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Auto Metro Train Shuttle between Two Stations

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Abstract: **The main of this paper is to illustrate the technology used in 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 paper presents the development process of a prototype for a driverless train implemented using a PIC microcontroller. Simulation for the system's circuits is done with the aid of Proteus software. The hardware circuits, which are built on printed circuit boards (PCB), are interfaced with actuators and sensors for automation purposes. The hardware is assembled in a toy-like prototype train. The C programming language is used for programming the microcontroller.**

Keywords: **Microcontroller, RFID, IR Sensors, D.C Motor, Train, IC, Station, Relay.**

1. INTRODUCTION

Thisprojectisdesignedsothatstudentscanunderstandthetechnologyusedinnow-a-days driverless metro trains which are used in most of the developed countries like Germany, France, and Japan etc. These trains are equipped with the CPU which controls the train. The train is programmed for a specific path. Every station on the path is defined and also the stoppage timing of the train and distance between the two stations is predefined.

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 PIC microcontroller 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.

2. OBJECTIVE

In this project, part of this automation tasks are considered, and a microcontroller-based prototype is developed. Actions such as traveling through a given path with predefined stations, sensing the arrival at the station and hence, proper stopping are implemented in the prototype. 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.

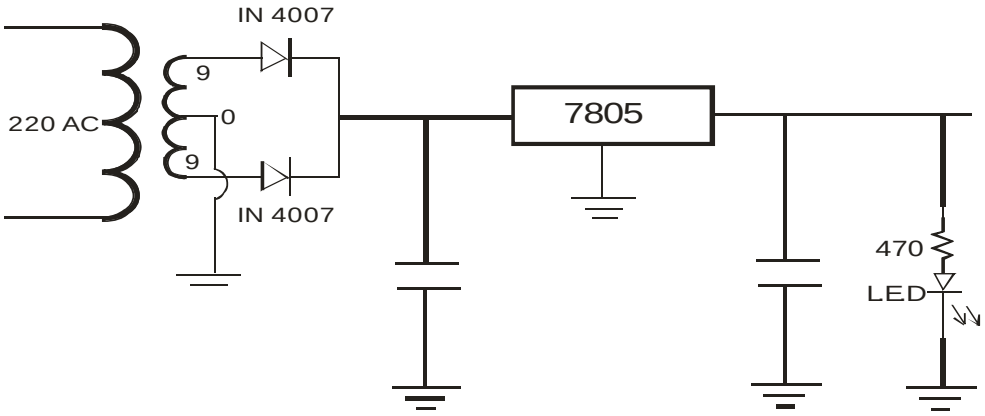
3. SYSTEM DEVELOPMENT

Techincal Circuit Working Of This Project:

5 Volt Regulated Power Supply:

In this portion of the project we use one step down transformer to step down the voltage from 220 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

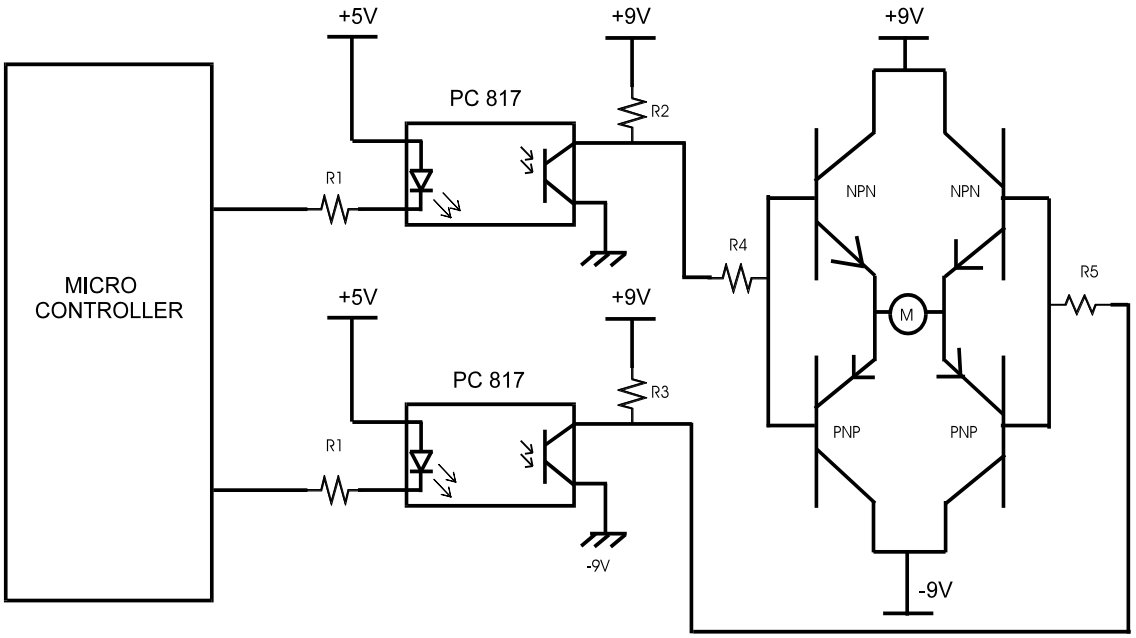
rectifier. Full wave rectifier converts the ac into DC with the help of two silicon diode. Output of the diode is pulsating dc, so to convert the pulsating dc into smooth dc we use capacitor as a filter. Output of the capacitor is further regulated by the 7805 regulator. IC 7805 regulator provide a regulated 5 volt dc to the circuit. Output of the IC 7805 is further connected to the microcontroller circuit.



In this project we use total 7 sensors; 3 infra-red + photodiode interruption sensor, 2 pressure sensorsand 2 reed sensors. For the interruption we use one infra-redLED plus photodiode. In normal condition infra-red light is focused on the photodiode. Photodiode offers a low resistance on light. When train cross the light then photodiode resistance become high and at that time we get a signal. Also we use three pair of infra-red photodiode sensor, 2 sensors on the track and 1 sensor under the barrier rod. On track sensor we check the in and out of train. When train is on the track then barrier is to be down by slow speed motor. If the barrier rod is not completely down due to any interruption then third infra-red sensor is active and will provide a signal to the controller, at this time motor is off. If there is no interruption in the front of the sensor, then rod comes down and one magnetic sensor is activated.

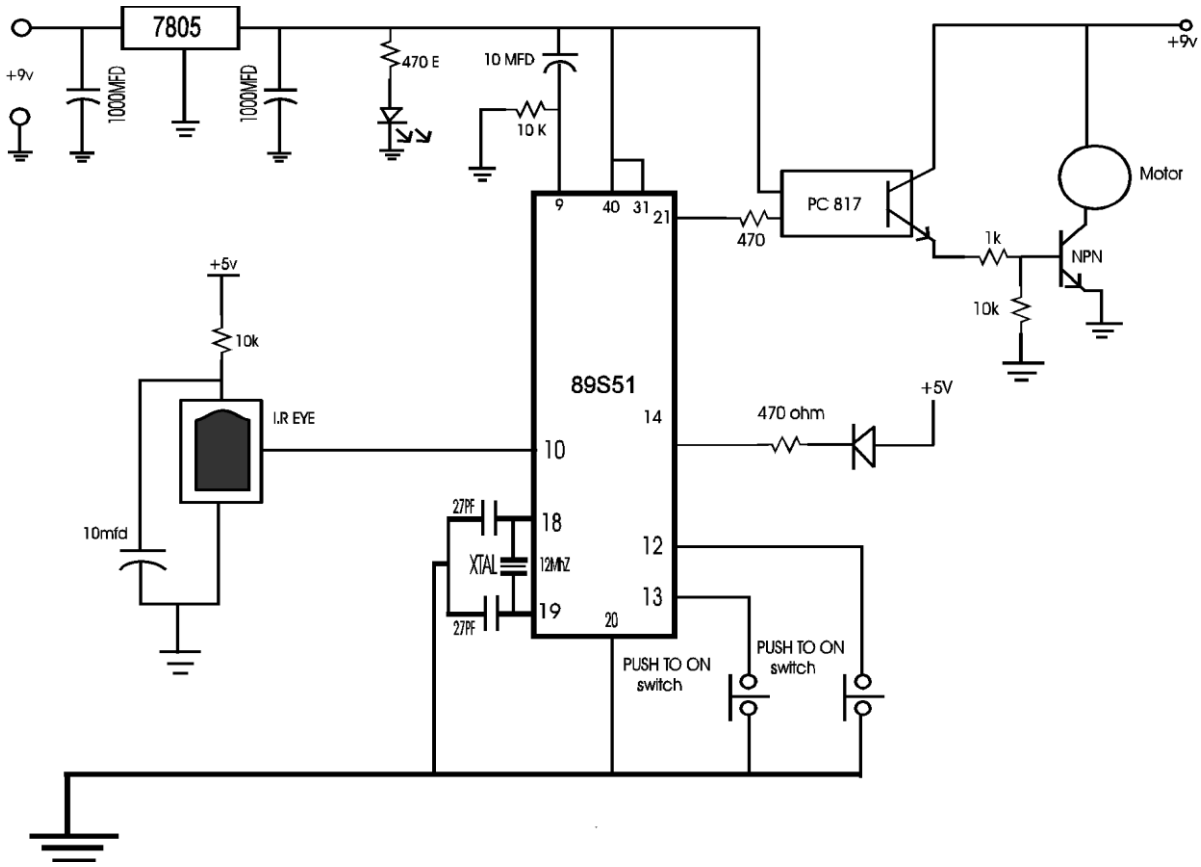
In this project we use a pressure sensor also. Pressure sensor is activated when infra-red sensor is first activated. To attach with the infra-red sensor and pressure sensor we use op-amp as an amplifier. In all infra-red sensors we use one infra-red LED and one photodiode. Infra-red LED is in focus with the photodiode. When light is interrupted by the train then photodiode resistance becomes high. So in that case negative pin of the op-amp is getting more positive voltage. As the output of the lm 339 is low positive input of op-amp is set on positive reference voltage. On this pin we connect a variable resistor to see the value. Variable resistor set the sensitivity of the photodiode interruption. Output of the op-amp is further connected to the microcontroller circuit. Here in this project we use IC lm 339. LM 339 is inbuilt four op-amps inside.

For controlling a dc motor we use H bridge circuit. Here we will use four transistor circuit to control the movement of dc motor for forward and reverse movement.



Collector of both the transistor is connected to the positive supply 9 volt. This 9 volt supply is for the DC motor. If we use 12 volt motor then we use 12 volt dc supply here. Emitter of both the transistor is connected to the DC motor. Emitter of the PNP transistor is connected to the emitter of NPN transistor. Collector of both the PNP transistor is connected to the ground potential. Base point of both transistors is joining together. On this point we give a voltage.

In this project Opto-coupler is connected to the P2.0 and P2.1. Pin no 40 of the controller is connected to the positive supply 5 volt. Reed sensor is connected to the p1.2 and p1.3. Pressure sensor is connected to the p1.0 and p1.1. When any sensor is activate then controller sense a negative output on the pin. So we connect a LED with controller pin to show the activation of the sensor.



In this train circuit we use microcontroller with start and stop switch. Pin no 40 of the controller is connected to the positive supply and pin 20 of the controller is connected to the ground pin. Pin no 18 and 19 is connected with the external crystal oscillator to provide a clock pulse o the circuit. Pin no 12 and 13 of the controller is connected with the start and stop switch. As we press the switch train is start and when we press the stop switch then train is stop. Motor is connected with the pin no 21 of the controller via opto-coupler and NPN transistor. One infra-red eye is connected with train to receive an incoming signal from signal pole. If the signal on pole is red then infra-red rays from the pole is receive by the eye and then train stop simmediately. Now if the interruption is removed from the barrier sensor the barrier is close and infra-red signal is off and train start again.

4. CONCLUSION

The driverless train prototype that is presented in this paper is in fact a final year project. A general conclusion that can be said about such engineering projects is that they are introducing students to 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.