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IR Carbide Cannon

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ABSTRACT: People along forest-side villages in Kerala always have the fear about the wild animals destroying their property and farms. Also they pose a threat to the people. An alarming system is really essential in order to divert these devastators. But the current solutions are of high cost or of potential danger to living things. In this paper we propose a novel system, IR Carbide Cannon, which is cost effective and possesses any threat to living things. The system is powered by calcium carbide and it fires a loud boom of sound on excitation of water by a spark. Calcium carbide and water are the fuel for the cannon. Both are easy to obtain and would do the job without flaws. We incorporate sensors and actuators for the automated working of the system.

KEYWORDS: Human wild conflict, Alarm systems, PIR Sensors

I. INTRODUCTION

People are taking on over forest and conquering the natural habitat of animals. Deforestation is a cause for animals entering human's natural habitat. Therefore human versus wild animal conflict is increasing nowadays. The causative for this cannot be undone easily as humans always are and is experiencing new technology and expanding his territory.

Kerala is a vast land of several diversities converging civilised areas and forests together. The main food source of Kerala is it's own agriculture. People who are living with the traditional agricultural systems have a lot of competitions including climatic changes and pests. And above that, they always have the fear about the wild animals destroying their property and farms[1]. This list longs with elephants, gaur, sambar, wild boar, bonnet macaque, common langur, blacknaped hare, peafowl, monkeys, and wild boars on the top of the list that give sleepless nights to those living and farming in the forest fringes. Birds and insects like locusts are engaged in a pitched battle with humans, though at a lesser degree. The growing presence and invasion of wildlife is creating more problems for farmers, already burdened by poor living conditions and the crisis of the agricultural sector. Meanwhile, the number of people killed in wild animal attacks is on the increase. In the past 10 years, nearly a thousand people in Kerala have lost their lives in such incidents[2]. It is a sad reality that the loss of human life in wild animal attacks gets much less attention from the media and the public than an injured wild animal. A remedy is really essential in order to divert these devastators. But the solution also was too high-end. It would cost money and the lives of animals. It is hard to solve this issue without harming any being.

The forests in Kerala are highly fragmented due to settlements and agriculture. Crop damage by wild animals in agricultural fields, adjoining the forest areas is very heavy. This is mainly due to the straying of wild animals such as wild boar, elephant, Indian porcupine and deer from the forest to the homesteads and plantations. Consequent to this, conflict between wild animals and farmers in the fringe areas of the forests and protected areas are increasing. At present Kerala has 24% of the forests as protected area [2]. Wild animals in these tracts are protected against poaching. Census figures show that, majority of these animals are increasing in number over the years (KFRI, 1993). Especially the population of sambar, wild boar, Indian porcupine and elephant are growing. In addition to this past activities like, large scale conversion of forests into monoculture plantations of teak and eucalyptus, shifting cultivation, hydro-electric projects and organised encroachments reduced the available habitat of wild animals in Kerala[2]. This scenario is leading to man - wildlife conflict in many places.

This paper focuses on diverting the animals in one hand and tending them back to the forest without harm on the other hand. IR Carbide Cannon makes a blast loud enough to give the animals high alert and on their fear, they retreat instead of continuing their way forward.

II. PROBLEM DEFINITION

Human versus animal conflict is increasing day by day as the animals wander around civilised land and eat the crops which are cultivated under human effort. The humans always have to make their cultivation safe as once wild animals like elephants or wild boars enter their field, it would be devastation. If animals run out of food, they gradually leave the forests and start grazing on civilised land. Therefore this leads to resistance against wild animals. There is just a need to divert the animals from entering the fields but most people facing this issue directly go for easier options even if it is harmful to the animals.

Fortyfive species of crops are being destroyed by wild animals in Kerala and major among them are paddy, coconut palm, plantains, cassava, arecanut, coffee, oil palm, pepper, jackfruit, mulberry and mango. It is hard and expensive to cover all the cultivable land in order to prevent animals that are attacking from one side of the land. Due to the vast area of cultivation land people can't reach all the boundaries. So an attack from the animals cannot be detected easily. This leads to the loss in cultivation. As for Kerala, animal attack occurs more in places near the forests.

The growing presence and invasion of wildlife is creating more problems for farmers, already burdened by poor living conditions and the crisis of the agricultural sector. In hilly areas, almost everything farmers grow is destroyed by wild boars, elephants and monkeys. Even when harvests are ready, they can be destroyed overnight, whilst government agencies and departments remain silent. There is no one to look into the plight of farming families whose only income comes from the land. Often farmers have to spend more than the meagre compensation they get, which, far too often, is obtained after tedious procedures. Meanwhile, the number of people killed in wild animal attacks is on the increase.

In the past 10 years, nearly a thousand people in Kerala have lost their lives in such incidents. Therefore, the need for resisting also is increasing day by day.

III. EXISTING SOLUTIONS

Cages are used as traps for animals destroying crops. Cages are effective traps but it won't be reliable for animals when they come in herds. It can't be set for every animal coming together. Cages are usually built with steel rods, so as the animal size increases, cages can't be easily built as per requirements. Also, it's a one-off and needs to be reset before the next go [1].

Electric fences are the next possible solution. High voltage is charged in each wire of the fence. This is a classic method used in most of the secured compounds, the fences also have a hazard sign board in every two metres or less to alert the bystander. Anyone who fails to notice or understand the caution board ends up in contacting the wires without knowing the risk. This system mainly focuses on keeping unauthorised personnel away [2].

But, in the case of animals, they aren't aware of this danger and come closer to the fence in search of food and have to face the shock from the fence. This is not just the case of animals, this can be deadly to anyone who approaches without knowing the risk, therefore application of electric fences can't be promoted everywhere as there are places where there will be human contact on the fence.

The next comes firecrackers. This method is seen in cultivation within the forest mainly done by tribal communities. It is very less seen in urbanised areas. Commercial dynamite or, more commonly, homemade bombs constructed with layers of powdered potassium nitrate and pebbles or an ammonium nitrate and kerosene mixture are often employed to make crackers. These crackers are thrown at birds and animals when they are seen in the compound. Another method is to embed firecrackers in food, mainly fruits or crops which attracts the animals that cause trouble. But, this has a lot of negative effects too. This method leaves the animal in pain even causing death. The Elephant tragedy in Palakkad which happened earlier in July 2020 had shaken the media all over the nation which led to a public outrage is a similar case.

The elephant which had entered the civilised area, in search of food, accidentally ate a pineapple embedded with explosives that was kept as a bait to eliminate wild boars that were attacking the crops. Even if it is the elephant or boars, this remedy can cause an injury and may lead to death as in similar cases. Therefore we have forwarded an effective solution for this scenario.

IV. PROPOSED SYSTEM

IR Carbide Cannon works purely with old school chemistry lessons powered by complex mechanical structure. The weapon uses calcium carbide as the primary fuel. In the main chamber, the carbide reacts with water in order to form acetylene gas. This gas is passed to another chamber with a larger mouth opening. The gas then mixes with oxygen and creates the highlight of the whole reaction. A large sound enough to alert every creature between a radius of about 300m and thus threatening the animals to retract from going forward[4].

The sound of the reaction can be adjusted in the fuel used. The weapon is triggered automatically by setting an infrared based heat sensing unit for recognising the presence of the animal. The size of the animal can be determined by IR sensing[1][3].

Market Analysis:

IR Carbide Cannon can cause a whirl in the market. Equipment which produces warnings are too costly and hard to find at cheap rates whereas this cannon is not costly and the parts are cheap and easy to obtain. Moreover carbide cannons are still green to hit the markets.

From our customer interaction, we learned the following:

- People close to animal threat areas are in need of this alarming technique.
- Less maintenance means less expenses which could help the market relevance of the product.

V. HARDWARE

Arduino UNO

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Relay

A relay is an electrically operated device. It has a control system and (also called input circuit or input contactor) and controlled system (also called output circuit or output contactor). It is frequently used in automatic control circuits. To put it simply, it is an automatic switch to controlling a high-current circuit with a low-current signal.

The advantages of a relay lie in its lower inertia of the moving, stability, long-term reliability and small volume. It is widely adopted in devices of power protection, automation technology, sport, remote control, reconnaissance and communication, as well as in devices of electromechanics and power electronics. Generally speaking, a relay contains an induction part which can reflect input variables like current, voltage, power, resistance, frequency, temperature, pressure, speed and light etc. It also contains an actuator module (output) which can energize or de-energize the connection of controlled circuits. There is an intermediary part between input part and output part that is used to coupling and isolate input current, as well as actuate the output. When the rated value of input (voltage, current and temperature etc.) is above the critical value, the controlled output circuit of relay will be energized or de-energized.

Water Pump

Water Pump is a common type of pump that can be found at home, in fields, on farms and other places. They are exclusively used for displacing water. Water pumps run on different sources of power. There are solar water pumps, electric water pumps, and engine water pumps.

- Dc voltage: 3 - 6V
- No load rated current: 0.05A or less
- Flow Rate: 70 - 120L / h
- Noise: 40dB MAX (background noise 35dB, 0.5M or less)
- Load rated current: 0.18A

Arduino Mega 2560

Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

Boost Step-up Power Module High-Voltage Generator

This high-voltage generator module is based on the principle of Tesla coil. This small high efficiency module can release high-voltage pulse output with simple external circuit power supply. Pulse current, voltage: Input dc 3.6-6v, output dc 400kv - 600kv. The bipolar discharge distance is 10mm-20mm / 0.4-0.8 inch, output voltage lines length is about 100mm / 3.9 inch. A small production with high-pressure science inverter transformer / booster finished module for high school science experiments, electronic equipment, negative ion generator, high voltage source to use when making small science.

IP68 Box

IP68 Junction Box or protection cases are sealed boxes used for the protection of microcontrollers and other electronic components. It can withstand any weather condition and also this enclosure's protection allows the equipment to be immersed in one metre of water without ingress for 7 days.

General Purpose PCB

Printed circuit Board commonly abbreviated as PCB is the base (literally) of electronics. The PCB provides support as well as electrically connects various Electronic Components in the circuit.

For testing or for mounting your components you can either design and manufacture a custom PCB or else you can mount it on a zero PCB and accordingly make the connections. General Purpose PCB are perfect if you have not finalized the design or you are making the circuit just once like for a school or college project.

Hyundai Power Bank 20000 mA

Power Bank is used for power supply. It will give 5V DC to the Arduino and also to the Boost Step-up Power Module High-Voltage Generator. It is rechargeable, and also has more efficiency than common secondary cells. The battery is lithium-polymer.

PIR Sensor HC-SR501

The PIR sensor stands for Passive Infrared sensor. It is a low cost sensor which can detect the presence of Human beings or animals. This sensor has three output pins Vcc, Output and Ground as shown in the pin diagram above. Since the output pin is 3.3V TTL logic it can be used with any platforms like Arduino, Raspberry, PIC, ARM, 8051 etc..

The module can be powered from voltage 4.5V to 20V but typically 5V is used. Once the module is powered, allow the module to calibrate itself for a few minutes, 2 minutes is a well settled time. Then observe the output on the output pin. Before we analyse the output we need to know that there are two operating modes in this sensor such as Repeatable(H) and Non- Repeatable(L) and mode. The Repeatable mode is the default mode. The output of the sensor

can be set by shorting any two pins on the left of the module as shown below. You can also notice two orange colour potentiometers that can be used to set the sensitivity and time which will be explained further below.

VI. SOFTWARE

Arduino IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.

Tinkercad

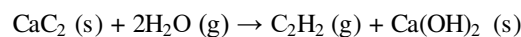
Tinkercad is a free, online 3D and circuit modeling program that runs in a web browser, known for its simplicity and ease of use. Since it became available in 2011 it has become a popular platform for creating models for 3D printing as well as an entry-level introduction to constructive solid geometry in schools. Basic circuit designing also is it's notable feature. It can run simulations based on Arduino Uno boards with relevant components.

Easy EDA

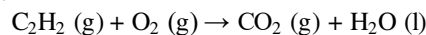
EasyEDA is a web-based EDA tool suite that enables hardware engineers to design, simulate, share - publicly and privately - and discuss schematics, simulations and printed circuit boards. ... Registered users can download Gerber files from the tool free of charge; but for a fee, EasyEDA offers a PCB fabrication service.

VII. PRINCIPLE

The main reaction going on is conversion of calcium carbide into acetylene which is the fuel of the device. Raw piece of calcium carbide is placed in the bottom of the body. When acetylene is to be needed, water is pumped to calcium carbide.



After the reaction, acetylene gas and calcium hydroxide is obtained. Calcium hydroxide drains out of the body. As acetylene gas is lighter than air, it reaches the top of the body waiting to be ignited. The spark plug then ignites the acetylene to lead to the following result:



The above reaction is the highlight of the idea which causes a blast without fire. The sound can be adjusted by controlling the amount of water pumped.

VIII. BLOCK DIAGRAM AND CIRCUIT DIAGRAM

Arduino Uno R3 is the microcontroller used in the system. The microcontroller is powered by a 5V power bank. The positive terminals are also linked with the common ports of the relay. All the components are to be grounded from the negative terminal of the Arduino. The PIR sensor (HC-SR501) is connected to the microcontroller, as an input signaling unit. It is powered from the normally-closed terminal of relay R1. The signal pin from the PIR Sensor is connected to the D13 pin on the Arduino board. The input of the water pump is sent from the D12 pin on Arduino to relay R2. When an animal enters the sensor field, the PIR sensor signals the Arduino board to start procedures by turning the water pump on. After specified time of pumping water, Arduino board stops signaling R2 and through D8 pin, the Arduino board charges the coil of relay R1 whose normally-open port is connected to the spark plug via high voltage transformer. The spark is to last for less than 1 second. The same procedure repeats as long as movement is detected in the sensor field.

Above given explanation is based on using a single PIR sensor close to the unit. If there are multiple sensors set up for adding detecting range or accuracy, it can be set up using either wired or wireless connections as per

feasibility. The same method mentioned above can be applied, by connecting sensor signals to the same input pin on the Arduino board.

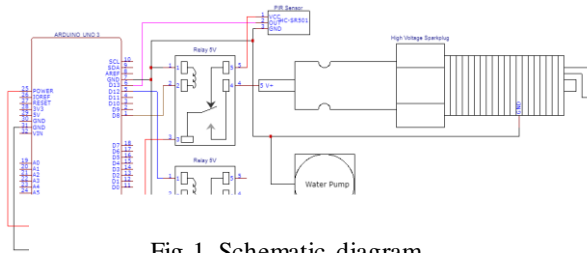


Fig 1. Schematic diagram

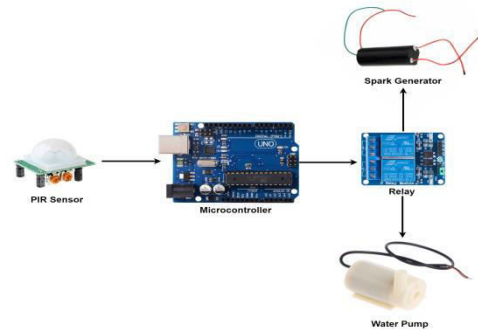


Fig 2. Block Diagram

IX. RESULT

Given below is the data obtained from trials conducted to measure the sound of blast.

Sl. No	Water (ml)	Carbide (g)	Sound (dB)
1.	50	10	130
2.	80	10	130
3.	120	20	180

Table 1. Trial Analysis



Fig 3. Experimental setup for field test

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BIOGRAPHY

Akhil V, Hareesh R, Rahul C P, and Yesudas P Y are 2nd year students from Computer Science & Engineering Dept. who are well aware about the day to day scenario in the agricultural field related to human wild conflicts. The aim for the team formation was to develop innovative ideas into helpful devices in order to reduce the risks and efforts for the worker or anyone in a hazardous environment.

Sebin Sunny P, Assistant Professor, in Electrical and Electronics Engineering Dept. has been motivating students to nourish their skills and abilities for creating innovative products.



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