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Development of Co-Operative Wireless Relaying Communication based Train Control System

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Abstract: Now a day's railway transportation in India becomes very important sources of travelling we need improvement in the present system of Indian railways. Our project is based on the CBTC system. The main objective of CBTC is to increase capacity by reducing the time interval between trains. In this, the exact location of the train can be determined using limit switches and transmitted to the control center using wireless transmission. We are using Zigbee for this purpose. Whenever train reaches the station, the train location information gets transmitted to control center. In addition to this whenever train detects any object in its way it automatically stops and continues its journey when object removed from its way. We also include signaling feature in this project as whenever red signal appears train gets stopped. This system provides easy navigation to passenger. We can implement it successfully for real time systems.

Keywords: CBTC system, signaling system, anti-collision, Zigbee, Infrared Sensors, microcontroller 89S51

I. INTRODUCTION

Due to rapid growth in private vehicles, People nowadays prefer railway for travelling than other private vehicles because of traffic. Railways also provide cheap transportation in compared to other sources but it is not much reliable. India has 115,000 km of track length. It runs 12,617 trains to carry over 23 million passengers daily – equivalent to moving the entire population of Australia – connecting more than 7,172 stations. Most of the times reasons behind train accidents takes place due to often the result of mechanical failures and human error, and often it's a combination of both. To prevent these accidents from happening, we need to take some major advancement in the technology involved in railways. CBTC (co-operative wireless relaying system) is a railway signaling system that makes use of the telecommunications between the train and track equipment for the traffic management and control. As Zigbee is low cost & low power consumption communication element which makes our operation more efficient. When train enters the station its limit switch gets switch off this information is transmit to control center through Zigbee. Whenever red signal appears the light intensity of signal falls on photo diode placed on the train which in turn stops the train. In addition to this, collision is avoided by using infrared sensors which placed at front and back of the train which detects the presence of any object in the path of train. All this information is communicating and updating using Zigbee.

II. PROJECT MOTIVATION

India is the country which having world's largest railway network. We need improvement in the present system of Indian railways. The motivation for the project came from the lack of control over railways in India as we hardly get to know the exact position of the train while standing at the station. The way Metro implements modern techniques to control the railways inspired us to design a system for the complete railway system of India. So this is mainly the goal of our project. Just because of lack of coordination between train's driver and server and sometimes negligence of authority's results in very terrible incident.

So, our project is motivated from such kind of incidents such incident which took place in India. This accident left a deep impact on our mind. Thus we want to build a system that can ensure the safety of people inside the train. No, we had our own idea for the problem and our work is not inherited from others. The system which we have designed is more reliable, accurate and stand-alone. This would enable us to free the railways not just by the use of driver but will also enable us to provide real time train tracking system.

III. LITERATURE REVIEW

A. *RFID ZIGBEE Based Inter platform Train Tracking System (IEEE 2013) Authors: - Anand Bansal; Ankit Aneja; Janender Bansal; Sachin Sharma; Raghav Ankur.*

This project aims to offer advancing technologies for overall development of the railway station. By implementing this system into the present system of railways the risk of accidents could be minimized.

B. Zigbee and RFID Based Train Tracking. System Authors: Niraj V. Chawale, Pratik J. Kadam, Sachin Khodke, Pawan Thakre, Pooja Borkhade, Krishna Dhobale.

In this project, Communication between train scanning system and central processing unit will be established by Zigbee modules. Such automation will be helpful to better security with high degree of accuracy.

C. An in-depot real-time train tracking system using RFID and wireless mesh networks (IEEE 2014) Authors: - Zongjian He; Yigui Luo; Junhao Zheng

Knowing the real-time position of moving trains is essential for public transportation safety. To get the period of time train position, signal based, video and sensor based solutions are projected. However, those solutions area unit either too costly or solely applicable for traditional driving situation. During this paper, we have a tendency to propose a real-time tracking solution for light railway trains within the depot to avoid potential collisions.

D. Implementation of Zigbee Based Train Anti -Collision and Level Crossing Protection System for Indian Railways. Authors: Arun P, Sabarinath G, Madhukumar S, Madhukumar S.

In this a cost effective and intelligent full-fledged Train Anti Collision system designed to prevent the train collisions. It aims to efficiently integrate into the existing signaling system and avoid accidents in manned as well as unmanned level crosses, without changing any of the existing system implemented in Indian Railway.

IV. SYSTEM ARCHITECTURE

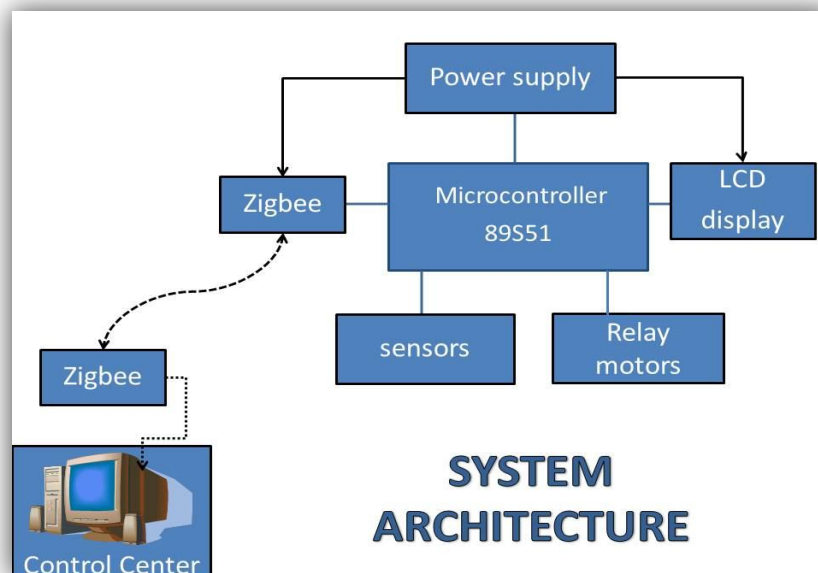


Fig. 1 block diagram

V. DESIGN IMPLEMENTATION & METHADODOLOGY

A. Hardware

Hardware consists of two parts i.e. one is main onboard circuit which is mounted on the train and other one is small circuit interfaced to computer via USB.

Main onboard circuit consists of microcontroller 89S51, Zigbee, relays, power supply battery, crystal oscillator, LCD display, various resistors and capacitors.

Other circuit is basically consists of Zigbee, some indication LED's and USB port which is used to connect the circuit to computer. Electronic hardware consists of interconnected electronic components which perform analog or logic operations on received and locally stored information to produce as output or store resulting new information. For communication between these systems, Zigbee modules are used.

B. Software

The main processing of the data is done by the 89S51 processor IC. In order to create program and convert it to .hex file we use WINAVR2010 version. This software will use make file information in order to create machine language program.

Software designed is based on the visual basic programming. This software is installed on the computer. We can control the train using software.

C. Principles on which Design works

- 1) Initially train waiting at car shed after turning power supply on the train will be showed at station no.1.
- 2) By pressing start button, train gets started .when train reaches the next station power supply breaks off and train stops. Now software indicating the train located at station no.2. After waiting for some time train again gets starts off to continue its journey.
- 3) Similar process takes place when train reaches last station but now train continues its further journey in opposite direction.
- 4) Whenever any object comes in the way of the train, infrared sensors detect the object and cut the power supply. This makes train to stop until the object is moved from its way. On the software there will be indication that train is stopped to avoid collision
- 5) Whenever Red signal appears on the signal, train gets stop because photodiode used on the train detect that red light and cut off the power supply to the train. Similarly for this software indicates the reason behind stopping as Red signal.

VI. COMPONENTS REQUIRED

A. Zigbee

We are using Zigbee module in this project for communication purpose. Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks. Zigbee is a low-power, low data rate, and close proximity wireless ad hoc network.

B. Microcontroller AT89S51

Low-power, high-performance CMOS 8-bit microcontroller with 4KB of ISP flash memory. The device uses Microchip high-density, nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pin out. On-chip flash allows program memory to be reprogrammed in-system or by a programmer.

C. LCD Display

LCD display can be interfaced with microcontroller to read the output directly. In our project we use a two line LCD display with 16 characters each. It displays train status information onboard.

D. IR Sensor

It allows you to detect an object's distance from the front end of the train. Infra-Red emitter sends out IR pulses. Position calculation is done through intensity of reflected light received by the detector.

E. Photodiode

It used to detect red light signal in order to stop or start the train. A photodiode is a semiconductor device that converts light into an electrical current.

F. Limit Switch

It identifies the station where the train has been reached. A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection.

G. Crystal Oscillator

Here we are using 3.579MHZ Crystal. This is a low cost crystal oscillator with oscillation frequency of 11.0592 Mhz. Crystal are normally required to provide clock pulses to your microcontroller or other IC's which require external clock source.

H. Power Supply

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. Here we are using 12 volt battery, but different components on hardware requires different voltage supply. so we are using two regulating IC 7805 and a bridge rectified and it provides a regulated supply approximately 5V.

VII. RESULT ANALYSIS

In this we use Zigbee module for the train control system. With the help of Zigbee module we can communicate between two trains, in this system train act as a router or end device and the computer in the controller room act as a coordinator.

Zigbee involves ring network topology in which several trains (i.e. router) are connected to controller room (i.e. coordinator). We can connect this coordinator to other coordinator (other control room based on different region), so as to create large railway network.

Due to use of Zigbee module we do not required a motorman in the train to drive the train i.e. train can be controlled from control room. This will avoid occurrence of human error.

Train can control itself automatically for conditions like from control room itself such as red signal or obstacle come in path of the train. We can give a command to a train to start or to stop, if any other emergency condition or any track problem occurred.

VIII. CONCLUSION

In Co-operative relaying based Communication Based Train Control System, where train-train communications are enabled.

CBTC is a railway signaling system that makes use of the telecommunication between the train & track equipment for traffic management & train control.

The automation discussed here are useful for reducing manpower and thereby increasing efficiency without compromising security constraint and helps to avoid human error. Further improvement is possible as for real life implementation, it is required to use more precise equipment and having more stability in all condition.

IX. FUTURE SCOPE

Zigbee module have some limitation about the connectivity range, we can create wireless sensor network using Zigbee over several kilometers but for the larger range distance Zigbee is not efficient. So INTERNET OF THING SYSTEM (IoTs) comes into picture for train communication and tracking.

With the help of IoT system the train communication will be done more significantly as internet service is available everywhere so the communication is easier and simple.

So for further studies we can try to implement IoT system instead of Zigbee module for ease of communication and tracking of train.

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