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POWER GENERATION THROUGH REGENERATIVE BRAKING SYSTEM TO RE ACCELERATE THE VEHICLE.

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Abstract: With a regenerative braking system, the vehicle's kinetic energy is briefly stored during deceleration and then used as kinetic energy. The DC motor, which produces the electricity that is stored in the battery, is rotated by the kinetic energy produced while braking. After pressing the brakes, the car is accelerated again using the energy stored in the battery. As a result, the engine's load will be reduced, allowing the car to accelerate again. Through this method, the electric dc motor recovers energy lost while braking by using the momentum of the vehicle. This is in contrast to the traditional braking system, which retains the extra kinetic energy in the battery after converting it to power. Using an IOT device and a smartphone, one may monitor the energy produced by a DC generator.

Keywords—DC motor, Arduino UNO, ESP8266 Wi-Fi module.

1. INTRODUCTION

Any moving body can be stopped or has its motion retarded by applying brakes. Therefore, the brakes are the most crucial component of an automobile. By causing the moving body to come into contact with a frictional rubber pad, also known as a brake lining, which absorbs kinetic energy and wastes it as heat in the surrounding air, a conventional braking system retards or stops motion. When we apply the brakes, the car's gained momentum is absorbed, and in order to restore it., we must start over and use more engine power to accelerate the vehicle again. As so, there will be a significant energy waste as a result. The fundamental law of physics is that energy can only change forms. it cannot be created or destroyed. An energy-recovery device called a regenerative brake uses the kinetic energy of a car to slow it down. This energy stored or used right away. Therefore, in electric trains, the energy produced during braking is returned to the supply system; in battery-electric and hybrid electric cars, on the other hand, the energy is stored in a battery or bank of capacitors for future use. Additionally, energy can be stored in a revolving flywheel or by compressing air. Regenerative braking is a feature seen on a lot of metro trains worldwide; it returns roughly 25% of the electrical energy to the power source.

Electric trams with regenerative braking systems are produced by Koda Transportation and are extensively utilized throughout Europe.

2. HISTORY

The front-wheel drive modifications Louis Antoine Krieger made to horse-drawn taxis in Paris in the 1890s are among the earliest instances of this technique. The driving motor in each front wheel of the Krieger electric landaulet was equipped with a second set of parallel enabling regenerative braking. C.J. Paulson received a patent for the first car with regenerative braking in 1908. John S. Raworth's Traction Patents 1903–1908 brought "automatic regenerative control" to tramway operators in England, providing them with both operational and financial advantages, as his son Alfred Raworth went

into some depth to explain. These included the tramway systems at, Rawtenstall, Birmingham, Devonport (1903), and numerous other locations. The motors acted as generators, stopping the cars and reducing their speed or maintaining control on descending grades.

From 2004 to 2007, the Delhi Metro deployed regenerative braking systems to create 112,500 megawatt hours of power, reducing the amount of carbon dioxide (CO_2) released into the atmosphere by about 90,000 tons.

3. WORKING PRINCIPLE

Regenerative braking makes use of the motor's mechanical energy by converting it into electrical energy and putting it back into the battery. Using the same principle as an alternator, the regenerative braking system has the ability to convert quite a bit of its kinetic energy into battery charge.

When in regenerative braking mode, the car slows down by using its motor. When the driver applies force to the brake pedal, the electric motor switches direction, slowing the car.

4.APPLICATIONS

1.Modern hybrid and electric automobiles use electric engines, making regenerative braking simple and efficient.

2.Regenerative brakes are suitable for railway locomotives since they preserve an enormous quantity of energy. The Jaipur metro system employs regenerative braking, which saves up to 35% of electrical energy.

3. Regenerative braking systems are used in electric elevators, crane lifting motors and kinetic energy recovery mechanisms.

4.1 ADVANTAGES

1. Energy conservation:

When braking, the flywheel absorbs energy using a clutch mechanism, which slows the automobile and speeds up the wheel. Another clutch system connects the flywheel to the drive train, accelerating the vehicle while slowing the flywheel.

As a result, energy remains intact rather than wasted as heat and light, as is typical of today's shoe/disc combination. This might save fuel usage by 10 to 25%.

2.Recharging the Battery:

The regenerative brakes gather energy, which is then utilized to replenish the vehicle's batteries. Because this energy would otherwise be wasted, it allows each car to have a longer charge while traveling.

3.Reduced Brake Costs:

Minimize the cost of replacing brake linings labour installation and machine downtime.

4.Extended Range

Regenerative braking system provide the automobiles to increase their driving range by recovering energy while braking. This is particularly beneficial for electric cars (EVs), since it reduces range anxiety and increases the practicality of these vehicles for regular use.

4.2 DISADVANTAGES

1.Complex Design

Implementing regenerative braking systems may complicate a vehicle's design, necessitating the use of additional components such as regenerative braking controllers, inverters, and energy storage devices like batteries or capacitors. This complexity might lead to higher production and maintenance costs.

2.Limited Efficiency

Regenerative braking is most effective in stop-and-go driving circumstances with a
Frequent braking action. Continuous high
Speed driving reduces efficiency because
The kinetic energy is available for the reg-
eneration decrease.

3.Thermal management:

During strong braking or quick deceleration, regenerative braking systems can produce a substantial amount of heat, which must be efficiently handled to avoid damage to components such as the electric motor or battery. Adequate thermal management increases the complexity and expense of the systems.

5. NEED OF IOT

IOT aims to link all conceivable things so that they may communicate with one another over the internet, therefore providing people with a safe and comfortable living. The Internet of Things connects our world as much as possible. Nowadays, we virtually always have internet infrastructure and may utilize it at any time.

Embedded computer equipment would be susceptible to internet influences. Common examples of embedded computer devices include

MP3 players, MRI, traffic lights, microwave ovens, washing machines and dish washers, GPS, and even heart monitoring implants or bio chips, among others.

5.1 APPLICATIONS OF IOT

1.smart grids and energy efficiency
2.smart cities
3.earth detection
4.gas detection
5.traffic monitoring
6.water flow monitoring
7.radiation detection
8.wearables
9.smart door lock protection

5.3 ADVANTAGES OF IOT

1.improved efficiency and automation of tasks
2.increased convenience and accessibility of information
3.better monitoring and control of devices and systems
4.improved decision-making
5.cost savings

5.4 DISADVANTAGES OF IOT

1.Security concerns and data breaches
2.privacy issue related
3.dependence on technology
4.high initial investment costs
5.limited battery life

6. INTRODUCTION TO ARDUINO UNO BOARD

The Arduino UNO is a typical board from Arduino. The Arduino software's first release was labelled as UNO. It was also the first USB board produced by Arduino. It is regarded as a strong board utilized in a variety of tasks. Arduino.cc designed the Arduino UNO board. The Arduino UNO is built on an ATmega328P microprocessor. It is simpler to use than other boards, such as the Arduino Mega board, etc. The board consists of pins for both analog and digital input/output (I/O), shields, and other devices. The Arduino UNO includes six analog pin inputs, 14 digital pins, an USB port, a power jack, and an ICSP header.

It is programmed using IDE, which stands for Integrated Development Environment. It works on both online and offline channels.

The Arduino UNO is well-known for its simplicity and adaptability, making it an ideal choice for both new and experienced users. It is frequently utilized in a variety of applications, from basic LEDs to blinking to complicated robotics and automation systems.

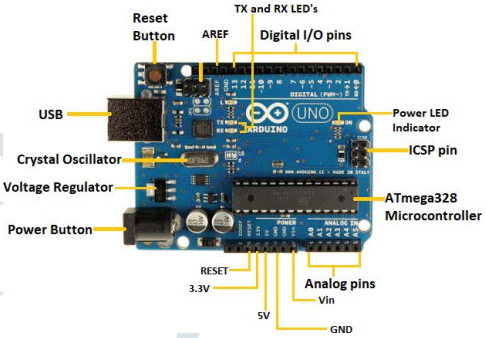

Fig 1: Arduino UNO

Fig 2: Components

1.The ATmega328 Microcontroller is a single chip microcontroller from the Atmel family. The processor code within it is 8-bit. system has storage (SRAM, EEPROM, and Flash), an Analog to Digital Converter, SPI serial ports, input/output (lines, registers, a timer, both internal and external interrupts, and an oscillator.
2.The ICSP pin on the Arduino board allows for firmware programming.
3.The Power LED Indicator indicates that the power is activated. When the power is turned off, the LED does not light up.
4.The digital I/O pins are either HIGH or LOW. The pins designated D0 through D13 are digital.
5.TX and RX LEDs light up when data is successfully
6. The Arduino UNO's crystal oscillator operates at 16MHz, making it a powerful board.
7.The voltage regulator transforms the input voltage to 5 volts.
8. GND- Ground pins. The ground pin functions as a pin with zero voltage.

6.2 INTRODUCTION TO ESP8266 WIFI MODULE

An ESP8266 Wi-Fi module is a system-on-chip (SOC) microprocessor designed

primarily for the construction of end-point IoT (Internet of Things) applications. It is referred to as a standalone wireless transceiver and is quite affordable.

It enables the internet connectivity to many embedded system applications. Esp 8266 systems created the esp8266Wi-Fi module to provide both TCP/IP functionality and microcontroller access to any Wi-Fi network. It delivers solutions to suit IoT industry needs such as cost, power, performance, and design. It may function as either a slave or a stand-alone program. If the ESP8266 Wi-Fi operates as a slave to a microcontroller host, it may be used as a Wi-Fi adapter for any microcontroller that supports UART or SPI. If the module is run as a standalone application, it performs the tasks of the microcontroller and Wi-Fi network. The processor of this module is based on the tensilica xtensa diamond standard 106 micro and performs easily at 80 MHz There are several types of ESP modules developed by third-party vendors.

7. METHODOLOGY

There are several prerequisites for regenerative braking, regardless of the mechanism of regeneration. The vehicle requires sufficient velocity, an energy-storing system, and a controller.

Regenerative energy can only be created when the vehicle is moving. The axles must have sufficient momentum to be exploited by the system.

The energy (electricity) generated by regenerative braking should either be used immediately or saved in a battery for later use.

There must be a controller that switches on and off the regeneration process based on demand and availability.

Frictional braking must be available to stop the vehicle in the event of a regenerator failure or an emergency.

Regenerative braking systems may not be sufficient to meet the fundamental braking system requirements on their own. This is due to the limits of energy dissipation at extremely high power. Due to design restrictions, the storage and generation systems may be unable to operate at certain levels.

There are several design combinations and control schemes available, similar to hybrid propulsion systems. The system should be designed and controlled in such a way that it ensures the desired braking performance while also gathering as much energy as feasible.

7.1 FABRICATIONS

7.1.1 DC MOTOR

The dc motor functions as a dc generator. This is linked to the end of the brake pedal via clamps. The motor's tip is attached to a wheel which may be meshed with the brake gear. It has a capacity of 12 volt.

The motor tip is attached to another wheel and mesh, which has a revolving tire. The revolving wheel has kinetic energy, which is turned into electrical energy via electromagnetism. The motor has a capacity of 12 volts and a maximum speed of 300 RPM.

Fig 3: DC MOTOR

7.1.2 ARDUINO UNO

The Arduino UNO board is the project's microcontroller and acts as its brain. The Arduino UNO is connected to a voltage sensor and an ESP8266 WiFi module. It has digital and analog input/output pins. It has 14 digital input/output pins (6 of which may be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator a USB connection, and a power connector. an ICSP header and a reset button. It also includes built-in USB interface for simple programming and communication with a computer. The code is fed into the Arduino Uno via the USB connection. The code is used to upload voltage generation data to the cloud, which we may access via mobile. It requires a 12v power to function properly. The lcd display is connected to an Arduino Uno to display the voltage created while braking.

Fig 4: Arduino UNO

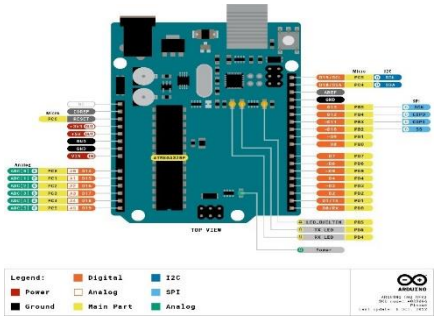

Fig 5:pin out diagram

7.1.3 ESP8266 WIFI MODULE

The ESP8266 Wi-Fi Module is a self-contained system on chip (SOC) with an inbuilt TCP/IP protocol stack that allows any microcontroller to connect to your Wi-Fi network. The ESP8266 may either host an application or offload all Wi-Fi networking functionality to another application processor. Each of the ESP8266 modules is provided with AT instruction set programs, so you simply need to connect it to the Arduino you're using and have roughly the same Wi-Fi functionality.

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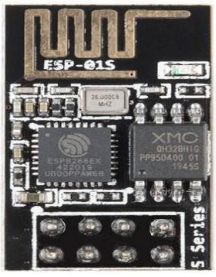

FIG 6: ESP8266 WIFI MODULE

7.1.4 VOLTAGE SENSOR

A voltage sensor detects the voltage in an electrical circuit. Voltage sensors have various applications, including monitoring and regulating equipment and machinery. A voltage sensor detects the voltage in an electrical circuit. Voltage sensors have a wide range of uses.

7.1.5 REGULATORS

A voltage regulator is a circuit that generates and maintains a constant output voltage, regardless of changes in input voltage or load circumstances. Voltage regulators (VRs) maintain voltages from a power supply within an acceptable range for the other electrical parts. Voltage regulators are mostly typically used for DC/DC power conversion, but some can also convert AC/AC or AC/DC.

7.1.6 DIODE

A diode is a type of semiconductor device that acts as a switch with only one direction for current.

It permits current to flow smoothly in one direction while significantly restricting

current in the opposing direction. Diodes, commonly known as rectifiers, convert alternating current (ac) into pulsing direct current. Diodes are rated by type, voltage, and current capability. Diodes have polarity, which is established by a positive anode and a negative cathode. Most diodes enable current to flow only when a voltage that is positive is applied to the anode.

7.1.7 LCD DISPLAY

A liquids-crystal display (LCD) is a flat-panel screen or other electronically controlled optical device that use the light-modulating properties of liquid crystals in combination with polarizers. These liquid crystals do not emit light directly, but instead need a reflector or backlight in order to create colour or monochrome images.

7.1.8 LITHIUM ION BATTERYS

A lithium-ion, or Li-ion battery, is a rechargeable battery that stores energy by the reversible intercalation of Li+ ions into electrically conducting substances. In contrast to other commercial rechargeable batteries. Three batteries are linked in series to create an overall voltage of 12V.Each battery has a capacity of 4V or 3000mAh. The lithium-ion battery is connected to a dc motor, and a diode is connected between the two. The power stored in the batteries is supplied to the Arduino Uno, allowing the device to function.

7.2 ARDUINO UNO INTIAL SET UP

Download the Arduino Integrated Design Environment (IDE) from https://www.arduino.cc/en/Main/Software. The most recent version is 1.6.5. This is the Arduino IDE once it has been opened. It opens into a blank drawing, allowing you to begin programming instantly. First, we need to configure the board and port settings so that we may upload code. Connect your Arduino board to the PC via the USB wire.

7.3 EQUIPMENTS USED

7.3.1 DRILLING

Drilling is a metal removal procedure that involves cutting or enlarging a circular hole in solid materials using a drill bit. The drill bit is a rotary cutting instrument with several points. The bit is pressed against the workpiece and spins at rates that vary from a few hundred to thousands of revolutions per minute. The presses the cutting edge against the workpiece, removing chips from the hole that will be drilled.

7.3.2 CUTTING

Cutting is the method of removing surplus material from a workpiece. We used a hacksaw blade to cut the workpiece to the desired dimensions.

7.3.3 SOLDERING

Electrical soldering is the technique of connecting electrical components to a circuit board using a filler substance known as solder to establish a junction between them. Solder is a fusible alloy with a melting temperature below 4 840°F.

7.3.4 WELDING

Welding is a manufacturing method that uses high temperatures to combine materials such as metals. Welding joins materials at high temperatures, whereas soldering and brazing prevent the base metal from melting. After cooling, the base metal and filler metal bond.

8.RESULT

The fabrication of regenerative braking system is done successfully and represent below.

Fig 7: RBS Not Applied

Fig 8: RBS Is Applied

8.1 EXPERIMENTAL RESULT

The output voltage varies from 5.5 to 6.0-volts. The output current varies from 90 to 100 mA.

The time it takes to fully stop from maximum speed to zero is 28 to 40 seconds.

Average output voltage (V): (5.5 + 6.0) / 2 = 5.75 V.

Average output current (I): (90+100) / 2 = 95 mA.

Average time required to complete stop (t) = (28 + 40) / 2 = 34 seconds.

Electrical energy stored (E) = V * (Ii - If) / 2 * t = 5.75 * (95 - 0) / 2 * 10*34 (If = 0 and 1 mA = 10-3 A) = 9.23 J.

The mass of one wheel (M) is 1250 grams or 1.250 kg.

The radius of the wheel (R) is 200 mm, or 0.2 meters. Maximum Average speed (N) equals 325 rpm.

Speed varies, before braking, from 300 to 350 rpm.

Angular velocity (ω): 2πN/60 = 34 rad/sec.

moment of inertia of Two wheels is calculated as 2*MR2 (considering the wheel as a ring), which is 2*1.250*0.22 = 0.1 kg/m2.

Rotational kinetic energy (K): ½ I ω2 = ½ 0.1 * 342 = 57.80 J.

Braking efficiency (η) = electrical energy saved / initial rotational kinetic energy = 9.23 / 57.80 =.1596J, resulting in η = 15.96%.

9.CONCLUSION

The regenerative braking system used in cars serves the objective of conserving some of the energy wasted during braking. The regenerative braking system is intended to recover some of the battery charge that is lost when the vehicle brakes. Friction brakes turn energy into heat, which is dispersed into the environment.

Energy is used to move the rotor of the generator, turning mechanical energy from the wheels into a usable charge for the battery. The regenerative braking system cannot be employed as the primary braking system of a vehicle since it cannot bring the vehicle to a stop. These brakes also increase the driving range of all-electric or hybrid automobiles. In reality, this technology has already contributed to the development of cars such as the Tesla, which operates solely on battery power. Sure, these automobiles may require fossil fuels throughout the recharging process. All vehicles in motion can benefit from regeneration, which recaptures energy that would otherwise be wasted.

Regenerative braking systems have plenty of space for development. Regenerative braking is currently extremely restricted and depends on unpredictable circumstances.

9.1 RECOMDATIONS

Because this concept is entirely based on an experimental test rig, if this technology is used in existing operational automobiles, there may be certain issues that make drivers uncomfortable. Because regenerative braking systems do not offer brakes at high speeds, they need be combined with other types of braking systems, such as Anti-Lock Braking Systems (ABS Integrating regenerative braking into a vehicle necessitates various adjustments in driving style, which are dependent on the technical setup of the system. This takes some time to adjust to, but studies have shown that drivers respond favourably and want to maximize the energy they can recover, so increasing their range. Furthermore, the use of regenerative braking is intimately related to ecodriving).

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