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WARNING SYSTEM TO PREVENT ELEPHANT INTRUSION

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Abstract —*Intrusion of elephant in forest border in various regions of India and across has been reported as a serious Socio-economic problem the world which poses a grave threat. Every year almost 100-300 humans and 40-50 elephants are killed during crop marauding in India. The system is proposed using embedded systems, MPLAB and PROTEUS software. So, this paper focuses on development of emergency response system to avoid this intrusion with the help of PIR sensors and vibration sensors and proper knowledge of elephant's fears.*

Keywords- *Embedded systems, Elephant intrusion, Crop marauding, PIR and vibration sensors.*

INTRODUCTION

Most areas that form elephant habitats within Asia are close to human settlements. In our densely populated subcontinent, elephants and people have to increasingly share land and resources, leading to frequent and often fatal conflict.

The current solutions for this intrusion can be solved by physically driving away marauding elephants and well maintained barriers and fences to keep out elephants [7]. Both these will be ineffective in long-term, as the former solution involves people getting too close to elephants or directly confronting them while the latter involves a risk that elephant may move towards villages which are less likely protected.

This paper involves proper understanding of elephant, its migration paths and usual crop marauding paths and proper utilization of its fears. Elephant fears for light (flashing lights, fire), heavy noise (Beating drums, bee sound) and tiger's roar. PIR sensor is used to detect the motion of object by emitting infrared radiation. Vibration Sensor is used to measure the ground motion. GSM (Global System for Mobile communication) act as a mobile phone or a modem device and it is used for making audio calls and messages.

This paper is organized as follows: section I. Existing methods, section IIProposed methods, section III Materials and methods, followed by result in section IV and conclusion in section V.

I. EXISTING ELEPHANT WARNING SYSTEM

This part illustrates the present method of detecting an elephant in forest border areas.

1.1Electric Fence Intrusion Alert System (eleAlert)

The electric fences intrusion system is implemented to detect the intrusion of elephant using fences which separate human and wildlife habitats. This method is to improve the effective electric fences to dominant the elephant conflict in many part of the world. Electric fence intrusion alert system uses a network of sensors to detect and locate damages instantly and alert communities under tread via the mobile communications network[7].

The method of detecting an elephant intrusion by eleAlert system is illustrated below:

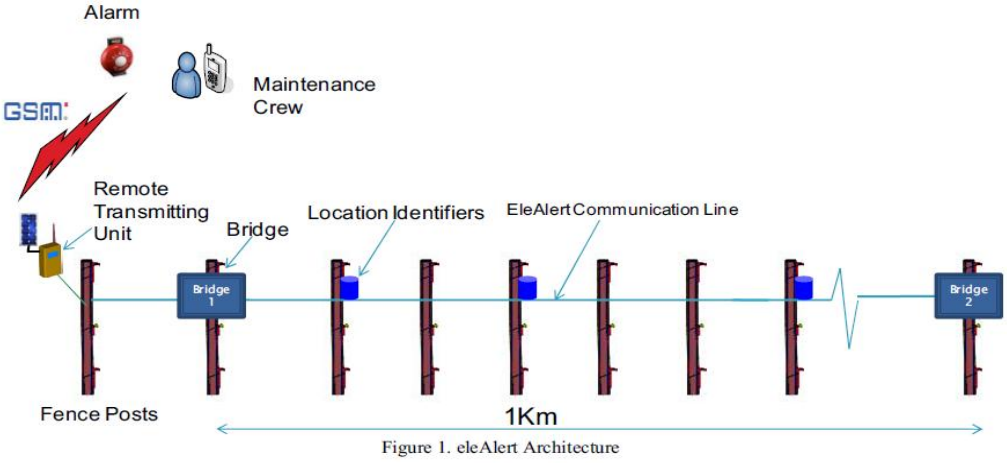


Fig 1. Electric fences intrusion alert system

In this system electric fences are used to detect the elephants but this would be harmful to animal and birds.

1.2 Detecting wild elephants via WSN for early warning system.

The sensor network acts as a virtual boundary around a village and a base station at the village to monitor intrusion. The boundary consists of nodes, placed strategically covering the whole area of the village with sensors attached to it. Each node in the sensor network consists of three main components; digital sensors, PIC microcontroller and its associated circuitry, and wireless communication module. The boundary is build up with Infra-red (IR) sensors and Passive Infra-red (PIR) sensors. The physical parameter and other characteristics of the elephant are considered in the detecting and identifying the elephant from rest of the animals [4]-[5].

The algorithm for detecting elephant through WSN system is shown below:

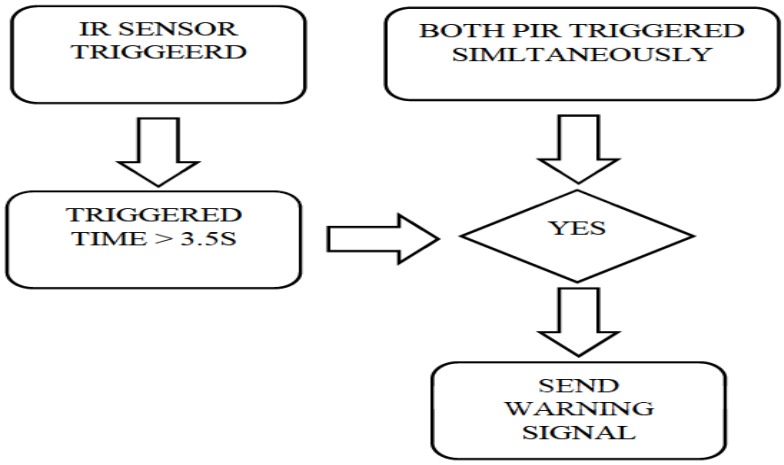
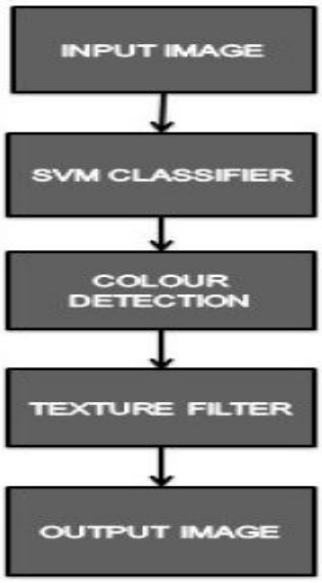


Fig 2 Basic elephant detection algorithm

1.3 An Automated Vision-based Method to Detect Elephants for Mitigation of Human-Elephant Conflicts

The live video input from the camera is converted into a sequence of images. These images are pre-processed to suppress the distortion and noise using filters, thereby enhancing its features. This pre-processing also ensures that the images are processed effectively, irrespective of the varying lighting conditions from which the video is recorded. Pre-processing involves techniques for brightness corrections and grey scale transformations. The pre-processing images is further segmented to identify the region of interest (ROI), which may have elephant or otherwise. The features are extracted from ROI and fed to the classifier to zero-in the identified object is an elephant. The initial data set consists of all frames converted from the video streams. The SVM training is carried out with a set of training images collected from various sources that provides annotated set of images. The trained set of images and test set are fed to the SVM classifier which classifies the images into two classes. Out of the two classes, class two contains the images with the presence of elephants [6]. To emphasize the correctness of the detection of elephants in an image, further each of the images in class two is considered and applied with color and texture features.



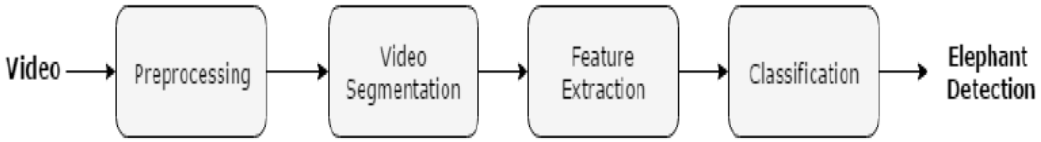


Fig 3 Workflow diagram for vision based method

1.4 Acoustic Detection of Elephant Presence in Noisy Environments

The communication of elephant with one another is by low frequency sound, which can travel several kilometers. The elephants communicate sound is called rumble, which prolong into infrasound band. The rumble is a harmonic sound. It is the fundamental frequency in the range of 15-35Hz in duration between 0.5 and 5s.The acoustic detection of elephants by their call is currently the most promising approach towards an early warning system that is able to detect the presence of elephants in large field areas.

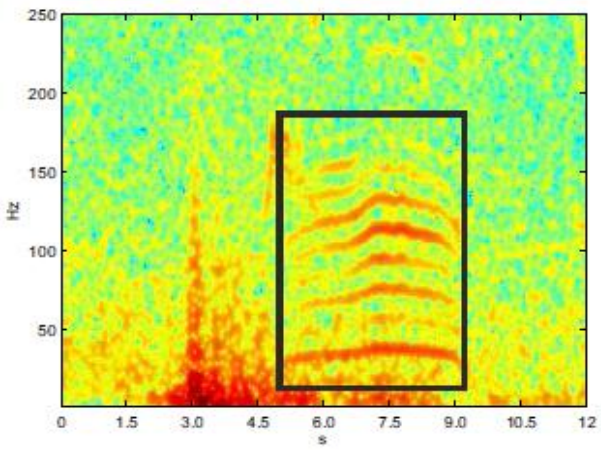


Fig 4A typical elephant rumble signal

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II. PROPOSED SYSTEM

This paper utilizes all these fears accordingly with the distance of the elephant from the human settlements [5]. The block diagram is shown below. As shown in the figure 5, our solution involves three PIR sensors and two vibration sensors.

- ✓ The two vibration sensors have different operating range (say 20m, 15m). When the heavy vibration caused by elephant movement is sensed within 20m, first vibration sensor sends the electrical pulses [2].
- ✓ It is then compared with the threshold value [11]. If the value matches, the powerful flashing lights are activated. This should drive it back to the forest. Due to this, vibration sensors will turn off the flashing light.
- ✓ If it doesn't and if the elephant continues in its path without fearing for the light, vibration sensor 2 gets activated once it is within 15m range and sends the electrical pulses, if it matches with the same threshold value and after some distance, it activate three PIR sensors [3] which in turn activates the sound system which produces bee's sound and with the help of GSM, messages and calls are sent to village representatives and the forest department and alerts them.
- ✓ If the bee sound drives the elephant back into the forest, again the message comprising of that the elephant are not in human settlement area are send to forest department.

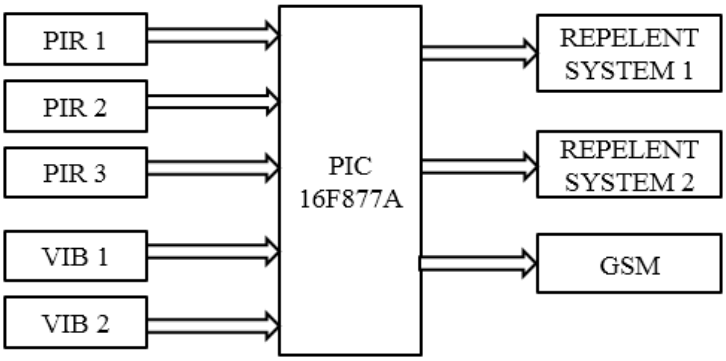

Fig 5 Block diagram for proposed method

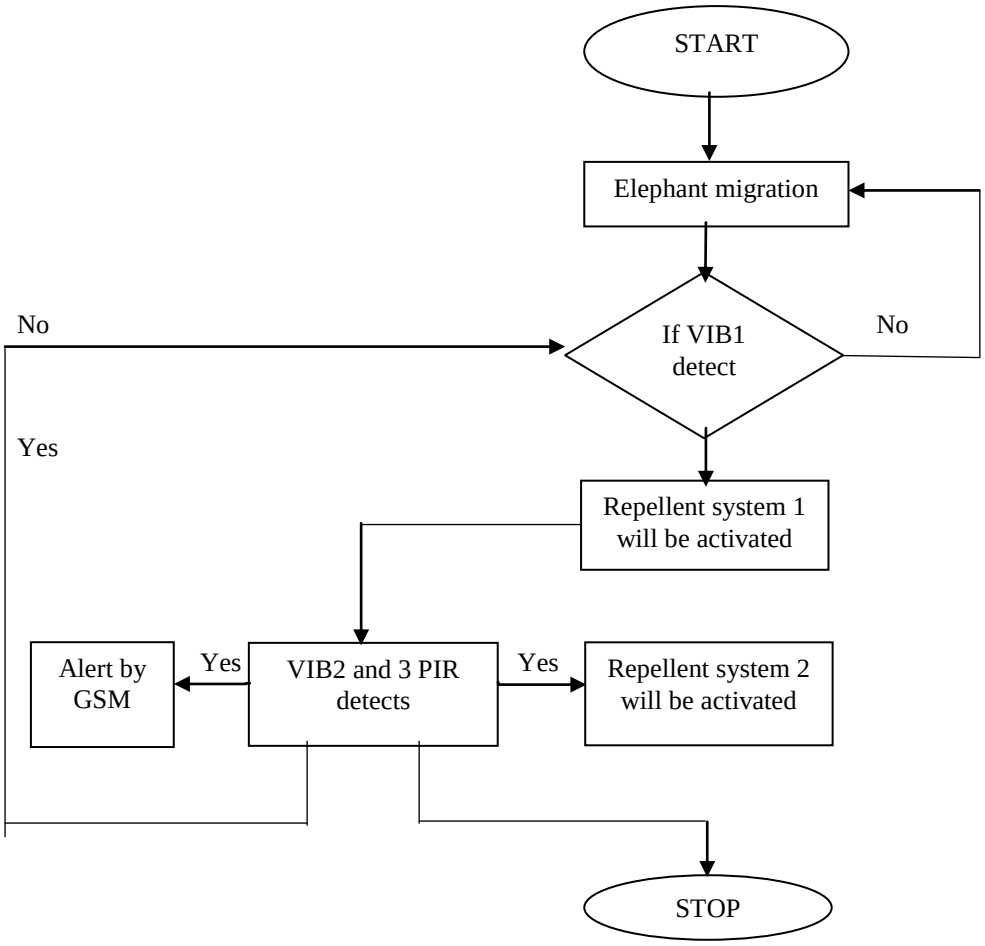

Fig 6 Flow diagram to detect the elephants

III. MATERIALS & METHODS

3.1 PIC Microcontroller

PIC is a family of microcontrollers made by Microchip technology. The acronym PIC stands for"Peripheral Interface Controller" or "Programmable Interface Controller". A typical microcontroller includes a processor, memory and peripherals. This controller is very convenient to use, the coding or programming of this controller is also easier. The main advantage using FLASH memory is that it can be write-erase as many times as possible. It has a total number of 40 pins and there are 33 pins for input and output.

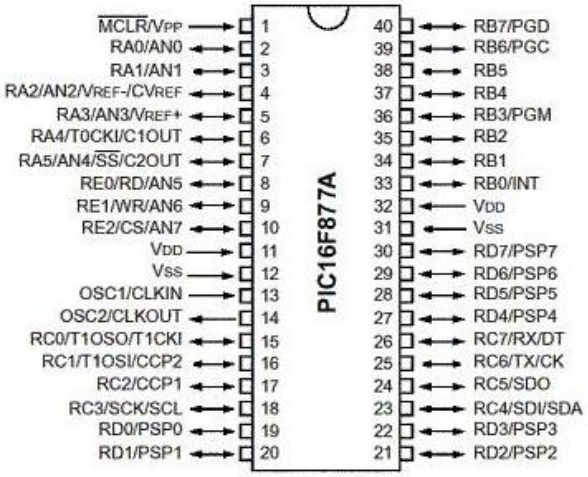

Fig 7 PIC Microcontroller

➢ **Features of PIC 16f877:**

- Flash Memory: 14.3 Kbytes (8192 words)
- Data SRAM: 368 bytes
- Data EEPROM: 256 bytes
- Self-reprogrammable under software control
- In-Circuit Serial Programming via two pins (5V)
- Watchdog Timer with on-chip RC oscillator
- Programmable code protection
- Power-saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug via two pins

3.2 Vibration sensor (SW18020P)

Vibration sensors are used for measuring, displaying, and analyzing linear velocity, displacement and acceleration. The two contacts of sensor are not connected in idle condition. When external force is acted upon either by movement or vibration, the sensor's two contact pin are closed and contact is made between the two pins. When the force is removed the terminals of sensor returns back to the open contacts.

Sensor is made up of a small spring mechanism, which makes the contact ON when the applied vibration force is at above a certain threshold [2]. Vibration sensor has two legs coming out of it. Normally the two terminal are insulated by a resistance value more than 10MOhm. When someone applies vibratory force on the switch, spring inside the switch vibrates and makes a momentary short circuit between the two terminals.

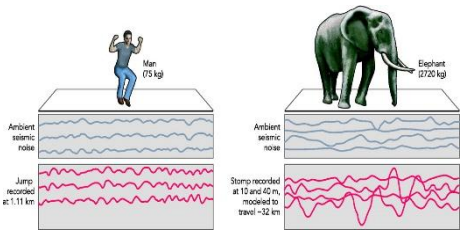

Fig 8 vibration sensor

In this proposed system vibration sensor are fixed by some threshold value which is equal to the ground acceleration that caused by elephant moment. If the value matches the threshold value, then the vibration sensor will detect the elephants from rest of other animals.

3.3 Passive Infrared (PIR) sensor

PIR sensor is used to detect the movement of an object. The detection range of PIR is between 5m and 12m. PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation.PIR sensor has a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and last pin will be power. Power is usually up to 5V. The motion can be detected by checking for a high signal on a single I/O pin.

In this proposed system Passive Infrared (PIR) sensors are used for the purpose of elephant detection in the field. This is a type most commonly encountered in motion sensing.

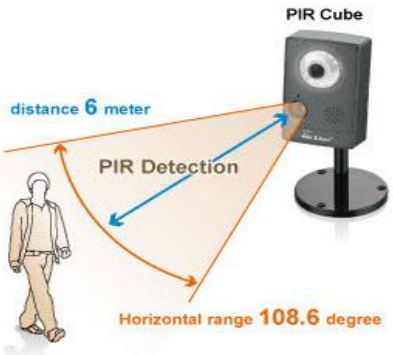

Fig 9 Passive infrared sensor

They are commonly used to detect the humans present in a room and security alarm systems. PIR sensors are used as motion detectors in many applications such as Hospitals, ATM and libraries.

3.4 Channel Voice Recorder and Playback APR33A3

APR33A3 uses 8 channels (M0 to M7) each channel having 1.3 minutes recording length. Supply voltage is 12v AC/DC. For recording, put the jumper in JP1 (REC) section and select the record mode J5 (M0-M7) to record the message. The message will be captured by MIC and recorded, status LED 2 will on in record mode which indicate that chip is currently recording. Once duration is full the LED 2 will off.

Connect the speaker to the J4 speaker section and check the recorded. Remove the jumper from JP1 and connect to ground, status LED 2 will on till the recorded sound play in speaker. In our proposed method, we recorded bees sound to divert the elephant into forest. It act as second repellent system.

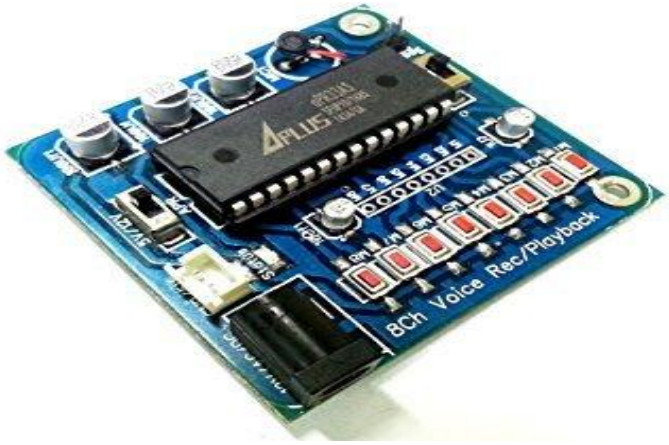

Fig 10 Voice recorder and playback APR33A3

3.4 GSM (Global System for Mobile Communications) SIM 900

The SIM900 is a Quad-band GSM solution in a Surface Mount Technology (SMT) module. It works on the frequency of 900/1800 MHZ. The modem consists of RS232 Interface which is used to connect GSM with the Microcontroller. The baud rate is configured from 9600-115200 through AT command. The GSM Modem consist of internal TCP/IP stack that enable user to connect with internet. It is applicable for SMS, Data and voice transformation in mobile to mobile application. It can be used not only to access the internet, but also for oral communication.

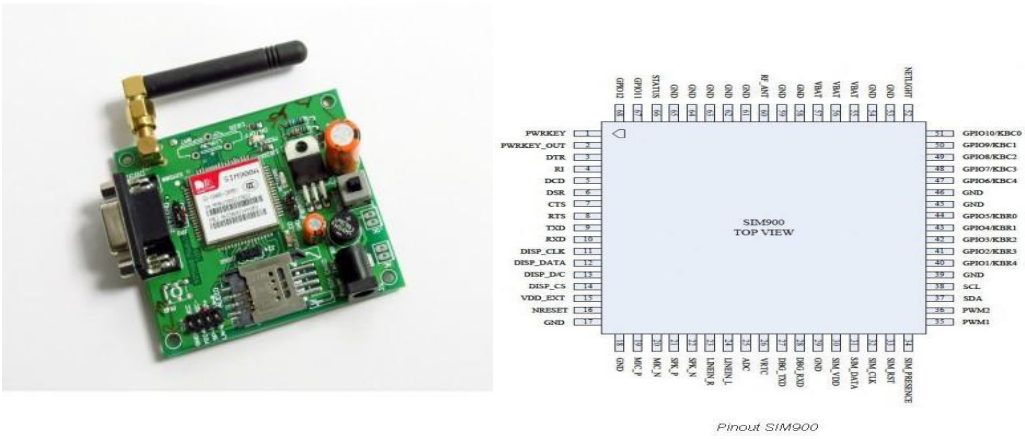

Fig 11 GSM SIM 900

In this proposed system, the GSM will send the alert by intimating a call. After that the message will delivered to forest administrator. Through this alert will pass all the village people who are nearer to the forest areas. By using this forest administrator will take necessary step to safeguard the people from conflicts.

IV. HARDWARE& SOFTWARE RESULT

Hardware and software results showing the detection of elephants and message alert is shown in fig 12 and 13. The vibration sensor detects the ground velocity [12] that caused by elephant movement and sends the electric pulses to repellent system. The three PIR sensors measures the height and width of elephant and send its signal to controller. The PIC controller after acquiring the signal from PIR and vibration sensor, it sends a message to GSM module to send the alert to forest authority. The alert will send by call and text message. Without any human interruption this system get activate automatically and divert the elephant back to forest.

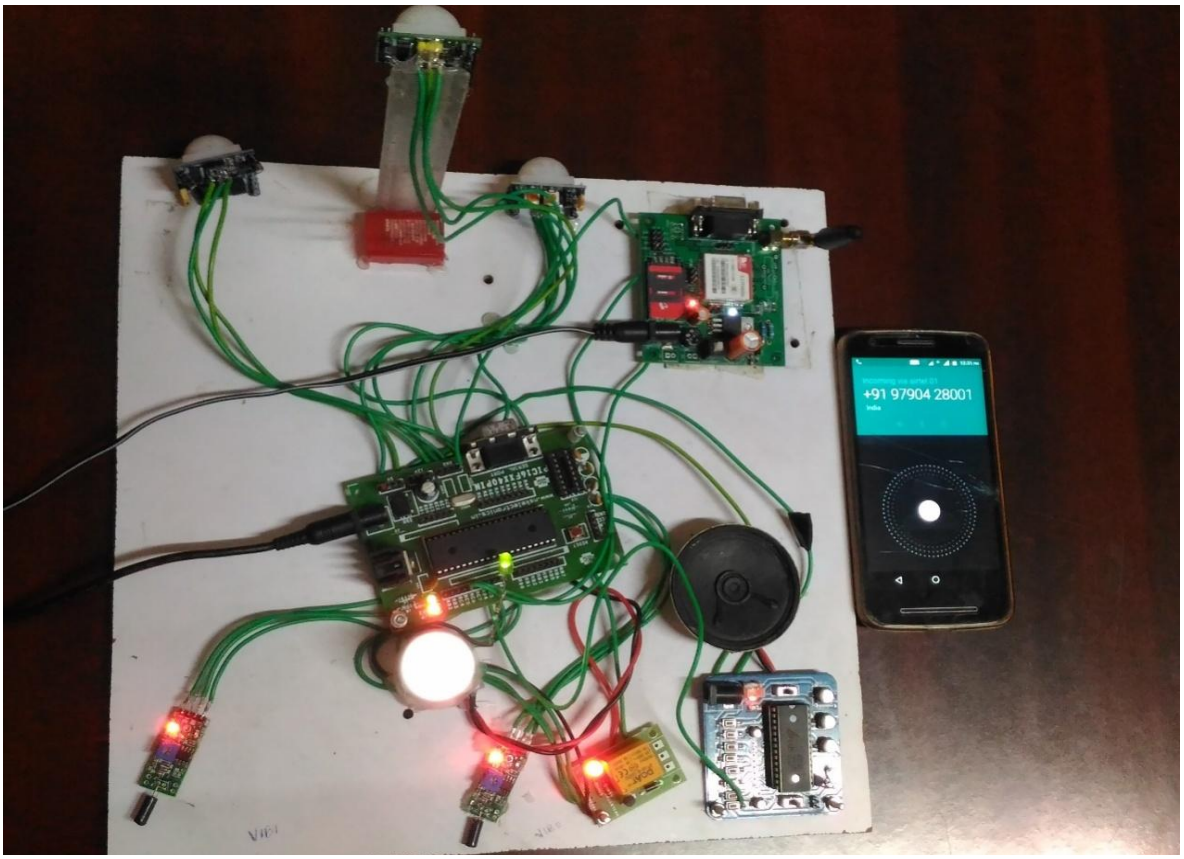

Fig 12 Hardware output

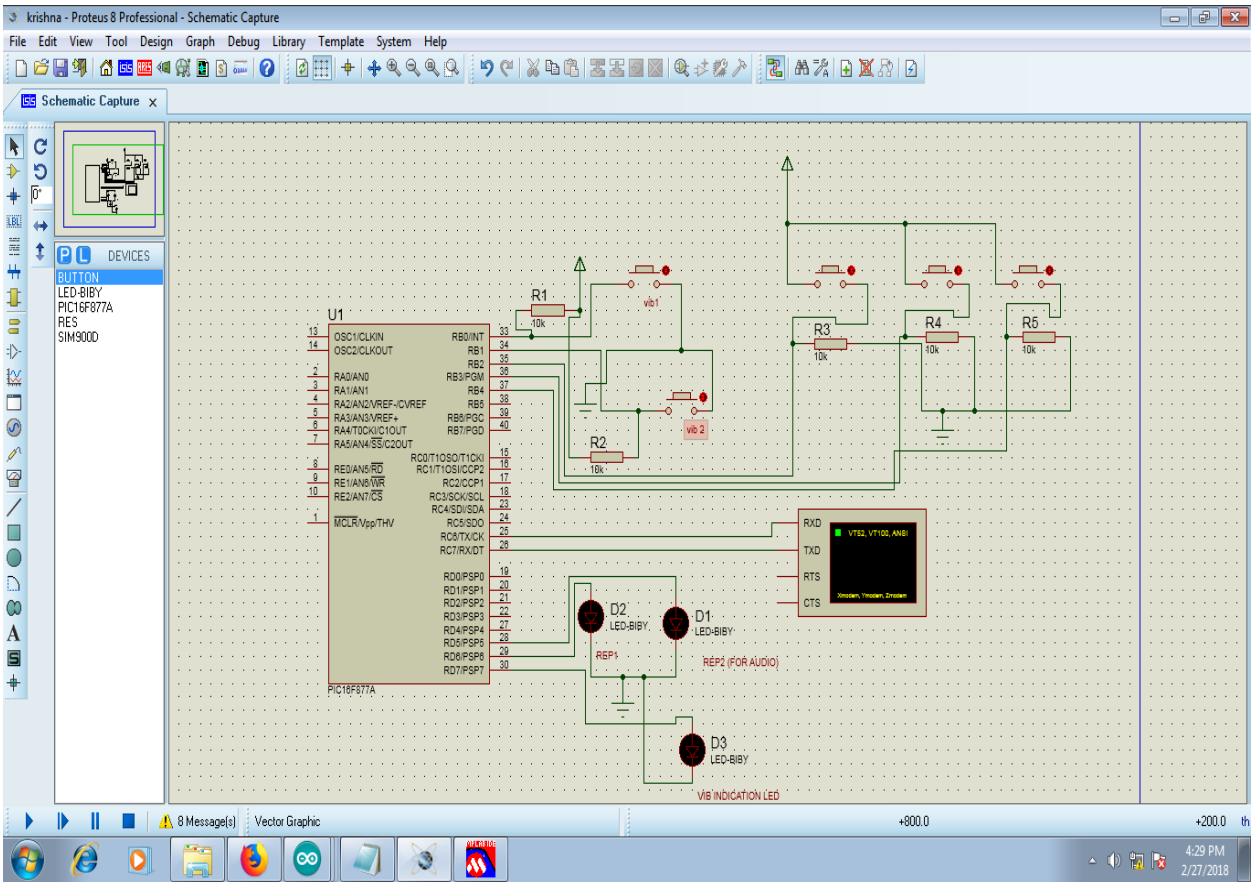

Fig 13 Software result 1

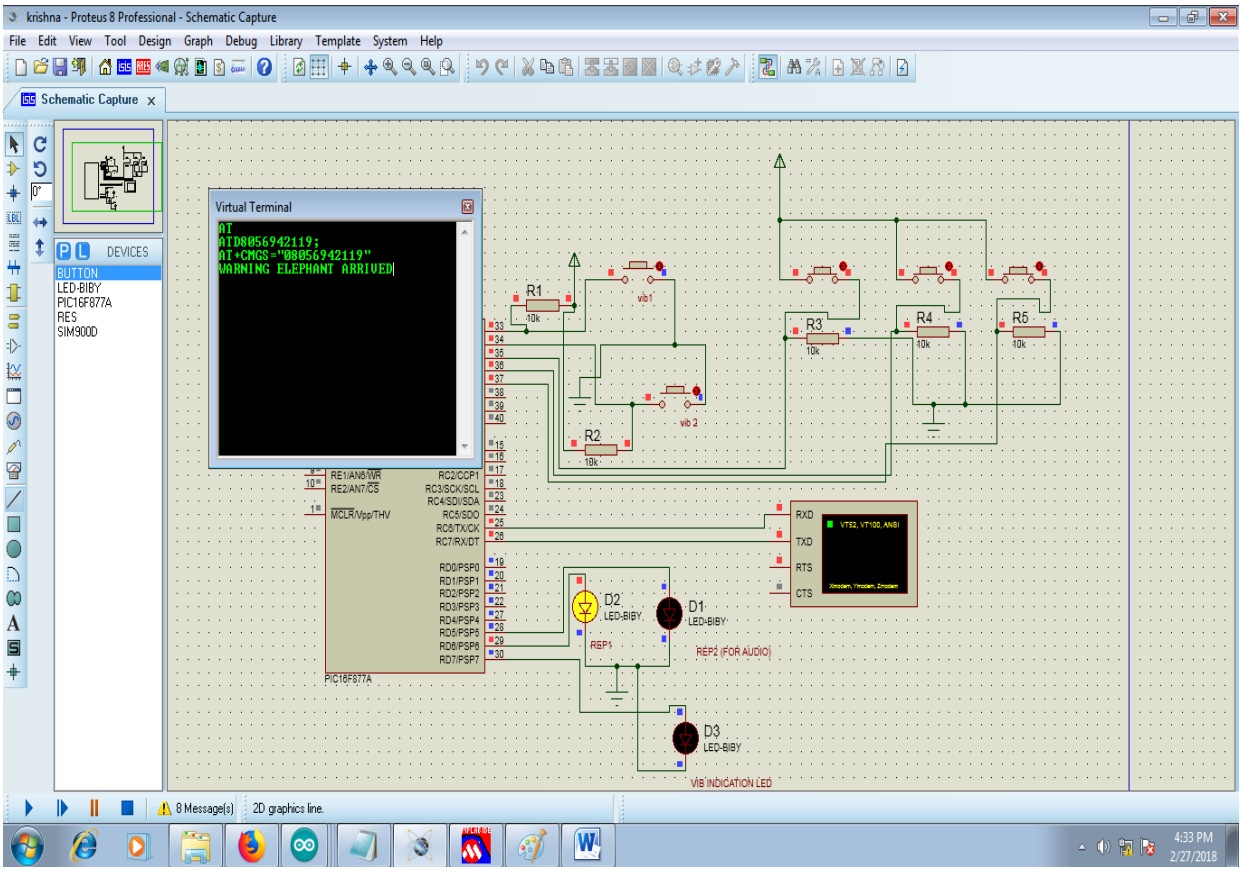

Fig 14 Software result 2

V. CONCLUSIONS & FUTURE ENHANCEMENTS

By installing this system in all danger spots which would have been located by now with the help of elephant movement history, we can eradicate the elephant intrusion near the forest borders. This system works automatically without human intervention and it will be active 24*7. This prevents the human confrontation with elephants. So, by utilizing this technology, average of 200 human lives and 45 elephant lives can be saved per year.

In the future, there will be a large scope, this project can also be developed by measuring various parameters including detection of Elephant's weight, odor and sound. Wireless sensor network can also be implemented. By executing these ideas, we can prevent crop raiding and destruction to human lives. By using acoustic sensor, sounds of an animals can also be detected.

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