Super-Capacitor Based Metro

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***Abstract*- The paper include the method of reducing the drawbacks of current metro system by using super-capacitor. Energy is generated from sources like solar, wind, hydro, coal etc. But there are disadvantages regarding building of plants, running, maintenance or availability of resources (fuels) which will be exhausted one day and also new generation of rapid trains requires even maximum effective energy management for reduction of energy consumption during the process. This project drives metro with the help of super-capacitor, it is a type of battery which is huge and very bulky, as this capacitor required some place to install it on train so that it will give power supply to motor. And, the super capacitor will charge itself through braking also. On the basis of the work of a metro-train, the super-capacitor system has been used for energy that tries to limit overhead current and, consequently, drop of voltage at the train pantograph. This will eliminate the use of overhead lines, construction of signal poles, electric wires and will also reduce the cost of maintenance. Its one time installation and maintenance cost being low with long lasting life. The super capacitor based metro train will be the mind blowing achievement in future by looking for rapid consumption of fuel in present situation.**

***Index Terms*- Super-capacitors; power managing; consumption of resource.**

INTRODUCTION

From last few years' people mobility has increased in urban areas, implying the necessity of rapid transit improvement in terms of passenger capacity and number of journey than metro is the best option. Metro trains aim to provide safe and comfortable journey to a large number of passengers in a short period of time, which makes it become an important part of public transportation. Great amount of energy is consumed in big cities due to largely working of metros. Due to this, there is a hike in cost consumption for maintaining the metro route and various aspects for running the metro. This problem is lowered by introducing the concept of super capacitor in the metros. This help in eliminating the case of overhead cables by installing super capacitor in metro. The super-capacitor uses the concept of charge and discharge. This super capacitor also get discharge by supplying continuous energy to motors of metro train so the charging of this capacitor is necessary to give continuous and. trouble-free operation of metro

Super capacitor will charge itself through a charging point installed at various station with the help of pantograph on the metro. As the metro reaches the station, the obstacle sensor will sense the station and will erect the pantograph for charging. The super capacitor has an advantage of fast charging and slow discharging which reduces the electricity cost of running the metro. The capacitor will charge up to its full capacity and will travel till next station. The charging will be done through pantograph.

Thus, this method will not only reduce the cost of installing overhead wires, but will also the save time and energy of humans required for maintaining it and also, electricity for running metro.

OBJECTIVE

This project gives brief idea about, how the use of super-capacitor in metro proves worthy. Considering the problem faced by metros nowadays, regarding the excessive use of electricity and the maintenance required for overhead wires. Super-capacitor has ability to minimize the use of electricity and eliminate the use of overhead wire concept.

Problem formulation and implementation methodology. This system is fully based on electronics (using microcontroller and sensors) and highly reliable and less expensive to implement and can be implemented. The main aim is to draw conclusion on problem of generation of electricity with the help of fossil fuel which are going to end one day. This system will help to save the fossil fuels and provide an efficient way of operating the metro.

It can also be used for storage of electricity as it charges quickly and discharge rate is slow. In local locomotives such as local trains this project can be applied.

HISTORY

Although initially the trains in London were drawn by steam engines, all metro trains, both now and historically, use electric power and are built to run as multiple units. Power for the trains, referred as traction power, is commonly supplied by means of a single third rail (as in New York). The current in the trains is generally 600 to 730 volts, although some cities, such as in London and Milan, use two wires, one which is positive and another negative. The practice of providing power through railway to the ground is due to the small gap between trains and tunnels, which therefore prevents the using overhead wires.

The overhead wires provides high voltages for running railway, overhead wires can be used in metros which doesn't have many tunnels on the way, an example of which is the metro in some part of China, overhead wires are also installed on some systems that are underground, in Barcelona, Fukuoka, Madrid, and Shijiazhuang. Lines that runs on street surface (such as in Boston) tend to acquire complete power from overhead wires, while travelling from the tunnel and from street in the suburban areas, as another rail would prove harmful for the street user. There are moving lines that make use of rails as well as overhead cable, with which vehicles can switch between the two and an example of this is in Rotterdam and former Chicago.

The electric power is DC instead of AC, which also requires large rectifiers.

DC motors were efficient earlier for railway applications; therefore converting AC to DC is considered infeasible.

METHODOLOGY

The super-capacitor unit is placed on train so that it directly transmits its power to the motor of the metro train. This super-capacitor is acts like a battery hence, battery also gets discharge by giving its power to full filling the need of some system operation. Just like that super-capacitor also get discharge after some period of time by supplying continuous power to motor, so it is necessary to charge this capacitor unit. The charging of super-capacitor bank is done on metro station means we will provide charging point on each and every station and the charging is done via means of pantograph which is situated at top of metro train. Pantograph is operated with the help of servo motor. A servo motor is device which rotates or pushes objects. It is a motor on servo mechanism which can rotate at specific angle. If motor works on dc then it is called DC servo motor and when it works on AC then it is called as AC servo motor. Thus these features are being used in toy car, RC helicopter and planes, robotics etc. We use line follower instead of rail route. This project uses line follower technique which follows black line. Train must be able to detect particular line and keep following it. Microcontroller is the important part which operates the whole system of metro train. It contains of motor which is operated through microcontroller. From supply it comes 230volts ac but our devices are work on12 volt so we have to step down this voltage to 12volt for operating whole project. There are two DC motor connected across each other. This motor will move in both the direction forward as well as in reverse direction. We provide logic 0 or 1 across

the input pin for rotating motor. The operation of the motor is explained below. Let's consider a motor connected with output pin for rotating a motor logic 1 & logic 0.

Logic 1 & Logic 0 = Clockwise direction

Logic 0 & logic 1 = Anticlockwise direction

Logic 1 & Logic 0 = No rotation

Logic 0 & Logic 1 = Idle (No rotation)

DESIGN

This project is designed on pcb layout and some part of hardware on sheet.

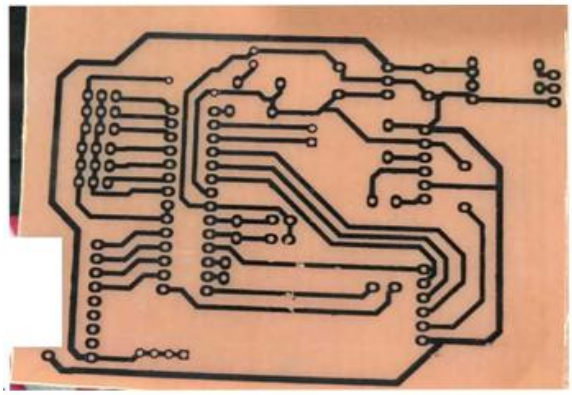
The circuit contains two ultrasonic range finder connected at front end of the metro and another at top of the metro. Then LCD is connected to the pins of microcontroller which is used to display the distance from metro to station. A motor driver IC is also connected which is used to drive the motors. A voltage regulator IC is connected to regulate the voltage between the supply voltage and voltage needed to drive the microcontroller. The main thing require to operate this project is the super-capacitor which is connected through resistor to prevent the

overloading of super capacitor. Servo motor is also used to provides control of angular terms in linear position, velocity and acceleration

Components: -

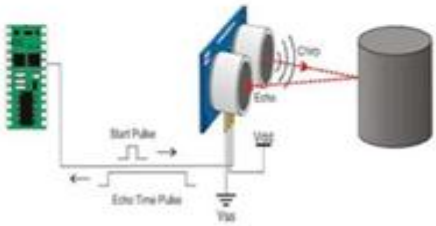
Printed Circuit Board

PCB was designed on Dip Trace PCB design software. Initially the schematic was generated which was printed on PCB by doing screen printing. Later the holes were drilled and the components were mounted following the footprints. For making reliable electrical connections between components lead and copper track soldering is used.



Ultrasonic Ranging Module HC - SR04

- 5V SUPPLY
- TRIGGER PULSE INPUT
- ECHO PULSE OUTPUT
- 0 V GROUND



MICROCONTROLLER ATMEGA328

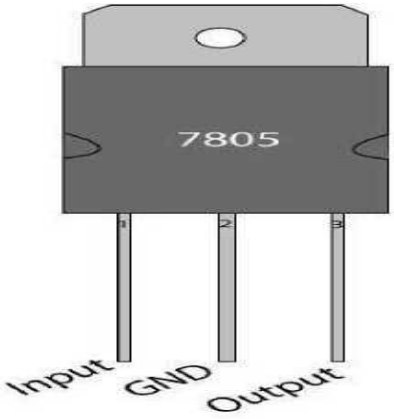
ATMEGA328P is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller that is used in ARDUINO boards.

VOLTAGE REGULATOR IC

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

7805 IC Ratings:

- Input Voltage range 7V-35V.
- Current range Ic = 1A.
- Output voltage range Vmax = 5.2 V, Vmin = 4.8 V.



PIN Diagram:

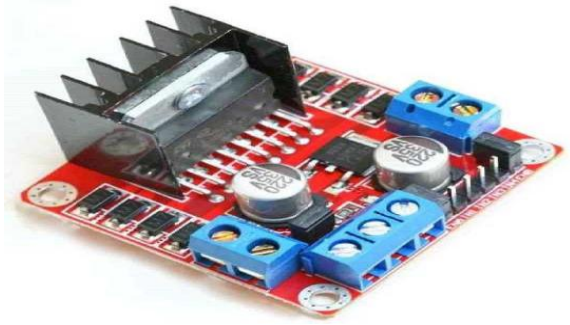
LCD

LCD display is an important part in almost all embedded projects and this project is interfacing 16*2 LCD with 8051 microcontroller. Many, find it difficult to interface LCD device with the 8051 but the fact is that by learning properly, it's a easy job and by knowing it can easily design projects like digital voltmeter, digital clock, home automation displays, status indicator display, digital code locks, digital speedometer/ odometer, display music players etc. Thoroughly going through will make able to display any text (including the extended characters) on any part of the 16*2 display screen. In order to

understand the interfacing first you have to know about the 16*2 LCD module.

MOTOR DRIVER IC

The L298N is an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. . It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together rand the corresponding external terminal can be used for the connection of an external sensing resistor. Supply is provided in addition to work at low voltages.



SERVO MOTOR

A servo motor is actually a rotor device that provides control of angular terms in linear position, velocity and acceleration. A suitable motor is attached to its sensor for feedback position. Often a sophisticated controller is used with servo motor. Servo motors are used in closed loop control system but there is not a specific type motor. Servomotors are commonly used in application like robotics, CNC machinery or automated manufacturing

SUPERCAPACITOR

A super capacitor (SC) (also called a super cap, ultra capacitor or Gold cap) is a high- capacity capacitor with capacitance values much higher than other capacitors (but lower voltage limits) that bridge the gap between electrolytic capacitors and rechargeable batteries. They typically store 10 to 100 times more energy per unit volume or mass than electrolytic capacitors, can accept and deliver charge much faster than batteries, and tolerate many more charge and discharge cycles than rechargeable batteries. Super-capacitor are used where there is charge/discharge cycle instead of long charge storage: within cars, buses, trains, cranes and elevators, where they are used for regenerative braking, short-term energy storage or burst-mode power delivery.[3] Smaller units are used as memory backup for static random-access memory (SRAM).

FUTURE SCOPE

This project will be useful for running metros and also railways. The following points will be the proof of using Super-capacitor

- As metro and railway uses electricity which consumes fuels. Due to this, fuels will be finish and to prevent this, usage of super-capacitor will be useful in future.
- Maintaining of overhead cables is expensive. And using super-capacitor, maintenance of overhead cables will be prevented and also cost will be reduced.
- Maintaining the whole metro system is costly and also time consuming, therefore using super capacitor will erase these disadvantages. As, this system requires only one time installation cost and maintenance

CONCLUSION

- The two ultrasonic sensors placed at the metro train detects the station and the obstacle in the rail root. The station and the distance of the obstacle is displayed on the LCD as shown.
- The microcontroller allows the super capacitor bank to be charged through pantograph controlled by servo motor if its value is below 7A, if its value is enough for the metro to reach next station the microcontroller does not gives command to the servo motor to charge the super capacitor bank.

- The super capacitor requires less time to charge and discharges slowly.

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