

Self-Responding Train Detection and Wildlife Alert System

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Received: 20th September 2018, Accepted: 11th October 2018, Published: 31st October 2018

Abstract

The paper presents the methodology to overcome the problem of wildlife animal's deaths due to railway accidents. Self responding train detection system has been implemented by using high sensitive vibration sensor mounted on track. Vibration sensor captures the data while train crossing the sensor mounted area of track. Sufficient numbers of sensor are deployed before the wildlife reserve area. Arrival of train is sensed before it enters the reserve area by the sensor and information is transmitted towards the receiver placed at the monitoring site. Eventually actuators are activated to generate exasperation sound wave to scatter wildlife animals from the railway track.

Keywords

Vibration Sensor, Train Monitoring, Wildlife.

Introduction

Transportation system is phenomenally used for goods as well as public transportation. Eventually railway becomes prime mean for transportation and railway track cover large geographical area in country like INDIA. The extensive network of the Indian Railways passes through several forest reserves, resulting in collisions of trains with a variety of wildlife species, including the tiger and bear. [1] According to survey given by Mukti Roy & Raman Sukumar on Railway Ecology pp 157-177 states that railway lines cross elephant habitats in several states, with accidents that resulted in more than 200 elephant deaths between 1987 and 2015 [2]. Similarly a 10-month-old tiger cub got killed and another got seriously injured when a speeding train hit them near Kelzar on Gondia-Chanda Fort section in Tadoba region. This news made NTCA to take urgent measures for preventing wild animal mortality due to train hits. NTCA has suggested several measures one being to decrease the speed of train in prone zone. However, a proposal in this regard for Tadoba is pending with NTCA. When it comes to justice for the animals, justice finds hard to prevail. Wildlife animals play vital role to maintain environmental condition for recycling of nature. It is necessary to minimize unfortunate wildlife accidents on railway track. If tracks are layed train cannot be stopped to move on these tracks but alternate arrangement can be done to avoid accident. Wildlife monitoring near the rail track can be one of the solution to the above problem [3]. Alternate solution could be to indentify the train entering the wildlife reserve area before time and alert the wildlife near the tracks. Train detection and wildlife alert system is reliable and simple way to avoid the possibilities of accidents of wildlife [4]. The paper presents train detection and alert system specifically for Tiger and Bors found maximum in the rich Tadoba-Adhari Tiger Reserve (TATR) area suffering casualties due to train route in the buffer zone.

Materials and Methods

Saving of wildlife animals is a prime concern and many research organizations & individual researchers are working in this area. Many systems are proposed and implemented. Some of the important contribution in this filed are studied and reviewed to improve the proposed system.

First system deals with alerting control room in case of emergency by calling via GSM modem. The work is based on accident of wildlife animals on track. The accident detection system design informs the police control room or any other emergency calling system about the accident of animals. However it saves only animals which are injured, it is not completely reliable technique to save wildlife animals [5].

Second system is build in which automatic calling and tracking system has been implemented by incorporating GSM and GPS technology that would be attached to the body of animal and would be continuously monitoring the position of the animal with respect to the GPS defined boundaries set up around the railway track. However this system only saves those animals which are under monitoring [6].

Third system is built to prevent the wild animal death from train accidents. In this each and every train has a receiver which can debug the implanted tag which is on animal ear and thereby stop the train when the animal is near a train section. Such type of system is concerned with monitoring of wildlife animals and monitoring of trains. It is very difficult for surveillance of all the animals species and also monitoring all the trains.

Self responding train detection system has been proposed. For the proposed system detection of a train is outmost priority before it enters the reserve area. The proposed system detects the vibration caused by train for identification of train. It

collects the constant vibration range up to 10 second and transfer information through a series of transceiver to the receiver station. In this paper, vibration of train is modeled with Accelerometer [7], Shock sensor and Vibration sensor [8]. The proposed system is divided into two parts first part is transceiver section and second part is receiver section both section communicate with each other by using WSN network [9].

Results and Discussion

Standalone transceiver section is deployed at the site around 5 KM before the wildlife reserve area. Each transceiver section is fitted with vibration sensor, memory, wireless module and microcontroller. Sensors are placed on the iron rod of railway track. The sensor captures information while the train crosses mounted area of sensor. The identification of train is done by the microcontroller using the data collected from the vibration sensor. The collected data is transferred to the receiver section through wireless module i.e. HC-12 module. HC-12 module allows communication among transceiver over a distance of 1 KM and frequency range 433.2-473 MHz.

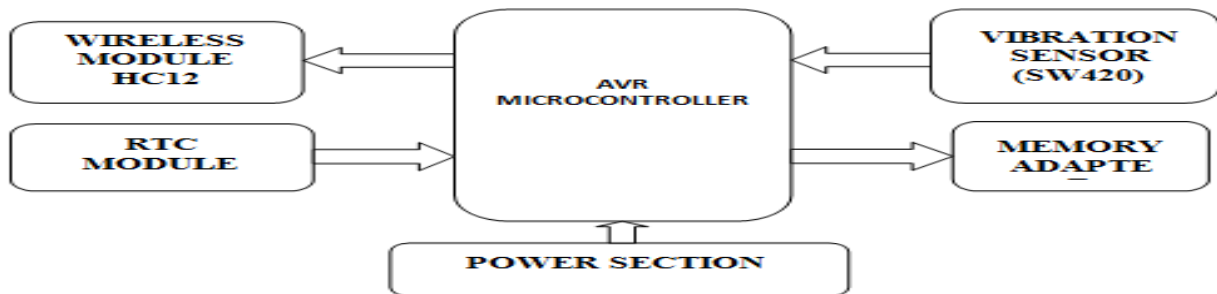


Figure 1: Transceiver Block

Figure 1 shows the transceiver block consisting of ATMEGA 328 microcontroller for data analysis and other control signal generation. The collected data from transceiver section is forwarded toward receiver section placed in the wildlife reserved area.

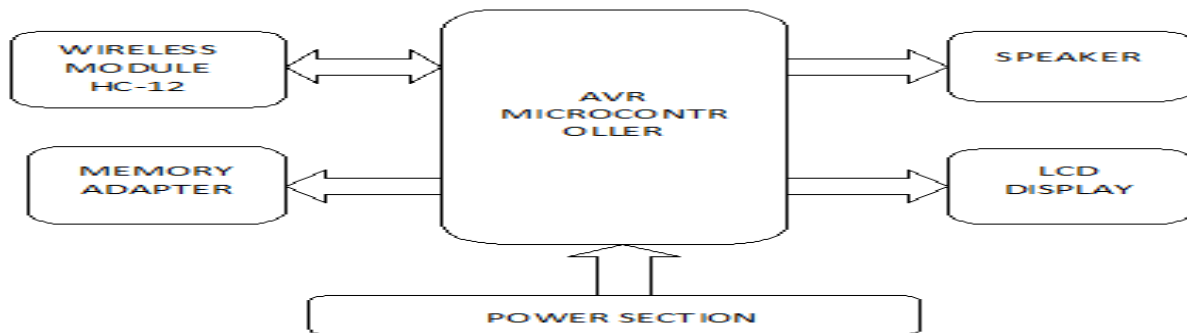


Figure 2: Receiver Block

Figure 2 shows the receiver block consisting of actuators, memory, wireless module and microcontroller. Frequency generators are used as actuators to produce exasperation sound wave of particular frequency [10]. The sound wave irritates the wild animal to run away from the railway in targeted area.

Proper position is identified for placing the sensor on the rail track for reliable working. Figure 3 depicts the spot of the rail track for placing the sensor.

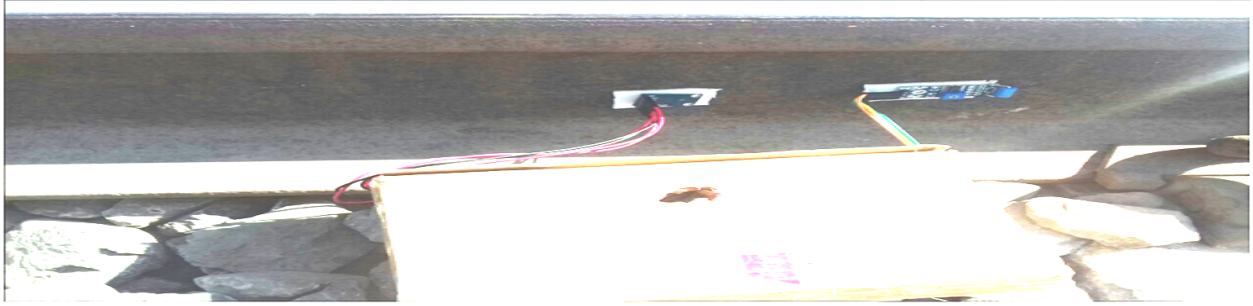


Figure 3: Sensor Placement on Track

Placing of sensor on the shown spot give the required readings.

Accelerometer, shock sensor and vibration sensors are placed on the track. Information from the sensors for passing by train is recorded for further analyses. Table 1 presents the reading recorded by various sensor for the same train and same location.

Date	Time(s)	X	A	B
27-01-2018	26	314	394	37
	27	313	516	37
	28	301	142	1023
	29	302	686	1023
	30	305	751	1023
	31	324	689	1023
	32	312	11	1023
	33	321	477	1023
	34	300	659	1023
	35	287	145	1023
	36	307	675	1023
	37	258	36	1023
	38	331	575	1023
	39	313	355	1023
	40	310	608	1023
	41	300	139	1023
	42	320	676	1023
	43	310	413	1023
	44	300	753	37
	45	359	685	37

Table 1. Reading Recorded by Various Sensors

Recorded data is represented in the form of graph with sensor reading on y-axis and time on x-axis. Figure 4 shows the summary of data acquired.

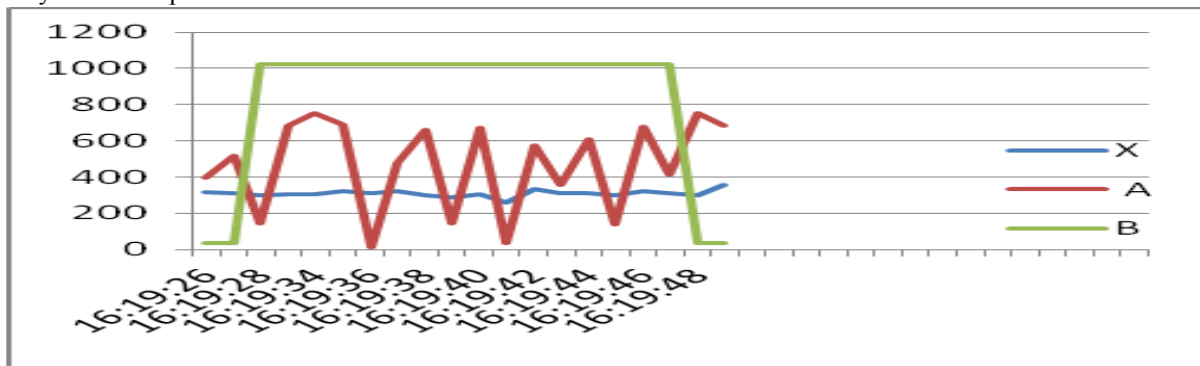


Figure 4: Linegraph for X-Accelerometer, Y-Shock Sensor and Z-Vibration Sensor

It is seen that Accelerometer sensor hardly shows any variation on account of the train. Shock sensor shows variation in the reading but the reading are random difficult for modeling the approached train. Vibration sensor readings are distinct and sufficient to identify the approached train.

Sensor	Method	Mode Of Train Detection	Range
Accelerometer	Approach detection	Moderate rail vibration	X=259 to 335 Y=287 to 337 Z=250 to 330
Advanced shock sensor	Approach detection	Slow rail vibration	<10
Vibration sensor	Approach detection	Fast rail vibration	1022 and 1023

Table 2. Sensor comparison

The comparison of three sensors shows sufficient and uniform reading is obtained using vibration sensor.

Conclusion

The paper analyzes three different sensors viz. Accelerometer, shock sensor and vibration sensor for the detection of train. It shows the vibration changes occur in sensor with respective to time. The selection of vibration sensor SW-420 for train detection is a good choice. By using WSN network sufficient number of sensors can be deployed to get information of the approaching train. Eventually sound wave frequency activators are activated to alert wide life animal and distract them from prone zone area of railway track.

Acknowledgement

Support to this research paper was provided by Chanda Fort, Chandrapur railway authority to deploy the transceiver module on the rail track.

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