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Driverless Metro using Regenerative Braking System

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Abstract:t: The regenerative braking system is an energyretrieval mechanism which stops a moving vehicle or objectsthrough the conversionof its motion or kinetic energyto electrical energy and stores it in batteries or capacitors. When conventional brakes are applied, kinetic energy is wasted into heat energy due to resisting force amidst the brakes and the wheels. Theresultant heat is released in the environment and accounts for an effective energy loss. The total energy wasted dependsupon the number of times, the intensity of force applied and the duration the brakes are applied.The aim of this project was to store the energy which is wasted during braking, and monitor it over a display. An Electric Motor is a device whichis responsible for this inter-conversion of energies.A Regenerative Braking System increases the efficiency of anelectric vehicle by saving the energy.

Keywords: Regenerative braking system, Kinetic Energy, Electrical Energy,Energy Recovery Mechanism, Electric motors.

INTRODUCTION

Regenerative Braking System: When a conventional vehicle applies its brakes, kinetic energy is converted to heat as friction between the brake pads and wheels. This heat is carries away in the airstream and the energy is effectively wasted .The total amount of energy lost in this way depends on how often, how hard and for how long the brakes are applied[1]. Regenerative braking refers to a process in which a portion of the kinetic energy of the vehicle is stored by a short term storage system. Energy normally dissipated in the brakes is directed by a power transmission system to the energy store during deceleration. That energy is held until required again by the vehicle, whereby it is converted back into kinetic energy and used to accelerate the vehicle[2]. The magnitude of the portion available for energy storage varies according to the type of storage, drive train efficiency, and drive cycle and inertia weight.

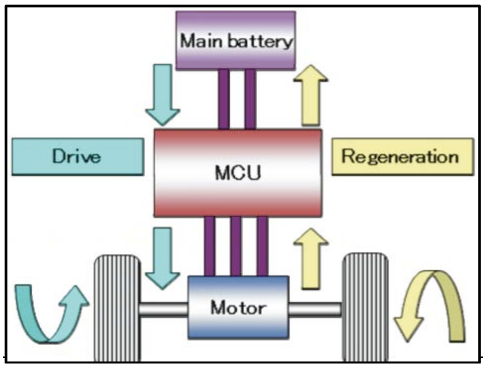

Fig. 1: Regenerative Braking Motor movement.

This technology of automotive industry is emerging rapidly and can prove to be very beneficial. The regenerative braking technology results in the regaining of the energy and alsoimproves the efficiency of the vehicle and saves the restored energy in the auxiliary battery.

The power retrieved by regenerative braking can only be used if that power is used consumed somewhere else synchronously. It promotes energy savings and reduced wear and tear of frictional brakes. There are many events of application of breaks while driving an automobile, because of which great energy losses occur, vehicles such as cars, taxis, buses, delivery trucks, trains, bicycles and so on there are, the even greater potency of restoring the energy, as shown in fig.2.

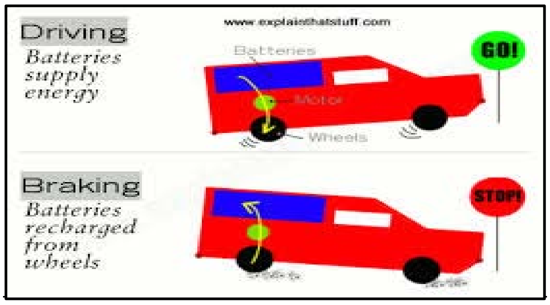

Fig. 2: An Example of Regenerative Braking System.

A load of work done over the engine is lowered, and thus the energy needed to run the vehicle. Energy is wasted when the brakes are applied, is guided by some energy transmitting system to the battery while retardation. This restored energy can be consumed back as kinetic energy whenever the vehicle needs the acceleration. The magnitude of the portion available for energy storage varies according to the type of storage, drive train efficiency, and drive cycle and inertia weight. City centre driving involves many more braking events representing a much higher energy loss with greater potential savings. With buses, taxis, delivery vans and so on there is even more potential for economy[3]. The energy that is stored by the vehicle, is converted back into kinetic energy and used whenever the vehicle is to be accelerated. The magnitude of the portion available for energy storage varies according to the type of storage, drive train efficiency, drive cycle and inertia weight [4].

METHODOLOGY

1. **BLOCK DIAGRAM:** The System is divided into two parts: The Electrical part and The Mechanical part. The Electrical part is responsible for controlling the motion of the train, and the Mechanical part is responsible for the braking of the vehicle. Fig. 3 represents the block diagram of the project. The Electrical part consists of an Atmega16 microcontroller, a colorsensor to detect the arrival of the station, IR sensor to detect the presence of any obstacle, an APR voice module IC, DC motors, Signal LEDs, LCD Display, a piezo-electric buzzer, signal LEDs, and the auxiliary rechargeable battery for storing the recaptured energy.

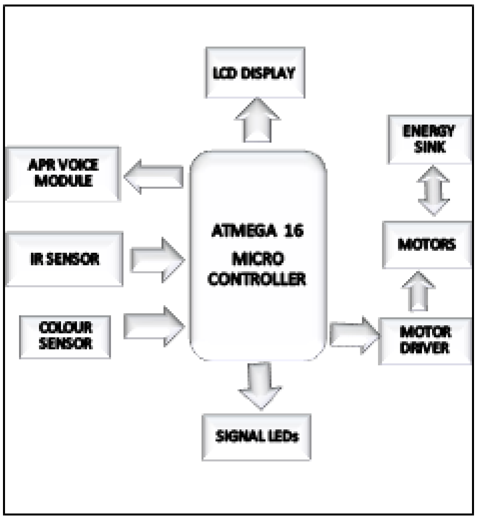

Fig.3: Project Block Diagram

The Mechanical part is responsible for demonstrating the working of regenerative brakes. As the brakes are applied, the motors start to move in the inverted mode, enabling the motion of wheels in opposite direction, slowing down the vehicle. The motor acts as a generator feeding this electricity into the auxiliary batteries.

2. **CIRCUIT DIAGRAM:**The circuit diagram of the project is shown in fig. 4. The project is divided into four parts: an input section, an outputsection, a controlling unit, and a braking unit. The Atmega16 microcontroller is the system CPU and is interfaced with IR sensor, color sensor, simple DC motors, Geared DC motors, Stepper motor, a motor driver IC, 16X2 LCD Display, buzzer, signal LEDs, APR module. A 12V Adapter or 9V battery is used to power up the circuit. The power supply consists of 7805 voltage regulator IC which converts 12V input supply to 5V constant output.

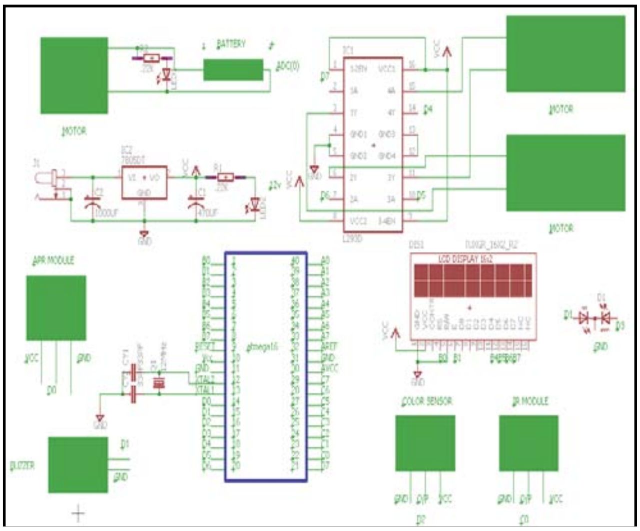

Fig.4: Project Circuit Diagram

3. **SOFTWARE SPECIFICATIONS**

- AVR Studio
- Programming Language: Embedded C

3.1 LANGUAGE USED: C

C is an obligatory procedural language. It has a simple compiler which indulges low-level approach to stack and proffer functions which are used tomap well to processor cycles. Therefore, C was favorable to many functions which were previously written in assembly language.

Reasons to choose **C language in embedded systems**:

- It is easier to understand.
- Reliable, scalable and portable.
- Minimal run-time support.
- Feasible compiler.
- Processor independent.
- Incorporates assembly language processes and high-level language features.
- Impartially competent.
- Easy to maintain and debug.
- Embedded applications are very suitable for industrial purposes.
- Provides direct hardware control
- Being comparatively small structured language, it offers more flexibility[5].

3.2 AVR Studio

Atmel Studio version 7 is an integrated development platform (IDP) for developing and debugging.Atmel SMART ARM-based and Atmel AVR microcontroller applications. Studio version7 provides all AVR and Atmel SMART microcontrollers. The Atmel version Studio 7 IDP provides a coherent and feasibledomain to code, compile and error and exceptional handling apps coded in C,C++ or assembly language. Also, associates to debugging and development kits inconspicuously[6].

4. HARDWARE EQUIPMENT

- ATmega16 Microcontroller
- 16x2 LCD Display
- IR sensor
- Color sensor
- Signal LEDs
- Rechargeable battery
- APR9600 IC
- 7805 Voltage Regulator IC
- Push Buttons
- Ceramic Capacitors
- Aluminium Electrolytic Capacitors
- Simple DC motor
- APR Voice module
- DC Geared Motors
- MOTOR Driver L293D
- Resistors
- Potentiometer
- 12V Adapter
- 9V Battery
- Connecting wires
- Jumper wires
- Stepper motor.

5. OPERATION

As mentioned earlier, the project consists of two parts: the Electronics and the Mechanical parts as shown in figure 6, and four sections, namely: the input section, the output section, the controller section and power supply. The first part of the project is accountable for controlling the vehicle motion. The system is equipped with a color sensor and an IR sensor. The color sensor is used to detect the arrival of the station. As soon as the station arrives, the color sensor signals the microcontroller that the station has arrived and the vehicle need to stop.

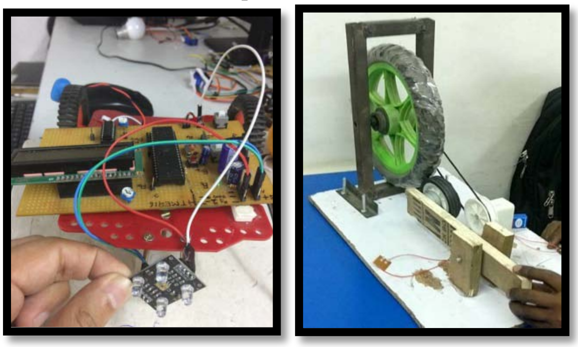

Fig.6:The electrical and mechanical parts of the project

On receiving the signal, the microcontroller cuts off the power supply to the motors, braking motor gets activated. The regenerative block comes into the action and the conserved energy is redirected to the rechargeable battery. IR sensor is used for obstacle detection and the same braking procedure is followed for stopping the vehicle in case any obstacle is detected. Until the obstacle is removed, the vehicle will not move any further.The System also includes an LCD Display which displays the status of motors, IR sensor, station arrival, and displays the battery percentage. The system also consists of a voice module IC to deliver the station arrival and departure message in the audible form. The vehicle stops for a specified time interval at each station and then continues traveling to the next station.

RESULT

The project demonstrated how the braking energy can be recaptured using regenerative braking systems. The vehicle stops when the station arrives and also if the presence of some obstacle is detected on the path of the vehicle. The status of the battery charged by braking is monitored over the display. Also, the status of IR sensor, color sensor, and motors is observed.

FUTURE SCOPE

A further research is required in the field of regenerative braking systems to develop an improved or upgraded system which is capable of restoring greater energy and decelerates faster. In near future, with better advancements in this field by the designers and engineers, these systems will become more and more common[8]. By recapturing the energy that is generally lost during the braking process, all moving automobiles can profit from these systems. The future technologies will contain new upgraded types of motors and generators, that will be highly efficient, better designs, less prone to energy losses. It is expected that the future technologies have more potential of improved vehicle efficiency[7].

CONCLUSION

The energy lost during the braking is conserved by the regenerative braking system. These systems can work at greater thermal reading ranges.Also, they are highly competent when correlated to the frictional brakes. Regenerative brakes are more effective at higher momentum. The more frequently a vehicle stops, the more it can benefit from this braking system. Large and heavy vehicles that movies at high speeds builds up lots of kinetic energy, so they conserve energy more efficiently. It has broad scope for furtheradvancements and the energy conservation. Enhances the growth of the economy[3].

REFERENCES

[1]. Khushboo Rahim, Mohd. Tanveer, Sandeep Soni, Jagandeep Kaur, Shruti Karkra, "***Regenerative Braking: Review Paper***", May 17 Volume 5 Issue 5 , International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC), ISSN: 2321-8169, PP: 736 – 739.

[2]. Pultkit Gupta, Anchal Kumar, Sandeepan Deb, Shayan, "Regenerative Braking Systems", International Journal of Mechanical And Production Engineering, ISSN: 2320-2092, Vol. 2, Issue-5, May-2014

[3]. Loi Wei Cheong, "A development and use of regenerative braking model for a parallel hybrid electric vehicle, "SAE Technical Paper Series, 2013.

[4]. S.J. Clegg, "A Review of Regenerative Braking System", Institute of Transport Studies, University of Leeds, Working paper of 471,1996.

[5]. Embedded system programming

https://www.engineersgarage.com/tutorials/emebedded-c-language
[6]. What's New in Atmel Studio 7? http://www.atmel.com/microsite/atmel-studio/
[7]. Future Scope http://www.iraj.in/journal/journal_file/journal_pdf/2-56-140048604775-78.pdf