

# Zigbee Based Monorail Control System

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**Abstract-** Zigbee based monorail is designed to operate and control the monorail wirelessly via computer from control room and without man power. The wireless operation takes place with the help of Zigbee hardware with a limited range. Passenger safety is further enhanced by sensor at both the ends of the monorail which avoid any kind accidents. The sensors also makes sure that the monorail halts when it reaches the track end.

For wireless data transmission and networking between sensor nodes, the project uses zigbee modules. Every node after transmitting waits for acknowledgment from the computer to make data transfer reliable. The Zigbee RF modules are engineered to meet IEEE 802.15.4 standards and support the unique needs of low cost, low power wireless sensor networks. The modules require minial power and provide reliable delivery of data between devices. The modules operate with the ISM 2.4GHz/800MHz frequency band

**Keywords -** MicrocontrolerAT89S51, IR Sensors, LCD, Relay Driver IC ULN2803, Limit Switch, Zigbee.

## I. INTRODUCTION

A monorail is a railway in which the track consists of a single rail, typically elevated. monorail, A single rail serving as a track for passenger or freight vehicles. Monorails have found applications in airport transfer and medium capacity metros. To differentiate monorails from other transport modes, the Monorail Society says Monorail. A single rail serving as a track for passenger or freight vehicles. In most cases rail is elevated, but monorails can also run at grade, below grade or in subway tunnels. Vehicles either are suspended from or straddle a narrow guide way.

It is designed to operate and control the monorail wirelessly via computer from control room and without man power. The wireless operation takes place with the help of Zigbee hardware with a limited range. Passenger safety is further enhanced by sensor at both the ends of the monorail which avoid any kind accidents. The sensors also make sure that the monorail halts when it reaches the track end.

## II. RELATED WORK

### A. Zigbee Technology

It is a short range wireless communication technology. In this system, Zig-Bee assembles the information acquisition, information transmission, information processing units.

### B. Relay driver IC

It is used to control the trigerring of relay switches. The ULN2803 is designed to be compatible with standard TTL families while the ULN2804 is optimized for 6 to 15 volt high level CMOS or PMOS.

### C. Power Source

A step down transformer is used which feeds 12V DC supply directly through tracks. Contacts embedded in the train's power supply unit gets the supply.

## III. HARDWARE PLATFORMS OVERVIEW

An evaluating hardware was developed with Maxstream, Zigbee pro Zigbee module, it consumes only 2mW and 1.25 mW power at active and sleep mode. It is compatible to transfer data up to 400 meters range at 250Kbps. Zigbee pro communicates based on DSSS (Direct Sequence Spread Spectrum) and it is very suitable for mesh, point-to-point and point-to-multipoint networks. It also gives 3V CMOS UART the option to interface external devices like, microcontrollers, sensors, etc. Zigbee pro manufacturer provides XTU software package to program the Zigbee module.

A controller is required to handle the events, the drawback of 8051 is that it can be programmed only for once hence we are using an 89S51 micro controller since it has 4KB Flash Memory and can programmed for multiple times. There are two versions available in this 89C51 and 89S51, 89C51 uses CMOS technology, and 89S51 uses ISP (in system programmable) technology. CMOS usually takes +15V to operate whereas ISP uses +5V. Controller is a 40 pin device, a supply is provided on 40 number pin and pin 20 is grounded, pin 18 and 19 are used for crystal oscillator. The value of crystal oscillator is 11.0592 MHz. Pin 9 is reset pin, which is connected to a capacitor and resistor, as the power is supplied to controller; it turns on at zero memory position. There are four 8 bit bidirectional ports in it, Port 0, Port 1, Port 2, Port 3

IV. BLOCK DIAGRAM

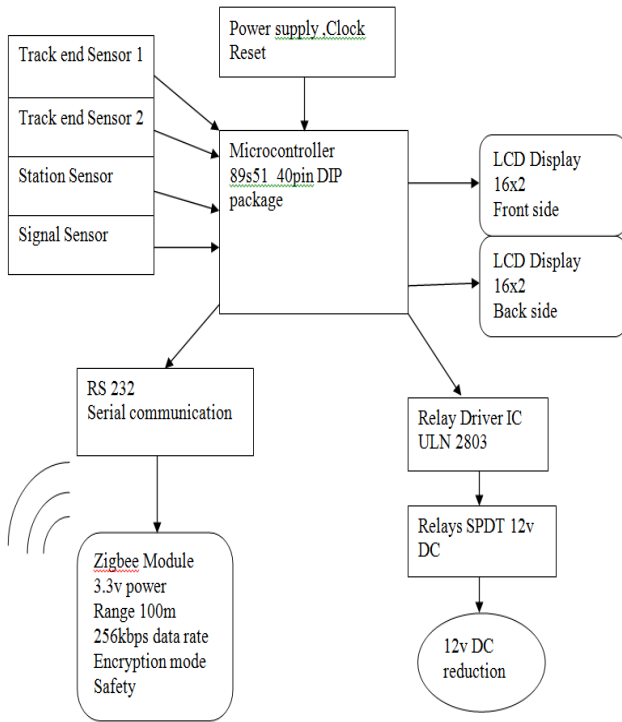


Fig. 1 Block diagram from train side

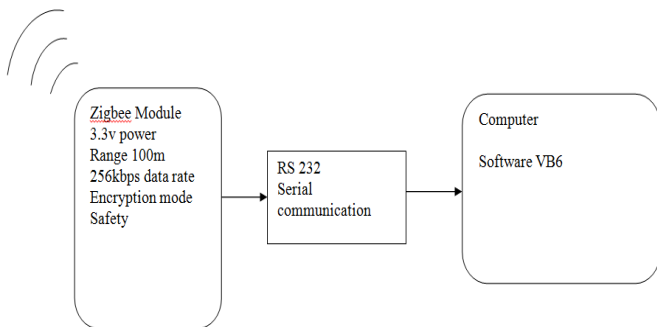


Fig. 2 Block diagram from control room side

The “Zigbee based monorail control system” basically consists of seven main blocks.

A. Zigbee

Two zigbees are used in this project one is connected to the train to receive command signals and send status of the train in real time mode. The other one is connected to the computer which stores the result and then sends the updated result to the computer.

B. Microcontroller

Micro controller senses the signal given from switches and decides the mode of operation. In voting mode, it increments the data for corresponding key, in counting mode micro

controllers fetches data from memory location and send it to display devices

C. LCD Display

Liquid Crystal Display which is commonly known as LCD is an Alphanumeric Display it means that it can display Alphabets, Numbers as well as special symbols thus LCD is a user friendly Display device unlike seven segment display which can display only numbers and some of the alphabets. Here we have used 16 x 2 Alphanumeric Display.

D. Sensors

There are four sensors:

1. Track end sensor1.
2. Track end sensor2.
3. Station sensor.
4. Signal sensor.

E. Relay driver IC

Relay Driver IC ULN2803 to control the motors of trains. It will control the speed and direction of the motors via Relay Switches. The eight NPN Darlington connected transistors in this family of arrays are ideally suited for interfacing between low logic level digital circuitry

F. Relay Switches

A relay is an electrically operated switch. Here two relay switches NT73 (JQC-3FC) are used to move the train in both forward and reverse direction and to control the switches relay driver ic is being used.

PCB Layouts:

