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AUTOMATIC SHUTTLING OF METRO TRAIN

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ABSTRACT

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 microcontroller 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. 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. The door closes when it reaches maximum time allotted for the door to remain open. The movement of the train is controlled by a motor driver IC which uses the concept of H-bridge operation is interfaced to the microcontroller. The train incorporates a LED 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 is 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. The system also includes new concept of an emergency response switch enchanced with the "GSM calling module" system which could be used by the passengers in case of any emergency during the journey. Also, The train is equipped with the "Anticollision" feature in whichit will stop automatically if there is any obstacle in its course. This is achieved by using an IR sensor as an obstacle avoidance system.

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INTRODUCTION

Today the urban cities are having various modes of transport to ease its citizens to travel from one point to other. The list of such transport systems is long among which the metro or subway system is the most popular. Unlike busses or trams the metro train systems are electric railways that operate on an exclusive rail network which are not accessible by the pedestrians and vehicles and which is often grade separated in underground or elevated railways. The world's first metro transit system was the London Underground Railway Network which was open for public in 1863. Since then the technicians and engineers have worked hard to make this system more efficient and have always come up with new technologiesevery then and now.

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This system has solved the traffic problem of various urban cities like New Delhi, New York, Beijing, Tokyo, etc. In India the metro transit system was first implemented in Kolkata as Kolkata Metro in 1984. Since, then the Governments of many states like New Delhi, Uttar Pradesh, Karnataka, Maharashtra, etc. have implemented metro transit systems in their State capitals. Modern services on the Metro systems is provided on the designated lines between the stations typically using EMUs or Electric Multiple Units on rail tracks. The Stations have high platforms, without steps inside the train, requiring custom made trains.

Working Principle

The prototype vehicle works on the principle of central control system i.e. all the functions of system are controlled by one single controller or computer on the basis of real time input provided by various sensors and other devices. The

microcontroller here used is AT89C52, which belong to the 8051 family. The power provided to the circuit is of 5V. The 7805 voltage regulator IC is used to provide the 5V uninterrupted DC to the system. The noise is removed by using the capacitor filter. The LED is used as an indicator in the power circuit. Two IR Sensors are mounted on each side which will detect the station and the metro will stop accordingly. Whenever the metro train is entering any station it will stoop as soon as the IR sensor in the moving direction detects the signal point on station. To prevent any collision with any foreign object lying on tracks there is also an object collision detection and avoidance system onboard. This is achieved by the another IR Sensor which will detect any foreign object in the route. On detection the system will itself send an alert message to the upcoming station about the blockage. The gates of the metro train will operate automatically. The gates will only open when the train will stop completely to ensure the safety of its commuters. The opening of gates will be followed by the buzzer sound which will alert commuters about the opening of the gate. After the certain time the buzzer will get activated again which will be followed by the automatic closing of gate. Once all the gates are closed the metro train will move to the next station. The 12V DC motors are used for the transmission of metro train in this prototype. These 12V DC motors are operated with the H-Bridge and to prevent the back EMF optocouplers are used. This back EMF can damage the microcontroller so it must be prevented from reaching there and it is done by using optocouplers. All the 12V DC motors are operated by using H-Bridge and each motor is connected to its own optocoupler. The LCD is also interfaced to the microcontroller to display the station and passenger related information. The LCD is operated in 4 bit mode to conserve the space and memory. An emergency response switch is provided in each coach which will alert the QRTs at the next station in case of any emergency. A GSM module is interfaced with this switch which will send the emergency message to the QRTs control room at the upcoming station.

Figure 1. SIM900 GSM Module

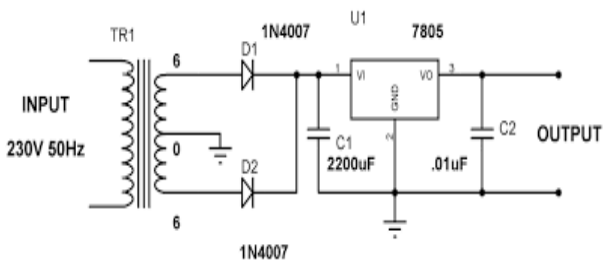


Figure 2. IC7805 Power Circuit

Components

1.Microcontroller

AT89C52 is an 8-bit microcontroller and belongs to Atmel's 8051 family. AT89C52 has 8KB of Flash programmable and erasable read only memory (PEROM) and 256 bytes of RAM. AT89C52 has an endurance of 1000 Write/Erase cycles which means that it can be erased and programmed to a maximum of 1000 times. AT89C52 has 3 timers - timer0, timer1& timer2. Corresponding to Timer2, there are extra SFRs (Special Function Registers). Also there are registers RCAP2H & RCAP2L to configure 16 bit Capture & Auto-reload modes of Timer2.

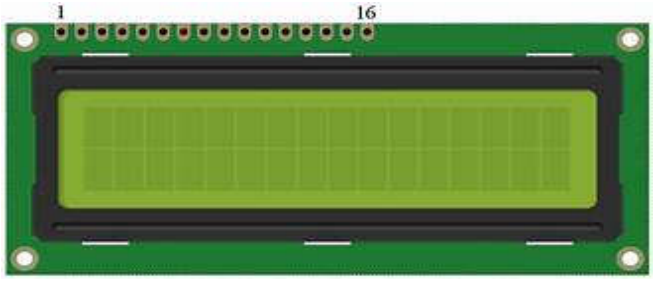
2. Darlington Transistor

The Darlington transistor (commonly called a Darlington pair) is a compound structure of a particular design made by two bipolar transistor connected in such a way that the current amplified by the first transistor is amplified further by the second one.This configuration gives a much higher current gain than each transistor taken separately. Wide variety of Darlington transistors are available that are varied by polarity, collector current, power dissipation, package type, maximum CE voltage and so on. These transistors are found in different types of applications such as power regulators, motor controllers, audio amplifiers, etc. Many opto-isolator circuits are made with Darlington transistors to have high current capacity at the output stage.

3. Liquid Crystal Display(LCD)

A **liquid-crystal display** (**LCD**) is a flat-panel display or other that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a Backlight or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays,

as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels while other displays have larger elements. Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes and polarizing filters(parallel and perpendicular) the axes of transmission of which are (in most of the cases) perpendicular to each other. Without the liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer. Before an electric fieldis applied, the orientation of the liquid-crystal molecules is determined by the alignment at the surfaces of electrodes. In a twisted nematic (TN) device, the surface alignment directions at the two electrodes are perpendicular to each other, and so the molecules arrange themselves in a helicalstructure, or twist. This induces the rotation of the polarization of the incident light, and the device appears gray. If the applied voltage is large enough, the liquid crystal molecules in the center of the layer are almost completely untwisted and the polarization of the incident light is not rotated as it passes through the liquid crystal layer. This light will then be mainly polarized perpendicular to the second filter, and thus be blocked and the pixel will appear black. By controlling the voltage applied across the liquid crystal layer in each pixel, light can be allowed to pass through in varying amounts thus constituting different levels of gray.

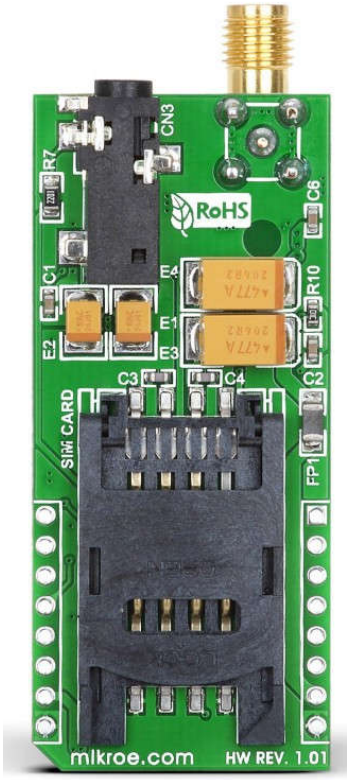


4.Light Emitting Diode(LED):

A light-emitting diode (LED) is a two lead semiconductor light source. It is a p-n junction diode that emits light when activated. When a suitable current is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm^2) and integrated optical components may be used to shape the radiation pattern. Which can be defined as the emission of light from a semiconductor under the influence of an electric field. The charge carriers recombine in a forward-biased P-N junction as the electrons cross from the N-region and recombine with the holes existing in the P-region. Free electrons are in the conduction band of energy levels, while holes are in the valence energy band. Thus the energy level of the holes is less than the energy levels of the electrons. Some portion of the energy must be dissipated to recombine the electrons and the holes. This energy is emitted in the form of heat and light. The electrons dissipate energy in the form of heat for silicon and germanium diodes but in gallium arsenide phosphide (GaAsP) and gallium phosphide (GaP) semiconductors, the electrons dissipate energy by emitting. If the semiconductor is translucent, the junction becomes the source of light as it is emitted, thus becoming a light-emitting diode. However, when the junction is reverse biased, the LED produces no light and—if the potential is great enough, the device is damaged.

GSM Calling Module

It is a emergency system installed in the metro train that would be used to send message regarding any sort of emergency situation in the metro train. A button would be installed in each coach of the train, which after being pressed manually will send message signal to the control room of upcoming station so that appropriate actions would be taken to relieve passenger from that problem. The message sent will be a text message. It is the mere advancement of the metro train that is not presently used practically but can be introduced as such in near future.



Respack

Respack is a device just similar to resistance box used for the variation of the resistances as per use of the circuit but there is subtle difference in the respack that is the resistance present in it are of same value and here the respack used RESPACK-8 which consists of 8 resistances of equal value i.e. 1 K ohm.

Conclusion and Future Scope

At the completion of the project we have arrived to a conclusion that this automatic system of metro shuttling is more efficient than the current manual system. There are many advantages of having such system like high accuracy, low accident rate, increased speed, etc. Automatic Metro is far cheaper to build and far cheaper to operate than conventional heavy rail. Automatic Driverless Metros are considerably more competitive than Conventional Metros and will become more so as they are industrially developed.

Sample Code:

```
#include<at89x52.h>
#include "E.O.L.h"

void main()
{
P0=0XFF;
P1=0XFF;
P2=0XFF;
P3=0XFF;
        lcdinit();
        delay(5000);
        lcdclr();
        lcdgoto(1,5);
        lcdstring("*PROJECT*");
        lcdgoto(2,1);
        lcdstring("Year:2017-18....");
        delay(60000);
        lcdclr();
        lcdgoto(1,1);
        lcdstring("*SMART METRO*....");
        lcdgoto(2,2);
        lcdstring("*system*.....");
        delay(50000);
while(1)
{
 if(start==0)
        {
   flag1=0;
   motor=0;
        lcdclr();
        lcdgoto(1,3);
        lcdstring("*METRO START*");
        delay(60000);
        delay(60000);
        }
       else if(stop==0)
       {
   flag1=1;
   motor=1;
        lcdclr();
        lcdgoto(1,3);
        lcdstring("*METRO STOP*");
        gled=1;
}
}
```

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