International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

Anti-poaching System to Detect Poachers and Conserve Forest Ecosystem

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Abstract - ***poaching has been defined as the illegal hunting or capturing of wild animals, usually associated with land use rights. in this project, we explore surveillance and target detection applications with radio detection as the primary means of sensing. radiofrequency (RF) sensing techniques are the next generation technologies, which offer distinct advantages over traditional means of sensing used for surveillance and target detection applications. this project proposes a system where using of intelligent sensors that would detect human activity within these forests and pass such information to a central control center for monitoring so that they can gear up and muster up for evasive action. the cell phone detector sensor will detect emissions from phones in the 0.8 to 2.5 GHz RF range. any signal from any cell phone will trigger a message from the unit along with its location code to the central server. the PIR sensor is an inexpensive sensor that detects the intruder motion. the sensor can detect up to 7-12 meters and covers up to an angle of 108°. the PIR is accompanied by a camera module which clicks an image of the scene, compresses into and uploads to the central server. the camera module is capable of capturing color pictures and providing a compressed version (JPEG) of the same. it uses a not so expensive camera module from 'ARDUCAM' that has a resolution of 2 mp. the interface to the micro controller is via a i2c (inter integrated circuit) for controlling the CMOS image sensor(ov2640). at the moment it is not known if the PIR sensor can be triggered by animals as well. in such a case it might be useful as a animal census unit as well. the device will be waterproof and ruggedized, they will be pole mounted, mounted on trees or other suitable natural structures or on a mobile platform that can be left around anywhere in the area of interest.***

Key Words: ***Anti-Poaching, Surveillance, PIR, Target Detection and Ruggedized.***

1. INTRODUCTION

Anti-poaching is an organized act to counter the poaching of wildlife. It is generally used to describe an overall effort against the illegal wildlife trade. Anti-poaching takes many forms and which depends mainly upon the habitat being protected. Typically, it is the act of actively patrolling land in an effort to prevent poachers from reaching the animal [10]. This system is one of the methods to detect poaching activities within a protected forest. The system is employed on the peripheries or within the forest and is capable of detecting emissions from cell phones and sending a notification to a central controller using a GPRS modem.

Poaching has been around for a long time around the world. Wild animals are targeted for their tusks, fur, skin and other body parts. Wild elephants, Rhinos, tigers, crocodiles, the list is endless. Illegal lumbering and felling of protected flora and fauna also fall in this category. In his lust for money man has stepped into this domain killing these animals mercilessly and denuding forests contributing to their near extinction state. People and government bodies striving for prevention of this crime and conservation are often outsmarted by the poachers, given the vast expanse of the forests. A very large force and huge resource is required to monitor the area for illegal activities which is unaffordable.

1.1 How does poaching affects humans?

Affect to the environment and ecosystem is directly connected to the everyday lives of humans, It is a circle and chain of life if it is disrupted it leads to greater consequences. Animal poaching does affect humans and environment in several ways; however, two major ways humans are affected would be spread of food borne illness and lack of natural resources. [10]

1.2 How does poaching affect environment?

"Since the animal population is harmed, the whole ecosystem is affected, meaning everything from the animals, to the plants, and even the people in a specific place are negatively affected. Forests and grasslands that rely on the nutrients brought by essential animals will have trouble finding enough nutrients elsewhere to grow and produce their food; therefore, as poaching animals depletes the population of animals, it also puts the plants and environment at risk of extinction." [1][2][3] [10]

2. LITERATURE REVIEW

1. Embedded human detection system based on thermal and infrared sensors for anti-poaching application. 2016. (Ting Feng Tan; Soo Siang Teoh; Jun Ee Fow; Kin Sam Yen.). The system was implemented on a Raspberry Pi 2 board. Experiments have been conducted to evaluate the functionality of the system in non-urban environment during day and night times. [4]

2. Demonstrating Low-Cost Unmanned Aerial Vehicle for anti- Poaching. 2020. (Joseph K. Paul; Tankala Yuvaraj; Karthikay Gundepudi.). The result of this solution gives the suitable approach towards reducing the poaching of animals by using Unmanned Aerial Vehicles. [5]

3. An Intelligent Real-Time Wireless Sensor Network Tracking System for Monitoring Rhinos and Elephants in Tanzania National Parks. 2017. (Erick Massawe, Michael Kisangiri, Shubi Kaijage, Seshaiyer Padmanabhan.). Collared to elephants and rhinos with built-in measures to use animal panic behaviors and horns synchronizations to detect and report poaching incidents and show the location through GPS. [6]

4. Exploiting Data and Human Knowledge for Predicting Wildlife Poaching. 2018. (Swaminathan Gurumurthy, Lantao Yu, Chenyan Zhang, Jin Yongchao.). It proposed an approach to assemble quantitative information through a questionnaire built upon a clustering-based division of the conservation area from domain experts. [7]

5. Design and development of wireless sensor node for anti- poaching. 2016. (Akshay D. Sonwane; V. N Bhonge; Ajay Khandare.). This paper proposes a microcontroller based anti- poaching system employing a WSN protocol, which is capable of detecting theft by monitoring vibrations produced while cutting trees using a MEMS accelerometer. [8]

6. GATA: GPS-Arduino based Tracking and Alarm system for protection of wildlife animals. 2017. (M. Gor; J. Vora; S. Tanwar; S. Tyagi; N. Kumar; M. S. Obaidat; B. Sadoun.). This paper proposes a system called as GATA for tracking and alarming for the protection of Wildlife Animals. GATA combined Wireless Sensor Network (WSN) and Global Positioning System (GPS) technologies. [9]

3. METHODOLOGY

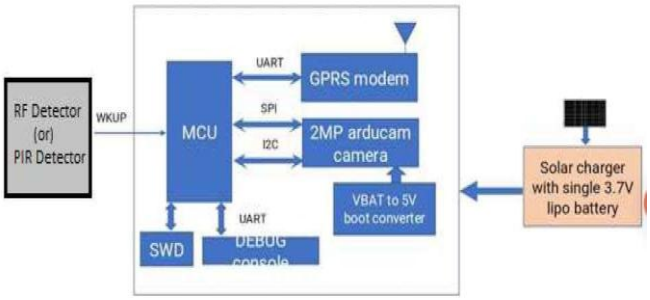

Fig-1: Block diagram of the proposed work

3.1. Cell phone detection sensor

In this part of the system the project consists of a phone signal detection sensor that would detect cell phones in use. The system comprises of a RF signal detector circuit built around an operational amplifier. The cell phone signal is captured by an antenna and is followed by a high speed diode to rectify this signal. This is then amplified by an operational amplifier of appropriate gain so that it can drive the I/O line of a microcontroller or we could use a signal conditioning circuit like a mono-stable multi-vibrator to generate a pulse of fixed width when a signal is detected. The heart of the sensor will be an inexpensive low power micro controller that will detect the output of the previous stage and after suitable filtering will decide to act on it. The Micro controller will also be connected to a GPRS modem with a SIM in it and will be able to coin a unique message indicating activity and issue an SMS (Short messaging service) message to one or more preprogrammed numbers. Detect an alarm from the preceding stage and wake up.

- It will interface to a GPRS modem device and transmit a formatted message to one or More pre-programmed numbers about the activity. It can wait for confirmations and Also build retransmission mechanisms for sure shot transmission of these messages.
- Ensure that its own transmission will not be treated as an intrusion activity.
- Implement logic to avoid any spurious messages.
- Pace the alarm messages suitably to avoid too frequent transmissions.
- Turn off all parts of the system that are not required for detection apart from going to Deep sleep on inactivity to conserve battery.

- It will monitor battery life and charging status and send a notification if the battery is Too low or is not being charged.

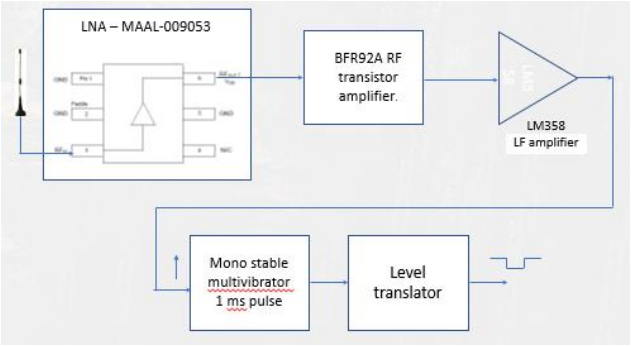

Fig-2: ***Cell phone detector module.***

3.2. Motion detector and infrared camera sensor that captures image.

The system is built around an inexpensive low power microcontroller from ST microelectronics. The device will be used to detect motion and take a picture of the scenario and upload the compressed image onto a central server, along with a short message to the control center indicating that an intrusion was detected and a snapshot taken is available for review.

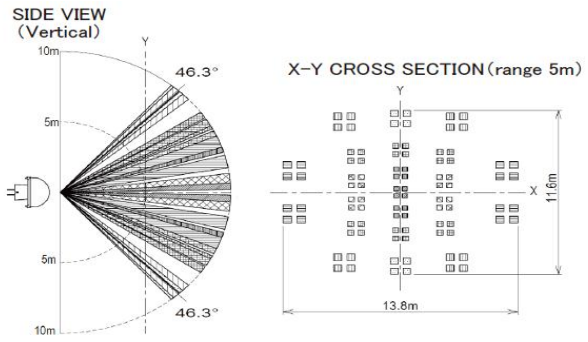

Fig-3: ***Detection range***

To detect motion, the device uses a PIR (Passive Infra-Red device) that senses body heat and consequently motion and produces a digital signal that will be used as a trigger to the control program running on the micro controller. The Micro controller that is powered by a battery is normally in deep sleep, which is the least power consumption mode. The trigger from the Micro controller will wake up the device from deep sleep. The Control program will then power up the camera unit.

The camera module is capable of capturing Color pictures and providing a compressed version (JPEG) of the same. It uses a not so expensive Camera Module from 'Arducam' that has a resolution of 2 MP. The interface to the micro controller is via a I2C (Inter integrated circuit) for controlling the CMOS image sensor(OV2640). The video from the CCD element is captured and converted to a digital image with the help of the onboard FPGA (Field Programmable Gate Array) device. Once triggered by the micro controller by a command via the SPI interface a single frame can be captured by the FPGA. The micro will poll a status register for the image capture to complete. The Camera lens is changeable and one can use a telephoto, Zoom or Fish eye kind of lens.

The Micro controller in the meanwhile will initialize the SIM800 GPRS Modem and connect to the cellular network. It will then read the captured image in parts from the camera module and transfer the same to a server on the web using FTP (File Transfer Protocol). The time stamp is embedded in the file name used to save the image. The control program on the Microcontroller also reports an intrusion via a message to a central control center whose number(s) are preprogrammed. The message is sent using the SMS (Short Messaging Service) provided by the cellular carrier. This will include the unique device identifier, the time stamp, the event and the file name corresponding to the event. With this message the control center can detect the event and inspect the saved file to determine the nature of the intrusion.

After such an event the device will enter sleep mode mandatorily for a given period. This is to conserve battery and also because of the fact that frequent captures after an initial trigger are not relevant. This mandatory sleep period is user programmable.

The PIR sensor used has a range of 12 meters and an angle of 108 degrees. At the moment it is not known If the PIR sensor can be triggered by animals as well. In such a case it might be useful as a animal census unit as well.

Each of these systems will have a built in unique identifier (ID) and also a Real Time Clock. The time of occurrence from the real time clock and this ID will be added to the message so that the controller can identify the location of the device based on its id.

The Device will be powered by a Li-Ion battery that will be sufficient to keep the device powered for at least a week without charging. The battery pack will also incorporate a charger that will top the Li-ion battery when required using power from the solar panel mounted above.

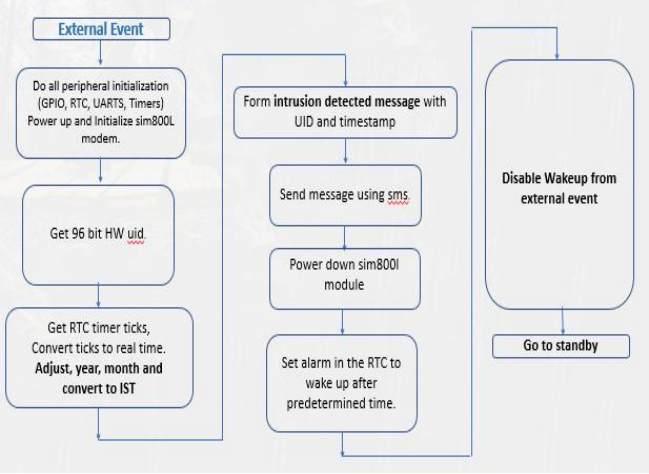

Fig-4: ***Flowchart of an event detection***

4. RESULTS AND DISCUSSIONS

In the case of cell phone detection, the forest official will receive an alert message about the power cycle, followed by intrusion message if any. The SMS consists of the event mentioned above along with the UID (unique identification number), the time and date of the event occurred.

Fig-5: ***Messages received from the system.***

Whereas in the case of a motion detector, the forest officer will receive an alert message about the event occurred, an image which has been captured by the camera, UID, date and time respectively. Using all these information, the forest official can track the intruder and take necessary actions.

5. ADVANTAGES AND DISADVANTAGES

The advantages of the device are,

- It is not expensive, can be deployed easily, self-contained and runs on batteries that are charged by solar power.
- It is ruggedized and so needs no maintenance and is tamper proof as well.
- Lower energy wastage.

Disadvantages or limitations are as follows...

- The device relies on the cellular network for sending notifications. May not be available in some parts.
- Though this is a limitation, there are no alternatives at the moment that can be demonstrated cost effectively.

If for a very prolonged period of time if there is no sunshine for at least a few hours a week, it is likely that the battery will drain out. It will anyway precede by several warning messages, upon which the ranger has to visit and change the battery pack.

6. CONCLUSIONS

The interference of human to wildlife can be controlled by this method. The wildlife which are vulnerable, endangered can be protected by this method. The RF based detection can at least track down human entering the forest land illegally and can control the misuse of human to the wildlife. The wildlife which are vulnerable, endangered can be protected when there can be a cut down of human inference with wildlife.

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