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Sensor based train accidents avoidance system by obstacle detection method

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Abstract: Railways are the most important means of linking connectivity mode of transport across city and worldwide. India has faced over 60000 rail accidents. Most of the accidents in rail occurred because of the obstacles between the railway lines and which couldn't get controlled due to the high speed of the train. The extensive analysis with data streamed values the locomotive equipment control should be traced before hand and the primary goal is to identify with the help of RFID and report to the main control station and driver. Anti-collision device system is automated for surveillance. Segmentaion of tracks each of 20km with the distinct track number and the status is shared with base station by using Radio frequency communication system for identifying trains. Different sensors are used for train detection, collision avoidance and for safety measures of Railway system.

I.INTRODUCTION

The railway transportation network is considered to be one of the safest and easiest network, but nowadays, it is not that much safer as lot of collisions occur due to worst weather condition, improper communication among the network and a sudden change in track or route change. The railway transverse the length and breadth of the country and can able to carry over 20 millions passengers and 2 million tons of freight daily. One of the world's largest utility employers, with more than 1.6 million employees, almost 15000 trains work everyday. Unfortunately there have been many accidents involved in the railways. Railway bridges also plays a major role in occurrence of accidents due to collapse by heavy rains, which may make the tracks weak and thus causes the accidents. There have been many train accidents occurring all over the world. The potential for a mischances is made higher as railroads control is just a greater issue. The other half, in the mean time, can't generally be said to be controlled by one element, as despite the fact that activity tenets and street outline benchmarks probably exist, the developments of street clients are not composed and checked by particular substance as unbendingly as rail developments. The train collision detection system can be done by identifying the possible train collision ahead of time and then it is reported to the main control room or driver before collision happens. Currently there is no complete solution to avoid train collision. Indian Railway have implemented the solution based on ACD (anti-collision device) system.

They have certain problems in station section and nearby mountains due to its design concept of using GPS for detection of track and it also involve the high cost of implementation. The train accidents can be reduced by exploiting the automated surveillance system, it is based on RFID, ARM controller and GSM, which will help to reduce the train accidents. Hence each train track is identified by track id by segregating the train track into segments, every train reads and sends its track id to nearby trains. If two trains are on the same track id then an alert is send to the main control room or to the train drivers. Nowadays, the simple sensors are used to detect any faults that occurs in train tracks and microcontroller is used to control the output based on the value of input which is the output of the sensors.

II.CLASSIFICATION OF TRAIN ACCIDENTS

The major cause of train accidents is human errors and their negligence, violation of rules and regulations.There are various scenarios like the driver fails to stop a train in the required positions,e.g.Level crossings, not maintaining speed limits and driving with excessive speed, failure in checking the brakes and safety systems leading to collision of trains. Also due to the

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incorrect operations of signals,allowing two trains in the same track by careless behaviour of the authority.

Train accidents may also occur due to the mechanical failures, poor design and improper maintenance of trains. Failure of electric cables, leakage of fuel or oil,combustion motors leading to fire accidents in trains.Climatic changes, damage by landslides, floods, fog, faults in tracks, tunnels and bridges and act of non-railway personnels, e.g.passengers are other causes. The train accidents are classified into different categories: Head-on collision, Rear collision, and collision with obstructions of the track. [6] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day."Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for. The main design of this project is to track the heart attack of patients who are suffering from any attacks during driving and send them a medical need & thereby to stop the vehicle to ensure that the persons along them are safe from accident. Here, an eye blinking sensor is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller.If eye blinking gets stopped then the signal is sent to the controller to make an alarm through the buffer. If spO2 sensor senses a variation in pulse or low oxygen content in blood, it may results in heart failure and therefore the controller stops the motor of the vehicle. Then Tarang F4 transmitter is used to send the vehicle number & the mobile number of the patient to a nearest medical station within 25 km for medical aid. The pulse rate monitored via LCD .The Tarang F4 receiver receives the signal and passes through controller and the number gets displayed in the LCD screen and an alarm is produced through a buzzer as soon the signal is received.

The head on collision is when two trains collide with each other facing towards each other.This type of collision occurs mostly in a single line railway.The rear-end collision is when two trains collide accidentally such that one train crash into another train in front of it, that is one train is damaged in the back end and the other train in the front end. This collision occurs mostly due to the drivers inattention or distraction.When there is obstacle in the track leading to damage of train, train collisions. The obstacle presence should be detected earlier and removed before the train passes on the track. Sudden detection of obstacles is not helpful because of the high speed of the train, the train requires a lead distance to stop. [12] discussed about Intelligent Sensor Network for Vehicle Maintenance System. Modern automobiles are no longer mere mechanical devices; they are pervasively monitored through various sensor networks & using integrated circuits and microprocessor based design and control techniques while this transformation has driven major advancements in efficiency and safety. In the existing system the stress was given on the safety of the vehicle, modification in the physical structure of the vehicle but the proposed system introduces essential concept in the field of automobile industry. It is an interfacing of the advanced technologies like Embedded Systems and the Automobile world. This “Intelligent Sensor Network for Vehicle Maintenance System” is best suitable for vehicle security as well as for vehicle’s maintenance. Further it also supports advanced feature of GSM module interfacing. Through this concept in case of any emergency or accident the system will automatically sense and records the different parameters like LPG gas level, Engine Temperature, present speed and etc. so that at the time of investigation this parameters may play important role to find out the possible reasons of the accident. Further, in case of accident & in case of stealing of vehicle GSM module will send SMS to the Police, insurance company as well as to the family members.

III.LITERATURE SURVEY

With the advancements in technology there is a need of computerizing all the current railway systems which requires a lot of manual work. The administration of railroads is diminishing immensely. Collision avoidance systems using IR sensor and anti-collision devices are being used by the Railway sector is still facing some problems due to the consideration of some factors such as cost effectiveness, despite it is increasing the amount spent on implementation of the devices[8].

Railways has put efforts to provide train safety through ZigBee and Infrared based sensor concepts. But it has disadvantages such as limited range of signal covered and difficulty in their implementations[8].

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It is very difficult to stop a train from colliding with other train or any obstacle, because of speed of the train, which need a lead distance to stop. The train collision avoidance system was developed by using RFID. The train tracks are divided into individual track segment number. Radio Frequency Identification (RFID) tags are placed at the beginning of each segment of track. Whenever the train passes the RFID tag this track number is read by the RFID reader and stored. Later GSM sends the stored data to the base monitoring station[17].

Image processing is used to detect the surface of the rail-head[13]. A camera is used for constant surveillance of the real time rail head surface, which detects the defects of the track[7].Therefore, this system cannot detect the defects before the approach of the train. Moreover image processing has disadvantages in real time that it cannot detect in bad weather and at the rate of high speed.

In Sensor based Train collision avoidance system, the detection of the train is done using different sensors, but the use of sensors result in varying time. The time variation can cause problems in the detection of the train. These problems were avoided by TTC which built using scratch pad sensor for the detection of the train easily[8]. This collision between trains is calculated and colliding trains were alerted.

Fig 1: GPS receiver connected to server

The train with an implanted RFID tag passes through the RFID reader which reads the RFID tag and sends the information to the database, including the RFID tag identification numbers of all the trains. It performs the comparison of the numbers in its database and sends to the signal to the signal generator, if an ID match is found in the application software. The transmitter receives the generated signal and the input signal is converted into a form depending on the destination. The signal generator converts the signal into a form, so that the next two units can process them and finally the signal is received by the camera activation unit. The FLIR Camera is activated by the unit and the signal from the FLIR camera is converted into an electrical signal by the image signal unit. Finally, the signal is transformed into a form that can be by received by the train with the help of signal generator and transmitter[16]. The train receiver onreceiving the signals from the two units sends it to the software application present on the train which helps the train driver to interpret the received image for further train functioning.

The best way to avoid train collision accidents is by implementing an automatic system that can warn

Type of accident	Number of persons											
	Killed				Seriously injured				Total			
	Passengers	Employees	Other	Total	Passengers	Employees	Other	Total	Passengers	Employees	Other	Total
Collisions	0	0	3	3	12	11	9	32	12	11	12	35
Derailments	0	1	0	1	4	4	0	8	4	5	0	9

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Accidents involving level-crossing	1	2	291	294	21	9	314	344	22	11	605	638
Accident to persons caused by rolling stock in motion	14	22	665	701	78	22	395	495	92	44	1060	1196
Fires in rolling stock	0	0	2	2	0	4	0	4	0	4	2	6
Others	0	2	3	5	9	15	15	39	9	17	18	44
Total	0	0	0	1006	0	0	0	922	0	0	0	1928

Table 1: Number of persons killed and injured in railway accident in EU(2014)

drivers if there is the danger of a collision[10].The automatic shutdown of the system is one of the safety type of system preventing it from the collision. GPS is used to know the exact positions and speed of other nearby train, a powerful RF transmitter is for communication between trains and a buzzer to warn the drivers of any risk of collision. The use of GSM and GPS technologies allows the system to track train and provides the most up-to-date information about ongoing trips.

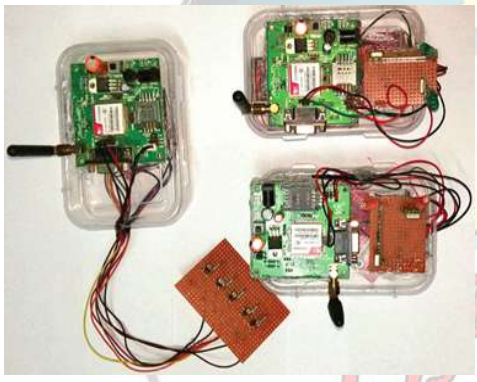

Fig 2: Hardware unit

An alerting system was designed with VCD[Vigilance Control Device] which works based on a Microcontroller. The VCD is a device which generates cyclic warnings to the loco pilot. Based on the loco pilot's reaction to the generated warnings (pre-defined actions to be performed) the system is set to automatically reset the vigilance cycle. The vigilance control device helps in improving the alertness of the system and provides warnings to the driver and the guard and brake application signals[11].

Rail accidents also occur due to crack and obstacle's presence in tracks. The obstacle detection system was developed using IR sensor and GPS-GSM model for alerting the driver and the guard about the obstacle's presence. However, this method becomes inaccurate in the remote areas of the rail as the track is curved[5].

IV. CONCLUSION

This paper concludes that various methods have been implemented to avoid train accidents to ensure railway safety. The collision avoidance system has been developed using RFID, sensors, GPS-GSM technologies and Microcontrollers. However, there does not exist the complete avoidance of train accidents since only collision avoidance is controlled. Instead sensor based control system can be used in detecting the cracks and obstacles in the tracks along with GPS-GSM technologies from effectively preventing train accidents.

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