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Accident Prevention using Hidden Markov Model as Speech Recognition

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Abstract:- In this era of digital world, we all have smart phones. There are so many features of smart phone which entertain us. But sometime it may become hazardous for us. Like uses of smart phone while crossing road and railway lines, either by indulging with head phone for listening music or something else, it may snatch our lives abruptly. According to the survey of road safety department of India around 1.35 lakhs people died every year in road accident and 10% of them due to mobile phones, either by using mobile phone while riding bike and driving cars or by crossing road by pedestrians. As well as there are more than 11,000 railway crossings are unmanned where accident ratio is higher. So, by having all these problems on mind; this paper proposes a system that can prevent accidents causes by smart phones or using mobile phones. This system can recognize train's horn, and alert mobile phone users prior from any casualties. Here the system uses Hidden Markov Model to train this network to recognize particular sound at real time and able to perform action accordingly before any casualties. The system can minimize the accidents at unmanned railway crossing.

***Keywords*:-** *Speech Recognition, Hidden Markov Model, Train, Unmanned, Accident, Mobile Phones.*

I. INTRODUCTION

India has more than 30,300 level-crossings at which vehicles cross the railway tracks, according to the Indian Railways public relations office and more than 11,000 of these are unmanned crossings where most of the accidents occur. It is required to prevent from accident either by managing these unmanned railway crossings or by providing prior notification to whom are crossing these tracks.

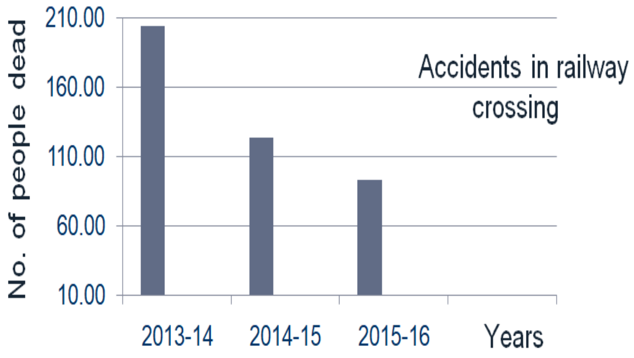

Fig 1:- Survey by Indian Railway Public Relation Office

Fig 2:- Unaware Smartphone User at Railway Track

Fig 3:- Unmanned Railway Crossing

Unmanned railway crossing means having no man to manage the gate at the time of passing train.

II. PROBLEM STATEMENT

By observing all the previous works a common problem has been identified that there is no prevention for walking people who indulge with their smart phone listening music through earphone. Either the system based on physical sensors which may recognize train or based on smart video surveillance that can detect motion at railway crossing through which gates can be managed. But if a person is playing loud music and passing through unmanned railway crossing then no sensor will save him because train cannot stop immediately, even heavy casualties may also occur.

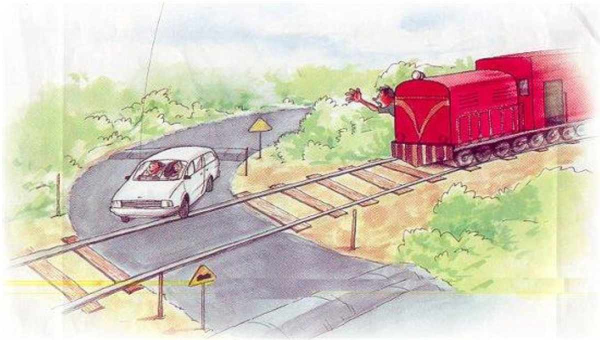

Fig 4:- Problem Observation

Another problem which has been identified that the speech recognition with a traditional approach is effective for high frequency signals or high energies but it may have some error rate or not having good level of accuracy when signal becomes weak. Systems based on Mel Frequency Cepstral Coefficient (MFCC) can correctly recognize only those signals which contain high level of energies.

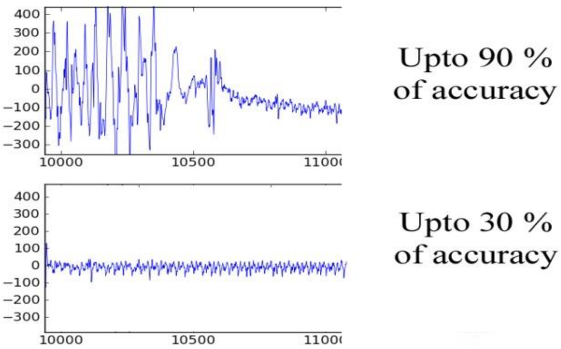

Fig 5:- MFCC based System

III. PROPOSED WORK

System provides an audio player which is able to play any audio files or songs both for loud speakers and earphones. System is able to recognize train's horn or its sound while playing songs as well and able to stop player to inform about train approaching there along with its distance using intensity of sound. System works in all circumstances, whether music is being playing loudly. System only recognizes train's horn or sound even if it is in noisy area, it does not give false alarm as it has been tested.

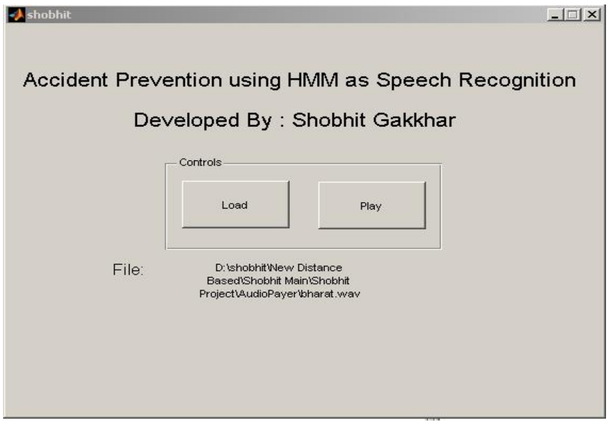

Fig 6:- Player GUI

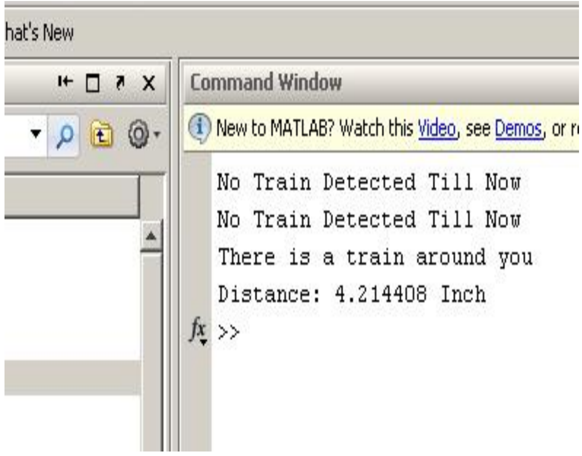

Fig 7:- Distance Measured

System is able to calculate the distance on the basis of sound intensity and it is also able to recognize low level of frequencies with high level of accuracy. System blocks audio player instantly when it has been detected train's horn or sound at real time.

Let it be more precise by flow chart of Voice Authentication System-

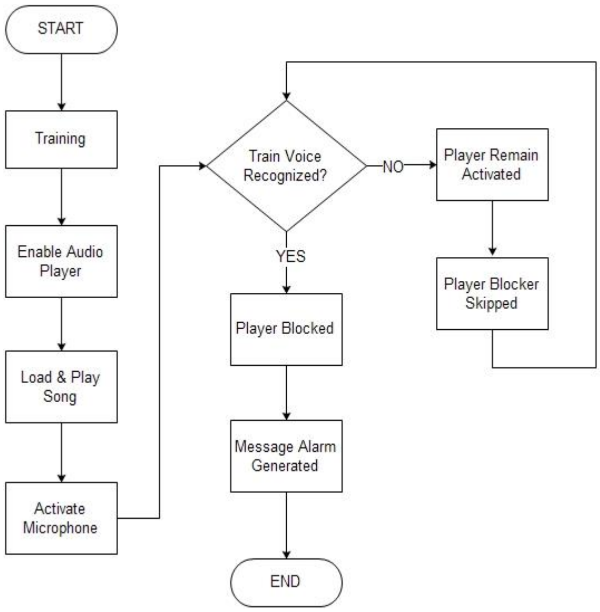

Fig 8:- Flow Chart

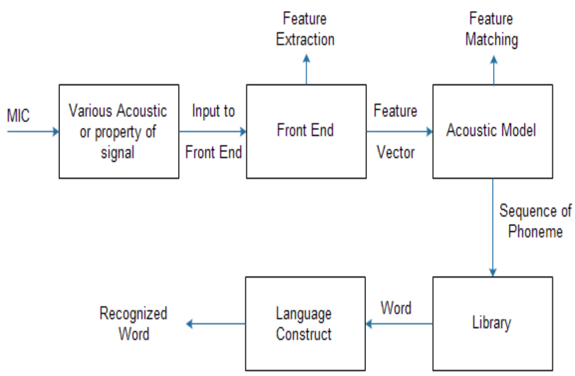

Fig 9:- Block Diagram

IV. PROPOSED METHODOLOGY

Speech recognition consists of two main modules –

- Feature Extraction
- Feature Matching

The purpose of feature extraction module is to convert speech waveform to some type of representation for further analysis and processing, this extracted information is known as feature vector. Once the feature vector is obtained we build the acoustic model. The acoustic model is used to score the unknown voice sample.

- In speech recognition, basic unit of sound is phoneme.
- Phoneme is a minimal unit that serves to distinguish between meanings of words.

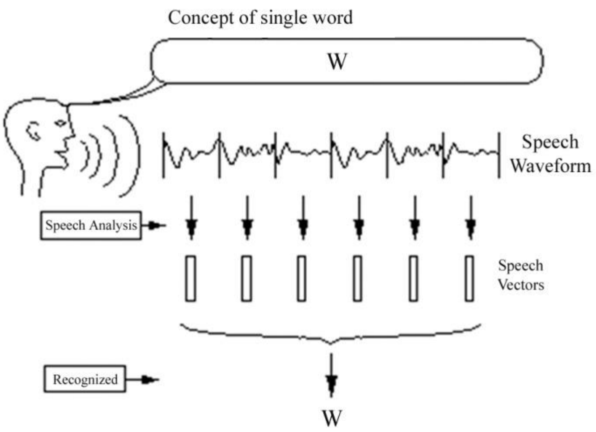

Fig 10:- Observing Speech Block Codes

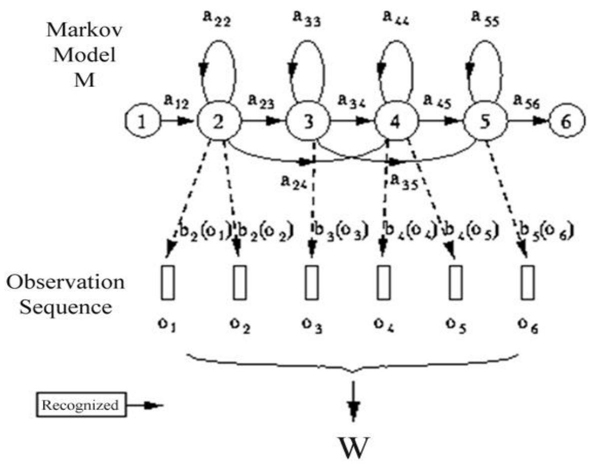

Fig 11:- Observing Speech Block Codes

Let it be more precise with an algorithm.

A. Algorithm

1. Initialize : P – probability ,

   q_t – State

   q_{t-1} – previous state

   O – Observation Sequence

2. Calculate first order discrete time markov chain that depends on previous state only-

   $$P[\, q_t = j \; l \; q_{t-1} = i \,,\, q_{t-2} = k \,,\, \ldots.] = P[\, q_t = j \; l \; q_{ti1} = i \,]$$

3. Calculate state transition probabilities a_{ij} is given by –

   $$a_{ij} = P[\, q_t = j \; l \; q_{ti1} = i \,] \,,\;\; 1 \le i \,, j \le N$$

   with the following properties $a_{ij} \ge 0 \; \forall$ j, i and $a_{ij} = 1 \; \forall$ i

4. Calculate Observation symbol –

   $$\bar{O} = (O_1 \,, O_2 \,, O_3 \;\ldots\ldots\ldots. O_N)$$

5. Calculate probability of all states -

   $$\pi_{t=1}^{n} \; P[q_t \; l \; q_{t-1}]$$

6. Match with observation symbol and acquire the final state according to the block codes obtained -

   $$P\,[q_1 \,, q_2 \,, u_2\,] = P\,[q_1 \,, q_2 \; l \; u_2\,] \,/\, P\,[q_1 \; l \; u_2]$$

Using Baye's rule P (A I B) = P (A,B) / P(B)

V. RESULT ANALYSIS

S. No.	Attempts	TP	TN	FP	FN
1	5	5	0	0	0
2	5	5	0	0	0
3	5	4	1	1	0
4	5	4	1	2	0
5	5	5	0	0	0
6	5	3	2	0	0
7	5	5	0	0	0
8	5	4	1	1	0
9	5	5	0	0	0
10	5	4	1	1	0
11	5	5	0	0	0
12	5	5	0	0	0
13	5	5	0	0	0
14	5	5	0	0	0
15	5	4	1	1	0
16	5	5	0	0	0
17	5	5	0	0	0
18	5	4	1	2	0
19	5	5	0	0	0
20	5	5	0	0	0

21	5	5	0	0	0
22	5	5	0	0	0
23	5	4	1	1	0
24	5	5	0	0	0
25	5	5	0	0	0
Total	125	11 6	9	9	0

Table 1. Result Analysis

TP – True Positive, TN – True Negative, FP – False Positive, FN – False Negative

$$FRR = \frac{(\text{Total no. of Trials} - \sum_{i=1}^{n} \text{True Negative}) * 100}{\text{Total no. of Trials}} \%$$

$$A = \frac{(\text{Total no. of Trials} - \sum_{i=1}^{n} \text{False Positive}) * 100}{\text{Total no. of Trials}} \%$$

$$FAR = \frac{(\text{Total no. of Trials} - \sum_{i=1}^{n} \text{True Positive}) * 100}{\text{Total no. of Trials}} \%$$

A – Accuracy Rate, FRR – False Rejection Rate, FAR – False Acceptance Rate.

Terms	Proposed System
FAR %	7.2
FRR %	92.8
Overall Accuracy in %	92.8

Table 2. Result Analysis

VI. CONCLUSION AND FUTURE SCOPE

Here the proposed system is able to recognize train's horn at real time along with its distance for preventing accidents related to the people walking through the railway crossing while listening music or playing loud music in their vehicles. System is able to generate alarm at real time along with blocking the audio player for a while. System is capable to save humans life somehow, which may reduce the accident rate at railway crossings and it also can be enhanced in future by implementing it on road accident prevention at real time with different prospects which may reduce the road accidents.

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