



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 2, February 2023

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.118

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

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# A Survey on IoT based Wildlife Analysis and Conservation

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**ABSTRACT:** In the last few years, Internet of Things (IoT) provides efficient technology support for the wildlife research. Today major percentage of 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. 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 [1, 2]. Protection of wildlife has become an important now a days, because of human activities such as hunting of wild animals and cutting of trees which causes major threat to the wildlife. Recent advancements in IoT technology and sensor technology have the potential to wildlife conservation. Physical fences are not suitable for animals because they may harm the animal physically. This can be prevented by using tracking of animal movement and keep them under a logical fence. This survey paper focused on implementation of a sensor network, aimed to track the location and health monitoring of the animals in sanctuaries and national park without hurting the animals.

**KEYWORDS:** Wildlife conservation, animal tracking, Health monitoring, Internet of Things, Sensors, challenges in animal conservation.

## I. INTRODUCTION

For the past few years, IoT is the technology that can make our lives more efficient, starting from the most mundane, everyday events to big, world changing ones. IoT technologies & several sensors together have been widely used for wildlife monitoring and tracking in a remote and geologically large habitat [3]. Generally, it is known that wild animals has similar physiological activities as a herd. Hence, different functional devices working as sensors could be installed either as collars kit or hidden in the ground or fixed on the trees, to monitor the physiological activities which is used to report animal data to the central server [4]. These sensors is attached to the microprocessor for collecting information from various sensors (e.g. ultrasonic, temperature, respiratory, accelerometer, gyroscope, etc), these local data will then be pre-processing and transmitted through the wireless communication technology to the transceiver for further processing. The collar kit is also having a GPS which helps in tracking of animal movement. All these tracking & health related aggregated data is given to microcontroller for monitoring purpose to the base station. Implementation of this IoT based wildlife monitoring system faces many challenges such as natural challenges, and technical challenges. These information's is collected by servers and stored in database for further use or these information's send through notification alert to wildlife authorities.

Paper is organized as follows. Section II describes Literature Survey. The proposed system represents the step of the wildlife monitoring system (WMS) with advantages and disadvantages in Section III. Section IV presents architecture design of WMS. Finally, Section V presents conclusion.

## II. LITERATURE SURVEY

IoT is a system of interrelated computing devices, 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.

Mr. S. Syed Husain [2] proposed a system in which, the design uses three sensors tilt sensor (to detect the inclination of tree when its being cut), temperature sensor (to detect forest fires), sound sensor (for effective detection of illegal logging i.e. even the sounds generated while axing the tree are also sensed) Data generated from these sensors is continuously monitored. This system can monitor real-time related parameters, e.g., temperature, relative humidity, and send the data immediately to the computer of the monitoring. The collected data will be analysed and managed by the computer. Compared with the normal meteorological information and basic forest resource data, the system can make a quick assessment of a potential fire danger. With respect to the sensors, their output devices are activated through relay switch. For RF transmitter used in animal body to track and identify to communicate and interface in RF receiver in microcontroller and sound sensor a buzzer is activated and for temperature sensor a water pump is activated.

Xiaohan Liu [5] describes an IoT platform for wildlife monitoring applications, especially on location tracking, habitat environment observation, and behaviour 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 behaviour 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.

M. S. Nakandala [6] explored 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.

Luís Nóbrega's [7] explored the SheepIT cloud platform that receives animal sensor streamed data, performs data analysis (e.g. rule management), allows farm managers to access animal information and trigger alarms in real-time when certain situations are detected (e.g. panic attacks, attacks from predators, abnormal number of infractions, etc.). The paper also describes some preliminary results of an animal posture monitoring use case, for which several machine learning algorithms were tested. The Sheep IT project aims at offering an IoT-based solution for monitoring, controlling, and managing herds of sheep weeding vineyards. To reach such goal, the system comprises several distinct blocks (and respective interactions), each of them being responsible for specific tasks. Among these tasks, the data gathering, data aggregation, data processing and data representation may be highlighted. Such local infrastructure is in turn interconnected through a wide-band connection (e.g 3G, 4G, LTE) to a cloud platform.

Jun Xu [8] focuses on the animal monitoring and tracking in large wild areas. Sensor identifies animal's appearance by different types of inputs such as smell, sound and image. With deployed sensors, the system gets animal appearance information in wildlife areas. Jun Xu, divide the whole observation area into small virtual grids. Then based on this grid structure network, Jun Xu designed the system model by utilizing a UAV and letting the UAV to explore and learn these "hot" small virtual grids. By treating each grid as a cluster of sensor nodes, data collection by the UAV is reduced to visiting the cluster head of each grid. The Markov decision process (MDP) model is used to do path planning for the UAV as each grid

represents a state of MDP. We solve the MDP model using Q-learning algorithm by letting UAV to receive rewards from grids when animal data is reported. The goal of our path planning approach is collecting animal data efficiently and then predicting future animal movements. The UAV is self-learning and can dynamically plan and adapt according to environment changes.

### III. PROPOSED SYSTEM

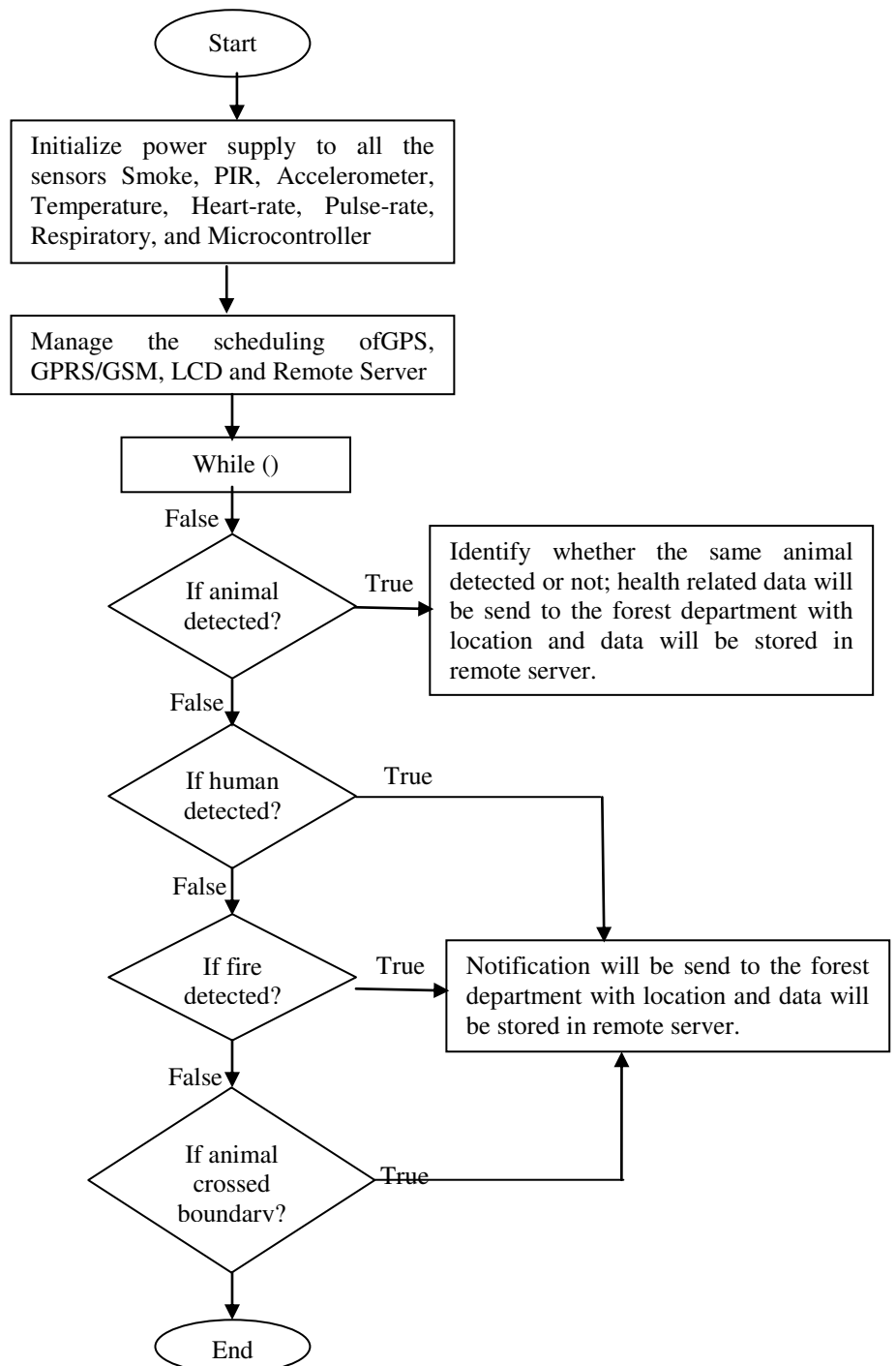


Fig. 1. Flow Diagram



The proposed Wildlife Monitoring System and tracking system will be implemented in real mode with all the mentioned sensors. The receive values from sensors will be transferred through GPRS and stored in remote server and shown in the LCD. Smoke sensor is used to sense the fire in the forest. Passive Infrared (PIR) Sensor is used to avoid deforestation. PIR sensor senses the human presence or motion near the animal boundaries or restricted areas. Accelerometer An accelerometer is a device that measures proper acceleration (or rate of change of velocity of a body) for habitat environment observation. Temperature sensor gives indication of their body temperature. Heartbeat Sensor is used to give digital output of heat beat when a finger is placed on it. Pulse Rate sensor that gives pulse in real time as it combines an optical heart rate sensor with amplification and noise cancellation circuit to make it fast and easy to get reliable pulse reading per minute. Respiratory sensor indicates relative pressure of the lungs as it expands and contract. Microcontroller Unit(MCU), memory, and power supply (battery and solar panel) is used as the brain to control the system with GPS and GSM module. Satellite positioning receivers (GPS) helps in tracking of animal behaviour movement. Global Systems for Mobile Communication (GSM) is used for long distance data transmission. The Remote Server is important for processing and sharing efficient data for the users. A liquid-crystal display (LCD) is a flat-panel display to view data received from all the remote servers.

**Advantages:**

- 1. Real time data of environment
- 2. Newer technology provides long range tracking
- 3. Better understanding of animal ranges and environments
- 4. Data collection for survival of large mammals.

**Disadvantages:**

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

**IV. ARCHITECTURE DESIGN**

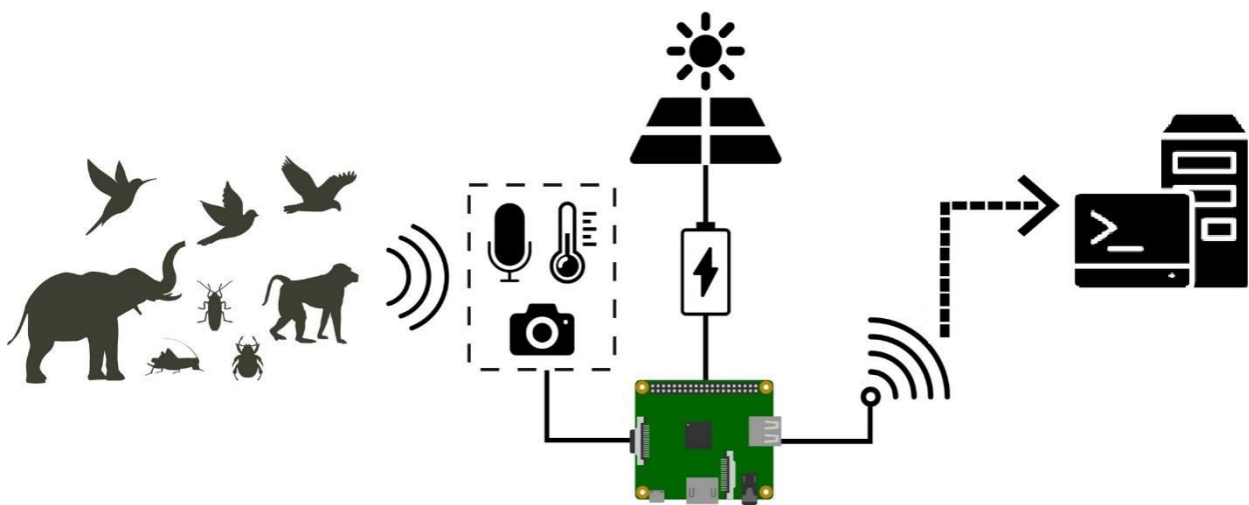


Fig. 2. Wildlife Monitoring System

Fig. 2. The hardware unit of Wildlife Monitoring System show how data is continuously captured from an ecosystem and uploaded automatically from the field to a remote server. The monitoring unit itself consists of three core components: (I) the core data capturing sensors, (II) a mobile network link for uploading data, and (III) a solar powered battery system.

The software unit is open-source Python and implements daily updates and logging to support remote management and trouble-shooting. The sensor software class separates data capture from post-processing and upload, and uses threading to allow these processes to run in parallel. These sensors is attached to the microprocessor for collecting information from various sensors, these data will then be transmitted to the transceiver for further processing. All these tracking & health related data is given to microcontroller for monitoring purpose. Post-processed data files are stored in a local upload directory and transferred to a central server via GPRS and stored in database for further use or these information's send through SMS alert.

## V. CONCLUSION

The proposed system will provide safety and security to wildlife and help to rise their numbers which are on disappearance. Wildlife monitoring system is useful for tracking and monitoring of animals. So, they can be protected from illegal hunting, killing or capturing of wild animals. This system provides accurate health information, location of the animal and identify the same animal. This system is also highly beneficial to the animal saver to search or monitor if animal are missing. Users can plan their activity to help the animal if they are in dangerous or abnormal condition as far as health of animal is concern. The next steps that will be carried out to identify the animals paws image and finding out the location of that same animal.

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**INNO SPACE**  
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**Impact Factor: 8.118**



**ISSN** INTERNATIONAL  
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