

IoT – Wildlife Monitoring, Virtual Fencing with Deforestation Notifications

Supreeth SK¹, Suraj DN¹, Vishnu AR¹, Vishruth V Sastry¹, Srinidhi kulkarni²

¹Dept. of Computer Science and Engineering, Jyothy Institute of Technology, Bangalore, India

²Asst Professor, Dept. of Computer Science and Engineering, Jyothy Institute of Technology, Bangalore, India

Abstract - India has been identified as an ecological blackspot where half of the wildlife is vulnerable to extinction. This is caused due to the destruction of forest areas for farming, logging and construction of new cities and towns. This is forcing the animals to move out of their habitat and into human establishments, which is causing problems to both animals and humans. Recent advancements in sensor technology has the potential to revolutionize our understanding of the natural and man-made environment by providing fine grained spatio-temporal data (moving object databases and real time locating system). Physical barriers cause physical damage to animals which can sometimes lead to death of the very animals we are trying to protect. This can be prevented by using virtual fencing which is a lifesaving improvement from the existing system. This project implements a sensor network, designed to track the location of the animals in sanctuaries and national park without hurting the animals. Forest fire and deforestation (or any illegal activities in the forest) can also be monitored through this system and it helps us preventing the destruction of wildlife.

Key Words: IoT, Sensors, Cloud Computing, Virtual fencing, Wildlife monitoring, Deforestation.

1. INTRODUCTION

The growth of environmental awareness and public concern for wildlife that began in the 1980s has continued into the 21st century. Large-scale alterations of the landscape such as hydroelectric development, or the cumulative effects of timber provide the detailed information required by studies undertaken to address environmental concerns and evaluate new policies, telemetry systems based on the Global Positioning System (GPS) were developed in the 1990s. Since commercial development of GPS-based telemetry systems for tracking animals began in 1991, a variety of configurations have been designed for use by researchers in different situations. In addition, numerous improvements have been made to the size and performance of GPS systems and their cost has been dramatically reduced. The enormous quantities of data generated by these systems clearly present a challenge to data management and analytical procedures. Given the variety of configurations and features of current GPS systems, researchers must carefully plan and select an appropriate system to address particular biological issues.

Protection of wildlife has become an important now a days, due to the effects of human activities such as hunting of wild animals and cutting of trees which causes major threat to the wildlife. Protection of wildlife and conservation is a challenge, especially in natural reserves, dangerous locations or hotspots near human environment. With growing human population and search for new habitats and unsustainable use of natural resources over exploitation of forests and wildlife taking place world over. This system helps to divert the animals while entering the village.

The developed system is not an in-laboratory research prototype, but a real-world working system that has been gathering science-quality data for over 6 years. This system is able to monitor the behavior of these wild animals at a much higher resolution than would be possible using traditional observational methods or other tracking technologies, including global positioning system (GPS) tracking. From many years we are getting news about smuggling of the trees such as sandal, Sagwan etc. These trees are very expensive and less obtainable in the market. To avoid such type of smuggling and to save the forests around the globe some preventive systems need to be developed.

Many wild animals have been killed due to road accidents and speeding vehicles passes through the wildlife protected area. Animals crossing boundaries have led to be killed. The impacts of roads include habitat loss, habitat fragmentation and habitat degradation that affect wildlife and its habitats both directly and indirectly especially on larger mammals. These animals have large ranges or undertake seasonal movements over large areas of mainly natural or semi-natural habitat. There has been less attention overall to animals in more modified landscapes with a long history of intensive land use and land management. The current government state forest system like active fires, smoke plumes and the fire risk in the forest. Due to active fires many birds and animals have been killed and the valuable trees are destroyed to this active fire. If anyone enters into an area where PIR sensor placed sensor detects the motion and it sends an alert to the server and SMS notification to the forest authorities.

1.1 Types of Sensors

Smoke Sensors: A smoke sensor is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as smoke alarm, generally issue a local audible or visual alarm from the detector itself.

Motion Sensors: A motion detector is a device that detects moving objects, particularly people. Such a device is often integrated as a component of a system that automatically performs a task or alerts a user of motion in an area. They form a vital component of security, automated lighting control, home control, energy efficiency and other useful systems.

Accelerometer: An accelerometer is a device that measures proper acceleration. Proper acceleration, being the acceleration (or rate of change of velocity) of a body in its own instantaneous rest frame, is not the same as coordinate acceleration, being the acceleration in a fixed coordinate system. For example, an accelerometer at rest on the surface of the Earth will measure an acceleration due to Earth's gravity, straight upwards (by definition) of $g \approx 9.81 \text{ m/s}^2$. By contrast, accelerometers in free fall (falling toward the center of the Earth at a rate of about 9.81 m/s^2) will measure zero.

2. LITERATURE SURVEY

Internet of Things (IOT) is a very common term nowadays. It's not a second internet; rather it's a network of devices that are connected to the Internet that is used every day to search Google, upload images and connect with friends. It's a network of products that are connected to the Internet, thus they have their own IP address and can connect to each other to automate simple tasks. However, IOT is still in its infancy. It has not been completely developed and is fragmented. For the IOT to be fully realized all devices need to be able to connect to each other, regardless of what company manufactured the product or which companies have business relationships with each other. In technical terms, the Internet of Things (IOT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IOT is the future of technology that can make our lives more efficient, starting from the most mundane, everyday events to big, world changing ones.

Existing research into wireless networks for wildlife tracking has resulted in homogeneous solutions. This is the "one size fits all" approach, where a single type of tracking device has been designed. This has segmented the solution space into animals which can be tracked using wireless networks and those that cannot, due to weight restrictions placed on the tracking collar. The objective of my research is to design a

single wireless network-based system that can be used to track and monitor both small and large animals. I argue that the vast diversity in the Animal Kingdom, especially with respect to bodyweight, should not be viewed as a hindrance, but rather something to be exploited. My philosophy is that devices with low functionality (due to weight or cost restrictions) should use the capabilities of more complex devices in order to result in a powerful network Solution.

The paper describes an IOT platform for wildlife monitoring applications, especially on location tracking, habitat environment observation, and behavior recognition. Since the wildlife moves in wide area, satellite positioning receivers such as GPS, Beidou, Glonass, Galileo, etc. have been used to track long distances. For behavior recognition acceleration, gyro sensors have been used. For habitat environment observation, monitoring sensors such as temperature, humidity, height, wind, light, camera, etc. have been used. There are two types of communication components used in here: cellular and capillary. For cellular type, Global Systems for Mobile Communication (GSM), Third Generation (3G), Long Term Evolution (LTE) for long distance communication are used. In habitat environment observation, sensor nodes are set up in the observation area, and are connected through sensor networks. The sensors collect the data and a notification is being sent to the concerned authority. [1]

The paper describes tracking of elephants and sending a warning message if the elephants cross the boundary line. To implement this wireless sensor network (WSN) have been used as a virtual barrier for covering elephant corridors or villages. Virtual barrier uses the height and length of an elephant as detecting parameters and is located outside the village and therefore can be used as an early warning system. The network communicates with the base station located at the village wirelessly and via mobile network it can inform an assigned personal. The sensor network acts as a virtual boundary around a village. This boundary is built with Infra-red (IR) sensors and Passive Infra-red (PIR) sensors. The physical parameters and other characteristics of the elephant are considered in the detecting and identifying the elephant from rest of the animals. [2]

The paper describes an RF module based virtual fencing. Here, whenever the animals try to cross the range of transmitter, the receiver will alert through a buzzer and display a message on the LCD. Wireless sensor network containing microcomputers, radio and sensors acts as a transmitter and are fitted into cattle neck collars and emit a sound when the animals approach the virtual boundary. Because of the sound emitted when the animals cross the boundary, animals get scared and make sure to stay inside the boundary. The alert message is given to the forest officials when the animals cross the boundary. [3]

The paper describes a wildlife intrusion and early forest fire detection using IOT. The wildlife is captured by using a camera. Ultrasonic sensor is used to measure the distance of a wildlife animal by using sound waves. The ultrasonic sensor sends out a high frequency sound pulse and then

times how long it takes for the echo of the sound to reflect back is measured. Once the animal is detected, ultrasonic sensor will send information and the captured image and it is stored in ubidots, simultaneously a notification is sent to the user along with an alarm. The alarm will be enabled once the animal is detected by the ultrasonic sensor is notified. The sensor used for humidity detection is DHT 11. The DHT 11 sensor monitors the moisture and the temperature of the forest 24X7 and the ranges are stored in ubidots. Once if any changes in the moisture or temperature are detected immediate notification is sent to the user. [6]

The paper proposed a wildlife monitoring system using wireless sensor network and detecting forest fire. In the forest fire monitoring system, LM35 temperature sensor, DHT11 humidity sensor, MQ-7 carbon monoxide sensor and the sound sensor are deployed at the site. These sensors acquire periodic measurements of the changes in the environment and provide their readings through the wireless network to the monitoring center. These measurements collected are combined together to detect any evidence of forest fire. A wireless distributed system for the detection of wildlife is proposed. This system tracks the wildlife continuously. In wildlife monitoring system, an infrared sensor, an ultrasonic sensor or Doppler radar sensor is being used. To monitor wildlife RFID system is used for tracking animals in long ranges. [7]

3. PROPOSED SYSTEM

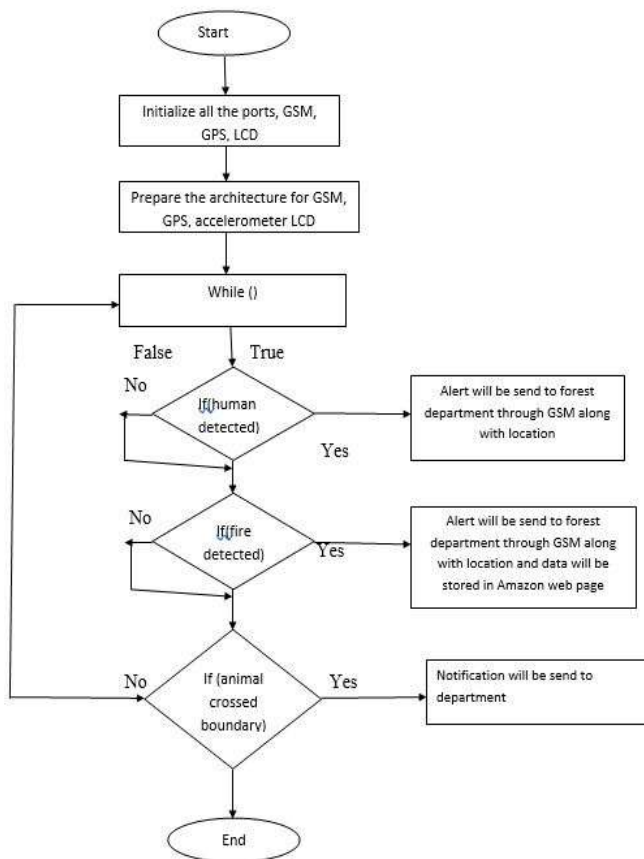


Fig-1: Flow chart

The proposed animal health monitoring and tracking system was implemented in real mode with all the three mentioned sensors. The received values from sensors was transferred through GPRS and stored in Amazon cloud. And is shown in the LCD. As a result, it is proved that the integration of GPS and sensors in the same microcontroller is possible without any complications and also, the data retrieved is accurate and there is no interference in the data. However, the GPS works only when there is movement in the model. And also, the accuracy and precision could not be achieved in previous models whereas this model achieves them.

Advantages:

1. Real time data
2. Additional environmental data collection
3. Newer technology provides long range tracking
4. Better understanding of animal ranges and environments
5. Data collection for survival

Disadvantages:

1. Cost of high-end technology
2. Need for software development to use data collected
3. Training of scientists to use technology
4. Matching up of technology to animals and environments (one size does not fit all)
5. Lack of methods to share data

4. ARCHITECTURE DESIGN

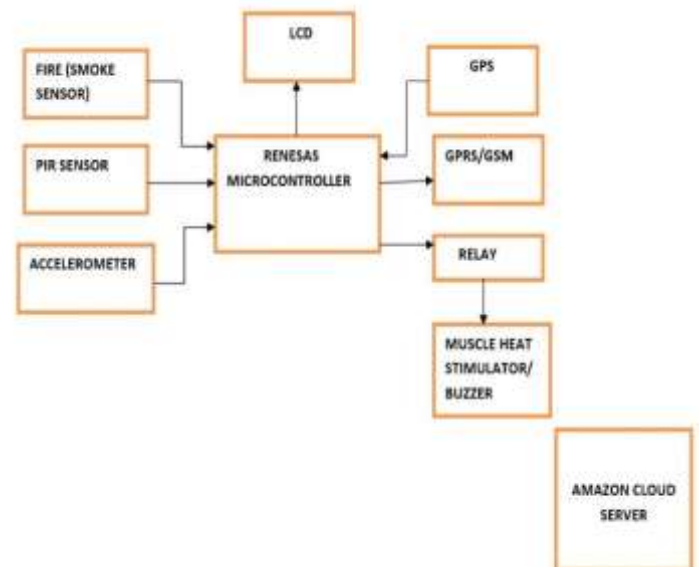


Fig-2: Block diagram.

In this project design, structured modular design concept is adopted and the system is mainly composed of Renesas microcontroller, GSM module, GPS module, PIR sensor, Smoke sensor, Relay, Accelerometer sensor and AMAZON cloud-based database.

Smoke sensor is used to sense the fire in the forest. PIR sensor is used to avoid deforestation. PIR sensor senses the human presence near the animal boundaries or restricted areas Heat stimulator device which is placed on the animal body, helps the animal to stay in the particular limited area, if the animal crosses out of the particular limited area then animal gets the body pain that is due to device which is placed on animal body. GPS is used to track the location of animals. These information's is collected by Amazon cloud via GPRS and stored in database for further use. Or these information's send through SMS alert. Embedded C is a set of language extensions for the C programming language by the C standards committee to address commonality issues that exist between C extensions for different embedded systems.

5. CONCLUSION

The proposed system will provide safety and security to wildlife and help to increase their numbers which are on extinction. Animal tracking system is useful for tracking and monitoring of animals. So, they can be protected from illegal hunting, killing or capturing of wild animals. Embedded system based this project provides accurate health information and location of the animal. System provide automated solution for data prediction. This system helps to divert the animals while entering the village. Because of this the human work can be minimized and the death of wild life also can be minimized. This system can also have its usage in border security system, home automation system, school zones, and in railway tracks and it has low cost and good performance.

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BIOGRAPHIES



Srinidhi Kulkarni

Assistant Professor, Department of Computer Science and Engineering Jyothy Institute of Technology, Bangalore, India



Supreeth SK

Dept. of Computer Science and Engineering Jyothy Institute of Technology, Bangalore, India



Suraj DN

Dept. of Computer Science and Engineering Jyothy Institute of Technology, Bangalore, India



Vishruth V Sastry

Dept. of Computer Science and Engineering Jyothy Institute of Technology, Bangalore, India



Vishnu AR

Dept. of Computer Science and Engineering Jyothy Institute of Technology, Bangalore, India