Wild Animal Movement Monitoring and Automated Alert System for Enhanced Forest Safety and Protection of Animals

Dr. V. SHAVALI[1], K. JASWANTH KUMAR[2], E. INDU[3], E. CHANDANA[4], C. RENUKA[5],

C. MANIKANTA[6], B. ANIL PRASAD[7]

[1]ASSOCIATE PROFESSOR, [2,3,4,5,6,7]STUDENT

[*1,2,3,4,5,6,7] Department of Electronics and Communication Engineering, SVIT, Anantapur, Andhra Pradesh, India.

Abstract - With the rapid innovations of wild life tracking technologies have made an enormous impact in ecology and conservation as movements and migrations of animals along with the areas being utilized as habitats can now be monitored This project paper outlines a developed strategy to prevent human and wildlife injuries and loss of life caused by animals straying beyond the boundaries of national parks and wildlife reserves. This project aims to develop a small and less power- used animal monitoring device using modern microcontrollers like ESP32 and GPS and GSM module and a temperature sensor for monitoring the body temperature of animals. This system will be able to integrate with ESP32 microcontroller and GPS and GSM module so that it sends data to a server for processing and send location information to user interface This flexibility of the approach is nearly unmatched because open-Source hardware and software are easier to modify and lower the complexity of the systems being used. Making it a useful solution for monitoring wildlife associated problems like illegal hunting, train disruption, prevention of Poaching, danger posed to humans by free-ranging animals.

Keywords-ESP32, GPS module, GSM module, temperature sensor, Poaching Prevention, Wildlife reserves.

1. INTRODUCTION

Wild life conservation is implementation of preserve or safeguard of wild animal species and their habitat it aims to ensure that nature will be around for future generations to recognize the importance of wildlife and wilderness for humans and other species alike this wildlife conservation holds seriousness as wildlife is essential in balancing the ecosystem and stabilize the different natural processes.

From the point of view of various surveys and reports The Earth has lost greater than 58% of its wildlife since 1970, and is presently experiencing its sixth mass extinction. While previous mass extinctions were caused by natural causes like asteroid impacts, volcanic eruptions, and climate shifts, however, the sixth mass extinction in contemporary times is due more to human-caused problems. Various issues include deforestation, habitat demolish, pollution, climate change, poaching, and the over exploitation of natural resources have accelerated the decline in species. India is home to a rich biodiversity featuring 104 national parks, 551 Wildlife Sanctuaries,131 Marine Protected Areas, 18 Biosphere Reserves, 88 Conservation Reserves and 127 Community Reserves, covering a total of 1,65,088.57 square kilo meters. These are used to save and protect the wild animals. Incidents occur where animals stray from their habitats into local human populated areas where they either kill or injury people or themselves get injured or killed. This has been happening with increased frequency and is fast becoming an issue of concern. To deal with those issues, many proposal systems are existed, but these systems have their own issues like delay in sending message alert to Base Station and wrong interfacing.

2. LITERATURE SURVEY

[1] In GATA: GPS -Arduino based Tracking and Alarm System for Protection of Wild Animals, Authors were Vora, S. Tanwar, S. Tyagi, N. Kumar, M. S. Obaidat. They used Arduino; Wi-Fi shield; accelerometer; this system allows for tracking animals in real-time by using those components. Sending alerts when animals cross boundaries, this is used as field trials on domestic animals showed that it was able to monitor animal movements relatively easily and at lower cost. This system suggested that the study has demonstrated the possibility for such systems to reduce accidents and poaching from illegal activities and reduces human-wildlife conflicts. This system is reliant on Wi-Fi shield making it less useful in remote areas since GPS and Wi-Fi work continuously which draw on battery life of the system, this system had some limitations regarding to networks and battery life and need improvement on the range of the system.

[2] In Automatic Tracking and Alarm System for Eradication of Wild Life Injury and Mortality, Authors were Nirit Datta, Souvik Sarkar, Ashutosh Malik, Deepak Punetha. This research presents an automatic tracking and alert system based on GSM and GPS technology to facilitate animal movement behavior in national parks and sanctuaries. It uses GPS enabled tracker which monitor the Animals location if the animal leaves the predetermined zones in which it would be tracked and sends alerts by way of GSM - System of alerts built in human-populated areas for the residents of these areas. This system offers an efficient means of notifying local communities and in remote wildlife reserves or dense forests network connection may be interrupt the absence of energy efficient systems like ESP32 and some mechanisms for constantly tracking animals means battery replacements would likely be a recurring hassle in long term use.

[3] In Tracking Animal Location and Activity with an Automated Radio Telemetry System in a Tropical Rainforest, Authors were Roland Kays, Sameer Tilak, Margaret Crofoot, Tony Fountain, this ARTS program is used for monitoring animal movement among the diverse trees in a tropical rain forest using radio telemetry which doesn't use any micro controllers uses only radio signals for tracking animals this is more cost effective than traditional GPS collars while providing continuous guidance it also provides high-resolution tracking data and that can be streamed live. This system Uses GPS collars are more accurate and it is ideal solution for tracking a smaller species. This system is more expensive because radio signal receivers are to be placed on top of the mountain and which requires organizations to rely on multiple base stations for effective coverage over large areas. It is not as appropriate for tracking animals as GPS making it less suitable for precise tracking applications Since electronic sensors employed in the rain forest environment may wear out and fail due to environmental use.

[4] In Automatic Detection of Moving Wild Animals in Airborne Remote Sensing Images, Authors were Yu Oishi and Tsuneo Matsunaga, this research utilizes airborne remote sensing images for the detection of moving wild animals with a cutting-edge image processing algorithm, this algorithm developed was able to successfully detect large sized mammals within snowy conditions because low visibility environments such a dense forests or periods of cloudy conditions lessen proper detection. This algorithm was also primarily tested in snowy environments The algorithm created is able to independently identify moving animals in airborne remote sensing images, showing an improvement for further detection over manual viewing. The research assessed the algorithm on high-resolution aerial photos and successfully extracted dummy targets in 2000x2000-pixel images, demonstrating its potential for large-scale wildlife monitoring efforts.

3. PROPOSED METHODOLOGY

In our System we used various technologies including GPS module and GSM module and ESP32 micro-Controller based systems these are utilized to create a real-time animal tracking and alert generation system. The System prototype construction involves several components which are working together to monitor the animal movement and provide alerts to authorities in the event of a breach of boundaries or temperature. Below is the detailed description of the components which are used in our system.

3.1 Block Diagram

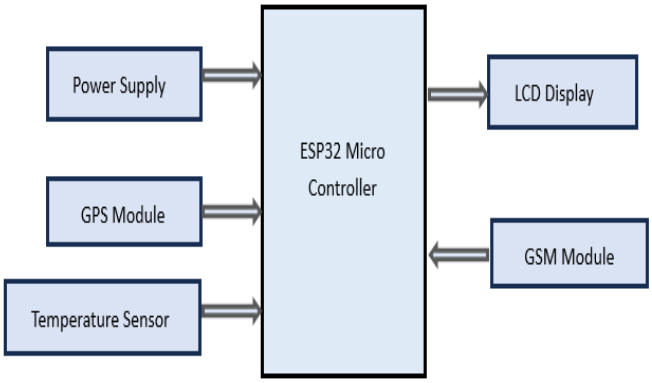

Figure 1: Block Diagram

a. ESP32 Micro-Controller

This ESP32 act as a main controller of the system which linking GPS, Temperature sensor, GSM and LCD display. After reading data from the GPS and DS18B20 sensors, the ESP32 will process the information and determine if the animal has breached the defined borders or if the temperature exceeds the threshold. If either of these situations occur, the ESP32 will send a notification to the user via SMS from the GSM.

b. Temperature Sensor

DS18B20 is a sealed digital temperature sensor used for sensing temperature of animals. If temperature threshold

is exceeded, it will notify the system and warn the authorities nearest to the animal about the potential danger to the animal.

c. GPS Module

The NEO-6M V2 GPS module is utilized to find the specific location (latitude and longitude) of the animal. The GPS module has high sensitivity that provides latitude and longitude data under critical circumstances. The GPS module subsequently sends the location information to the ESP32 microcontroller, which takes action to process the location data and show it on the LCD.

d. GSM Module

The SIM800L GSM module allows the system to notify when the animal crosses a boundary or exceeds the dangerous temperature, delivering SMS notification via UART to the ESP32, which will send a text message and google Maps location to several predetermined phone number.

3.2 System Architecture & Working Principle:

The ESP-32 Micro controller based Wild Animal Monitoring and Alert System has set of features designed to monitor and track the location of wild animals in real-time and it also monitors their body temperature using a built-in sensor system. This system operates in two autonomous modes which are Normal mode and Alert Mode. In the First mode which is in Normal mode the animal's GPS location is updated continuously in real-time on an LCD display and in an alert mode, it takes or generates immediate action when the temperature Exceeds a user defined threshold temperature.

This system uses the ESP32 to initialize all hardware components which are DS18B20 temperature sensor; the NEO-6M GPS Module; the SIM800L GSM Module; and the I2C 16x2 LCD display; necessary for functionality.

The NEO-6M GPS module gets co-ordinates means latitude and longitude of where the animal is located and the DS18B20 temperature sensor can determine the body temperature of animal. All values are updated and displayed continually on the screen in real-time for monitoring the animal's vital data. The System checks the temperature of animal by reviewing the readings from DS18B20 sensor. This system will remain in a state of Normal mode as long as the body temperature is under threshold temperature and will simply update location of the animal in GPS format and displays on LCD display.

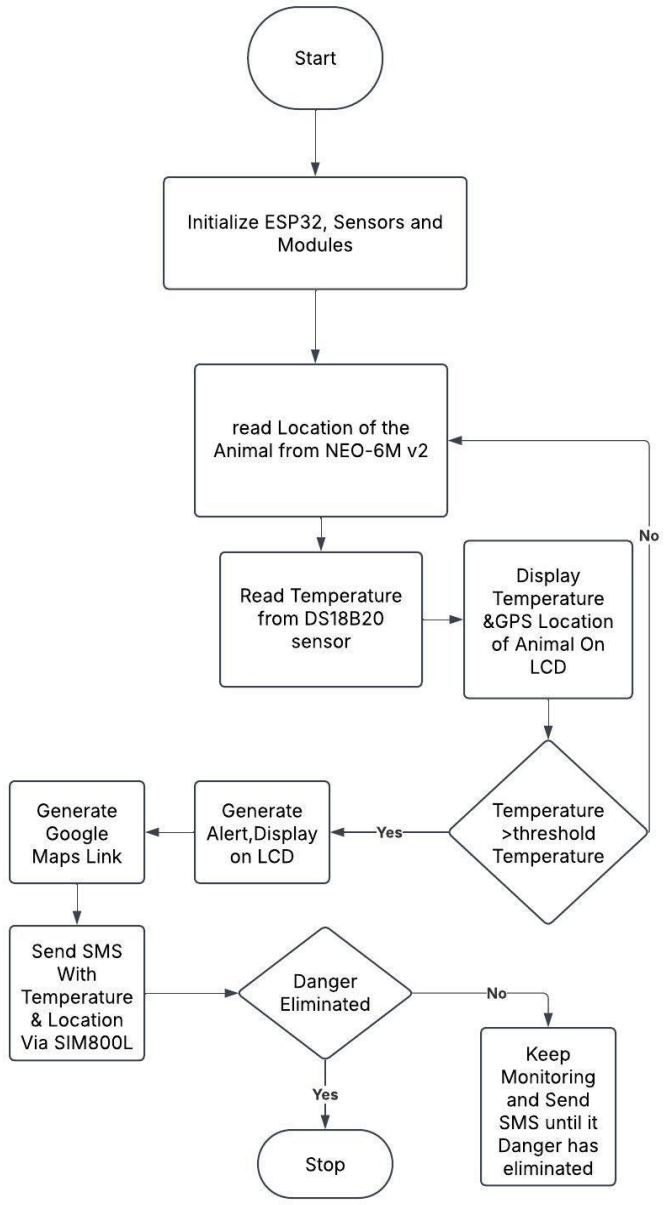

Figure 2: Flow Chart of Working of proposed system

The alert mode activated when that the temperature exceeds the designated threshold. In alert mode GPS location is queried again for precise location information, and the LCD is loaded with an updated temperature reading. Once in alert mode the ESP32 generates a google maps link with the animal's GPS co-ordinates. The ESP32 communicates with SIM800L GSM module via UART to send an SMS alert that includes current temperature reading and the location link to a number of users like researches or conservationists to take action.

This system will continue monitor and check for danger to ensure the threat is resolved means the temperature is

below the threshold again, if danger persists, the system will continue to send SMS alerts at the predefined SMS frequency and until concerns ease. Once the system stabilizes temperature, the system will return to Normal mode. Through the combination of IOT-based monitoring with wireless communication the system allows for rapid action to assist in preventing illegal activities, poaching prevention, to improve conservation of habitat & animals and for animal safety and wildlife research purpose.

3.3 Hardware Implementation

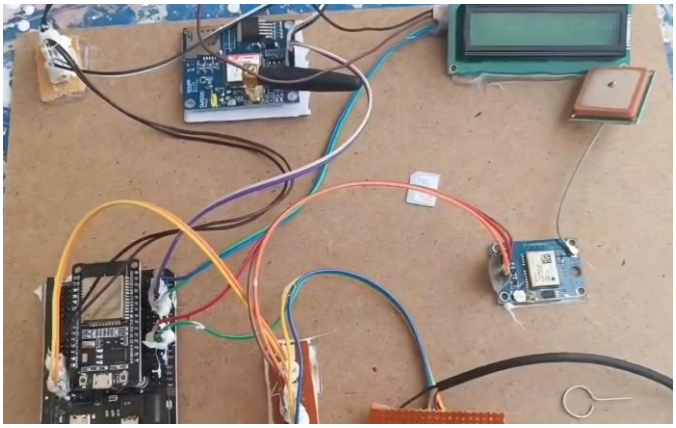

Figure 3: Physical Connection of System

This Wild animal monitoring and alert system is based on ESP32 Micro-controller, this system utilizes both hardware and software algorithms where the firmware for the ESP32 has been created with Arduino IDE programming with libraries used for GPS was Tiny GPS++ and for DS18B20 was one wire, Dallas temperature library and for GSM Software Serial commanding AT commands libraries.

4. RESULTS

Since we found that this system monitors animal temperature and GPS location in real-time and it generates accurate and timely SMS alerts to registered mobile number when the temperature exceeds the threshold and provides a google map location link.

Figure 4.1: Initializing Wild Animal Tracking System

Figure 4.2: Getting GPS co-ordinates of Animal

Figure 4.3: latitude and longitude values of Animal

Figure 4.4: initial temperature of Animal

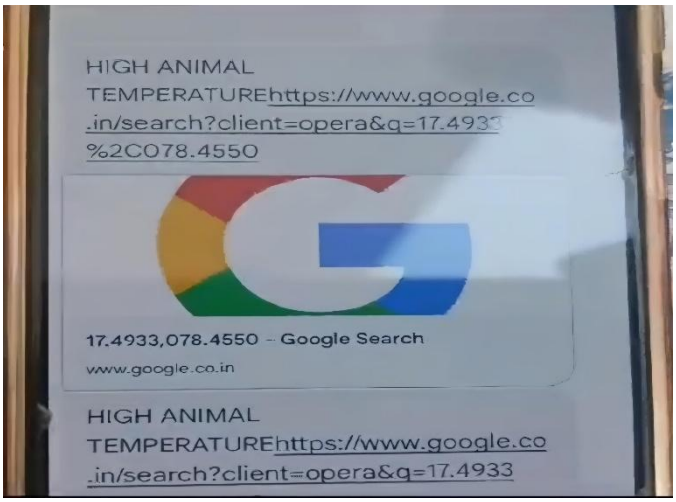

Figure 4.5: High temperature alert SMS and google map link when temperature exceeds threshold voltage.

Figure 4.6: Temperature exceeds the threshold temperature.

5. CONCLUSION

Our developed wild animal monitoring and alert system establishes reliable and reusable alternative systems for the conservation of wildlife species. This system facilitates remote monitoring with continuous tracking of temperature and location of the animal on a connected LCD to the micro-controller. This system will continuously upload GPS location when animal temperature exceeds threshold temperature of 33.7^0C it obtains GPS location again and automatic SMS alerts are sent to the registered mobile number with temperature readings and google maps link, and by using commands we can continue monitor the location of animal. The results of testing show that our system has a capability of a high-level accuracy of GPS tracking (±2.5m) and accurate readings for temperature tracking ($\pm0.5^0$C) and SMS alerts are sent efficiently about the animal temperature and location within 5 seconds. Overall, our system can enhance protection for wildlife to prevent poaching, enhance detection to mitigate disease transmission in wildlife through early detection and enhances conservation of wildlife animals.

6. FUTURE SCOPE

In the future it has the ability to run on solar power for more energy efficient manner and integrating in more sensors to obtain more monitoring.

6. REFERENCES

[1] Nirit Datta1, Souvik Sarkar2, Ashutosh Malik3, Deepak Punetha4 “Automatic Tracking and Alarm System for Eradication of Wild Life Injury and Mortality” 2016 IEEE.

[2] Roland Kays1,2, Sameer Tilak3, Margaret Crofoot2,4, Tony Fountain3“Tracking Animal Location and Activity with an Automated Radio Telemetry System in a Tropical Rainforest” Advance Access publication on 12 August 2011.

[3] Images Yu Oishi1, Tsuneo Matsunaga2 “Automatic Detection of Moving Wild Animals in Airborne Remote Sensing” IGARSS 2010.

[4] M. Gor∗, J. Vora †, S. Tanwar ‡, S. Tyagi §, N. Kumar ¶ “GATA: GPS-Arduino Based Tracking and Alarm System for Protection of Wildlife Animals” 2017 IEEE.

[5] Dr. Mohsin Ali Gazi*” Health Monitoring of Wild Animals- An Overview” January 25, 2025.

[6] [1] Mattisson “Effects of species behavior on GPS Collar Fix Rates”, (2010).

[7] A. Tovar, T. Friesen, K. Ferens- “A DTN wireless sensor network for wildlife habitat monitoring” 23rd Canadian Conference on Electrical and Computer Engineering (May 2010).

[8] Lorenzo Quaglietta- “A Low-Cost GPS GSM/GPRS Telemetry System: Performance in Stationary Field Tests and Preliminary Data on Wild Otters” Journal, January 2012, Volume 7 Issue 1.