Smart Forest/Zoo Monitoring System Using Wireless Sensor Network & Android Application

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***Abstract* - In this paper, we present the design of a prototype system of Smart Forest/Zoo Monitoring System using WSN & Android Application that allows forest officers or zoo guides to effectively find animals nearby their location. The proposed scheme consists of Wireless Sensors Networks, embedded web-server, central web-server and Android mobile phone application. In the system, low-cost wireless sensors network modules are deployed all over forest/zoo animals with different sensors nodes. The location of the animals nearby will be detected by sensor node and is reported periodically to embedded web-server via the deployed wireless sensor networks. This information is sent to central web-server using Wi-Fi networks in real-time, and also the forest officers or zoo-keeper can find nearby animals using Standard Mobile devices.**

Keywords*- *Wireless Sensor Network, Android, Arduino MEGA, ZigBee, End Device, PIR (Passive-Infrared Sensor).

I. INTRODUCTION

Researches regarding animal detection have been an important field to numerous applications. Many algorithms and methods have been deployed by human beings in order to have a better understanding on animal behaviour [1]. This application can also act as a warning system to the forest/zoo officers in order to deal with the wild animals for early precaution measures. The proposed system can be narrow down to three sections, Detection, Tracking and Identification of animal. With the integration of Wireless Sensor Network (WSN), Radio Frequency Identification (RFID), Global Positioning System (GPS) and android smartphone, the development of New Zoological System for animal tracing ability, Identification, and anti- theft for the management and Security and monitoring of animal health in Forest/Zoo.

The proposed work combines the embedded technology with the wireless communication technology. This project deals with the monitoring and tracking of all the wild animals present in forest/zoo. This system even sends the alert to the authority about any emergency. This paper involves the use of PIR (Passive-Infrared Sensor) which senses the presence of animal. It controls every component of the system [1]. This system will send animal‟s latitude/ longitude to the android device and some more added functionalities.

A. Sensors

Sensor is a device which senses the signal as an input from the physical environment. The specific input would be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is a signal that is changed into human-friendly display at the sensor location or transmitted electronically over a network for reading or processing. Our Wireless senor system can be divided into two sections. Our

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B. Boundary Section

This section monitors the boundary of the forest. The intrusion of the animals into the village areas near the forest will be detected and avoided in this section. The Infra- Red or Passive Infra-Red sensor is used to detect the motion of animals in the forest border. The ZigBee receiver will receive the signal from the ZigBee transmitter of the animal section whenever the animal is moving towards the forest boundary. When the presence of the animal is detected near the boundary area the controller sets the alarm. This will help to warn the localities near the forest boundary areas and also to scare the animal away from the boundary areas. All these information is updated in the cloud through the Wi-Fi module (ESP8266).The block diagram of this section is as shown below [1].

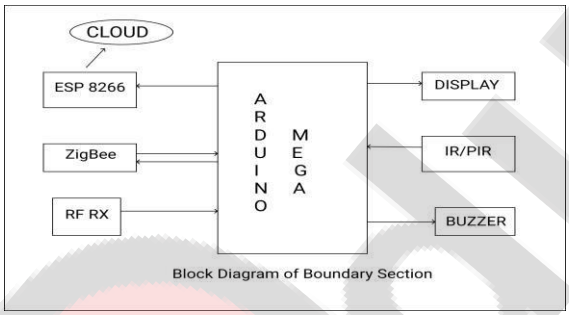

Fig. 1 Block Diagram of Boundary Section

C. Animal Section

This section is used for detection, tracking and to monitor the health of wild animals. The temperature sensor monitors the health condition of the animal. The ZigBee transmitter transmits signal to the receiver at the boundary section if the animal is moving towards the boundary area. The GPS modem tracks the location of the animal and the location is updated to the cloud through the Wi-Fi module and this information is sent to the android device of the concerned authority. The GPS module will receive string from satellites and send to the Microcontroller. The microcontroller will extract latitude and longitude information from string and send it to the Wi-Fi module. And this will be sent to the android device in NMEA data format**.** Below Figure explains the working of the animal section [1].

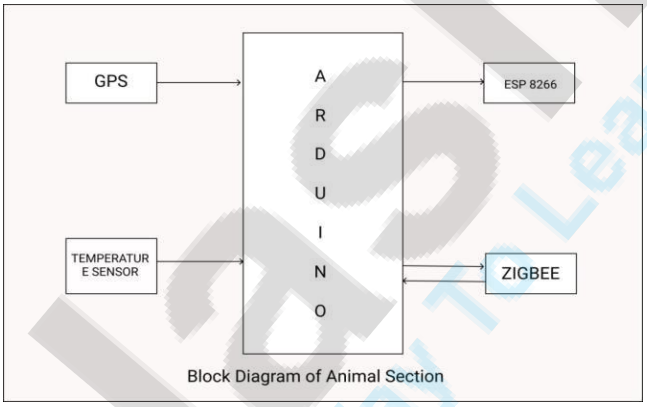

Fig. 2 Block Diagram of Animal Section

D. ZigBee:

ZigBee is built for control and sensor

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networks on IEEE 802.15.4 Standards for wireless personal area network (WPANs), and is the product from ZigBee alliance. It is popular for low data rate wireless applications.

Fig. 3 ZigBee

These devices are used in home automation, medical, energy. In smart energy application ZigBee products are used to monitor & control use of energy and water, which helps consumers save energy and water and save money too.It

has bands of operation such as 868/915 MHz and 2450 MHz.868/915 band provides about 250 kb/s data rates. End devices have the property to go to sleep mode which indirectly saves battery consumption and care about the security of the information which belongs to security layer.

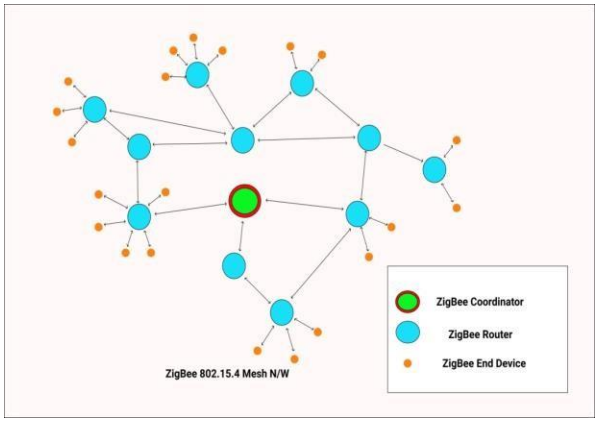

Fig. 4 ZigBee 802.15 Mesh N/W

As shown in the above network diagram, ZigBee network consists of Coordinator (C), router (R) and end devices (E). It supports mesh-routing.

i. Coordinator (C) -

Always have to install first in order to establish ZigBee network services; it starts a new PAN (Personal Area Network). Once started, Other ZigBee components, viz. R and E can join the network (PAN). Its responsibility is to select the channel and PAN ID. It assists in routing the data through the mesh network and allows join request from R and E. It is mains powered (AC) and supports child devices- It will not go to sleep mode.

ii. Router (R) –

First router needs to join the network then it can allow other R & E to join the PAN- It is mains powered (AC) and supports child devices- It will not go to sleep.

iii. End Device (E)-

It doesn‟t allow other device to join the PAN nor can it assist in routing the data through the network. It is powered by battery and doesn‟t support any child devices. This end device can sleep. Hence, Consumption of battery can be minimized to great extent. Two topologies are present viz. Star and Mesh, as mentioned. ZigBee supports mesh routing. PAN ID is used to communicate between ZigBee devices, it is 16 bits number. Co-ordinator will have PAN ID set to zero always and all other devices will receive a 16 bits address, when they join PAN. Two steps in Completing ZigBee Network Installation.

- ✓ Forming the network by Coordinator.
- ✓ And joining the network by Routers and end devices.

E. Arduino Mega

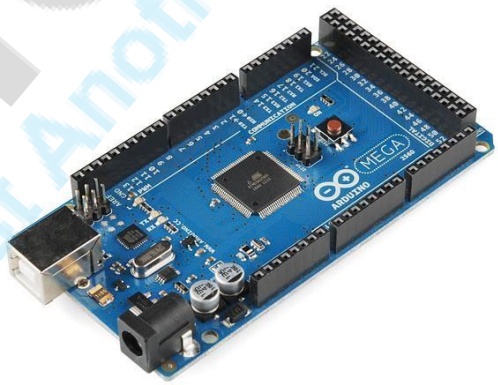

Fig. 5 Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board which consists of 54 digital input/output pins in which 14 pins can be used as PWM outputs, 16 pins for analog inputs, 4 pins for VARTS-hardware serial ports, 16 MHz crystal oscillators, a USB Connection, a power jack, an ICSP header, and a reset button. It consists of each and everything required supporting

the microcontroller, just connecting it to the computer with a USB Cable or powering it with AC-to-DC adapter or battery to get done. It is suitable with most shields designed for the Ardiuno Duemilanove or Diecimila.

ICSP header is a striking addition to Arduino Mega which is used for programming the Arduino and uploading the code from the computer. There is no such big difference between Arduino Uno and Arduino Mega except later comes with more memory space, bigger size and more I/O pins. This microcontroller comes with two voltage regulator i.e. 5V and 3.3V. It basically provides the flexibility to Arduino Pro Mini which comes with only one voltage regulator. Arduino IDE called Arduino software is used to program the board which is a common software used for all boards belonged to Arduino family. ATMEGA 16 availability on the board makes it different than Arduino Pro Mini which uses USB to Serial converter to program the board. USART which contains a rest button and 4 hardware serial ports produces a maximum speed for setting up communication.

II. Literature Review

Forest Monitoring System Using Wireless Sensor Network [1] mentioned about forest monitoring but it is totally related to health monitoring of wild life animals. Author has referred this paper and tried to track live location of animals and show it on Android Smartphone.

Smart Parking Service based on Wireless Sensor Networks [3] have mentioned about sensors used to detect cars on parking area, which gives signal to base station about presence of car. Author tried to use such sensors as collar sensor for animals and boundary sensor to cover boundary of forest. Sensor will detect the animals and send location to base station.

III. Problem Definition

A. Existing System:

In Existing System, the manual power had been used in order to manage forest/zoo with the help of handheld transceiver, communication is maintained in order to manage the whole forest/zoo covering the vast forest area is a challenge. Detecting the location of wild life animals with the existing system can be a difficult task.

IV. Objective/Scope

To monitor forest and zoo premises using combination of WSN, Arduino MEGA, and Android Application to take precautions from wild life animals, which indirectly helps officers and guards to stay alert from nearby animals, which would harm them if they approach them carelessly which also ensures the animals safety.

V. Research Methodology

A. Proposed System:

Our System is dependent on the wireless sensor networks deployed throughout the entire forest/zoo area. The wireless communication happens over the sensor network, Wi-Fi module and a Smart phone or a computer that notifies the concerned forest authority of the parameters that are tracked. It informs the authority about animal‟s presence nearby their location in order to take precaution from future mishaps. This data are even saved in cloud for future analytics such as animal migration tracking, health of animals, etc. The working is as follows:

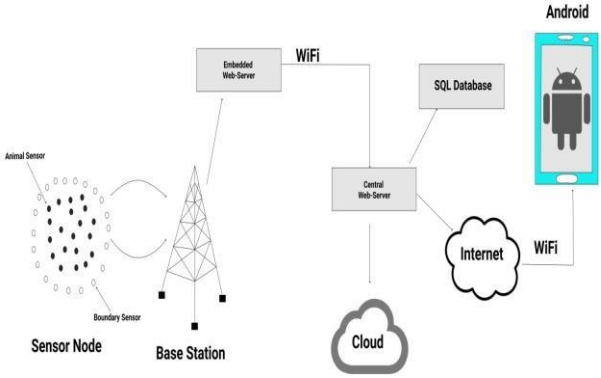

Fig. 6 Architecture of the proposed system

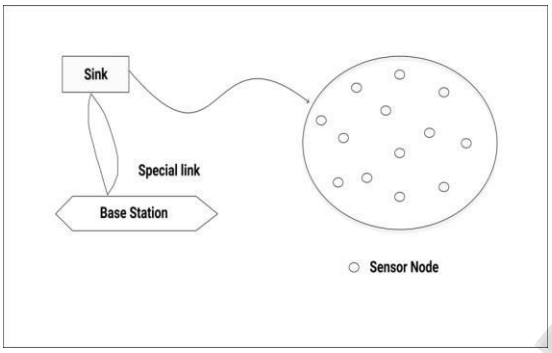

Fig. 7 Sensor Node Architecture

I. The Sensor node in forest area will sense the wild animals across the boundary.
II. This Sensed data will be forwarded to Embedded Web-Server through Base Station.
III. With the help of Wi-Fi, Embedded Web-server data will be carried forward to Central Web-Server.
IV. From Central Web-Server, data is stored as backup in cloud system and also in SQL database.
V. From Central Web-Server, with the help of Internet/ Wi-Fi, data can be fetched from Android Smart phone.
VI. This data will be the location of the animal around the user using Smart Phone.
VII. This System can even send Alert to the Smart Phone using push notification function in Android.
VIII. This system can detect animals that are near boundary area using boundary sensors.
IX. This system requires low-cost sensor in order to implement this method.
X. Sensor along with GPS gives latitude & longitude to Central Web-Server.

VI. Analysis & Findings

The results demonstrated that a GPS location needs to be collected at least once every 10 seconds to be able to predict selection of patches that are 10 with at least 90% accuracy. The precision relationship is further confounded by the animal‟s movement, both its speed and duration. In the simplest case where the animal moves slowly or in a straight line, then the sample interval with no associated loss in predictive ability. As precision requirements increase, the burden on data storage increases, but as the interval between GPS fixes increases predictive decreases.

VII. Limitations

1. Highly impossible to put collar sensor to each and every animals.
2. Continuous Internet connection is required; if internet fails then this system will not work.
3. Maintaining or servicing the sensors is time consuming.
4. Observing misplace of sensor in forest area is tough
5.

VIII. Future Scope

1. Health care and pregnancy test can be done through sensors on animals.

2. Compact size sensors can be used for animals.
3. Detection of animal location can be improved.
4. Covering large forest with minimum base stations.

IX. Conclusion

This paper basically presents the design, implementation method, prototype of Wireless Sensor Network for Forest/Zoo wildlife Monitoring. This prototype system mainly comprises of Detection, Tracking & Identification of wild-life animals. Here, we have used multiple sensor across boundary area and even collar sensor for each and every animals present in forest/zoo. It provides current location of animals present nearby the android device which is used by forest officers. It gives periodic alert through push notification and helps in precaution from future accidents. This system is highly beneficial in preventing animals and officers who work in forest and also people who visit zoo. It also aims on animal location and tracking through Android Smart Phone. This paper presents a low-power consuming, less complex and an economic solution to the existing problem.

X. References

1. "Forest Monitoring System Using Wireless Sensor Network", B S Sudha, Yogitha H R, Sushma K M and Pooja Bhat.
2. "CONCEPTS AND EVOLUTION OF RESEARCH IN THE FIELD OF WIRELESS SENSOR NETWORKS" Ado Adamou ABBA ARI, Abdelhak GUEROUI, Nabila LABRAOUI and Blaise Omer YENKE .
3. "Smart Parking Service based on Wireless Sensor Networks", Jihoon Yang, Jorge Portilla and Teresa Riesgo.
4. Integration of Android Operating System with Wireless Sensor Network Revathi Gujjarlapudi, Archana Kakaraparthy, Kalyan Mohan Goli KL University, AP, India
5. Agriculture Environment Monitoring System using Android Wi-Fi Mr. Kalpataru B. Patil, Mr. Mahesh B. Girase Mr. Vijay A. Mali Mr. Sachin S. Koli Prof.Jayvant R. Saindane.
6. Wireless Sensor Networks- A Review on Topologies and Node Architecture Shamneesh Sharma, Dinesh Kumar and Keshav Kishore.
7. Wireless Sensor Networks „Future trends and Latest Research Challenges" Dr.Deepti Gupta *Department of* Applied Science and Mathematics Ajay Kumar Garg Engineering College ,Ghaziabad (U.P.), INDIA.
8. Real Time Animal Detection System using HAAR Like Feature, Nidhi Daxini, Sachin Sharma, Rahul Patel, Student, Dept of EC, SPCE, Vishnagar, Gujarat, India Research Scholar, Dept of Gujarat Technological University, Ahmedabad, Gujarat, India Assistant Professor, Dept of EC, SPCE, Visnagar, Gujarat, India.
9. "TOWARDS INTERNET OF THINGS (IOTS):INTEGRATION OF WIRELESS SENSOR NETWORK TO CLOUD SERVICES FOR DATA COLLECTION AND SHARING "Rajeev Piyareand Seong Ro Lee, Department of Information Electronics Engineering,Mokpo National University, 534- 729, South Korea.
10. The Design and Evaluation of a Mobile Sensor/Actuator Network for Autonomous Animal Control Tim Wark, Chris Crossman, Wen Hu, Ying Guo Philip Valencia, PavanSikka, Peter Corke, Caroline Lee, John Henshall, Kishore Prayaga, Julian O"Grady, Matt Reed, Andrew Fisher.