An Implementation of Sensors based to Mitigate over Train-Elephant Conflicts

V.Kanchana, M. Prabu

Abstract: ***Animal accidents caused due to train are one of the major issues these days. "Train-Elephant Conflict" Causes difficulties for both the human and the elephants. It is very dangerous issues and this causes a vast reduction in the animal species. More over elephants are the species that are rare to see and this accident still reduces the population of elephants. Mostly at night times the forest officials and the train operator cannot so attentive due which accidents occur. In the proposed system, there is an acoustic sensor fixed at the path of elephant which would be sensed and an automatic message will be sent to the train operator, thereby minimizing the accidents occurring.***

Index Terms: Acoustics, Train-Elephant Conflict, Sensor, accidens

I. INTRODUCTION

Few years before, many trains are running and the tracks were fetched in the forest border and forest area. Due to reduce the traveling time and reaching the destination soon. Goods trains and passenger trains have been increasing widely as is one of the faster mode of transportation. Due to this, many animals are suffering moreover due to deforestation, animals are facing a, lot of problems for their food and survival. In this situation when animals cross the railway tracks in search of food, there occurs accidents Elephant train conflicts happening recently in many places. This cannot be prevented as train operations cannot stop the frequency of the train and moreover the due the elephant nature of movement makes it difficult for tracking.

The solution for this is to fix the acoustic sensor in the path ways of the elephant and the places near track. Sensor sense the movement of elephant and automatically a message would be sent to the train operator and the forest officers. Thereby they can control the train speed and minimizing the train elephant conflicts.

There are several researches on elephant sound and tracking taking place around the world. Some of the research works are discussed below: Singh and Chalisagaonkar (2006) have proposed restoration of corridors to facilitate the movement of wild Asian elephants in Rajaji-Corbett elephant range their method is based on how railway lines, highways and human settlements along the shift passage have affected the seasonal movement of the elephants.

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V. Kanchan, PG Scholar, Department of Computer Science & Engineering, Adhiyamaan College of Engineering (Autonomous), Hosur. India.

Dr. Prabu Mohandas, Department of Computer Science & Engineering, Adhiyamaan College of Engineering (Autonomous), Hosur. India.

II. LOCATION AND METHODS

Krishnagiri and Dharmapuri districts of Tamil Nadu are in Hosur and Bangalore railway divisions respectively. The Forest division falls in Eastern Ghats division and the area around Anusonai village has been declared an elephant reserve due to death of a large number of elephants. The forest division contains roadways and railway lines (Figure 1). Many elephant accidents occur in the railway route.

Figure1. Railway Track Fetched Areas

A. Plans Made by Government

So many schemes and idea to prevent the Human-Elephant Conflicts. In north India, much state government has raised the funding aspects and projects to avoid Human-Elephant Conflicts. The national status mainly focus on Project Elephant (PE), a centrally sponsored scheme, was launched in February 1992 by Government of India, to provide financial and technical support to major elephant bearing states in the country for shield of elephants, their habitats and corridors. It also seeks to address the issues of Human-Elephant Conflicts and welfare of domesticated elephants. The project is being implemented in 13 States/Union Territories, such as Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Meghalaya, Nagaland, Orissa, Tamil Nadu, Uttaranchal, Uttar Pradesh and West Bengal.

In Tamil Nadu, Project Elephant is implemented in four elephant reserves i.e. Nilgiris elephant reserve, Coimbatore elephant reserve, Anamalai elephant reserve and Periyar elephant reserve. With considerable population of elephants, Tamil Nadu is a leading State in elephants and their habitat management.

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Table.1. Literature Review of the Various Train-Elephant Conflicts

Si. No	Author/Principal Investigator/Co-Principal Investigator	Title of the Project work/Documents/Reports	Technology/ Methodology
1	Asela k. Kulatunga	Train- Elephants Accidents	Digital Camera
2	G. Weerawansha A. K. Kulatunga S. Samaraweera	Early detection of wild elephants to prevent train-elephant accidents	Camera, Infra red Senes
3	Prithiviraj Fernando H. K. Janaka and etc.,	Identifying Elephant Movement Patterns by Direct Observation	Camra- Sex, Ear (R &L) Tail, Shape of Spine ,body
4	Matthias Zeppelzauer	Automated Detection of Elephants in Wildlife Video	Video Camers
5	Government of Nairobi	A mammoth task: Rangers sedate and fit GPS tracking devices on migrating elephants	GPS technology
6	Matthias Zeppelzauer	Establishing the fundamentals for an elephant early warning and monitoring system	Camera, Acoustics
	Ministry of Environmental and Forests (MoEF), India	"Environment ministry favours electronic surveillance along railway routes to prevent train-elephant collisions"	"e-eye" infra-red cameras
7	Elephant Family	Saving Elephants on India's Railways	GIS/Camera
8	Anil Kumar Singh, Ashok Kumar,Vivek Menon	A Scientific Approach to Understanding and Mitigating Elephant Mortality Due to Train Accidents in Rajaji National Park	Data Survery/Field Visit

Out of 26,000 elephants estimated in India, Tamil Nadu has a population of 4,015 elephants. 100% Central assistance is received every year from Government of India for this scheme. The scheme is being implemented to progress the elephants nature and improve their habitats, including fire prevention measures, water facilities to elephants, payment of compensation to the damages caused to crops and loss of human lives caused by elephant, digging of elephant proof trenches etc, to control the human-animal conflict. This scheme was implemented with a cost of Rs.2.64 crore during 2010-2011 including expenditure towards setting up rescue centers for elephants which are orphaned from wild, rescued from wild or private persons for illegal possession. During 2011-2012, it is proposed to implement this scheme at a cost of Rs.3.09 crore.

III. METHODS

The methodology for elephant tracking (Elephant's Entry) focuses on wireless sensors with high quality acoustic sensors. Wireless sensors in specific to be used for this work is Acoustic Sensors.

For this paper, will consider forest village areas and train track located areas. We made a survey regarding the elephant entry areas from forest officials and village people. According to the survey reports, we identified the trusted places (Elephants entry places). Based on the report and trusted places, we fetch the (acoustic) sensors as per the methodology. The first confirmation, Acoustic sensors to map the elephant's entry and send the information to the officials (Village/forest officials. After getting second information, the forest/ village officials make an effort to avoid the Train Elephant conflicts. Using acoustic wave receptors can help to tracking elephant vocal. An acoustic sensor along with the hardware devices is used to record and store the sound in the database (Figure 3).The recorded sound is classified into two categories 1) Noisy elephant sound 2) Noiseless elephant sound. In the Noisy elephant sound, there is some possibility of noise like car, air etc. An Adaptive filter and MFCC are used for eliminating noise and is executed in MATLAB. The noise is compared with a database after removal. Once it matches, the system generates an alert SMS to the train operator, the station master and the forest officials.

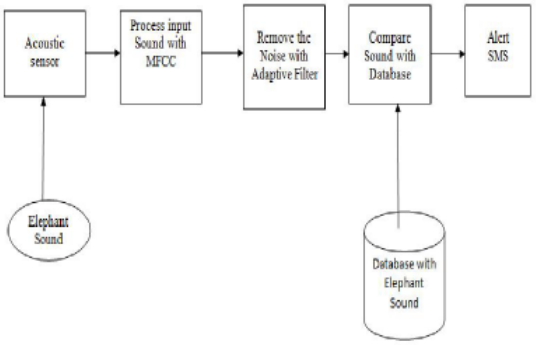

Figure 2. Sound Comparing with Trained Data set

Mel Frequency Cepstral Coefficient (MFCC) and an Adaptive filter are used for noise reduction. a transfer function controlled by the variable parameter and a means to adjust that parameter according to the algorithm.

The aim of this feature extraction process is to obtain a new sound representation which is more

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compact, less redundant and more suitable for statistical modeling. There are several steps in the implementation of the MFCC these are shown in following steps.

Step 1: Frame Blocking

The framing process is first applied to the Sound signal of the producer. This signal is a division blocked into M segments (frames).

Step 2: Windowing The second process of the giving out is to window the frames individuality such to minimize the signal discontinuities at the beginning and the end of each frame.

Step 3: Fast Fourier Transform The next process is the Fast Fourier Transform (FFT) where each frame of M samples is converted from time domain to frequency domain.

Step 4: Mel-Frequency Wrapping The spectrum from the FFT process is then Mel Frequency Wrapped. The major aim of this process is to convert the frequency spectrum to the Mel spectrum. Step

5: Cepstrum In the final process, the log Mel spectrum is then converted back to a time domain and the result is called the Mel frequency Cepstrum Coefficients (MFCC).

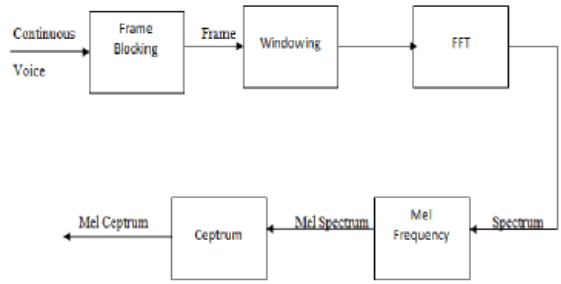

Figure 3. Noise Comparing with MFCC

Acoustic sensor is used for identifying Elephant calls. Elephants communicate by low-frequency sounds with their group. These sounds can travel distances of numerous kilometres. Rumble is the most common elephant call, which spreads into the infrasound band. The fundamental frequency of the rumble is in the range of 15-35Hz and occurs in the duration between 0.5 and 5s. The elephant detection using acoustic calls detects the presence of elephants over huge distances .The current study also sketches the progress of a seismic technique for elephant detection. This technique is based on the vibrations caused by elephant footfalls. The investigation starts with the spectral differences among species and then considered their temporal differences. Based on those findings a technique is developed which differentiates various species. Finally, a method for detecting elephant vibrations is achieved.

IV. FUZZY LOGIC

Fuzzy logic provides a methodology to model uncertain and human way of thinking reasoning and perception. In Boolean logic, there are two concepts 'true' and 'false', which are represented by 1 and 0 respectively. This means any proposition can be true or false. Fuzzy logic is an extension of Boolean logic that allows intermediate values between these two extremes.

Fuzzy systems provide the means for presenting the expert knowledge of humans about the process in terms of fuzzy rules (IF THEN). A fuzzy rule is the basic unit for capturing knowledge in fuzzy systems. Fuzzy inference is the process of mapping from a given input to an output using fuzzy logic. The goal is to obtain a conclusion consisting of one or more consequents from a premise consisting of one or more antecedents. By mapping, decisions can be made or patterns recognized. The process of fuzzy inference involves membership functions, fuzzy logic operators, and if then rules. There are two types of fuzzy inference systems that can be implemented in the fuzzy logic toolbox: Mamdani-type and sugenotype. These two types vary in their output. A fuzzy rule, like a conventional rule has two components: an 'if part and a 'then' part which are referred to as antecedent and consequent, respectively. The main structure of fuzzy rule is given in eq.1

$$IF < antecedent > THEN < consequent > \quad \ldots\ldots(1)$$

The predecessor of fuzzy logic has condition that should be satisfied by a degree. Typically, the antecedent of a fuzzy logic can merge multiple single condition into complex condition using logic gates such as AND, OR and NOT logical operators. The resultants of fuzzy logic are classified into two major categories: Fuzzy consequent (Eq.3, in which C is a fuzzy set), functional consequent (Eq.4, in which p,q and r are constants). Fuzzy Interference System (FIS) integrate an expert's affair to form a system design. They can be comprised of four blocks. A FIS consists of a fuzzifier which will transform the 'crisp' inputs into fuzzy inputs through membership functions which constitute fuzzy sets of input vectors, a knowledge-base which encompass the related information which is given by the expert in the form of linguistic fuzzy rules, an interference system (Engine) which uses them together with knowledge-base for inference by a method of reason and a defuzzifier that modifies the fuzzy results of the interference into a crisp output through defuzzification method.

The knowledge-base consists of two components: a data-base, which defines fuzzy set membership functions which is used in the fuzzy rules, and a rule-base encompassing a collection of linguistic rules that can be joined by some specific operator. Depending on the resulting method of fuzzy rules, there are two common types of FIS, which may change based on the differences between the specifications of the resulting part (eq.2 and eq.3). The first fuzzy system uses the inference method proposed by Mamdani in which the rule consequence is defined by fuzzy sets and has the following structure [13].

$$IF\ x\ is\ A\ and\ y\ is\ B\ THEN\ f \text{ is C}\ldots\ldots\ldots\ldots..(2)$$

The second fuzzy system proposed by Takagi, Sugeno and Kang (TSK) has an inference engine in which the conclusion of a fuzzy rule comprises a weighted linear combination of the crisp inputs rather than a fuzzy set. The TSK system has the following structure.

$$\text{F x is A and y is B then } px+qy+r\ldots\ldots\ldots(3)$$

Here p, q and r are constant parameters.

1) *Fuzzy Rules Determination.*

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Many investigators have examined the technique for formatting the rules and skilled person's knowledge is the one most commonly used. The expert is asked to recap the familiarity about the system in the form of a basis and outcomes. The rules and rule determinations are based on fuzzy classifier techniques.

V. RESULTS AND CONCLUSION

Elephants produce a broad range of sounds from very low-frequency rumbles to higher frequency snorts, barks, roars, cries etc. the input is taken from an acoustic sensor and the result of the sound from elephant. Different elephant call types and the recorded elephant audio samples are taken from the website for analysis. The audios taken are implemented by using MATLAB. (Figure 4,5,6 shows the conversation of elephant sound into wave containing noise.

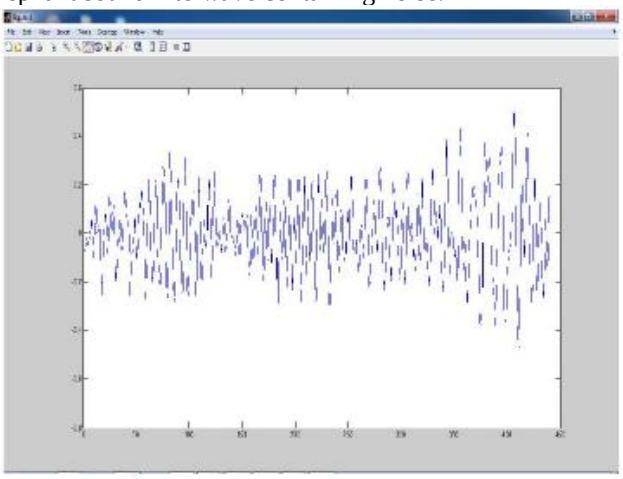

Figure 4. Elephant Voice Converted in to Wave

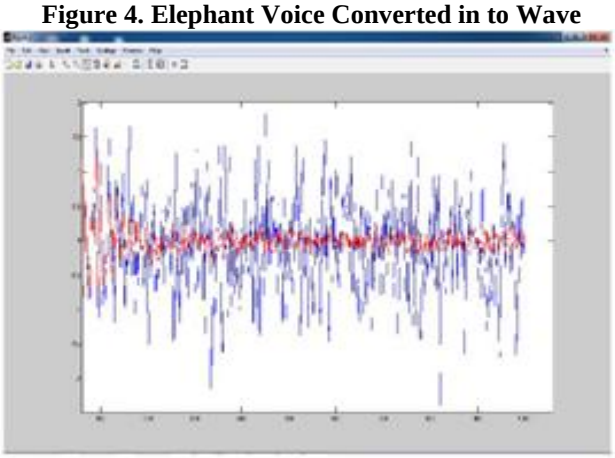

Figure.5. Elephant Voice with Noise

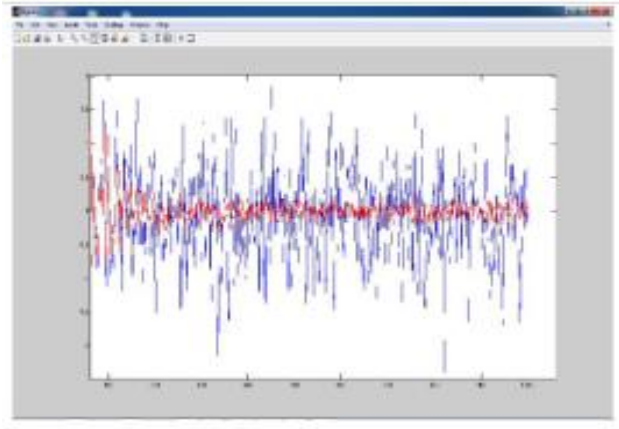

Figure.6. After Removing Noise

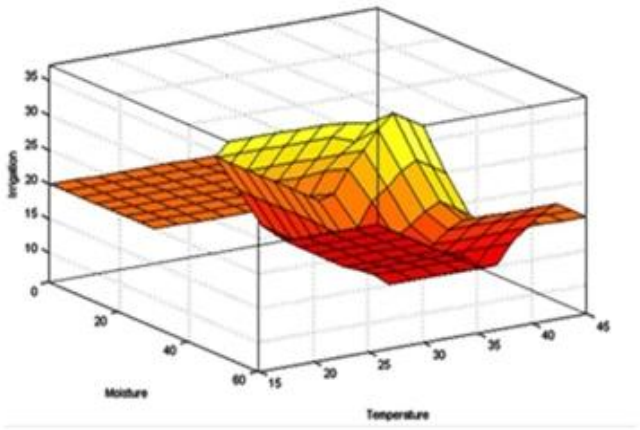

Figure 7.Surface Viewer for the Entry Detection System

The elephant path detection systems organized according to acoustic Sensors which obtained by the Fuzzy logic . Fuzzy logic is controlled according to the data coming from the sensors. The surface view distribution is obtained using this kind of entry (choice based) can be seen in Figure. 9.

This paper implemented the to reduce the conflict among Train-Elephant. We are implemented this paper based on results of the fuzzy logic and the MATLAB tool. The factors are categorized and the given as a input for the fuzzy logic . As well as the same time the acoustic based on inputs are given to the MATLAB and executed properly. The system is completely automatic; Elephant vocalizations and algorithm have presented been with practical details. The noise reduced alogirhtm MFCC is used to reduce the noise formt he input signals. After sound matches with the trained sounds (dataset of record) . Based on the recorded events, the fuzzy logic is used to design the alerts based on their entries. Alerts will be sent the station master, the train operator and the forest officers to enable than to take necessary actions.

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