

## GATA: GPS-Arduino Based Tracking, Alarm and Message Alert System for Protection of Wildlife Animals

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**ABSTRACT:** Wildlife and forest departments are facing the problem of movement of animals from forest area to residential area in present scenario. The number of trees has reduced drastically from the forest that creates an unhealthy environment for animals to survive in the forest. In this project we propose a system GPS-Arduino Based Tracking, Alarm and Message Alert System (GATA) for tracking and alarming for the protection of wildlife animals. GATA combined Wireless Sensor Network (WSN) and Global Positioning System (GPS) technologies. Wild animals straying out of wildlife sanctuaries and natural parks have been tracked by auto generative location tracking and movement patterns. Automatic location and movement tracking have been implemented using GPS. In the event of straying of a wild animal out of the predefined zone of sanctuary or natural reserve, an alert is sounded on a fixed base station (BS). As a prototype, we are going to develop this hardware on the cows, which shows the proposed approach is very efficient in terms of flexibility and cost. Because of this GATA model we can save the wildlife without getting escaped from the forest with the help of the alarm and also, we can protect the human population.

**Keywords**–GPS monitoring; Arduino; GSM module; Wildlife Sanctuaries; National Reserves.

### I. INTRODUCTION

For years an animal tracking system has been used to analyse animal behaviour for many reasons, such as to observe a managers and livestock producers. Now a day's wild animals are becoming less in number because of industrialization and cutting of trees in the forest area. Hence it is important to save life of wild animals in the sanctuaries. Animals move freely in the area of forest without any fear. Since many years these wild animals are being tracked by using conventional methods such as using wireless transmitter and

receiver pair. Here wireless transmitter is kept in the collar of animal and receiver is with forest officer. But when area of forest is large enough to not fall within the range of wireless transmitter-receiver, we can't locate animal. Usually area of sanctuaries is in the range of hundreds of kilometres in length.

Hence, we require a device which will work even when area of sanctuary is hundreds of kilometres. For this purpose, we must go for technologies such as GPS. This system uses this technology to locate location of animal in sanctuary. GPS Modem receives string of data from the satellites and sends it to microcontroller. Low-power microcontroller extracts Latitude and longitude information from string of data received from GPS modem.

It also activates IR Sensor by detecting the movement of animals and send this information to GSM modem. GSM modem has SIM card, which is used to send SMS to the forest authority or to any government authority[1].The GPS location data will be sent only if the change of the movement occurs within a particular distance (threshold) to save SMS cost.

As a result, in this paper, we explore the possibility to apply an open architecture for animal tracking systems using Arm controller with environmental sensors. After acquiring the location information, the sensing subsystem will send that together with environmental data towards GSM networks using SMS services to Android OS phones for mobile monitoring, searching and tracking. The rest of the article is structured as follows. Section II highlights previous work done by researchers in this domain with challenges and our contributions. Section III presents the proposed hardware and its components. We present the performance evaluation results in Section IV and finally, Section V concludes the article with future scope.

## II. LITERATURE SURVEY

This section describes the previous work done by re- searchers in selected domain. Global navigation satellite system (GNSS) was defined for the navigation system that provides the geospatial positioning with global coverage, where whole system was made up of constellations of various orbiting satellites linked to the ground stations. The GPS has proved to be the most popular GNSS module, which has the potential to be a very efficient tool for wildlife studies [2].

When GPS is used in combination with WSN it provides higher Amount of reliability on data that was received from the sensors finally sent to the BS. This makes real time monitoring of animals very easily and less cumbersome task as compared to earlier technologies of radio tracking and photo identification [3].

A lot of questions related to animal ecology can be answered using the data collected from the GPS modules, such as resource selection, animal movement, foraging behavior and predation. Existing software tools for the study of the Movement of the wild animals in sanctuaries have always been based on the radio tracking technology which have again focused more on data analysis than the required data management. This system of animal tracking with GPS has reported on GPS accuracy [4-5], selecting appropriate GPS collar sampling frequencies [6], and GPS errors on movement characterization. A persisting challenge is labor and huge cost for monitoring all animals in a group [7].

There has not been sufficient research regarding the way to implement a power efficient module consisting a microcontroller for monitoring, and hence sending less redundant data to the BS that effectively visualize the motion of animal on real time and keep a check on them. Another work was conducted with lots of sensors called zebra net and used solar energy out the zebra net suffered from the energy issues and the device was not handy to tie to the animal [8].

Current research included the tracing of entire path covered by animal for a period of time. However, this model suffered from lack of real time data [9-10].

Some tiny pet collars have been researched to track animals, but fail to provide monitoring feasibility. Inertial sensors were used[11] to monitor the behavior of wildlife accurately, but the proposals were lacking of their location. RFID-based tracking system was used in [12-13], but suffered from security issues due to presence of air interface between GSM and RFID.

Zhou *et al.*[14] used infrared thermal camera to track and save the deer's from getting killed in road accidents.

In [15] GPS, GSM and RFID were combined onto a single platform to make the monitoring system more effective.

### A. Research Contributions to the Work

Following are the research contributions of proposed work:

- We have presented an architecture to monitor the movement patterns of animals while they are under observation.
- With the help of proposed hardware module, any immediate decision can be taken as and when required.
- A GSM mobile layer was added to the BS that deals with the requests between the BS and GSM module.
- Estimate the performance evaluation of our proposed scheme over other existing approaches.

## III. METHODOLOGY

In existing system, the operation is based on Accelerometer and WI-FI shield and there is no optional indication was present ,when the animal is crossed the desired boundaries. The only intimation is alarm or buzzer sound. Fig.1 shows the hardware module of existing approach.

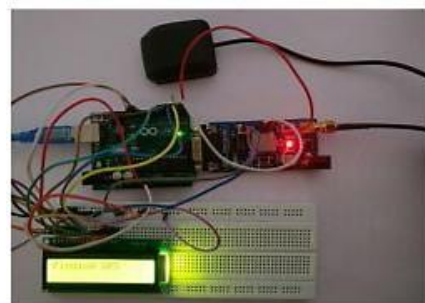


Fig.1: Hardware module of existing system in our proposed approach, we have efficiently used the GPS technology for real time animal tracking. Arduino Microcontroller between BS

and wireless network, as shown in Figure 2. Here, BS is monitored by using appropriate modeling that can visualize the motion path and specific location of the animal. Complete working hardware module of the proposed approach is shown in Figure 5. In this , when animal is crossed the specific boundaries an alternative information is given by GSM module i.e. A message alert and alarm is sounded.

#### IV. SYSTEM ARCHITECTURE AND COMPONENTS

**GPS Module:** GPS stands for Global Positioning System. To accurately find out the geographical on the earth by receiving information from the GPS satellites, a GPS navigation device is used. It is being used in automobiles and Smartphone. It is satellite-based navigation system consisting of 24 satellites placed into orbit by U. S. Department of Defense (DoD).

Initially GPS was invented for military applications only. But in 1980's U. S. Government decided to allow GPS to be used by civilians also [16]. The GPS modem is as shown in below figure.



The Neo 6A [17] is a complete GPS engine module that features super sensitivity, ultra-low power and small form factor. The GPS module provides the micro-processor with different types of data related to the location of the animal. The connection will be made such that the transmitter pins of the GPS module are connected with the receiver pins of the Arduino, and similarly the receiver pins of the GPS module are connected with the transmitter pin of the GPS module.

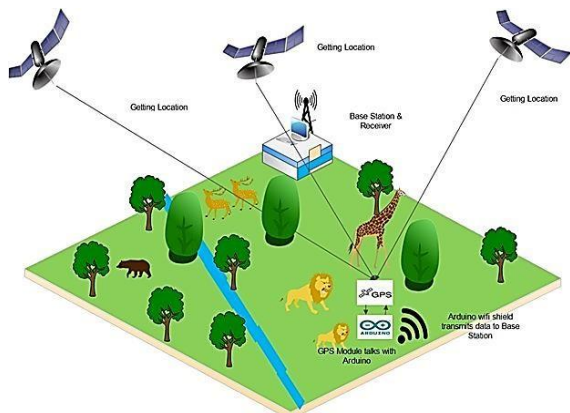


Fig. 2. System Architecture

**Arduino:** The Arduino UNO [18] is used for the implementation of the proposed architecture that comes with the microprocessor: ATmega328. In our approach, general purpose of Arduino is to act as a link between user and the GPS module, which provides a path to read the data from GPS module. are connected with the transmitter pin of the GPS

module. In this we are using two Arduino UNO boards. One is connected to animals and another one is at base station.

**GSM Module:** GSM stands for Global System for Mobile Communication. GSM modem is same as that of mobile phone, which has SIM card. It is used to send SMS to the forest authority [1]. Microcontroller extracts Latitude and Longitude information from the string of data, sense movement of animal and sends it in the form of SMS by using GSM modem. Thus, forest officer come to know the actual geographical location of animal. The below figure shows the GSM modem.[19]



Sim 800 GSM module is used .It is connected to first Arduino UNO for sending message to base station when animal is getting away from the sanctuaries and it sends information about location in terms of latitude and longitude.

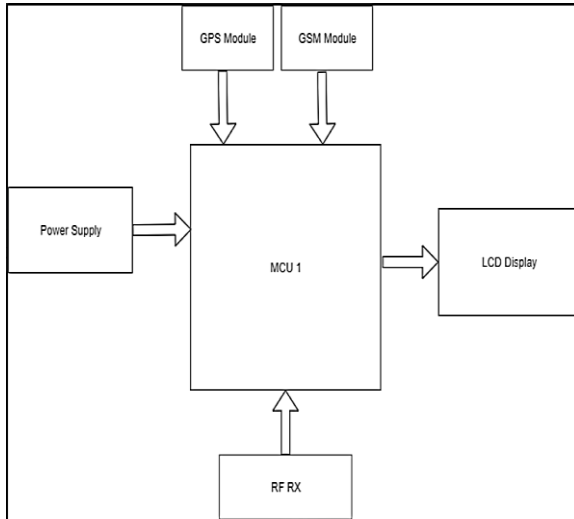
**RF Receiver and RF Transmitter** receiver and one LED is connected to first Arduino and It is located at the animal and receives data transmitted from the GPS and GSM on the module attached on the animal and the location is detected.

Transmitter is connected at base station Arduino. When the animal moves from out of range the transmitter lost the signal and LED will turn off.

**IR Sensor:** Infrared Sensors are connected around the Sanctuaries. By the motion of animals, it will sense and gives intimation to base station by turning on the lamps and gives alarm alert to base station by switching on the buzzers. The below figure shows the IR Sensor module.



**Lamps and Buzzers:** Lamps and Buzzers are connected to second Arduino .They both are gives information to base station when animal is getting away from the sanctuaries.



**Fig 3 :** Block Diagram used at Animals

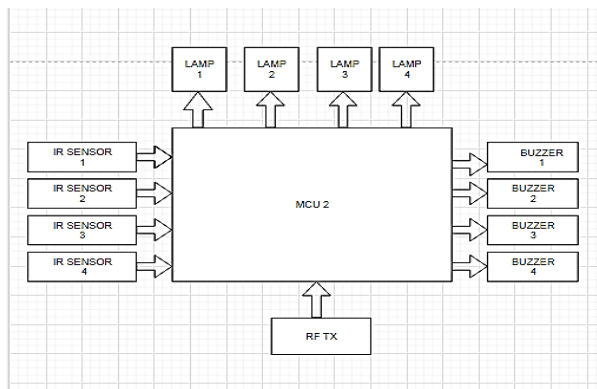
Where

MCU 1 is the microcontroller Arduino UNO 1

RF RX is the radio frequency receiver

GSM is the Global System for Mobile Communication

GPS is the Global Positioning System



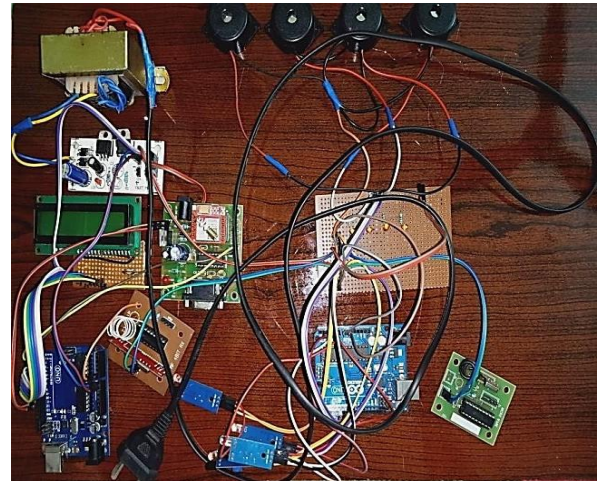
**Fig 4:** Block Diagram Used at base station

Where

MCU 2 is the microcontroller Arduino UNO 1

RF TX is the radio frequency transmitter

IR Sensor is the infrared sensor



**Fig 5 :** GATA Working Hardware Module

## V. RESULTS AND DISCUSSION

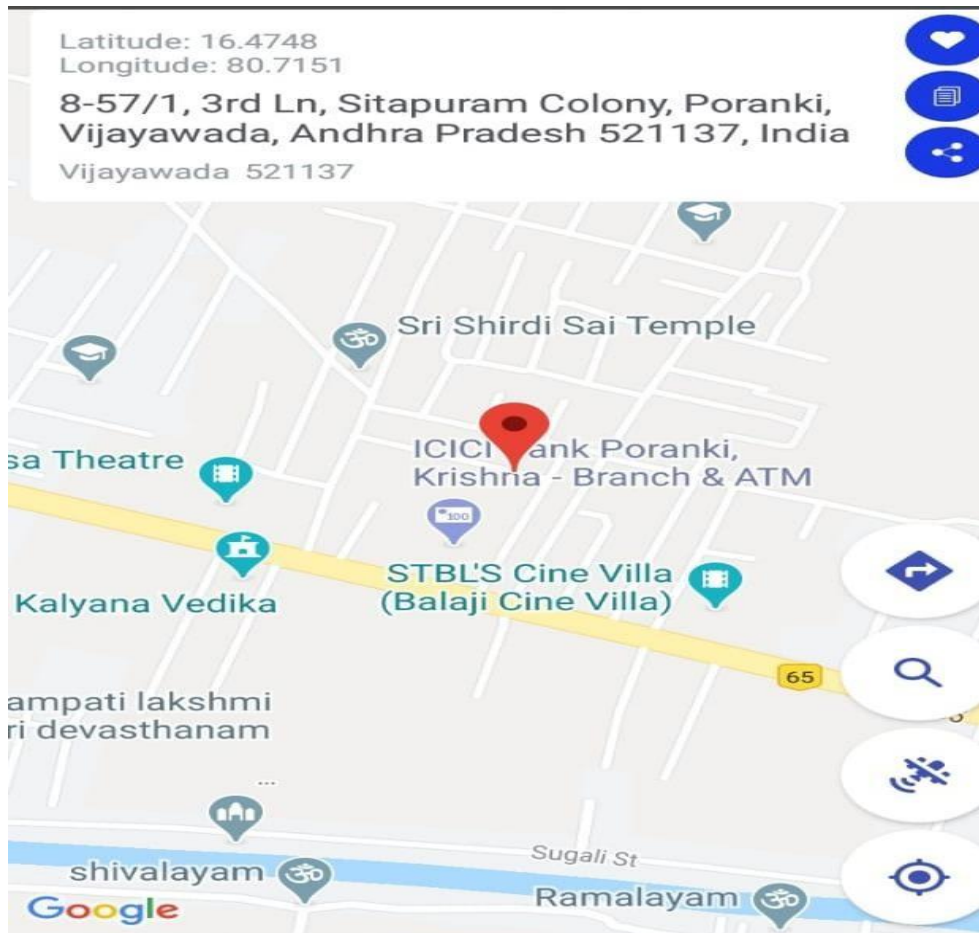
For the implementation of the various scenarios as discussed in earlier section, we have implemented our proposed approach and were able to get the desired results. The GPS module works only when IR sensors are activated. According to this project, whenever an animal goes out of the boundary the LED in its receiver section is changed to off state and so an intimation is sent to base station. For actual implementation of the proposed approach, module was tied on the neck of a domestic cow, as shown in Figure . Cow was allowed to move around freely in our society campus. In scenario 1, three cows are moved in three different paths, not triggering any alert as they were in the vicinity of the defined boundaries. Scenario 2 disrespects the event when one cow moved out of the boundaries and sounded an alert at the BS. Scenario 3 disrespects the event when two cows moved out of the boundaries and sounded an alert at the BS ,i.e. , two buzzers are sounded and two lamps are activated. Scenario 4 defines when the GPS signal is lost, i.e. when the module had drained its battery, an alert was sounded regarding the same and pointing its last known location. We can observe that when the cow is at rest, power is also conserved and unnecessary usage is also avoided.



**Fig. 5:** Different scenarios of proposed scheme (a) Scenario: 1 Three animals under monitoring, (b) Scenario: 2 An animal crossed the boundaries that were defined, an alert was sounded off at the BS, (c) Scenario: 3 Two animals are crossed the boundaries that were defined , two alerts are sounded off at the BS (d)Scenario: 4 GPS module malfunctioned and animals



**Fig:6** - The above figures show the alert messages sent to mobile via GSM module



**Fig:7** - The above figure shows the details of location from latitude and longitude Information

## VI. CONCLUSION

Due to rise in movement of animals from the forest area to residential area, now time has come to take strict decisions by the Government agencies to monitor the animal tracking on a continuous basis.

New mobile tracking/searching system in a compact platform for animal behavior toward GSM networks is proposed in this paper. We practically utilized the mobile phone - Android OS - function for easy-to-use for mobile users to observe the animal location over environmental and global location data.

This paper proposes a new system called GATA (GPS- Arduino Based Tracking, Alarm and Message Alert System for protection of Wildlife Animals) that combined GPS technology, Arduino UNO and GSM module. Because we chose the use of Arduino UNO, Android OS, GSM, and GPS System mainly because of the availability and accessibility with an open platform architecture and reasonable cost. Each module is also self-contained and not complicated to troubleshoot to recreate and analyze for research community.

Our proposed architecture was also implemented in hardware and tested on animals using an Arduino UNO, GPS and GSM technologies. The module was utilized to keep a check on the animal to not cross predefined boundaries and sound an alert if it does so. Each module used so far, is known to be very less complicated to be troubleshooted, and for further analysis.

This would eliminate human, animal death and injuries and can also help the forest departments or any other responsible authorities to monitor their movement so that they do not stray out of their habitation zone.

Our proposed architecture was also implemented in hardware and tested on animals using an Arduino UNO, GPS and GSM technologies. The module was utilized to keep a check on the animal to not cross predefined boundaries and sound an alert if it does so. Each module used so far, is known to be very less complicated to be troubleshooted, and for further analysis.

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