Design & Development of Power Generation by Suspension System & Its Applications Using IoT

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Abstract*— This project addresses both the efficient harvesting of energy wasted at speed breakers and the smart control of a DC motor using an Arduino microcontroller. The research involves a mechanism where a roller displaces vertically downward when a vehicle passes over a speed breaker, converting this linear displacement into rotary motion to generate electricity. The harvested energy is stored in a battery for future use. Simultaneously, an Arduino-based control system is implemented to manage the speed and direction of a DC motor by using suspension type power generation we used in domestic appliances like mobile charging & small scale industries. Input signals from an Android device are transmitted through IoT, controlling the motor through PWM concepts. The Arduino IDE is used for software implementation, and the schematic diagram and interfacing of the ATMEGA328 microcontroller with each module are detailed. This project aims to showcase the synergy between energy harvesting and smart control systems, promoting sustainability and intelligent transportation practices.

***Index Terms*— Regulated power supply (RPS) ,Input modules (Suspension mechanism, Dynamo), Output module(LCD, DC motor , Mobile charging, Controller (Arduino), Software (Embedded C)**

I. INTRODUCTION

A large amount of energy is wasted by the vehicles on the speed breakers through friction, every time it passes over it. Energy can be produced by using the vehicle weight and speed. So here we propose a smart speed breaker that generates power. The reciprocating motion of the speed breaker is converted into rotary motion using the rack and pinion arrangement. We design a smart speed breaker that can pass vehicles coming from both sides and yet generate energy from it. The system makes use of mechanical assembly with metal sheets with linkages that press down with spring arrangement. The system makes use of the speed breaker press and then uses a rack and pinion arrangement to press down and run generator motor thus generating energy. The spring mechanism is the used to drive the speed breaker back into original position. It converts rotary motion into linear motion, but sometimes we use them to change linear motion into rotary motion. This mechanism is very economical and easy to install. By doing proper arrangements we may generate high power electricity from road traffic.

Now-a-days electric energy is lot in each and every ones mind. Well it is now possible while you are driving your car or riding any kind of two wheeler. This can be done when we drive or ride over a speed breaker. Yes you read it right while riding or driving over a speed breaker. The conventional speed breakers are only used to reduce the speed of a vehicle which totally depends on the material with which the speed breakers are made. Sometimes these speed breakers are made of rubber, sometimes of concrete or sometimes mixture of concrete and pavements. This can be done by introducing some of simple mechanisms under the speed breakers. One such simple mechanism is a rack and pinion gear while the other one is a small generator with some wiring. With the help of these small mechanisms here is how we can implement the power generation program from the speed breakers.

Today most of the industries use DC motors. So, speed controlling of DC motors plays a very vital role. Therefore our paper concentrates on monitoring and controlling the speed of DC motor using Android mobile application, with the help of IOT technology. Smart phones have in built IOT technology, so and external IOT module is interfaced with the microcontroller unit (ARDUINO) for wireless communication. The IOT module receives command from the mobile phone android application. So, according to the input signal, with the help of arduino, MOSFET can be used to vary the voltage as well as

the speed of the DC motor using PWM technique. Direction of the DC motor can also be varied with the help of relay circuit or H-Bridge network.

II. LITERATURE REVIEW

"Power Bump" is a child of the imaginations, of three fourth year engineers, and their academic capability. A machine made with the vision and intention to aid the human race in its own way, by taking in its input from vehicles that are almost unaffected by its presence and converting it into electricity. But, given the fact that we are living in the 21st century, it would't be fruitful to further discuss this innovation without knowing the answers to three very important questions. Mohamad Ramadan et al, [1] designed the energy recovery system to make the pollution free environment as its goal.

Module by using AT command & loops back to the first step & again read the SMS in SIM. This process will repeat continuously. There are many advantages of controlling a motor using SMS i.e. Manual work will be reduced as the speed of motor is controlled by giving instruction to the MCU, cost of wiring will also get reduced by using wireless technology, using this method speed of DC motor is controlled wirelessly from far distance.[14] Ritesh Chaubey and his team investigated about the implementation of microcontroller, to control the speed and direction of a dc motor in either direction i.e. clockwise or/and anticlockwise, using android mobile applications.

III. EXISTING SYSTEM

Certainly, here's an outline of the existing system for the design and development of power generation by using suspension system : Traditional Regenerative Braking Systems: Conventional regenerative braking systems typically rely on basic control algorithms and limited feedback mechanisms. They often lack real-time monitoring and optimization capabilities, leading to suboptimal energy recovery and performance. Conventional DC Motor Speed Control: Traditional speed control methods for DC motors involve open-loop or simple closed-loop control schemes. These systems may not adapt well to varying driving conditions and lack the ability to optimize motor performance in real-time. Limited IoT Integration: Existing systems may incorporate basic IoT connectivity for remote monitoring and data logging but lack advanced control features. IoT integration is often limited to basic telemetry data transmission without leveraging advanced analytics or predictive capabilities.

IV. PROPOSED SYSTEM

The integrated project intricately combines two crucial aspects: the efficient utilization of wasted energy at speed breakers and the intelligent control of a DC motor using an Arduino microcontroller. The fundamental premise of the research revolves around a mechanical mechanism that activates when a vehicle traverses a speed breaker. This mechanism involves a roller that moves vertically downward, creating linear displacement. This linear motion is ingeniously converted into rotary motion, driving a generator motor that subsequently produces electricity. The harnessed energy is thoughtfully stored in a battery for future applications.

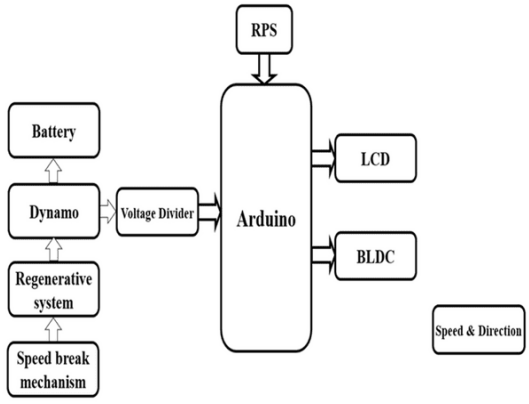
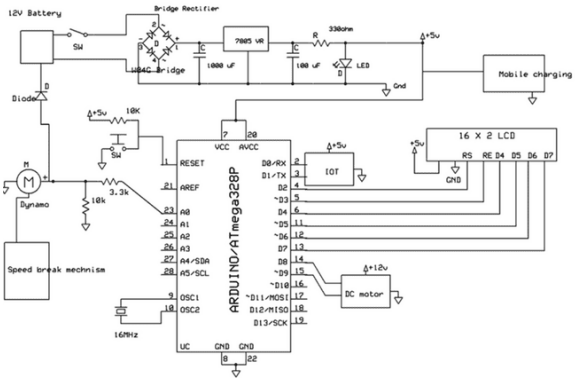


FIGURE 1 BLOCK DIAGRAM OF PROPOSED SYSTEM

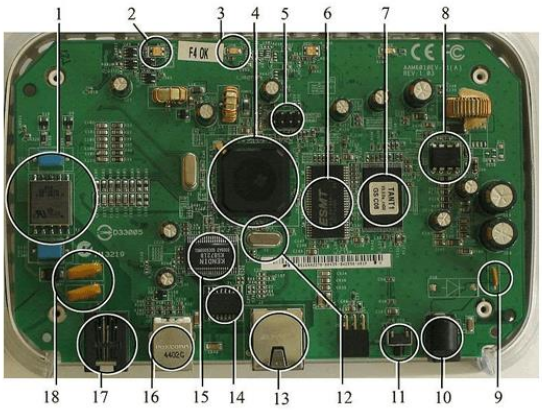
The software aspect of the project is implemented using the Arduino Integrated Development Environment (IDE), providing a user-friendly platform for programming and configuring the microcontroller. The schematic diagram and detailed interfacing of the ATMEGA328 microcontroller with each module are provided, ensuring a comprehensive understanding of the project's architecture.

SCHEMATIC DIAGRAM



V. EMBEDDED SYSTEMS

5.1 Embedded Systems: An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of its own.) Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.



5.1.1 History: In the earliest years of computers in the 1930–40s, computers were sometimes dedicated to a single task, but were far too large and expensive for most kinds of tasks performed by embedded computers of today. Over time however, the concept of programmable controllers evolved from traditional electromechanical sequencers, via solid state devices, to the use of computer technology. One of the first recognizably modern embedded systems was the Apollo Guidance Computer, developed by Charles Stark Draper at the MIT Instrumentation Laboratory. At the project's inception, the Apollo guidance computer was considered the riskiest item in the Apollo

5.4 APPLICATIONS OF EMBEDDED SYSTEMS:
5.4.1 Consumer applications: At home we use a number of embedded systems which include microwave oven, remote control, vcd players, dvd players, camera etc….

5.4.2 Office automation:
We use systems like fax machine, modem, printer etc …

5.4.3. Industrial automation:

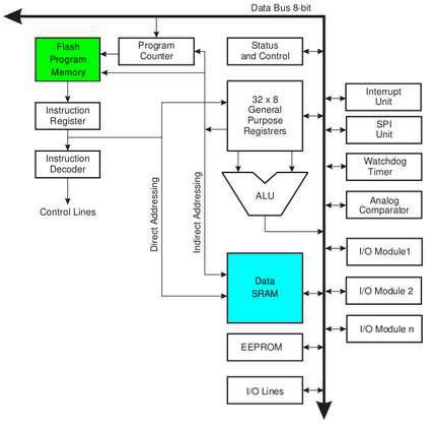
Today a lot of industries are using embedded systems for process control. In industries we design the embedded systems to perform a specific operation like monitoring temperature, pressure, humidity ,voltage, current etc.., and basing on these monitored levels we do control other devices, we can send information to a centralized monitoring station.

VI. HARDWARE DESCRIPTION

6.1 Micro controller:

6.1.1 Introduction to Microcontrollers:

Circumstances that we find ourselves in today in the field of microcontrollers had their beginnings in the development of technology of integrated circuits. This development has made it possible to store hundreds of thousands of transistors into one chip.



VII. SOFTWARE DESCRIPTION

The Arduino Software (IDE) makes it easy to write code and upload it to the board offline. We recommend it for users with poor or no internet connection. This software can be used with any Arduino board.here are currently two versions of the Arduino IDE, one is the IDE 2.0.0.

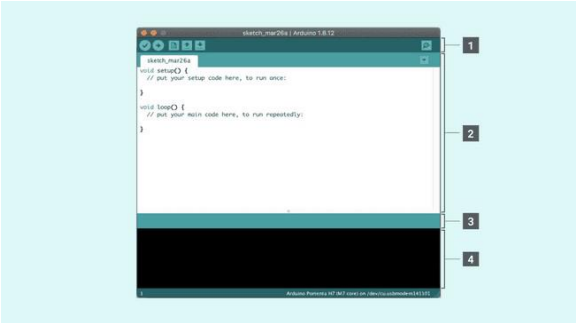
7.1 Arduino IDE − Compiler

here are currently two versions of the Arduino IDE, one is the IDE 1.x.x and the other is IDE 2.x.

The IDE 2.x is new major release that is faster and even more powerful to the IDE 1.x.x. In addition to a more modern editor and a more responsive interface it includes advanced features to help users with their coding and debugging.

The following steps can guide you with using the offline IDE (you can choose either IDE 1.x.x or IDE 2.x):

1. Download and install the Arduino Software IDE:
   - Arduino IDE 1.x.x (Windows, Mac OS, Linux, Portable IDE for Windows and Linux, ChromeOS).
   - Arduino IDE 2.x
2. Connect your Arduino board to your device.
3. Open the Arduino Software (IDE).



VIII. SOURCE CODE

```
#include <LiquidCrystal.h>
#include <stdio.h>
LiquidCrystal lcd(6, 7, 5, 4, 3, 2);
unsigned char rcv,count,gchr,gchr1,robos='s';
//char pastnumber[11]="";
float voltage=0;
int sti=0;
String inputString = ""; // a string to hold incoming data
boolean stringComplete = false; // whether the string is complete
int m1a = 8;
int m1b = 9;
```

```
int pwm_pin = 10;
int cntlmk=0;
void okcheck()
{
unsigned char rcr;
do{
rcr = Serial.read();
}while(rcr != 'K');
}
void setup()
{
Serial.begin(9600);serialEvent();
pinMode(m1a, OUTPUT);pinMode(m1b, OUTPUT);
analogWrite(pwm_pin, 0);
digitalWrite(m1a, LOW);digitalWrite(m1b, LOW);
lcd.begin(16, 2);
lcd.print(" Suspention ");
lcd.setCursor(0,1);
lcd.print(" power gen ");
delay(2000);
Serial
```

IX. RESULTS

The below figure shows about the overall project of design and development of power generation by suspension system and speed control of dc motor using IOT

In our project majorly we developed the power generation by suspension mechanism and we controlled the speed and direction control of dc motor using iot module.

Here is the output of the power generation by suspension system for domestic uses (mobile charging)

ADVANTAGES:

Energy Efficiency: They recover and store energy during braking, converting it into electrical energy. This stored energy can be reused, improving overall energy efficiency.

Fuel Economy: By harnessing energy during braking, regenerative braking systems can reduce fuel consumption in hybrid and electric vehicles, enhancing their overall efficiency. Extended Range for Electric Vehicles: For electric vehicles (EVs), regenerative braking helps increase their range by recovering energy that would otherwise be lost as heat during traditional braking.

CONCLUSION

In summary, this project successfully tackles the dual challenges of energy wastage at speed breakers and intelligent motor control. The mechanism utilizes a vertically displacing roller to convert linear motion from passing vehicles into rotary motion, generating electricity stored in a battery. Simultaneously, an Arduino-based control system, receiving input signals through IoT from an Android device, manages DC motor speed and direction using PWM concepts. The project emphasizes the seamless synergy between energy harvesting and smart control, promoting sustainability and intelligent transportation practices. With transparent documentation using the Arduino IDE and detailed interfacing information, this initiative showcases an interdisciplinary approach toward a more energy-efficient and technologically advanced future.

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