

Smart Metro Train

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Abstract: *The main aim of this paper is to make a driverless train which is programmed to run between two stations. The train is a toy-like prototype which follows a specific path. Station on such a path, timing of the train and the distance between stations are predefined. The paper presents the development process of a prototype for a driverless train implemented using a PIC microcontroller. The prototype provides passengers counting and generates warning signal when the compartment are full. It also provides automatic opening and closing of doors.*

Keywords: Driverless train, Passenger counting, Warning signals, Obstacle detection, Full automation

1. Introduction

In modern days metro train transportation has become the most economical and safe way of public transportation system. It helps to connect two major cities and provides a high speed transportation services to the public. The unmanned metro train (Driverless) allows a highly secure and high performance means of transportation. The prototype makes use of microcontroller to control the train movements. It also controls passenger counting and generates a warning signal including automatic opening and closing of doors. The train runs between two predefined stations. It also provides a facility of collision avoidance in case of two trains being on the same track. The distance between two stations are also predefined. The train runs between two stations without human intervention. It provides a reset switch to the passenger which acts as an emergency braking system to stop the train in case of emergency. The main idea of the approach is to allow automatic metro train system which is completely unmanned and is precise and errorless in its operation. Counting of passengers happens by using bidirectional detection by IR and photo diode arrangement.

2. Related Work

Existing vs. proposed work

The proposed work allows a high speed metro train to run between stations with little or no human interventions. The entire train operation is microcontroller controlled. It helps to reduce the error or short comings of the existing metro train system.

Disadvantages of existing system:

- Requires human intervention.
- High cost.
- Manpower required for its operations.
- More time consuming.
- Installation and integration is time consuming.

Proposed work overcomes the above shortcomings:

- Less manpower.
- Errorless operation.
- Provides better guidance to the passenger.

- Hassle free operation.
- Low operation cost.
- Better safety features.
- Automatic closing of door is provided after the prescribed number of person entered.
- Display unit is provided.

A wireless camera is interfaced for continuous monitoring.

3. Project Description

This project is designed to demonstrate the technology used in metro train movement which are used in most of the developed countries. This train is equipped with a controller that enables the automatic running of the train from one station to another. This proposed system is an autonomous train and it eliminates the need of any driver. Thus, any human error is ruled out. In this project microcontroller from 8051 family has been used as CPU. Whenever the train arrives at the station it stops automatically, as sensed by an IR sensor.

Then the door is opens automatically so that the passengers can go inside the train. The door then closes after a prescribed time set in the controller by the program. It is also equipped with a passenger counting section, which counts the number of passengers leaving and entering the train. The door closes when it reaches maximum occupancy level irrespective of time allotted for the door to remain open. The passenger counts are displayed on a seven segment display interface to the microcontroller. The movement of the train is controlled by a motor driver IC interfaced to the microcontroller. The train incorporates a buzzer to alert the passengers before closing the door and also warn them before staring. As the train reaches the destination the process repeats thus achieving the desired operation. Further the project can be enhanced by making this system more advanced by displaying the status of the train over an LCD screen for the convenience of the passengers. The status of the train consists of the parameters like, expected arrival and departure time etc.

4. Design and Simulation

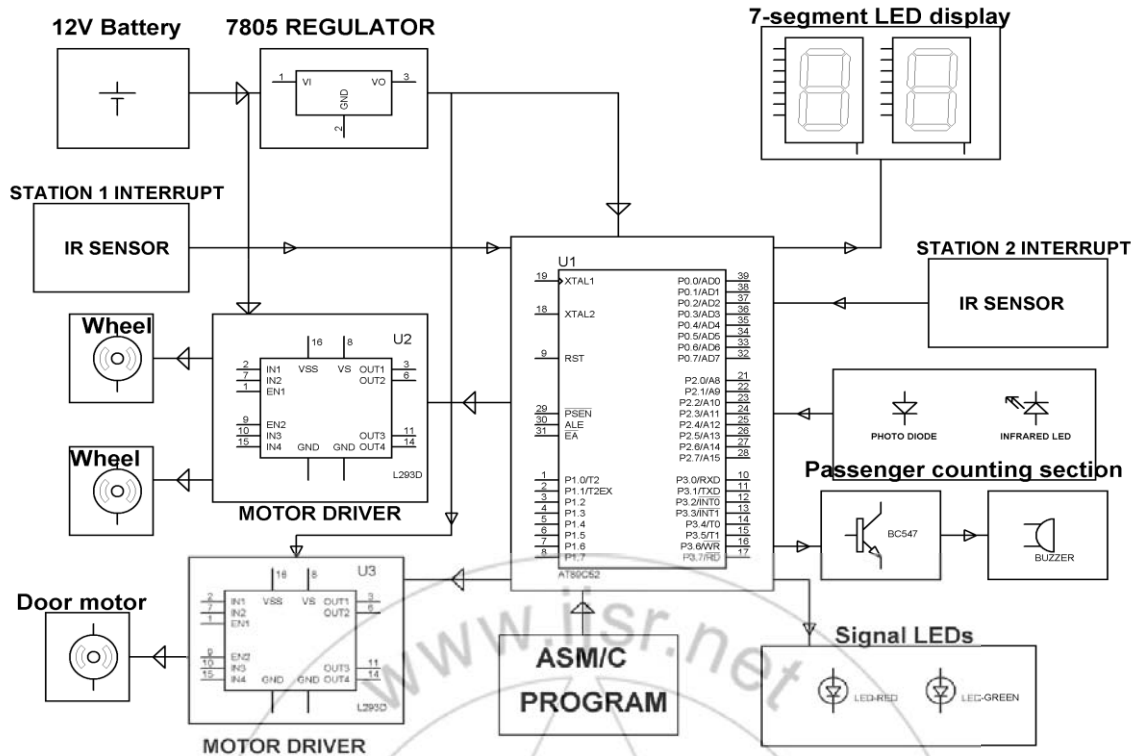


Figure 1: Block diagram of smart metro train

The metro train prototype works on a PIC microcontroller which is programmed using Keil compiler. It has a software as well as a hardware part to it. Fig.1 shows the block diagram of smart metro train which consist of signal LEDs,

passenger counting section, two motor drivers used to drive the door and wheels respectively, seven segment LED display, 12V battery, 7805 voltage regulator and IR sensors.

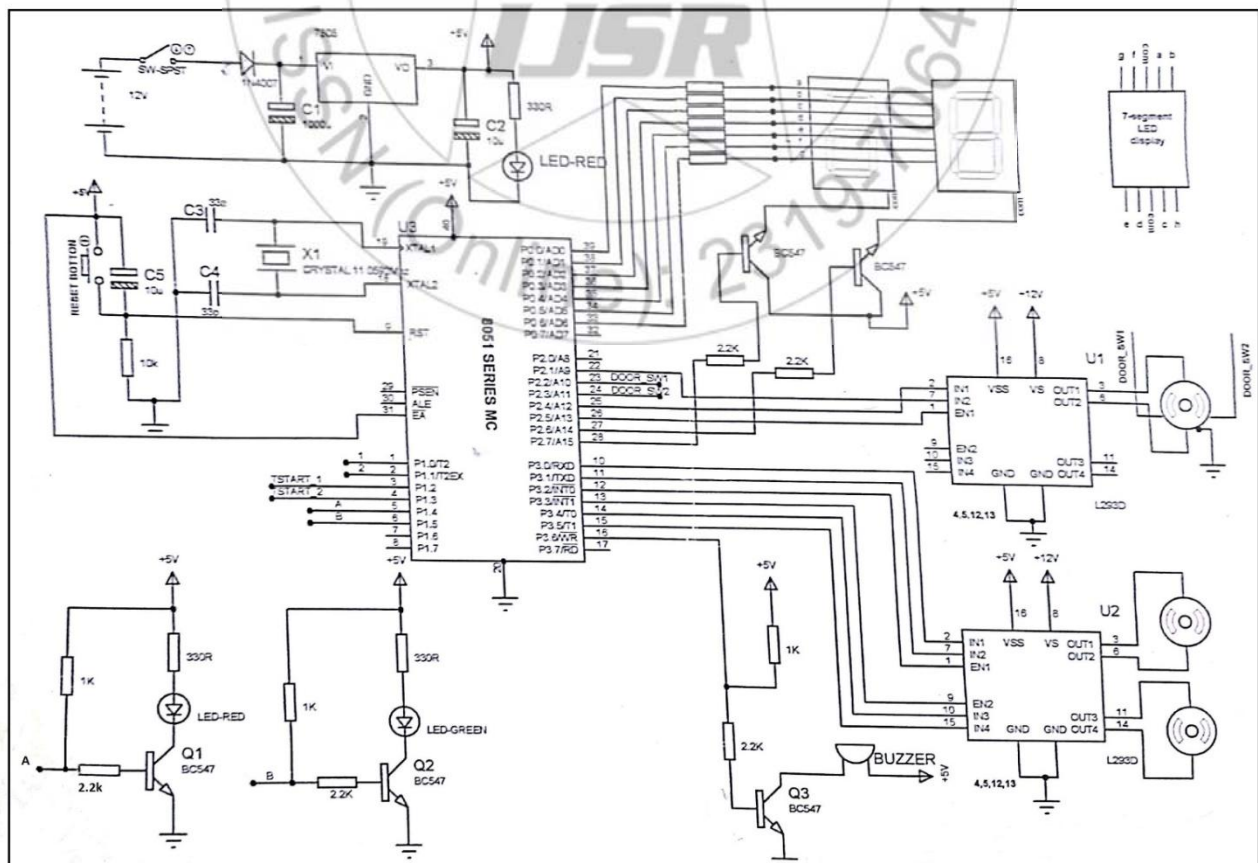


Figure 2: Circuit Diagram of smart Metro Train

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The main circuit of the metro train consist of a voltage regulator (7805) which converts 12V DC supply to 5V DC which drives the microcontroller .A timer device for providing the clock pulse to the microcontroller is done by a crystal oscillator. There is a motor driving circuit which controls the motor driver IC (L293D) for the door and wheels of metro train. The Buzzer circuit gives indication when the train compartment is full. The display section which consist of 7-segment LED display to indicate about the passenger count.

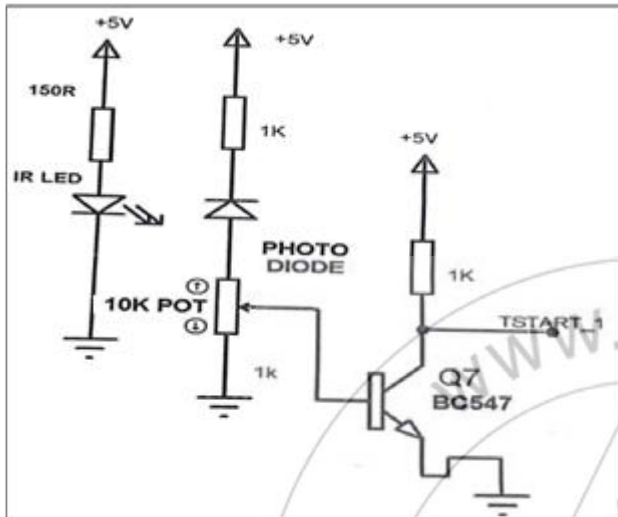


Figure 2.1: Circuit Diagram for forward running of motor

Figure 2.1 indicate circuit for the forward running of motor for the train wheels.

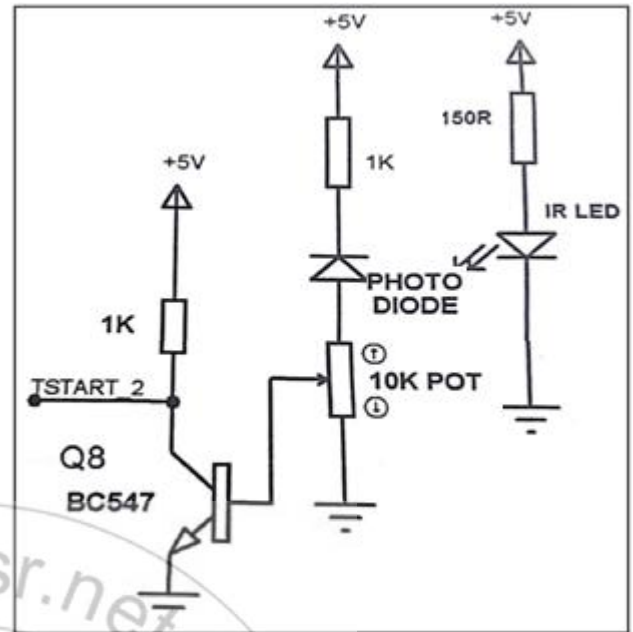


Figure 2.2: Circuit Diagram for reverse running of motor

Figure 2.2 indicate circuit for the reverse running of motor for the train wheels.

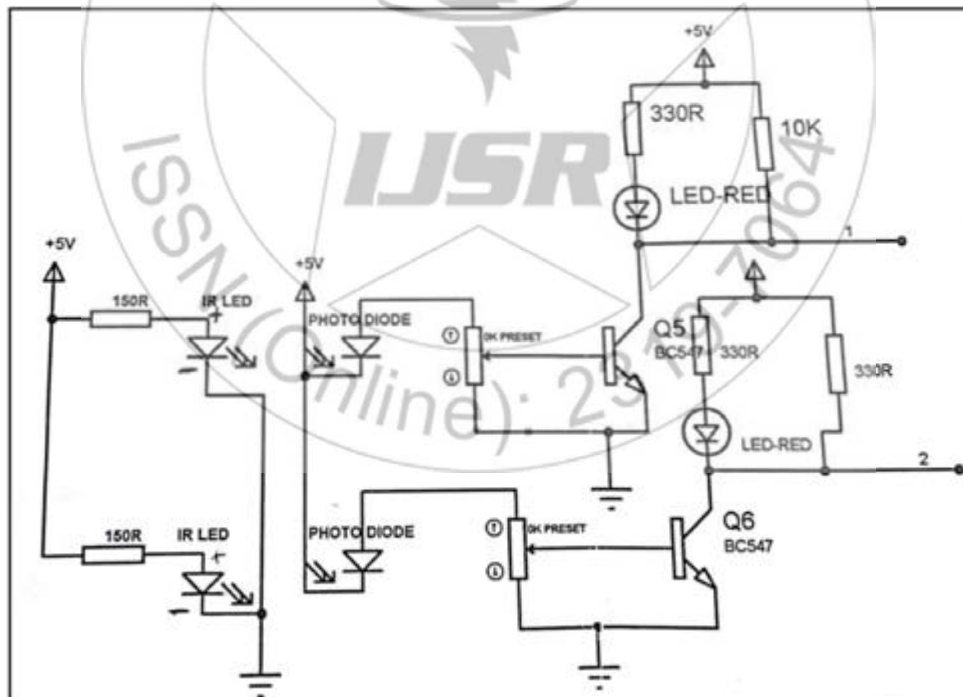


Figure 2.4: Circuit Diagram for Passenger counter

Figure 2.4 indicates the circuit for passenger counting.

4.1 The Hardware Implementation

After testing the circuits with stimulation, hardware implementation started by assembling the components on printed circuits boards (PCB). ARES software, which is part of proteus is used to produce the schematic for three PCBs

that are used in implementing the hardware system. One PCB is designed to hold the main controller circuit components, and two small identical PCBs are used to implement the IR sensors. A PIC microcontroller unit is used in each of the three circuits. The main controller circuit is installed in a toy-train representing the prototype and interfaced with the dc motor to actuate the train movement, another actuator to control the opening and closing of the

door, an LCD to display messages, and a buzzer to announce audio warnings. An IR detector is also incorporated in the main control circuits, while the two IR transmitters are located along the path of the train to present stations at which the train has to stop.

4.2 The Software Implementation

We use keil compiler to programme the microcontroller atmega89s52 which is from the family of 8051 microcontroller. This 40 pin microcontroller is programmed using c-assembly language. The programme of opening and closing of door, forward and backward moving of train ,obstacle detection system, warning generation when the capacity is full and people counting system are burned in the microcontroller.

5. Result and Discussion

Metro train prototype solves the problem of man metro train. It makes the journey hustle free, makes the journey safe. The unmanned (driverless) metro train provides errorless services for human intervention. The metro train compartment capacity is predefined and is programmed in the microcontroller to generate the warning signal which causes the compartment door to close when the train is full. There is people counting system at the entrance of the compartment door. It also provides collision avoidance system in case of two train being on the same track therefore provides more safety. The distance between two station is predefined and the train will stop at the station for predefined time.

6. Conclusion

Nowadays the accidents of trains are increasing day by day. Of these major accidents are occurring due to human faults. A man can do a mistake but a programmed processor doesn't have a chance of doing error. This is the main reason behind this project. This is a highly advanced technology which is currently used in developed nations such as Japan, Germany, France etc. By using this auto metro train the timings of the train will be exact and it avoids a lot of inconvenience to the passengers. This project will greatly reduce the human intervention in the control of trains and hence saves a lot of time and money. Thus the project "AUTO METRO TRAIN TO SHUTTLE BETWEEN STATIONS" is greatly useful in all aspects.

7. Future Scope

The metro train in the current project is designed to run only between two station but by programming microcontroller differently we can design it to run between more than two stations. We can incorporate automatic announcement system to inform the passengers about the next station. We can introduce RFID based ticketing system at each station. We can also implement GPS tracking to show the status of train.

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