

Piezoelectric Energy Generation from Metro Trains as Road Transportation

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ABSTRACT

The transportation sector is one of the most trending sectors which is contributing great advancements in terms of technology. The railway sector being a part of it, has made a great progress in the last decade in providing economical as well as a safe mode of transportation. This paper mainly aims at providing a modification to the existing metro train, where the trains run on a virtual track by means of which it can run on the roads just like other vehicles. It is also an unmanned train which runs between the stations provided, and has an automatic mechanism of starting and stopping of the train. It also provides visual indications regarding the arriving stations to its passengers. It also provides a concept of piezoelectric generation of power using non-conventional sources of energy where the electrical energy is harvested to produce clean electricity.

Keywords-Virtual track, Piezoelectric power generation, Micro controller

I. INTRODUCTION

From the invention of the trains which run on the man made tracks, to the speediest of the trains which run on virtual tracks, there is a massive improvement in the railway sector. The very first metro train in India was introduced in 1984 in Calcutta. Over the years it has made tremendous growth and has been expanded across the whole country with many modifications in terms of speed, the facilities and the comfort provided to its passengers.

One of the major problems that the metro train is facing is its construction. The construction of flyovers or the underground path and the tracks for the stations consumes huge amount of resources as well as requires a lot of time (almost years together). This usually results in the traffic problems to the passengers travelling in that area. The tracks also need huge amount of power to run the train. The management of the high power tracks is also risky as it is dangerous if a person tries to cross it.

The first objective of this paper is to provide virtual tracks to the train, where in the trains can easily run even on roads which minimizes the resources for construction as well as saves the time of construction. The virtual track is just a lane which is usually painted with a particular colour on the road, which the train follows. The train, on encountering a particular station, stops automatically and also provides visual indications via LEDs and LCD to its passengers as to which station it is. It waits for a predefined time and then again automatically resumes and travels to the next station.

The second objective of the paper is the power generation using the piezoelectric sensors where electricity can be tapped from the pressure applied by a foot of a person. This module can be implemented on the track or even the platforms where the train halts, so that the electricity can be generated by using the pressure developed when the train runs on the track or when a person walks on the platform respectively.

II. BLOCK DIAGRAM

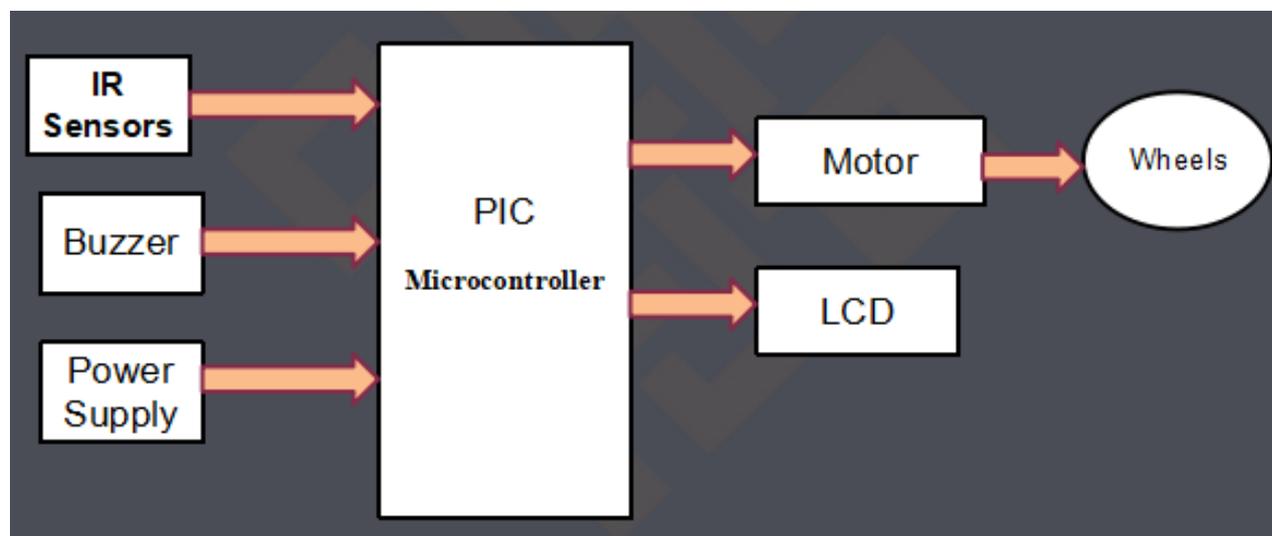


Fig 1. Block Diagram of Smart Road Metro Prototype

A PIC Microcontroller PIC16F877A is used to control all the operations of the train. The IR sensors are used to keep the train on the track and also detect the arrival of the stations. The IR sensors remain high whenever the train follows the path. As soon as the train deviates from the path the sensor becomes low enabling the train to follow the path. A motor driver L298d is used to control movement of the wheels.

Table1. Control of Movement of Wheels using Motor Driver IC

IN1	IN2	IN3	IN4	Direction
0	0	0	0	Stop
1	0	1	0	Forward
0	1	0	1	Reverse
1	0	0	1	Left
0	1	1	0	Right

III. WORKING PRINCIPLE

3.1 Concept of virtual track: The virtual track for the train is provided by painting a path(white in colour) on the road on which the train travels. The front end or the engine end of the train is attached with the IR sensors on the either ends. The IR sensors are placed such that the path provided is always between the two IR sensors. The value of the IR sensors in this scenario is 1(high). The path of the train is monitored by the sensors regularly and if there is any deviation from the path, the value of the IR sensors becomes low (0) and this information is sent to the controller immediately so that it corrects the movement of the train back to the required position either by turning right or left.

Whenever there is a break in the path, the train stops indicating the arrival of the station. This is indicated by LEDs which glow when the doors open and close. A 16X2 LCD is used to display the station name. The train stops for a duration of 20 seconds, then the train proceeds towards the next station and the process continues.

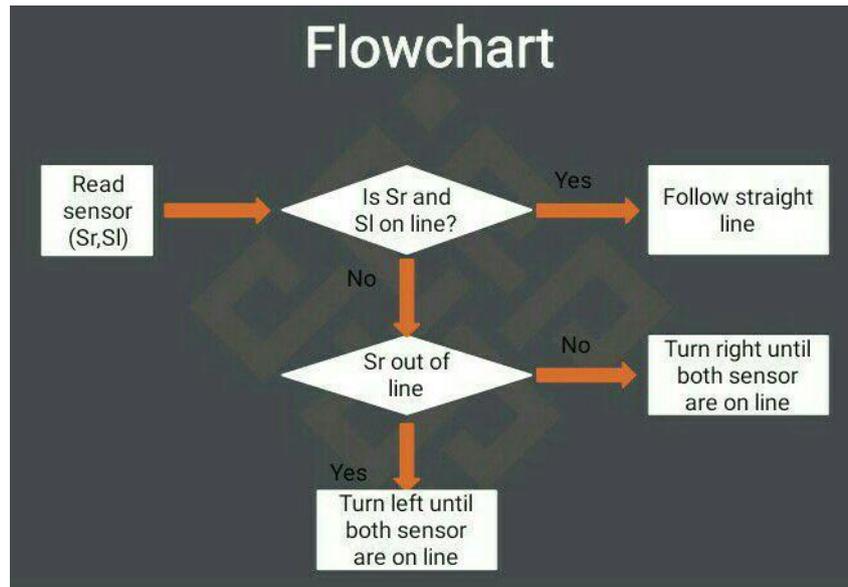


Fig 3. Flowchart representing the virtual track mechanism using IR Sensors.

Sr and Sl are the right and left IR sensors attached at the front of the train. Both the sensors will be high or 1 if the train is on the path. As soon as the train deviates from the path, the sensors become low or 0. The sensor which becomes low is decided based on the direction in which the train deviates from the path. The train then returns to the path and the sensors become high.

3.2 Concept of Piezoelectric Power Generation:Energy can be harvested by extracting the energy in one form, converting it to a useful form and the storing it. Energy can also be tapped from some materials when pressure is applied on them, or even when subjected to vibrations.

When piezoelectric material is placed under mechanical stress, a shifting of the positive and negative charge centers in the material takes place, which then results in an external electrical field. When reversed, an outer electrical field either stretches or compresses the piezoelectric material.

Now a days most of the people use trains as their medium of transport since it is economical, reduces time consumption, and also provides safety.

When the piezo electric generation module is present as a floor to the people on the platforms, electricity can be tapped easily and can be used for various applications. The voltage generated ranges in between 1 to 10 volts and power generated is upto 5 watts. On an average one footstep of a person can produce around as much electricity as to light up an LED.

When the piezo electric module is laid under the track of the train,since the weight of the train is more, the wheels of the train lay more pressure and hence, more electricity can be tapped from it. Thus electricity generated by these means,can be utilized for lighting purposes inside as well as outside the train.

The electricity generated in this process is in the form of AC. This is then converted to DC by using a rectifier circuit and stored in a battery which can then be utilized for various applications like lighting the surrounding lanes or even for the lighting inside the train.

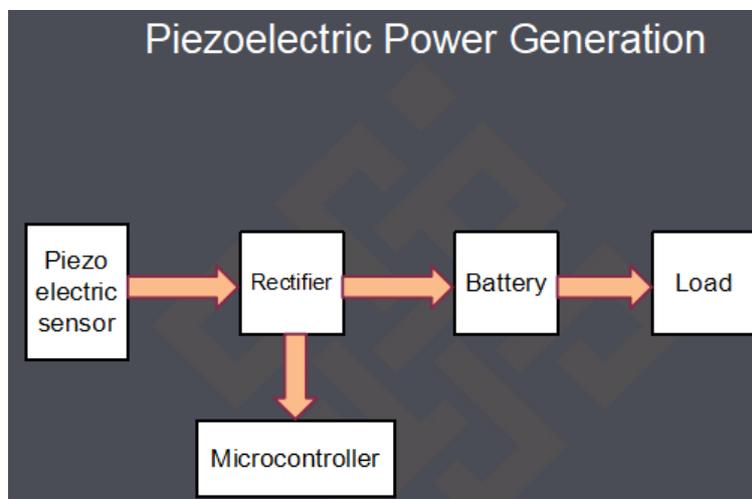


Fig 2. Block Diagram representing the piezo electric power generation.

IV. CONCLUSION

The Indian Railway sector which is regarded to the fourth largest railway network in the world has made great advancements, starting off with the charcoal fueled trains to the electrified trains such as metro trains. This paper provides the concept of trains running on virtual tracks on roads which can minimize the expenditure of labour, resources and the cost of construction. It also provides a smart way of generating electricity by means of external stimulus such as pressure.

Advantages -

- The concept of virtual track minimizes the consumption of resources, labour as well as time.
- The piezo electric power generation produces clean electricity and uses non conventional energy sources for the generation of electricity.
- The old aged people and physically disabled people can also easily travel as it runs on roads just like any other vehicles.
- The power consumption for the train is also less compared to the existing system.

Future Scope -

- The indication seat availability in a particular compartment of the train can help the passengers board the train with ease.
- The RFID ticketing system can be implemented.

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