BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT
Avalahalli, Yelahanka, Bengaluru-560064

Department of Electronics and Telecommunication Engineering

Mini Project Presentation

on

"PiEnergi: Harnessing Power Through Piezoelectric Speed Breakers"

Presented by:

AKANKSHA V. GHAT	**1BY20ET005**
MUSAVEER AHMED KHAN	**1BY20ET036**
S.VARSHA	**1BY20ET048**

Under the Guidance of:
Dr. SARITHA I G
Assistant Professor, Dept of ETE,
BMSIT &M

CONTENTS

INTRODUCTION

- Electricity is a necessary and vital resource, which has unquestionably changed technology, having an impact on all aspects of existence.
- As the world's population is currently rising along with the general demand on electricity, developing alternatives to the current accustomed methods of electricity generation is therefore critically compelling.
- The speed bumps' nature of being repeatedly run over by oncoming vehicles presents the potential of harvesting the corresponding mechanical energy and converting them into electrical energy.
- Whenever a vehicle decelerates through a bump, its weight is exerted on this, and the energy is accordingly transferred from the vehicle to the speed bump.
- This project therefore aims to quantify the real potential of generating electricity from speed bumps through developing an energy recovery system by utilizing the piezoelectric effect.

LITERATURE SURVEY

TITLE	AUTHOR	PUBLICATION	METHODOLGY	DRAWBACKS
Design and fabrication of Speed Bump for Energy Generation (2020)	M Palanivendhan, S Logeshwaran, G Naresh, K Ankush, A Sidhaant, S Shivam	ICMECE	A rack is fixed below the upper part of the speed breaker which is in constant mesh with a pinion. The rotation of pinion activates the rotation of a geartrain. A generator rotates whenever a vehicle passes over the bump and generates electricity.	Provides only a peak voltage of 3.87 volts which is not sufficient for the charging of any devices.
Compressed Air Production Using Vehicle Suspension (2019)	S.Vigneswari, , V.Vinodhini	IJRASET	The cylinder arrangement is attached on the wheel axle. This motion is used to suck the air from the atmosphere. Thus the piston inside the cylinder creates the internal pressure which is supplied to a pneumatic device which rotates a generator and generates electricity.	Expensive to fix a device for each car.

LITERATURE SURVEY

TITLE	AUTHOR	PUBLICATION	METHODOLGY	DRAWBACKS
Using Road Speed Breakers to Extract Electric Power (2018)	M. Mari Durai	IJARBEST	The speed bumps goes on up and downward motion and crankshaft converts reciprocating motion into rotating motion through connected alternator unit to run the alternator to produce electricity.	Mounted on bearings which creates balancing problem leading to mechanical vibrations and needs maintenance.
Simulation of Power Generation From Speed Breakers Using Roller Mechanism (2019)	Mr. Gunanithy S, Prof. S. Nagarajan	IJESRT	In this mechanism when vehicle is passing over the roller it tends the roller R1 to move due to friction between the tire and the roller surface. The Rollers R2 and R3 is connected with the R1 so these two rollers also will rotate. And all three rollers are connected with each other roller will rotate if any of the roller rotates. So, the end of the Roller R1 it is connected to gearbox with help of Timing unequal pulley. The output of the Gear box is connected to 18 phase generators	Not efficient for passing more than one vehicle at the same time.

STATEMENT OF THE PROJECT

“Design and development of a power generator capable of harnessing mechanical energy from vibration on piezoelectric speed breakers and converting it into electrical energy.”

OBJECTIVES

1. To create a system to place a structure containing an array of piezoelectric sensors.
2. To design and implement the harvesting circuit.
3. To interface harvesting and charging circuit to a microcontroller board-Arduino Nano.
4. To enable authorization to the charging port.
5. To generate voltage from the array of piezoelectric sensors.

PROPOSED METHODOLOGY

- The proposed station-like system captures the untapped energy generated by vehicles passing over speed bumps. Piezoelectric devices are utilized to convert the mechanical stress into electrical energy through the piezoelectric effect.
- The generated voltage is regulated, stored in rechargeable batteries, and managed by a processor. This system takes advantage of the piezoelectric properties of certain materials, which produce an electric charge in response to applied mechanical stress.
- The proposed system utilizes strategically placed piezoelectric devices on speed bumps to capture the maximum mechanical stress exerted by passing vehicles. When the piezoelectric material experiences mechanical stress, it undergoes a change in charge centers, resulting in the creation of an electrical field. This field can be stretched or compressed by an electrical field when its direction is reversed.

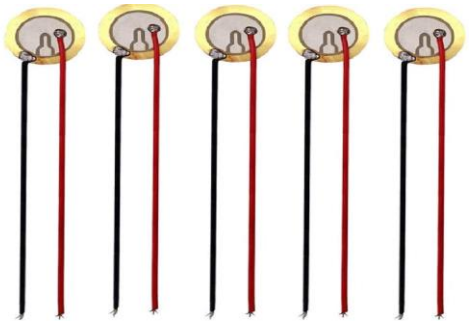


Figure 1: Piezoelectric sensors

PROPOSED METHODOLOGY

- The piezoelectric devices are connected in series underneath the speed bump, allowing them to collectively convert the mechanical stress into voltage. A voltage detector detects this voltage, which is then regulated to maintain a constant level using a voltage regulator. The regulated voltage is stored in a reusable battery for later use. The entire system is connected to a microcontroller processor, specifically the Arduino Nano.
- The Arduino Nano is an open-source microcontroller board based on the Microchip ATmega328P MCU. It processes the received voltage input from the piezoelectric devices, monitors the battery capacity, and ensures the secure utilization of the electricity stored in the rechargeable batteries. Additionally, an RFID sensor is incorporated to authenticate users and grant access to the collected energy

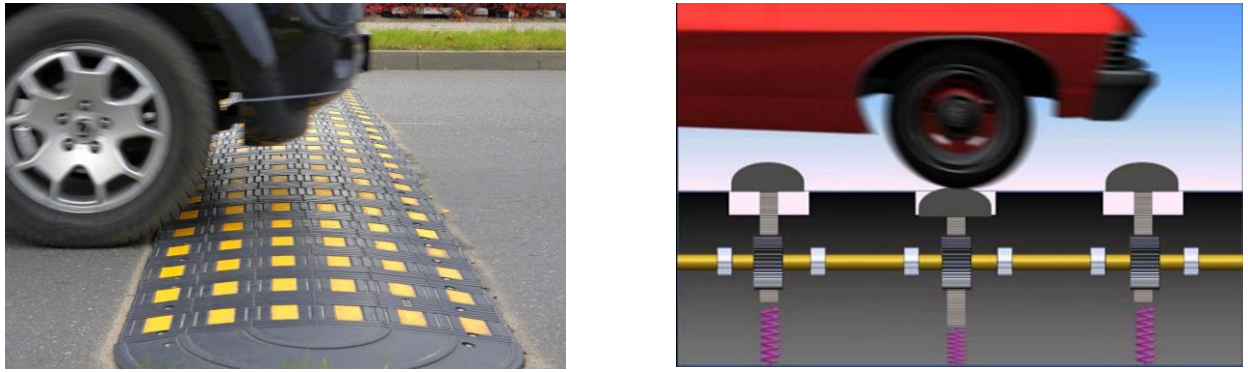


Figure 2&3: Piezoelectric Speed Bump Illustration

BLOCK DIAGRAM

Oncoming Vehicle on speed bump

Impact on Speed Breaker

Generation of energy due to friction

Generated energy compresses the piezo electric material

Production of Voltage

Speed Breaker System

Processor System

Reduction of Voltage

Transfer of regulated voltage to Arduino Nano

Display of Processed Data on LCD

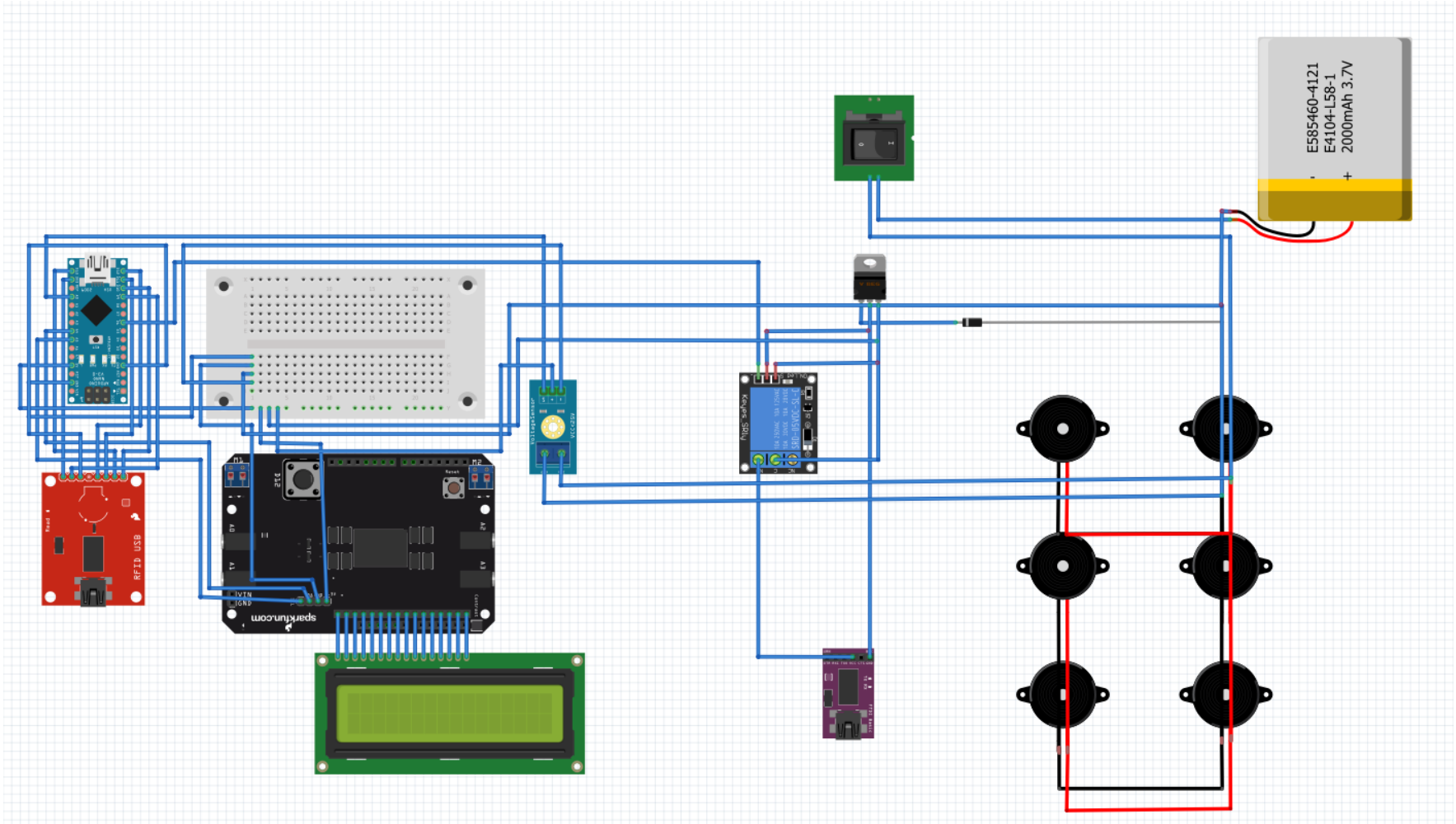
Relay of Energy to the USB Port

Charging of Mobile phone

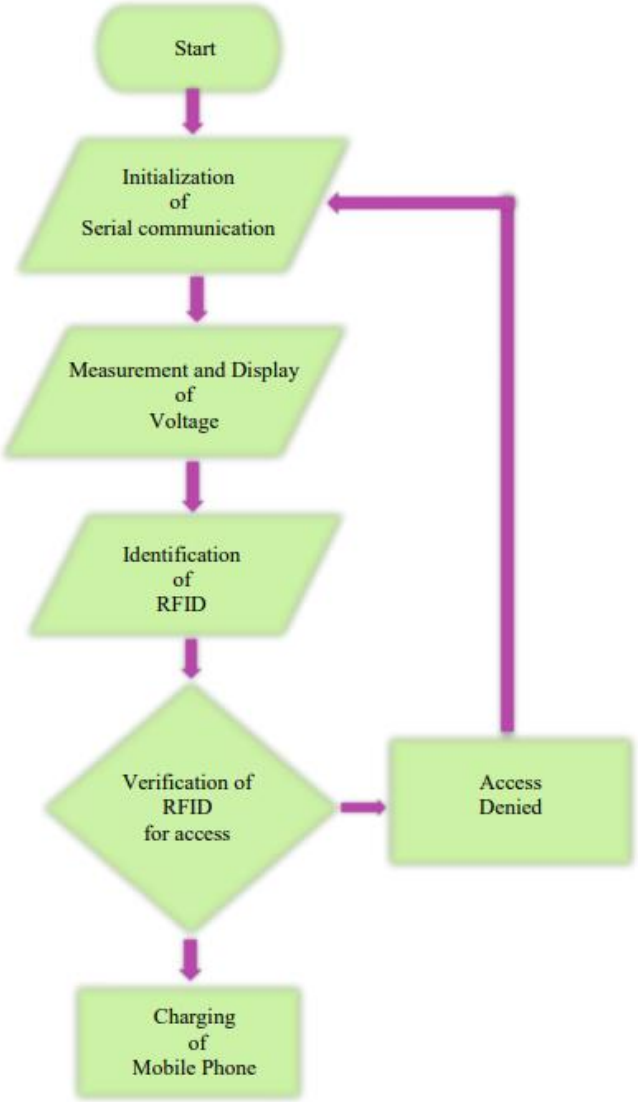
REQUIREMENT SPECIFICATIONS

1. Piezoelectric Devices
2. Voltage Sensor (Vcc<25)
3. Voltage Regulator (KA 7805)
4. One Channel Relay (HE JQC3FC)
5. USB Module (T-6855)
6. LCD Display 16x2 (RG1602A)
7. 12C LCD Display Driver
8. Arduino Nano
9. RFID Sensor (RFID-RC522)
10. Arduino Software (IDE) based on C++

CIRCUIT DIAGRAM



ALGORITHM


Start
Initialization of Serial communication
Measurement and Display of Voltage
Identification of RFID
Verification of RFID for access
Access Denied
Charging of Mobile Phone

IMPLEMENTATION

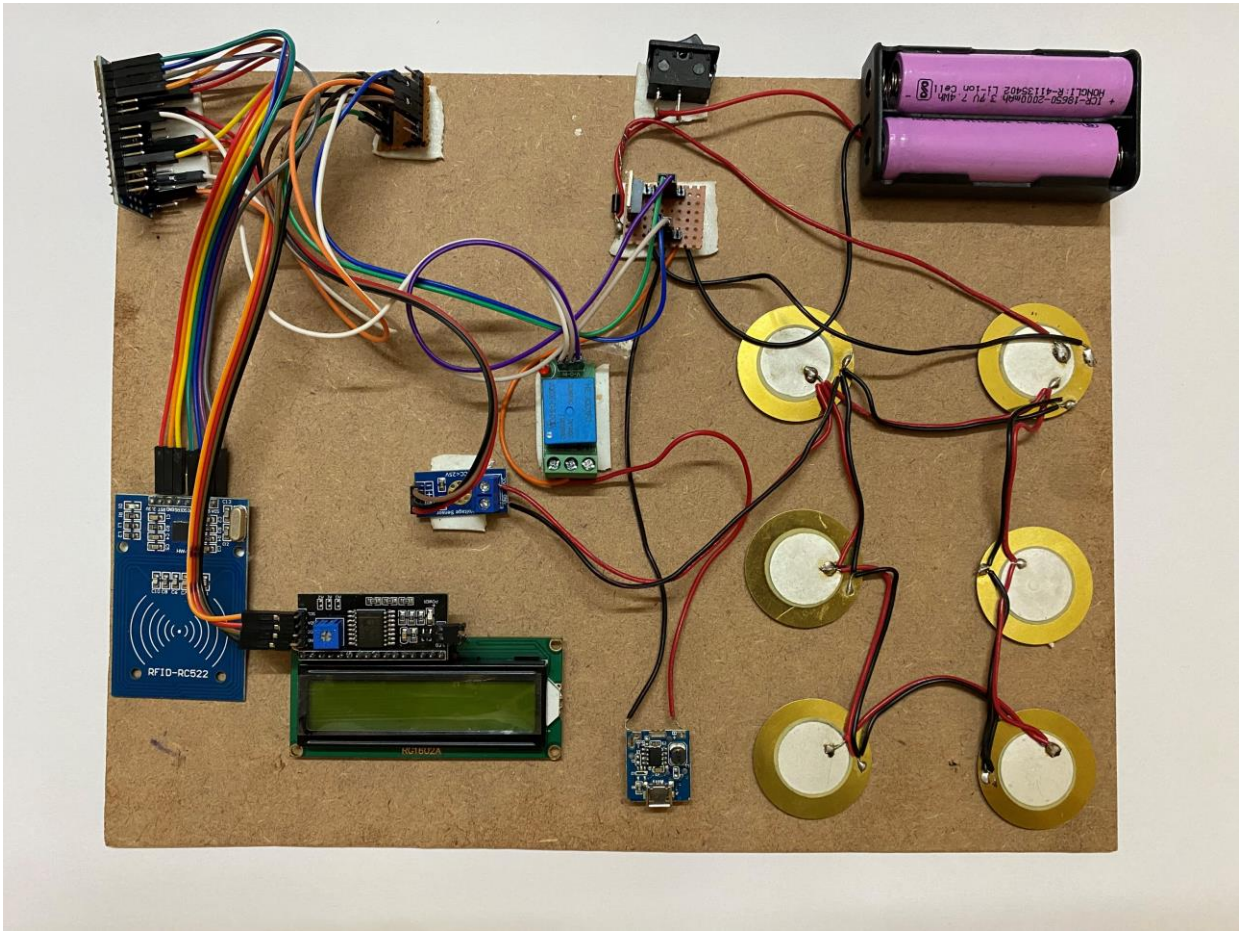


Figure 4: Circuit Implementation

RESULTS

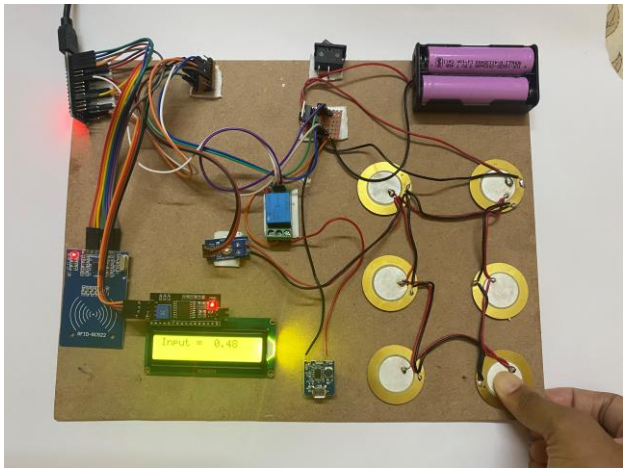


Figure 5: Input voltage

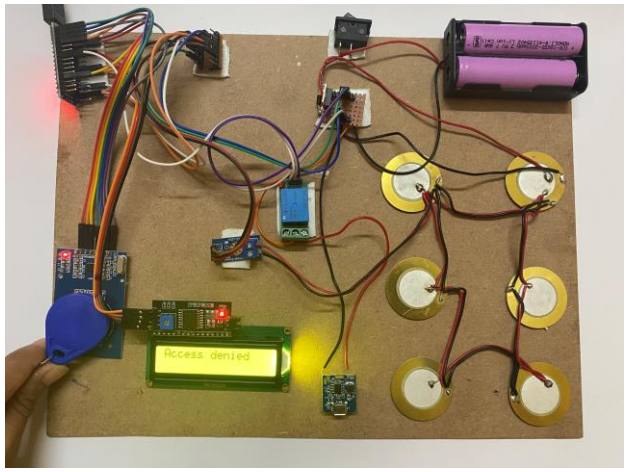


Figure 6: Access Denied

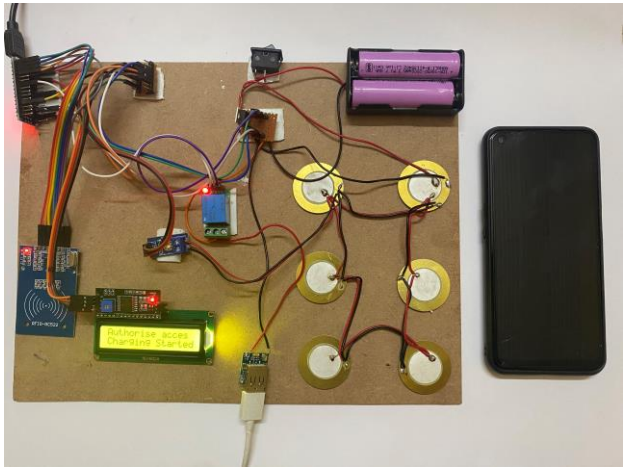


Figure 7: Access Authorized

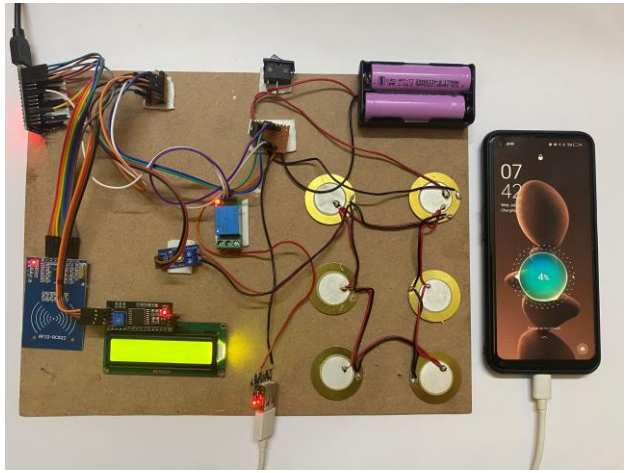


Figure 8: Mobile Charging

ADVANTAGES

1. **Clean, Renewable energy source:** This project harnesses energy from mechanical vibrations which are a source of clean energy.
2. **Recovers energy from untapped sources of energy:** This project harvests energy from various sources such as footsteps, speed bumps which usually remain as untapped sources of energy.
3. **Instantaneous Power Generation:** This project produces electrical energy almost instantaneously when subjected to mechanical stress or vibrations making them suitable for applications where immediate power generation is required.
4. **Small and Compact:** This project uses piezoelectric sensors typically small and compact in size, which makes them suitable for applications where space is limited or where portability is essential.
5. **Scalability:** This project can be easily scaled up or down to meet specific power requirements by optimizing the design.

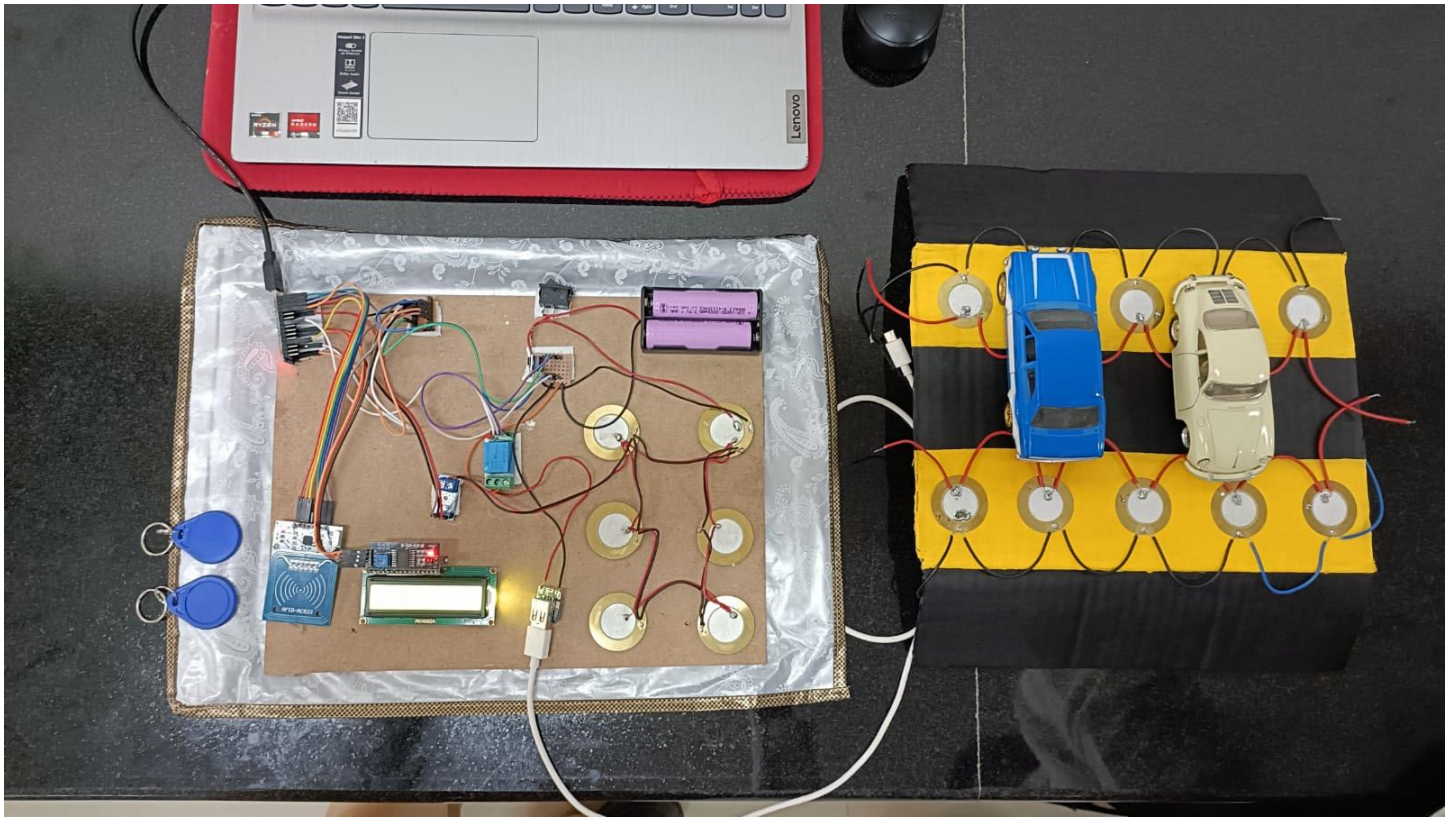
DISADVANTAGES

1. **Low power output:** The power output from this project is generally low compared to conventional power generation methods.

APPLICATIONS

1. **Transportation sector:**
   - Harvesting energy from speed bump, bridges, railway tracks, road pavements
2. **Automobiles:**
   - Harvesting energy from vehicle parts like tires, engine, suspensions
3. **In-water Applications:**
   - Harvesting energy from hydraulic pressure system with fluctuations as source of energy
   - Harvesting energy from fish-tags, with fish swimming as source of energy
   - Harvesting energy from water waves by a floating energy harvester
4. **Wind Applications:**
   - Harvesting energy from high-rise buildings with large vibrations produced by wind
   - Harvesting energy from flow-induced vibrations inside of a heating, ventilation and air conditioning system
5. **Human Body:**
   - Harvesting energy from process of walking
   - Harvesting energy from upper limb movement
   - Harvesting energy from heartbeat vibrations

PROPOSED MODEL



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