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# An Automatic Wildlife Tracking System Using GPS and Wireless Sensor Networks

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## ABSTRACT

In existing days, floral and faunal preservation and monitoring is given more importance for preservation of various endangered species. To overcome the problem of human and animal injury and mortality due to the drifting of wild animals out of the national forests and wildlife safe houses by the use of automatic tracking and alert system. Automatic tracking and alert system has been implemented by incorporating GSM and GPS technology in the form of a device that would be attached to the body of an animal and would be constantly observing the location of the animal with respect to the GPS defined boundaries set up inside a wildlife sanctuary or national park. In case an animal strays out of the GPS defined zone, an alarm system that will be fixed in a human occupied zone will go off, updating people about the approaching danger. This device can be beneficial for monitoring wildlife related complexities like poaching, railway and roadway accidents, destruction of vegetation and threat to human life on the occasion of straying of wild animals out of their habitation zone[1]. Studying the activities of wild animals is a problematic task due to the difficulties of tracking and classifying their action. In this work, we have suggested a hierarchical, wireless sensor network mounted in this park, to collect information about animals behaviors using a device implemented on them. Once a wild animal crosses a defined boundary then its location is detected using GPS and that location message will be sent to the receiver (or) the information can be uploaded to a website where all the respective officers can see the location of wild animal. This solution reduces power consumption and facilitates animal's behavior monitoring for biologists.

## Keywords:

Boundaries, Electronic device, GPS Technology, GSM Technology, Human-Animal Conflicts, Location, Monitoring, Tracking, Wild animal.

## 1. INTRODUCTION

Electrocution, Rail and Road accidents causes more than 50% of all wild elephant death in India— according to a latest article published in “Times of India”. In our country, population growth forces people to occupy forest fringe areas which are previously natural habitats and migration path of wild elephants. Wireless Sensor Network (WSN) is considered as a collection of sensors devices, called sensor nodes, which are linked by means of wireless communication channels to achieve distributed sensing tasks. A sensor node in the wireless sensor network is a minor device which is capable of gathering facts (or) data from the neighboring regions. The set-up consists of a low-cost sensor nodes with limited battery power. With limited computational capabilities, the sensor nodes have to use the available source of energy. A network of wireless sensor nodes can be used to gather information from variety of applications including military, environmental, medical, habitat monitoring, and scientific applications [2]. The wireless sensor set-up is arrayed with hundreds or thousands of wireless sensor nodes.

Monitoring the behavior of wild animals is a hard technological task to implement. There are some commercial devices that can track animals using GPS and obtain some vital signs through sensors. The information given consists

only of raw data without processing, thus, these solutions are not able to recognize animal patterns with the data obtained from its attached sensors. This kind of classification is usually done using neural networks, which can detect a specific behavior, such as sleeping, running, copulating, etc., in either a supervised or an unsupervised way, depending on the network requirements [3]. Generally, the computational costs of a neural network are high enough to need specific platforms able to parallelize this information and classify it. Hardware like the board allows us to develop spiking neural networks easily; however, the size and power consumption of this board are extremely high for a sensor network.

## 2. NETWORK TOPOLOGY

### 2.1 Aim:

The main aim of this network is to gather locational information from the wild animals with the lowest power consumption possible and store it in a website, so that the forest department officers and other concerned department members will be able to know the location of wild animals and they can use that data for future activities. This information can also be utilized by researchers for future studies. The information will be collected and sent by the collars (or) a tag which is implemented in the body of the wild animal, while a

mote network will transmit it to the corresponding base station located in the forest.

## 2.2 Collar (or) Tag:

Tags are implanted on the target animals and their role is to collect location related information such as latitude and altitude from the environment using multiple sensors. Those sensors are a GPS (location and time) and an accelerometer. The periodical measurements of each sensor are done using a low power consumption microcontroller. The process to obtain data from each device is organized as a task. This makes it possible to set the microcontroller to sleep mode when there are no devices receiving data (this increases battery life and avoids using interruption signals that could block the microcontroller). A special task monitors the power from the collar, disabling devices to increase battery life. The radio module is used to transmit data through the network to the nearest points inside its action radius. If the signal does not reach a valid point to transmit data, i.e. the animal is outside the network coverage area, the device carries an SD card where the information is stored (it can be accessed later), avoiding data loss. The collar does not spend the whole time transmitting information in a continuous way, but it receives variation alerts from the different sensors; these variations indicate the information the device has to send, although a periodicity limit has been established to reduce transmit power consumption. To improve its battery life, a neural network has been implemented inside each collar. This pre-trained network processes data from sensors, obtains the locational information and sends it to the nearby base station.

### 2.2.1 GPS:

GPS is a device, which is usually carried by a moving vehicle or person that uses the Global Navigation Satellite System (GNSS) Networks. GNSS network integrate a range of satellites that uses the microwave signals that are transmitted to GPS devices which in return gives information on location, speed, time and direction. So, a GPS tracking system can possibly give both real-time and past navigation data on any kind of journey (or) circumference. There are two types of GPS device: GPS logger and GPS Pushers. GPS logger simply store the position of the device at regular intervals in its interval memory, it can be either a memory card slot or interval flash memory card but the GPS Pusher pushes the position of the device as well as other information like speed, altitude to a determined server, that can store and analyze the data.

### 2.2.2 Accelerometer Sensor:

Accelerometers are Micro-Electro-Mechanical Sensors (MEMS). Accelerometer works on the principle of Newton's second law, which states an object remains stationary until an external force is applied on it ( $F=ma$ ). Accelerometer is used to measure the acceleration of an object (or) a person. So, by using this sensor we can measure the speed (or) velocity of an animal.

### 2.2.3 GSM:

GSM (Global System for Mobile Communication) uses various frequency bandwidths like GSM-400, GSM-800, and GSM-900 to provide GSM services to customers. GSM has an ability of continuously transmitting data and location corresponding to an object to a cell phone on the other side. The tracking system proposed can be used in cell phones, cars for anti-theft and in wildlife animals for their movement tracking and also for alerting.

## 3. LITERATURE SURVEY:

- An Article was published in "THE HINDU" dated April 26, 2012. It was about the death of 28 elephants in the state of Karnataka in the last two years due to electrocution that comes as a shocker.
- Similarly, another article dated September 22, 2016 and it was about the death of 166 human due to the wild animals attack during the year 2012-2015 in the state of Tamil Nadu
- An article was published in "DECCAN HERALD" dated March 03, 2015. It was about the death of five peoples in the span of 2 months. In that two were died in a leopard attack in the Erode area, two men were crushed by a herd of elephants in Coimbatore and a woman was mauled to death by a tiger in Nilgiris district.
- An Expert committee sent their report to Chennai High court after analyzing various wildlife settlements in Tamil Nadu. After analyzing various settlements experts found that many tribal peoples were died due to the migration of wild animals in the area like Bokkapuram, Doddalingi and Boodhanatham settlements.
- An article was published in "TIMES OF INDIA" dated Aug 20, 2007. It was about the frequent criss-cross movement of Wild Elephant, Leopard near the Krishnagiri District.
- In recent days death of Elephants due to train crush is increasing near Nilgiris district

## 4. RELATED RESEARCH METHODOLOGY

Design of this system consists of wireless sensor nodes capable of collecting information from surrounding regions and also from the wild animals. It follows LEACH protocol to meet requirements of WSN. Clustering infrastructure is the basic for LEACH protocol architecture for data aggregation. Also DEEC protocol provides a hybrid approach for data collection that adapts to the changes in the data delivery rate [4]. This component is the main interaction to the human for tracking, searching, tracing and monitoring the wild animals. There are four modules to be used in this project. 1) SMS-GSM module receives environmental and location information toward GSM networks using SMS

services. In addition, this module also supports a control transmission logic sending back to the sensing device.

2) Environmental monitoring module displays human readable information so that the information is very useful for further processes. 3) Map and Tracking module performs three main functions: first to display the exact location of the wild animal using Google MAP API, second to find out the direction from the current location to the target and finally to show tracing pattern using the location history for animal behavior analysis. 4) RF Location and sound processing module works together. The main function of this module is to warn/alert forest station base office when the wild animals come closer to the boundaries [5].

## 5. PROPOSED METHODOLOGY

In recent days, more Elephant deaths are caused due to train accidents mainly occurs in the regions like Nilgiris District and Krishnagiri District. There are some cases where more human deaths and vegetation damage occurs, when elephants stray out of their habitation zone. This automatic tracking and alarm system is to preserve the endangered animals like Bengal Tigers straying out of their boundaries may be good news for the poachers or may be vulnerable to road or railway accidents. A GPS defined boundary would be set up at distance of 1km (for example) from the boundary of the wildlife sanctuary or national park. We will be defining two boundaries using GPS, when the tag implanted wild animal approach near the first boundary then the alerting system will be Turned ON. This alerting system consists of a voice recorder and a speaker. When the animal comes close to the first boundary then the prerecorded sound like Gun Firing, Crackers sound will be played via speaker. Suppose the animal crosses the first boundary and continue to move towards the secondary boundary. After reaching the second boundary the location of the wild animal will be send to the forest station base office and after that using a GSM module an alert message will be send to the nearby village panchayat office.

## 6. HARDWARE SPECIFICATION

### 6.1 GPS Modem:

The GPS receiver has an ability to track down the date and time of a particular moving object find at a exact location. With the help of automatic tracking and alert systems, it tracks the exact co-ordinates of a specified living object only if it is pre- installed into it. The embedded system helps in alerting the people when an animal crosses the defined boundaries. This salient design keeps monitoring a moving object continuously at regular intervals of time.

### 6.2 GSM Modem:

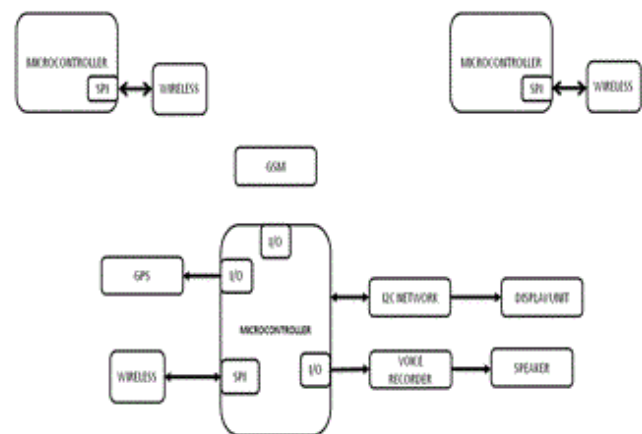
GSM modem, it has an ability of continuously transmitting data, location that can be transferred to a receiver module via mobile phone. The tracking system has been proposed and it can be used in mobile phones, cars for anti-theft and in wildlife animals for their movement tracking.

### 6.3 Alarm Circuit:

A buzzer or alarm gets activated only when the animal or object tries to cross the pre-defined area. A small amount of current could be passed through the animal body in order to indicate that it has crossed the boundary line. But application of electrical shocks might trigger psychological effects in animals which might stop an animal from moving further. To overcome this, the alarm circuit is used to alert the humans in case of danger would will be under the control of the forest department or any responsible authorities and buzzer may be attached to an electric pole.

## 7. SYSTEM OVERVIEW

The Real Time Monitoring System is divided into two modules which are Transmitter module and Receiver module. In the Receiver Part there will be only a mobile phone, which can get the data regarding the location of wild animals.



## 8. CONCLUSION

In recent days, most of the species are getting extinct. Most of the species have become rare. Thousands were in danger of extinction and various species are on the margin of elimination. Automatic tracking and alert system overcome the problem of human and animal injury and death due to the drifting of wild animals out of the national parks and wildlife sanctuaries. This system is flexible, efficient and easy for an implementation process and can be more beneficial for monitoring wildlife related complexities like poaching, accidents, train delays, destruction of vegetation and threat for the human life on the occasion of deviating of wild animals out of their habitation zone. When the animal crosses their boundary, sensor provides an alert to the control system to take certain action. In this system the sensors are placed in the detecting areas from where the animal can cross their boundary. The sensors would pick up the signals using a

designed control circuit and pass it on to the transceiver. The transceiver, in turn, sends an SMS to the forest official concerned in charge of the area where animal movement has been tracked. This work presents a WSN, implemented in a distributed system with a sensory fusion integration in order to study and classify animal behaviors in real time, which is a novelty for animal tracking networks. We have presented a network topology that allows this kind of processing of the information obtained from the sensory fusion, and the communication between every element on it. Best battery life is obtained when data is sent after a classification step using a neural network embedded in the collar. Testing results for signal coverage are presented.

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