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Driverless train using Atmega16 for Crowd Management, Disaster Management and Anti Collision

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Abstract: The main aim of this paper is to illustrate the technology used in driverless metro train movements which are used in most of the developed countries. This train is equipped with a controller that enables the automatic stopping of the train from station to station. This train also has other features which are crowd management, disaster management and anti-collision. This paper presents the development process of a prototype for a driverless train implemented using Atmega16.

Keywords: Microcontroller, Atmega16, relay, Train.

I. INTRODUCTION

This project is designed so that students can understand the technology used in now-a-days driverless metro trains which are used in most of the developed countries like England, Germany and Japan etc. These trains are equipped with the CPU which controls the train. The train is programmed for a specific path.
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 Atmega16 microcontroller has been used. Whenever the train arrives at the station it stops automatically, with the help of relay switch. Then the door opens automatically so that the passengers can go inside and outside of the train. The door then closes after a prescribed time set in the controller by the programmer. The control is done through a communication based train control where a trackside computer is used to monitor the train running on the assigned line and convey this information to the centralized computer. The train is controlled by the automatic train control system.

II. OBJECTIVE

In this design, part of this automation tasks are considered, and a microcontroller-based prototype is developed. Actions such as travelling through a given path with predefined stations, sensing the arrival at the station and hence, proper stopping are implemented in the prototype, predefining capacity of train and thus managing crowd, automatic stopping of train in case of a disaster or collision. Messages that are synchronized with the train's progression through its path are announced to passengers via a display. Moreover, alarm signals are produced as appropriate. Controlling of the doors in terms of open and close and timings of such actions are considered.

III. SYSTEM DEVELOPMENT

A. Technical Circuit Working Of This Project: 5 Volt Regulated Power Supply:
In this portion one step down transformer is used to step down the voltage from High volt ac to 9 volt ac. Output of step down transformer is further converted into dc with the help of the rectifier circuit. Here we use full wave rectifier. Full wave rectifier converts the ac into dc with the help of two silicon diode. Output of the diode is pulsating dc, so to convert the pulsating dc into smooth dc we use capacitor as a filter. Output of the capacitor is further regulated by the 7805 regulator. IC 7805 regulator provide a regulated 5 volt dc to the circuit. Output of the IC 7805 is further connected to the microcontroller circuit.

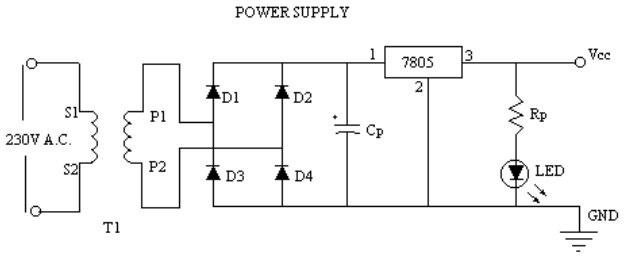

Fig 1. The Conversion circuit of High Voltage to Low Voltage supply.

B. Controlling the movement of the train
Normally when the train is moving, the relay switches are placed such that one sensor is placed beside the train and other one beside the track. When the train is moving the relay switch is in normally open condition which gives continuous high signal to controller and thus train keeps running. When the station arrives the relay circuit goes to normally closed condition because of the second switch placed beside the track. This send low signal to the microcontroller and thus train stops moving. The movement of train is monitored on the control system and

the running and stopping action of train can be controlled from there. This monitoring is done with the help of Zigbee module which sends continuous signals to the control system.

C. Controlling the opening and closing of doors

As the relay switch is closed it sends low signal to microcontroller, the microcontroller sends a high signal to the door motor driver such that it drives the motor to open the door, for the passengers to get in and out. The microcontroller is programmed such that the door is opened for particular time duration and then the microcontroller is programmed to signal the motor driver to rotate the motor so as to close the door. Also when the train reaches its maximum passenger count the door closes before its waiting time.

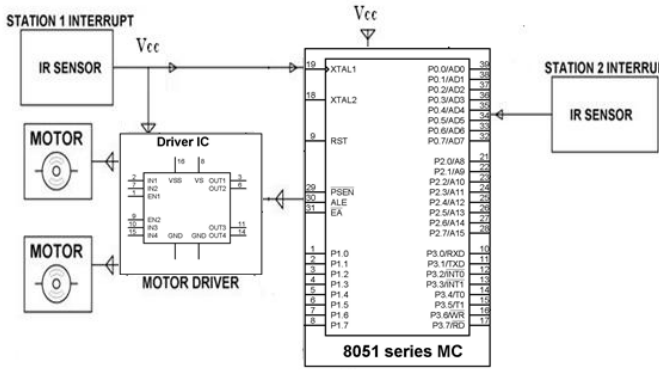

Fig 2. Block Diagram for Movement of Train.

D. Controlling the count of number of passengers entering and leaving the train

A passenger counter system consists of an IR LED-Photodiode arrangement – one at the door and another a little distance away. When a person enters the door, there is an interrupt between the IR LED and the photodiode and accordingly the corresponding transistor sends a logic high signal to the microcontroller. As the person leaves the area and goes further inside interrupting the second IR LED-Photodiode arrangement, the 1st IR LED-Photodiode arrangement comes back to its normal operation and a low signal is send from the corresponding transistor to the microcontroller. This transition from high to low of the microcontroller pin causes an increase in the number display of the LCD display programmatically. When the count reaches a maximum, the microcontroller is programmed so as to trigger a buzzer alarm. Similarly when an interrupt is sensed between the 2nd IR LED-Photodiode arrangements, the transition from high to low signal of the microcontroller causes a decrease in the number count of the LCD display.

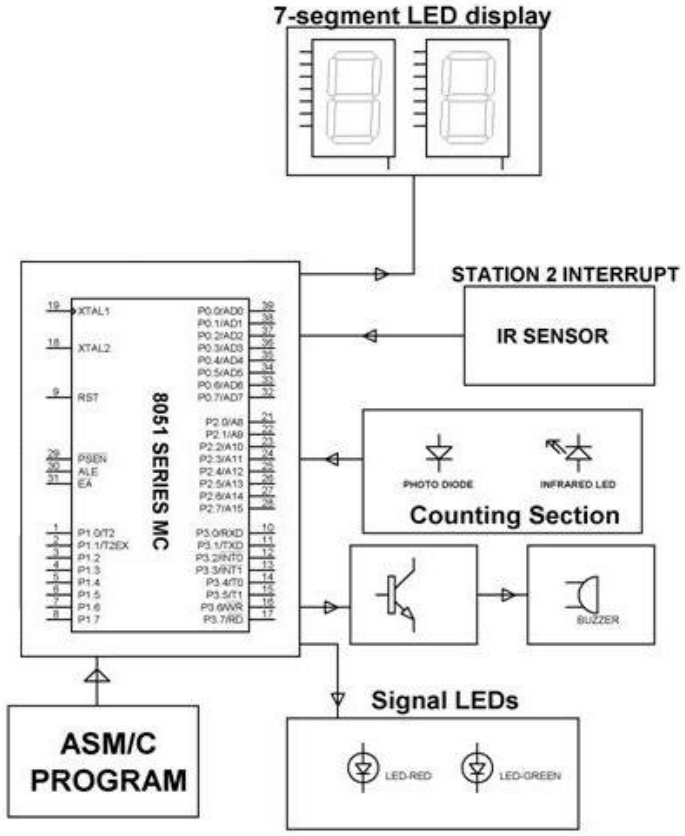

Fig 3. Block Diagram for Passengers Circuit in Train.

E. Automatic Light and Fan operation

When the passenger count is increased from 0 fans in train are automatically turned on. When the passenger count becomes 0 it turns off fan. For automatic action of light we have used LDR sensor. When the passenger count is more than 0 and no light is falling on LDR then lights in compartment are turned on. Otherwise lights are turned off. Head light of train gets turned on when there is no light falling on LDR.

F. Disaster management and Anti-Collision

For the Disaster management and anti-collision purpose anti-collision device is used. It is placed above the wheels of train. When any foreign object is sensed by anti-collision device it sends low signal to the microcontroller which in turn sends low signal to motor driver and thus stops the movement of train.

G. Speed Control in Tunnels

Speed control system consists of a reed switch which is placed on the top of the train. When the train enters a tunnel reed switch senses it with the help of magnet placed on the tunnel. This sends signal to microcontroller which reduces the speed of the motor and thereby decreasing train's speed. As soon as train leaves the tunnel it starts moving at its actual speed.

IV. ADVANTAGES AND DISADVANTAGES

Advantages of fully automatic train control system:

- Easy way of transport from and to remote area

- High speed technology
- Modernity
- Accessibility
- Increased train frequency
- Power efficient
- Reduces human effort

Disadvantages of fully automatic train control system:

- Expensive
- People might not feel safe to travel in fully automated train.
- Increases unemployment

V. MODIFICATION

The modifications required for practical implementation of this concept in our regular trains are as following:

A. Sensor Placements

Two IR Sensors are to be placed on each end of the train perpendicular to the platform. The first sensor IR1 is placed just above the wheels of starting coach of the train While the second sensor IR2 is placed on the last coach at the same position of the first sensor. When the train reaches the beginning of the platform the IR1 light is reflected by a white strip attached beneath the platform. When the first receiver of IR1 detects the light it sends a low signal to controller and controller will drive off the motor using motor IC. As the last coach of the train reaches the platform, the IR2 sends a low signal to controller. When controller receives the signal from IR2 it commands the door control logic to open the doors of the train.

B. Placement of strip

Beneath the starting of the platform a vertical white strip is attached for reflection of IR signal. While for underground metro train a black strip is attached horizontally along the line of action to absorb the IR signal.

C. Inertia calculation

When the IR1 sends a low signal to controller the speed of train has to go zero from the defined speed within the length of the platform. The inertia should be calculated such that when speed becomes zero the train should be exactly parallel to the platform.

D. Anti-collision system

There will be sensors fitted on tracks which will continuously communicate with the server computer. If any foreign body is noticed on the tracks then the server computer will be informed, which will stop the train.

VI. CONCLUSION

A general conclusion that can be said about such engineering projects is that they are introducing an open horizon of developments. Such projects can only represent a minor part of what the future and technology integration may look like for the modernization of different service sectors including transport. Researching and developing a working prototype enhance self-confidence and assure that it is possible to design a system and apply it for solving a particular problem by acquiring the necessary information. Moreover, developing a prototype system can serve as a basis of a far more sophisticated and advance form of control system such as a real driverless train system.

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