GPS based Animal Tracking with SMS Alert

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***Abstract*— Animal tracking system is based on the Global positioning system (GPS) that receives the signal from GPS satellite. This project is a tracking system with a modem connected to it. So, if the user wants to know the location of a particular animal then the user can send the message to the GSM modem then the microcontroller ATmega328P collects all the data from the sensor like temperature sensor, accelerometer MPU 6050. The received data is processed and provided in the form of longitude and latitude to the GSM module. GPS Module synchronizes with ATmega328p microcontroller and temperature as well as accelerometer sensor to inform the authority about the present condition of the wild animal. The intention of this system is to inform the forest officer. They can proceed their further step to save the animals. For this target a simple prototype is developed due to which the data can be measured by the sensors then SMS can be sent to the concerned number so that the location of the animal can be determined.**

Keywords: GSM, GPS, SMS, Animal tracking

I. INTRODUCTION

Every living creature on this earth has an important role in the ecosystem. At this time the wild animals are more prone to trafficking so they are now endangered. So, in every country we see that there are wildlife animal reserves and national parks where these animals can live freely in the forest however these are monitored by human beings. Also, now days these wildlife national parks have become popular for a tourist area. Now day's wild animal becoming less in number because of Forest destroyed by human civilization. It is important to save the life of wild animals in the sanctuaries. In every year wild animals tracked and killed by people. But these animals also undergo some disease, movement of animals can destroy. Due to a disturbance in the movement of animals suffering from some diseases. Endangered animal like Rhinoceros, Elephants, White Tiger, Panda and many other animals.

Nepal is a tourism place containing different national park and wildlife areas. Recently it contains ten national parks, three wildlife reserves and six conservation areas. Animal location, movement, and body temperature of the animal can transfer to the officer of wildlife/national parks. If there are some wounds on the animal body and because of wounds temperature of animal rises, then the system can send SMS to the forest officer so he/she can give immediate attention. Also, if an animal goes out of the wildlife area then the system can send the SMS to the forest officer so he/she can give immediate attention. If someone tries to kill the animal movement of the animal can drastically change to its limit and send SMS to the officer. World Wide popular animal Trafficking by people. This system gives animals' information to the officer. The objectives of this project are to track the animal, to sense the temperature and motion and to alert the user with SMS.

II. LITERATURE REVIEW

GPS wildlife tracking is a process whereby scientific researchers or conservation agencies can remotely observe relatively fine-scale movement or migration patterns of wild animal using the Global Positioning System and optional environmental sensors This kind of technology is very useful to protect the endangered animal like One-horned rhinoceros (Eksinge gainda) Scientific Name: *Rhinoceros unicorns*, Red panda (Habre) Scientific Name: *Ailurus Fulggen*, Bengal tiger (Pate Bagh) etc. GPS and GSM based animal tracking system is a combination of GPS module, GSM module, Arduino microcontroller, temperature sensor and accelerometer sensor which can track the wild animals from any remote area to the authority, which helps in keeping track of animals health, death and much vital information required for ecological research. Here this system is attached to the Animals body to which GPS satellite sends the longitude and latitude value to the GPS receiver which then sends the information to the microcontroller, then microcontroller sends required message to GSM module which then sends the message to the registered number. By this process authority will be in contact with the animals for the required information.

In Nepal, endangered species, including rhinos and tigers, are suffering from the combined effects of poaching and habitat destruction. The drones can address both. The small-scale, remote-controlled drones are still being refined. They are light enough to be launched by hand and fly a pre-programmed route of up to 20km (12.5 miles), filming the ground below with stills or video camera. If they see poachers in the area, they can send out a team to catch them [1].

Due to rapid poaching of Elephant in Malaysia. Research is carried out in the University of Nottingham "Tracking endangered elephants with satellite technology". Once the GPS collar is fitted the elephant's whereabouts can be tracked in the field using VHF radio signal or at any location with an internet connection to access the GPS locations transmitted by the collar via satellite phone. The project is also looking at non-invasive techniques to extract DNA and hormones from elephant faces, developing cost-effective strategies to mitigate human-elephant conflict and improving our understanding of elephant ecological function in tropical rainforests [2].

The Clark GPS Animal Tracking System includes GPS-based tracking collars and a hand-held, mobile base station. These collar electronics are then contained within a watertight housing, which is mounted on a collar that can be sized for different wildlife species. The tracking collar collects and stores time-stamped data for the geographic location of the collar, which can be downloaded to a distant base station using the radio transceiver. To complete the one collar including all expenses and labor required for the construction costs about $840 [3].

P. A. Lemnell [4] filed a patent in US named "Animal Tracking System" which can indicate the direction and behavior of animal such as hunting dog. RF transmitter and receiver was used for data transmission.

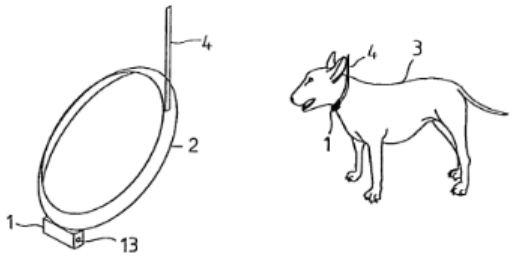

Fig.1. Design of an animal tracking system [4]

H. Rebeecca et al. did a case study in northern Australia demonstrating "the potential for combining GPS collars and satellite images in a WSN to monitor behavioral preferences and social behavior of cattle" [5, p. 3586].

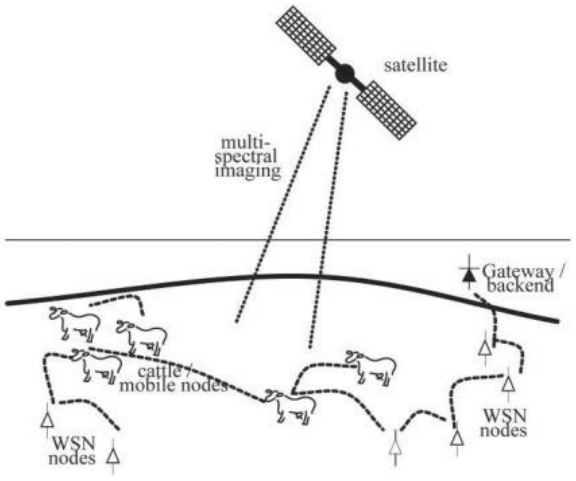

Fig.2. GPS with Wireless Sensor Network (WSN) implementation in northern Australia [5, p. 3591]

III. METHODOLOGY

A. Block diagram of a system

The system consists of a GPS module, temperature sensor (LM35), Accelerometer (MPU 6050) and GSM Module all handled and controlled by ATMega328 Microcontroller.

The project revolves around the core concept of serial communication. The GSM Modem is interfaced with the microcontroller (ATmega328p). A GPS module is used to detect the location of the wild animal, a temperature sensor is used to sense the temperature of the wild animal and accelerometer is used to detect the orientation of system in three different coordinates.

The overall system is controlled via mobile phone which communicates with the system via GSM Module (SIM 900A) for the tracking of the animal, to

get their location and for the temperature and vibration of an animal.

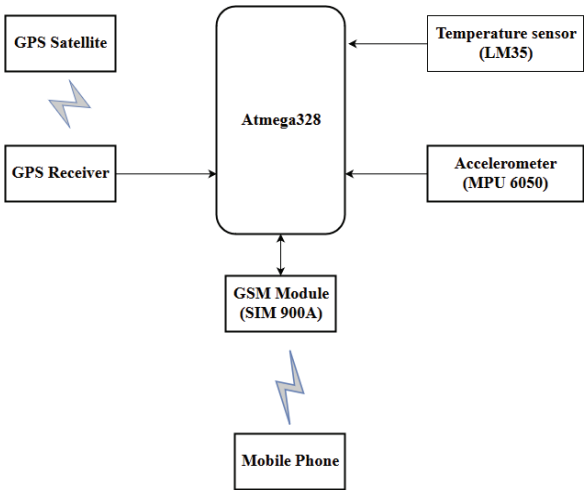

Fig. 3. Block Diagram of system

B. Flowchart of the System

This project is developed for the purpose of tracking endangered animals to facilitate the required protection to save them. In this system user send a message to the system to access the required data. This projects basically involves AVR ATmega328P microcontroller and a GSM module. Here the microprocessor collects the data from GPS module, temperature and accelerometer sensors then it sends the information to the registered number.

In this tracking system, the device collects the data for every instance. Then, if the animals cross the predefined boundary then it automatically sends a message of the animal's location continuously. Then if the animal is in the predefined boundary then if users send the "location" then the system sends the data to the users.

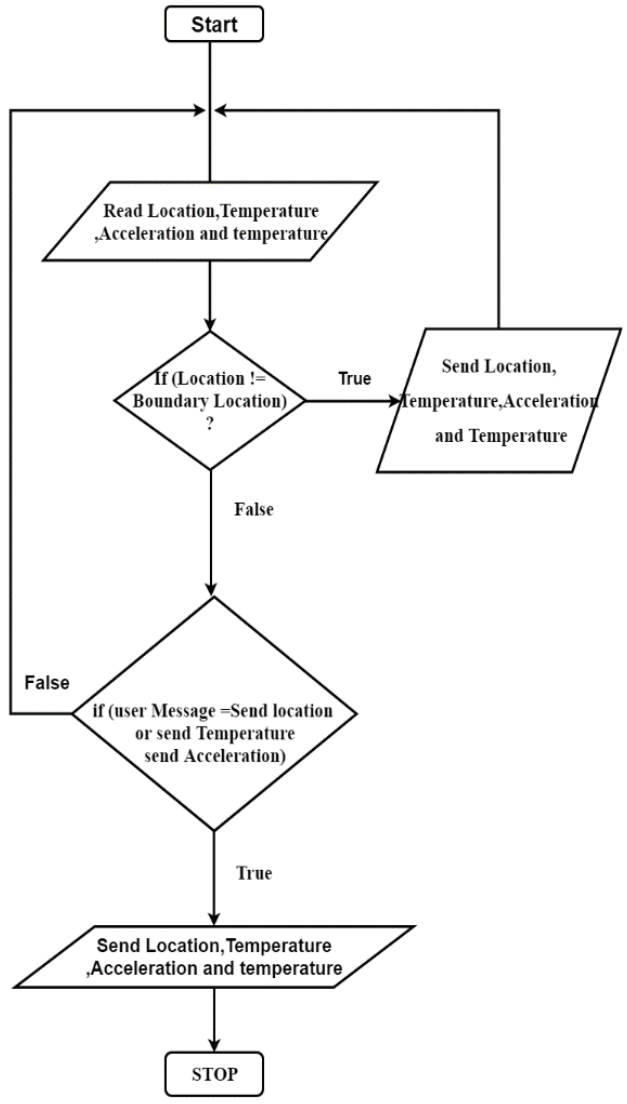

Fig. 4. Flowchart of the System

IV. RESULTS AND DISCUSSION

A. Location tracking

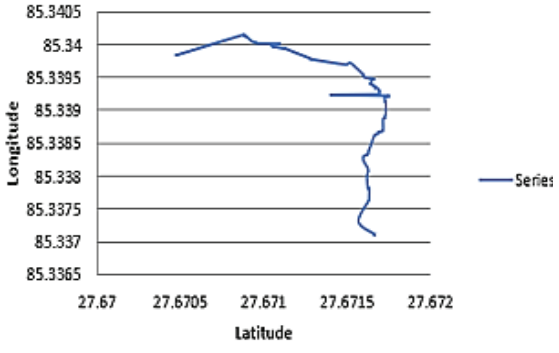

Fig. 5. Latitude vs Longitude data

As testing of the GPS module, the obtained latitude and longitude can be represented in map form using google map as shown in figure below. The testing is done inside lalitpur.

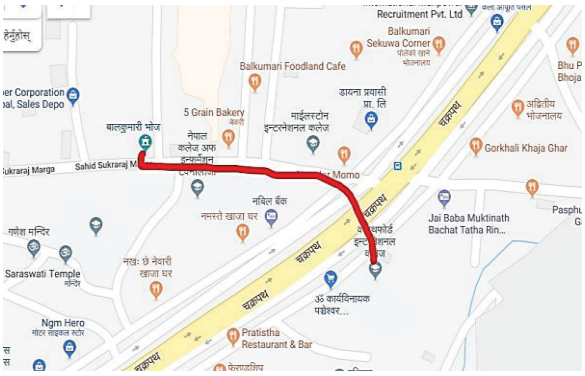

Fig. 6. The 2D map of the tracked location (Google Map)

B. Monitoring the temperature and orientation

The temperature sensor and accelerometer are used in the system for monitoring the temperature and motion/vibration of the testing entity which provides the basic health status to the concerned user.

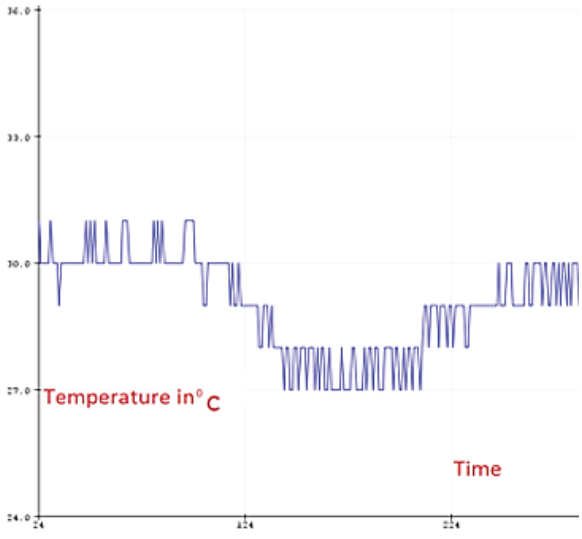

Fig. 7. Temperature vs Time (ms)

This is the snapshot of Arduino IDE serial plotter at 9600 baud rate measuring temperature by LM35 which is based on laboratory testing of the temperature sensor on different time interval at different temperatures showing the variation in 27-33 degree centigrade. Also the outcome of the testing of an accelerometer is shown in figure 6. The accelerometer gives the value in x, y and z coordinates by which the status of orientation of the animal can be determined so that required action can be taken if found abnormal.

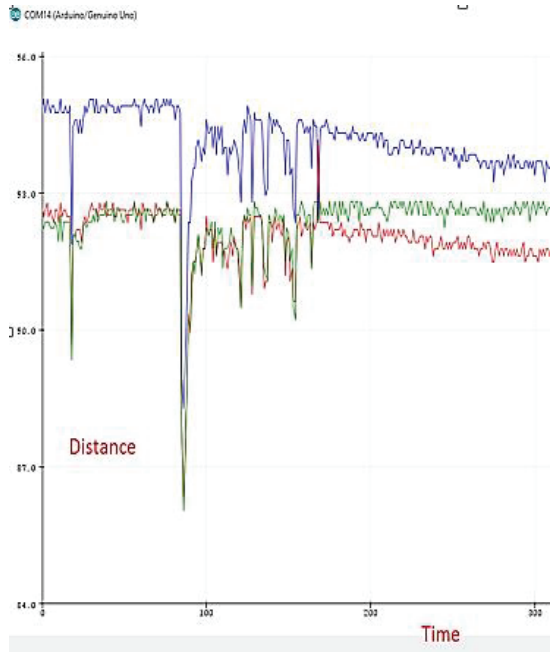

Fig. 8. Orientation vs Time (ms)

This is the snapshot of Arduino IDE serial plotter at 9600 baud rate measuring x, y & z orientation by the accelerometer which is based on laboratory testing of the on different time interval at different temperatures showing the variation in x, y & z coordinates.

C. SMS Alert

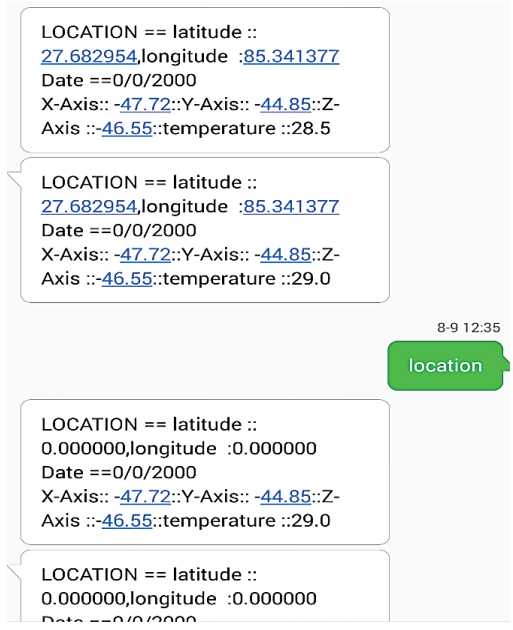

Fig. 9. SMS via GSM module

If the user sends message "location" to the system then the system provides the location of animal, acceleration of animal in coordinate format and temperature in degree centigrade as shown in figure 5.

The summary of power requirment by the designed system is tabulated as follows:

Table 1: Power Requirement of System

Component	Operating Voltage	Operating current	Total power	Remarks
GPS Module	3.5V	45mA	0.157 5 Watt	Its working temperature -40 to 80 ºC
GSM Module	4.5V	2A	9 Watt	GSM give high performanc e at 2.5A- 3A
Accelerome ter Sensor (MPU6050)	3.46V	100 mA	0.346 Watt	
Temperatur e Sensor (LM35)	12V	60µA	720 µWatt	
AT Mega 328p	2.4 V	20 µA	48µW att	
Total	25.86 V	2.145 A	9.54 Watt	

Comparing the designed system with existing system, it is seen that commercially available tracking systems have the data storage capacity needed to frequently collect animal location data, also evaluate animal behavior at fine spatial resolution. The designed system is limited up to laboratory and on campus testing. It is intended to attach the system to the neck of animal such that sensors will be very close to the body of that animal but this system is not tested in real wildlife zone.

V. CONCLUSION

The designed system has three major functions; first of all it can track the location then monitor the health status, finally alert the user in two different ways i.e. on the request basis or the direct alert. By increasing the other sensors other hygienic parameters of animal can be determined. Hence, by using GPS and GSM technology it is possible to locate animals and monitor their health issues.

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