's causing the destruction and the signals generated by the gps device are monitored continuously monitored in a base station. Whenever the leader crosses the border, its expected to generate an alert message. The biggest flaw that we see here is the assumption, i.e, the leader elephant is assumed to lead a pack of elephants into the proposed border, which has a high error rate in reality, because in real life, there are high chances that the elephants may split themselves up and carry on with their massacre. Another disadvantage is that, finding the leader of the elephants is a very tiresome process. Hence we find this method,

3.3. Bee Hives along the Border

Its one of the earliest methods, in which bee hives are set up along the borders where the wild elephants are expected to attack which leaves the elephants

with no choice but to leave the area due to fear of getting stung as well as the sound of the bees.

4. Proposed System

For a working proof of concept demo, the borders are split into three layers, such that each layer is kept at a particular distance from each other. The proof concept discussed here uses basic sensors for demo purposes, hence it cannot be used for real life purposes as its not completely efficient, for which we will have to use better sensors, which shall be discussed in detail as we move further into the section. Taking the proof of concept into consideration, the first layer consists of a normal Infrared Sensor which detects and informs the presence of an obstacle. Apart from informing, the infrared sensors also provokes an "elephant repelling sound" on the spot through a buzzer which makes wild elephants to go away from the conserved area. The second layer consists of a piezo electric vibration sensor, which is set to a particular threshold value, such that it produces a repelling sound as well as an alert message to confirm the incoming swarm of wild elephants. The alert message is sent to the base station using a GSM Module. However, in practical life the use of basic IR sensors and piezoelectric vibration sensors are considered to be less feasible, hence we go for better sensors and concentric arrangement of the system. Concentric arrangement helps in reducing the number of sensors used to an extent. Coming to the components used in real life, instead of basic IR sensors, we shall use ROBODO SHARP IR sensors / PIR SENSORS for the outer layer, and we shall replace basic piezoelectric vibration sensors with SEISMIC SENSORS to measure the ground motion when its shaken by a perturbation. Any kind of alert messages shall be dealt using a GSM module, and in addition to elephant repelling sound we can also use certain odours to make the elephant go back into the forest. A study shows that elephants are usually afraid of large sounds and fire, hence we have also planned to create such a system which creates human like environment, so as to make the elephant believe that a particular sound is created by a human.

5. Components Used

"Proof Of Concept or Proof Of Principle is a prototype which is not intended to deliver market demands rather it tests whether the idea is viable and gives the opportunity to be explored and developed."

5.1. Infrared Sensors

Infrared Sensors are also known as IR Sensors. Its basically used to sense the characteristics of its surroundings. It has a transmitter part which transmits the IR radiation. Upon hitting an object the IR radiation is sent back to the receiver, whose presence is known by a buzzer beep, which is interfaced with the IR sensor.

5.2. Piezoelectric Vibration Sensor

Piezoelectric Vibration Sensor is used to confirm the presence of the proposed obstacle i.e ELEPHANTS. So when it exceeds a particular threshold, it confirms the obstacle's presence using a buzzer beep which is as well interfaced with the sensor. Basically piezoelectric materials responds to strain or applied force by generating a measurable output voltage.

5.3. GSM module (Global System for Mobile Commuications)

A GSM module is also known as a GPRS module helps in establishing a connection between a mobile device and a GSM system.

6. Proposed Components (in real life)

6.1. PIR sensor

Normal IR sensors sends the radiation in a Linear manner. But a PIR sensor, senses anything that is around it within a range of 10m from the sensor. The average range is between 5m and 12m. They are made up of Pyro Electric Sensors, which detect levels of Infrared radiation.

6.2. Seismic Sensors

A seismic sensor is used to measure the ground motion when it is disturbed/shaken by a perturbation. Since elephants are large obstacles, their arrival shall definitely produce large amounts of ground motion hence, it can be easily detected.

6.3. GSM module

Even in real time the GSM module helps communicating and sending alert messages regarding the danger to the conserved ones. The above components play an important role in our project. Apart from these components we require CCTV/Thermal Cameras, Mini Speakers, Micro SD Card Module, USB Micro SD Card Reader, Jumper Wires, Breadboard and other obvious components. Our entire project is controlled by an Arduino Uno R3 which shall be replaced by a Raspbery PI in the near future.

7. Repellent System Through Sound

Ultrasonic sounds are loud nerve-crushing sounds which directly penetrates into the brain and nervous system of the Elephant and causes pain and discomfort in them. Hearing this, they start repelling from the conserved areas as it is hard for them to stay there. These sound alarms are externally connected to our Arduino microcontroller. Apart from ultrasonic sounds, Elephants are scared of tiger and honey bees buzzing sound as well.

7.1. Through Odour

Elephants do not like the smell of lemon, Honeybee pheromones and Chillies, Which can be easily interfaced using a sprinkler and a pump with our Arduino microcontroller.

7.2. Through Light Signals

Elephants are allergic to light signals. That too if the flickering light is accompanied with sound buzzers, the Elephant feels more abnormal and repels back from the source signals.
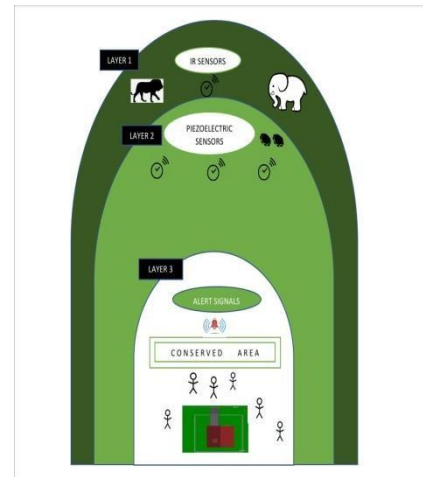

Fig. 1:Simulated Environment of Animal Attack

8. Simulation and Result

When an Elephant starts approaching the conserved area, it reaches the first layer with InfraRed sensors, then the transmitter gets disturbed and sends back signals to the receiver and automates a frightening noise. Information regarding the presence of an obstacle is also sent. Although the IR sensors are sharp enough to capture the Elephant's presence there is a chance of a miss. If that is the case, the elephant moves forward. Once when it reaches the next layer containing vibration sensors, the seismic vibrations are recorded and gives confirmation alerts of the presence of an elephant to the people living there. This is aided by the use of GSM module. Along with this is a very loud ultrasonic warning system.
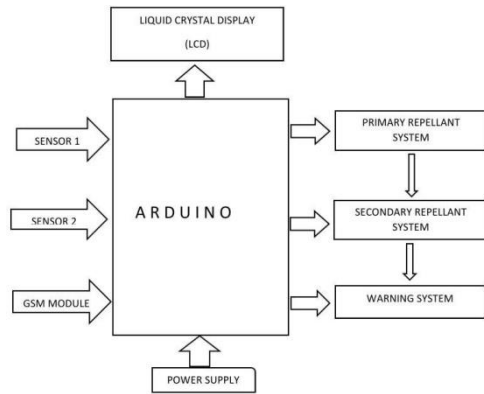
Fig 2: Proof of concept block diagram

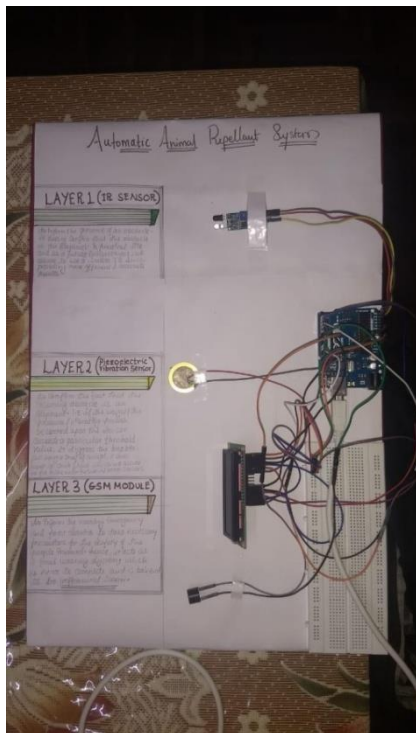The intrusion of wild elephants into the conserved area was detected successfully.

Fig 4:Proof of Implementation

9. Advantages

There will be no need for human surveillance as the system is fully automated. The system doesn't harm the Elephant, It only repels them back.

Agricultural farms and human lives are avoided from the impending danger. It avoids frequent animal extinction, as some human animal conflicts are dealt in a wrong manner by the humans, hence informing the concerned authorities before hand, helps them to take necessary precautions before any harm is caused to the humans, resources or the elephants.

10. Conclusion and Future enhancement

To reduce the cost of power supply and enhancing them, we would like to replace the direct current with the use of Solar Panels. Though our proof concept may seem to be wired, its predicted to become wireless soon with better funding and proper support.

Although we are currently restricting our views only towards Elephants, we are determined to add more features in the near future and increase our depth of view towards other animals as well, in order to reduce the Human-Animal Conflicts more efficiently in other domains as well.

Fig 3: Proof of concept design

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