ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Train Collision Avoidance Using ZigBee Technology

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ABSTRACT

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios.

The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer.

The accidents between trains are increasing due to negligence of intelligent techniques implemented in the trains and improper control signaling from the Train Traffic Control Station (TTCS). The Train Tracking Chip (TTC) modules and Train Identification Chip (TIC) modules are using to sense the presence of trains on the same track. The signals from the moving train are transmitted through the GSM network to the stationary trains on the same track and to the TTCS. By using this method one can determine whether the trains were heading for Rear-end collision or Head on collision. The TTCS transmits control signal to stop or move the trains.

Keywords: ***Train Collision Avoidance, GSM, LabVIEW, Train Identification Chip, Train Tracking Chip.***

INTRODUCTION

The Railway network is the world's biggest transport system. The Indian Railways is one of the largest railway networks in the world. There have been many accidents occurs in the railway network system. Most of the accidents occurred due to the collision between the trains and detrains. The proposed system is used to predict that kind of collision between trains and prevents them from occurring. By preventing these kinds of accidents more number of Iives can be saved. Because of these cases in the railways we considered collisions are the most dreaded accidents. It is very difficult to stop such a collision, because of speed of the train, which need a lead distance to stop. Collision occurred by two ways due to human error. The two types of Collisions are,

1. Head - on collisions
2. Rear- end-collisions

As in the proposed model, collision occurred by the above stages can be predicted and controlled. Those head on collision and rear end collision are happening due to the human carelessness therefore these conditions are more in our country. The Rail Safety Act regulates the safety of most rail transport including heavy and light rail systems, therefore most public and

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private sidings, each tramways and tourist and heritage rail operations. The main railways regulated by the Act include the Melbourne heavy rail system, the Melbourne tram and light rail network, Victoria's regional standard and broad gauge rail networks and regional tourist and heritage railways. Thus the Railways excluded from coverage under the Act include railways in mines, amusement and theme park railways and slipways. This railway has certain duties to protect and to prevent destruction in their path. But still there is lot of train collisions are occurring due to lack of awareness.

LITERATURE SURVEY

Railway collision is a major problem so this work is concentrated to avoid major and small causes of train collision on same track. Proteus software helps to route mapping and direction for the railway. The primary goal of our anti-collision system is to identify such collision points and to report these error cases to main control room and substation .using this electronic software and ultrasonic /DSLR (Digital Single-Lens Leflex) sensor defense a fog problem because of ultrasonic distance sensors range. To build this system, advanced sensing technology, long distance communication system (RS 485protocol), microcontroller (AVR AT8Mega) and wireless Communication protocol has been used.

Railways are providing Eco-Friendly transport system for the mankind. Train accidents can happen very often due to safety violations which results from human errors or limitations in the operation of the existing system and also due to equipment failures'. Our project is fully concentrating on avoiding train collisions and ensures passengers safety through android system integrated with ultrasonic and MEMS sensor based control system inbuilt in the train. Emergency alerts can be sent through traditional tele-communication systems such as Walkie-Talkies or other communication devices. However, Collision avoidance systems using IR sensor and anti collision device 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. Currently, to some extent the Konkan Railways has put efforts to provide train safety through Zigbee and Infrared based sensor concepts. Even though it has the disadvantages such as limited range of signal covered and difficulty in their implementation in the real world it is still being used. Hence these drawbacks can be overcome in our project by using android based electronic component for the fast communication with latest technology (ARM-7 LPC 2148) to avoid collision and it gets operated through the GPS /GSM concepts. Here RTOS is ported with ARM7 which deal with much more complicated tasks. Our work will be accepted worldwide because of its effectiveness and its robust communication features.

This work is concentrated on predicting the major cause of railway accidents that is collision on the same track. The primary goal of this anti-collision system is to identify collision points and to report these error cases to main control room, nearby station as well as grid control stations. So that if any collision likely to occurs then this system will help to avoid such conditions by giving an alarm to concern units. Implementation of an efficient Zig-Bee based Train Anti-Collision for railways is being proposed in this paper. A safe distance of 1 Km has been maintained between two trains after applying the emergency brake in case of collision detection. Based on the studies, it is observed that even for two trains traveling at 140kmph, the safe distance after automatic braking under normal conditions is approximately 920m. All sub modules have been designed and simulated using Proteus electronic simulation package and the prototype is implemented .It is expected that if this system is implemented widely, train collisions and accidents can be avoided. The up-gradation is also done by following the idea of checking cascaded connection of the compartments in sequence manner.
Implementation of an efficient ZigBee based Train Anti-Collision and Level Crossing Protection System for Railways is being proposed in this paper. The

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system has four sub modules namely, Train Module, Control Centre Module, Signaling Post Module and Level Crossing Gate Module. A safe distance of 1 Km has been maintained between the trains after applying the emergency brake in case of collision detection. Based on the studies, it is observed that even for two trains travelling at 140kmph, the safe distance after automatic braking under normal conditions is approximately 920m. All sub modules have been designed and simulated using Proteus electronic simulation package and the prototype is implemented. It is expected that if this system is implemented widely, train collisions and accidents at the Manned/Unmanned level crossing gate can also be avoided in the future.

EXISTING METHOD

As in the existing system, the following shows some existing techniques. The Anti-Collision Device (ACD) is a self acting Microprocessor-based data communication device designed and developed by Kankan Railway. The system consists of Loco ACD with a console (message display) for the driver (in each Loco Engine), Guard ACD with remote (fitted in Guard Van), Station ACD with console (fitted in Station Masters' Cabin), Manned and Unmanned Gates ACD with hooters and flashers (in each location) and Repeater ACDs (fitted at locations having obstructions in radio communication such as hilly areas) which work in concert to prevent the following kinds of collisions and accidents like Head on collisions ,Rear end collisions ,Collisions due to derailment, Collisions at the level crossing gates .

Train accidents can happen very often due to safety violations which results from human errors or limitations in the operation of the existing system and also due to equipment failures'. As by the project is fully concentrating on avoiding train collisions and ensures passengers safety through android system integrated with ultrasonic and MEMS sensor based control system inbuilt in the train. Emergency alerts can be sent through traditional telecommunication systems such as Walkie-Talkies or other communication devices. However, Collision avoidance systems using IR sensor and anti-collision device 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. Currently, to some extent the Konkan Railways has put efforts to provide train safety through Zigbee and Infrared based sensor concepts. Even though it has disadvantages such as limited range of signal covered and difficulty in their implementation in the real world it is still being used. Here RTOS is ported with ARM7 which deal with much more complicated tasks. Our work will be accepted worldwide because of its effectiveness and its robust communication features.

PROPOSED METHOD

In the proposed system the Train Identification Chip (TIC) inbuilt with GSM (Global System for Mobile Communication) module is used to communicate between the train and the Train Traffic Control Station. The TIC in the train and TTC on track at certain distances can make the assurance of train safety at each check point crossings. In the TTC [Train Tracking Chip] we have fixed the scratch pad. This scratch pad is the sensor which will give necessary signals to tracking of the train. The scratch pad is done by defining 9 pins, this pins are spring type will access the moving train. The pin holds the data about the checkpoint, train track number and direction of the moving trains. The total TTC module is placed in the railway track.

The TIC module is a module which is placed in the moving trains which consists a scratch reader. This Zigbee has the link between the train and the control station and vice versa. This module in the train when moving, the scratch reader will scratch the scratch pad in the track. This will retains at every checkpoints. In each checkpoint the details of the trains are communicated to the control station therefore the collision between the trains can be prevented. The messaging between the Train and TTCS is controlled by a PIC Microcontroller.

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The Fig.l explains the function of the TIC and TTC module. In the Fig. 1, it consists of two modules TTC and TIC this module is combined to train tracking module. The TTC module is the module which consists of sensor called "Scratch Pad". This is the Sensor which is placed in the track. In the Scratch Pad the train track number, checkpoint number and the direction are fixed. The next module to the TTC is the TIC module, which consists of sensor called Scratch reader. The Zigbee module also consist microcontroller, LCD display and. The whole TIC module is placed in the moving Train. In the TIC module, TIC is used to transmit and receive information between TTCS and Zigbee.

BLOCK DIAGRAM

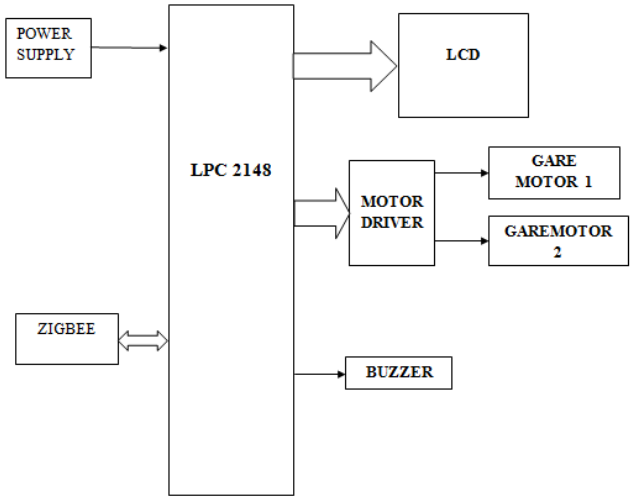

Fig.3.1..Block Diagram

ZIGBEE

The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking (Zigbee networks are secured by 128 bit symmetric encryption keys.) Zigbee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

Zigbee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive.

Zigbee is a low-cost, low-power, wireless mesh network standard targeted at the wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. Zigbee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB of flash memory. Zigbee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and Australia. Data rates vary from 20 kbit/s (868 MHz band) to 250 kbit/s (2.4 GHz band).

The Zigbee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of Zigbee routers to extend communication at the network level.

Zigbee builds on the physical layer and media access control defined in IEEE standard 802.15.4 for low-rate WPANs. The specification includes four additional key components: network layer, application layer, Zigbee device objects (ZDOs) and manufacturer-defined application objects which allow for

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customization and favor total integration. ZDOs are responsible for some tasks, including keeping track of device roles, managing requests to join a network, as well as device discovery and security.

Zigbee is one of the global standards of communication protocol formulated by the significant task force under the IEEE 802.15 working group. The fourth in the series, WPAN Low Rate/ Zigbee is the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Other standards like Bluetooth and IrDA address high data rate applications such as voice, video and LAN communications.

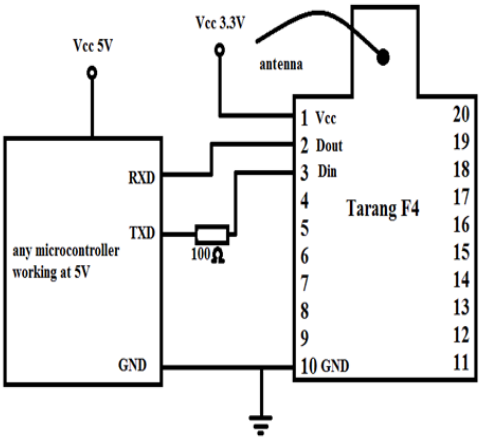
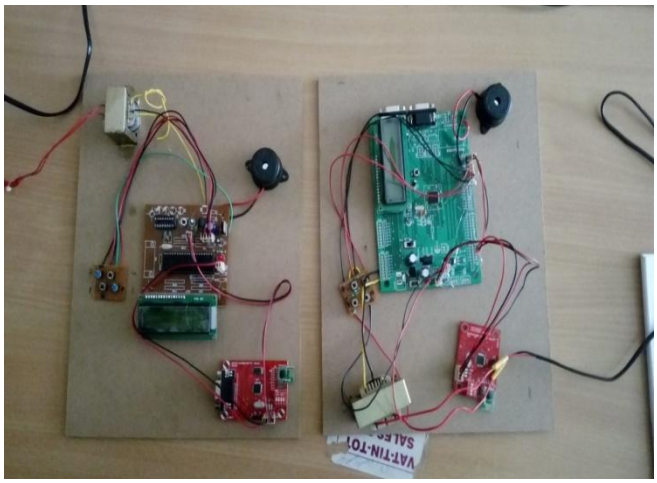
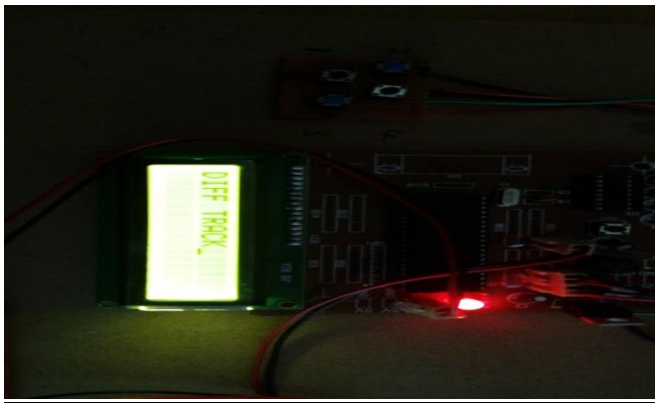
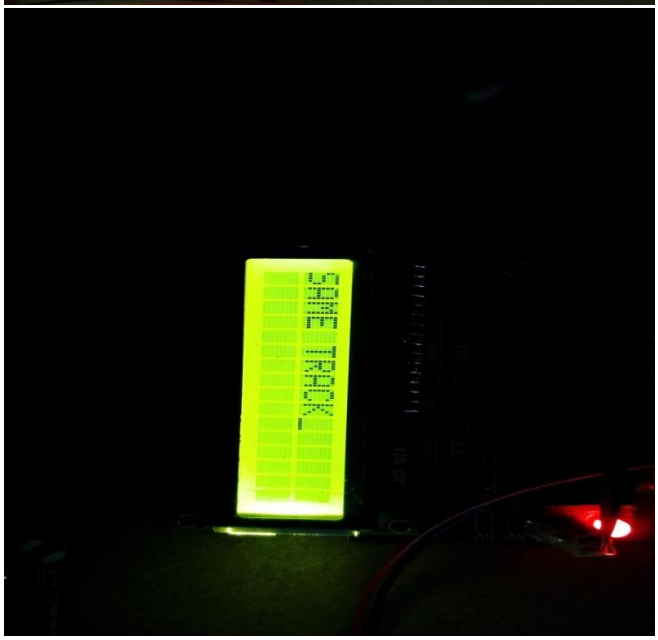


Fig 4.10.1 Zigbee PIN Diagram

RESULT & ANALYSIS







CONCLUSION & FEATURE SCOPE

It has been estimated that if the system is implemented in the railaway networks, train accidents can be prevented. This collision between trains is calculated and colliding trains were alerted. By this project train collision is stoped. Many human lives and many properties can be saved if this system is implemented. The scenario of accident in Trains due to collision will be controlled with the help of this project.

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