Animals and Vehicle Collision Avoidance Using Wireless Sensor Actuator Network

Prof. Latha Venkatesan, S.Omar Farooq, J.Faisal Imraan, K.Jegan Kumar, J.Naveen Kumar

Abstract— The environmental impact of roads is of increasing international interest and concern. 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. These animals have large ranges or undertake seasonal movements over large areas of mainly natural or semi-natural habitat. There has been less attention overall to animals in more modified landscapes with a long history of intensive land use and land management. On the positive side, the road is the most beneficial thing for the mankind, without which globalization is very hard to achieve. Wireless Sensor Networks (WSNs) are used in various scenarios, including rural and forest environments. Wildlife protection and conservation is a challenge, especially in natural reserves, dangerous locations or hot spots near human environment (i.e., roads, railways, and other civil infrastructures). This project proposes WSN based system for wildlife management in the surrounding area of human passages to establish safe ways for animals to cross transportation infrastructures.

Index Terms— *Conflict, Environment-Overlap, Infra Red Sensor, Menace, Nodes, Passive Infra Red Sensor and Wireless Sensor Network*

1 INTRODUCTION

In India, there are many highways and roads that run across protected wildlife areas, for example the mudumalai wildlife sanctuary in Tamil nadu. In places like that it is inevitable that the wild animals will enter the highways. This very often leads to fatal accidents resulting in loss of wildlife and also human life. As of now there are no proper/autonomous systems to prevent accidents like these. This project aims at developing a multifaceted system to prevent accidents like these. In this project large wild animals are detected near the human-animal environment overlap to avoid fatal accidents.

In India, man-animal conflict is seen across the country in a variety of forms, including monkey menace in the urban areas, crop raiding by ungulates and wild pigs, depredation by elephants, and cattle and human killing by tigers and leopards. Damage to agricultural crops and property, killing of livestock and human beings are some of the worst forms of man-animal conflict. The increase in man-animal conflict is likely due to their shrinking habitats, which enforces them to live close to human habitation. Crops like sugarcane and tea estates are reported to provide excellent cover for wild animals. In India, wild elephants probably kill far more people than tiger, leopard or lion. In places like national highways and roads it is inevitable that the wild animals will enter the highways and the railways. Elephants are gentle giants; left to themselves they are like most other animals who really don't want anything to do with humans.

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2 EXISTING SOLUTIONS

Boundary walls and solar fences around the sensitive areas are built to prevent the wild animal attacks. But this system doesn't allow the animals to have a large living range and independence of movement.

Overhead or underground structures as in figure 2 are built to divert the wild animals into a different path not interfering with vehicle traffic. But this system takes longer duration, labor and moreover not economical and satisfactory

Some devices of information technology, viz., radio collars with very high frequency, global positioning system and satellite uplink facilities, are being used by the research institutions to monitor the movement of lions, tigers, elephants, olive ridley turtles, and other wild animals to understand their movements and their use pattern of the habitat. But installation of the system becomes difficult and is not always possible.

3 PROPOSED SYSTEM

3.1. Strategy

The system is designed to manage the wildlife from fatal accidents in transport environments. The detector circuit on both sides of the route, detects the entry or presence of a wildlife animal which is about to cross the road. The detector circuit as shown in figure 1 passes the information to the control unit as shown in figure 2 by means of short range communication. The controller section comprising of a microprocessor or microcontroller manages the traffic according to the signal received, by showing a red or stop signal on both directions. Once the animal has crossed the road the controller gives ready to go signal.

Incase the creature halts in between the route, for more than a prescribed time limit beyond the change of traffic signal; a warning signal/sound is generated to scare away the creatures. If the animal stays or is present in the route even after the warning signal, which may be due to a prey attack or injury, a message is passed to a security personal. The security person after receiving the information takes the necessary according to the scenario. Thus the animal and mankind both can be benefitted.

3.2. Working

For the implementation of this project, a module on the exterior of road and another module along with traffic signal. The module at the roadside has an ir sensor, which is used to sense the animal on the roadside.

A passive infrared sensor (pir sensor) is an electronic sensor that measures infrared (ir) light radiating from objects in its field of view. They are most often used in pir-based motion detectors. Here it is used to detect the presence of an animal.

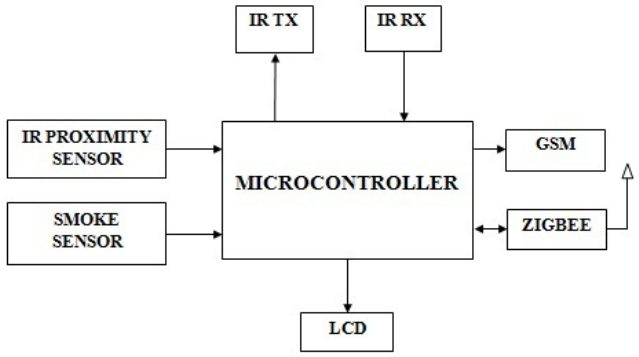

Fig 1. BLOCK DIAGRAM OF THE SENSOR MODULE WITH ALL THE SENSORS AND DEVICES REQUIRED ATTACHED TO IT.

In this project we use microcontroller having inbuilt ADC assuring error less and faster processing. If the animal enters the road side ir sensor senses it and traffic signal is automatically switched to red signal with the help of pic.

Zigbee is used to send information to the traffic module about the status of the roadside. Zigbee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. Zigbee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones.

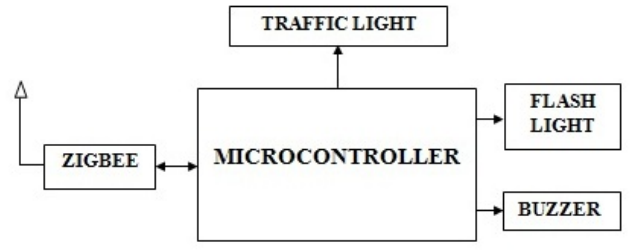

Fig 2. Block diagram of the actuator module with all the devices (actuators) required attached to it.

If the animal stays on the road for a longer duration, an alert/warning signal will be generated on the road using a buzzer and flash light. If the animal stays even after the warning system, then an alert sms will be sent to the forest authority through gsm. Gsm (global system for mobile communications) is an open, digital cellular technology used for transmitting voice and data services.

Thus when an animal comes close to the highway the system can automatically detect the presence of the animal close to the highway and steps are taken to manage the traffic accordingly and scare the animals away from the highway, simultaneously the forest officer can also be informed of the whole system. The flow chart of the whole process is shown below in the figure 3. The flow chart describes the sequence of events that

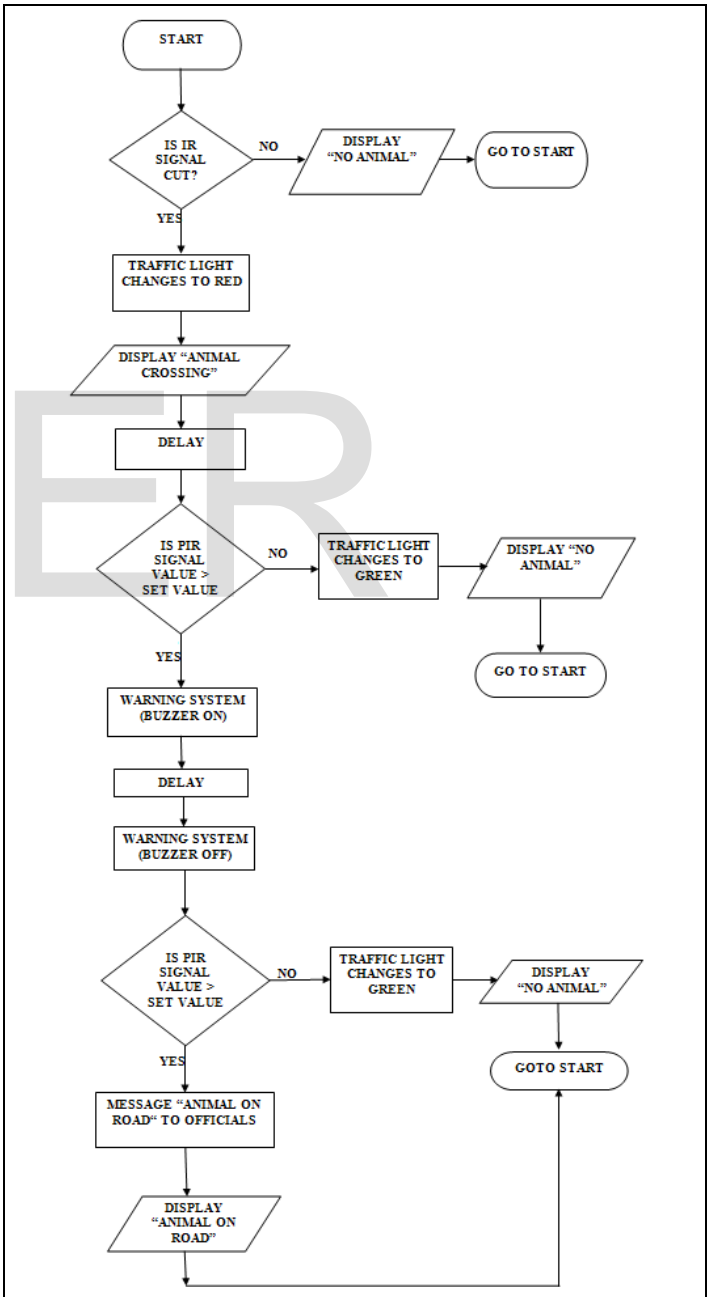

Fig 3. Flow chart of the intire system showing the sequence of the events that will be taking place.

have to be performed.

4 PRACTICAL CONSTRAINTS

To extend the system over the range of the traffic light (say a km), multiple (say 20) sensor nodes (say a 50m) has to be placed along the road side.
The extension will be as shown in the figure 4.

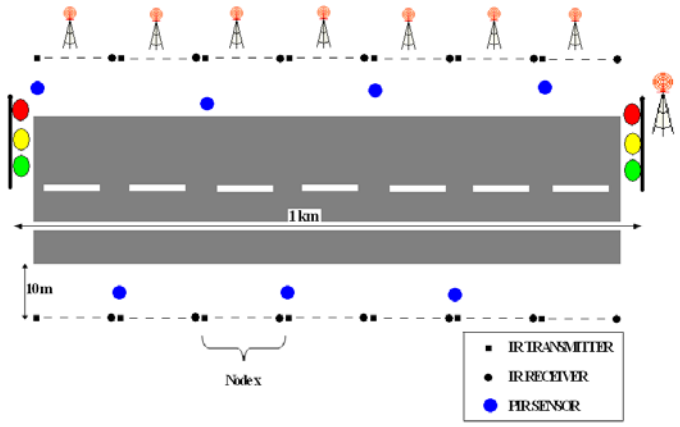

Fig 4. Deployment of the nodes on the road, the figure shows the position and deployment of the sensors.

The other practical constraint is the position of the sensors,
Ir sensor is placed at a distance (say 10m) away from the road towards the forest, which gives a period to clear the existing traffic before the animal reaches the road.
The ir sensors have to be placed so as to cover most of the animals, which can be achieved by multiple layers of sensors (say at 0.1m, 1m & 5m).

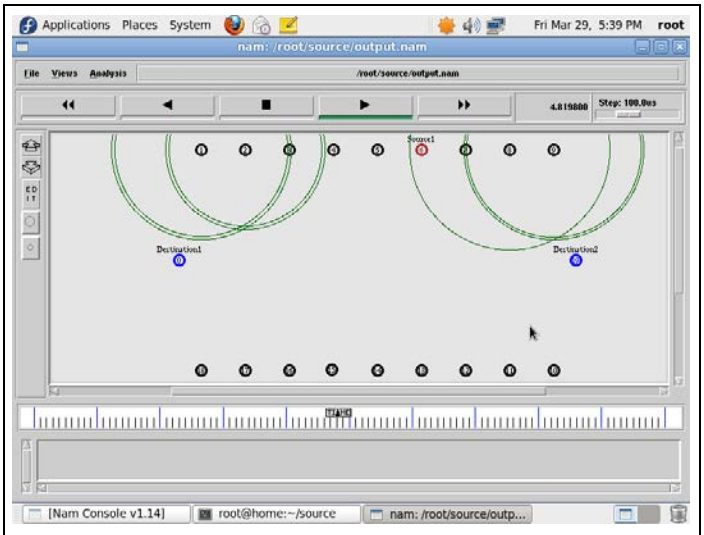

Fig 5. Snapshot of the simulation performed to show the multihop transmission technique among the nodes.

The communication between the individual nodes is also via short range communication (zigbee) and the info is passed to the control section by multi hop technique, which conserves power consumption and easier communication. The communication will be as shown in the figure 5.

5 CONCLUSION

The scope of the project lies in conserving wildlife and also avoiding accidents causing harm to human and animals. The disadvantages of existing systems lead to a design of low cost, large scale effective system to avoid the accidents caused by animals and also preserve wild life. The project mainly concentrates to avoid the animal vehicle crashes along the roads crossing the wildlife sanctuaries or forest. The system consists of low cost wireless sensor nodes deployed along the road side. The design of sensor node and programming of the processor are explained in this paper. Also the deployment of sensor nodes and performance of the project is tested using ns2 simulation software.
For the future up gradation of the project, free space optics can be used to cover longer distances. Ir cameras instead of pir sensor can be used to exactly predict the animal by excluding the human beings from the living organisms.

REFERENCES

[1] Antonio-Javier Garcia-Sanchez, Pawel Kulakowski, Alejandro Rodríguez, "Wireless Sensor Network Deployment for Monitoring Wildlife Passages" in sensors -ISSN 1424-8220 www.mdpi.com/journal/sensors
[2] Dargie, W. and Poellabauer, C., "Fundamentals of wireless sensor networks: theory and practice", John Wiley and Sons
[3] Rosie Woodroffe, Simon Thirgood and Alan Rabinowitz, ed. (2005). *People and wildlife: Conflict or Co-existence?*
[4] Kenichi Mase, Takehiro Kajita and yunzhe Zhang, "A Wide-Area Bird Monitoring System Using Geographically Distributed Base Station," IEEE WCNC 2011- service and application.
[5] http://en.wikipedia.org/wiki.
[6] DATASHEETS www.microchip.com