Fabrication of Footstep Power Generation Using Spring Mass and Piezoelectric Material

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Abstract: The use of electricity is growing exponentially. Human movement energy is used extensively in this experiment even if it can be extracted. Human movement, including running and skipping, is used as energy in this work as a notion for energy storage. This footstep power generation system makes use of piezoelectric sensors. To produce a voltage from a footstep, the piezo sensors are placed beneath the platform. Our monitoring circuitry receives the maximum output voltage produced by the arrangement of the sensors. This energy is stored in the battery and can be used at any time.This model is mostly suitable for situations where there is a lot of pedestrian traffic. This method of generating electrical charges and storing them for later use promotes an environmentally friendly approach to energy generation and clean green energy development.

Keywords: *Piezoelectricity, Plates, Footsteps, Power Generation, Electricity*

1. Introduction

Electricity demand is rising daily as a result of human advancements and uses in modern life. One of the many methods for producing electricity is foot traffic energy generation, which may prove to be a productive approach.

Walking is the most important thing a person does in his life. Every stride a person takes transfers their weight to the road surface through their footfalls, but they also lose energy to the road surface through impact, throbbing, and sound. Footstep power generation technology is based on the piezoelectric principle.

Piezoelectric materials can accumulate an electrical charge when subjected to pressure and strain. Put differently, the capacity of some materials to produce an electric potential when a load is present is known as piezoelectricity.

The idea of using human movement waste energy to create power is especially pertinent and important for countries with high population density areas where people's mobility will be invaluable for generating electricity from foot traffic.

Fig 1: Model of footstep power generation

According to Ratnesh Srivastava, in the last few years low power electronic devices have been increased rapidly. The devices are used in a large number to comfort our daily lives. For meeting this power demand, we introduce a foot step power generation. The main objective of this system is to capture the typically wasted energy surrounding a system and transforming it into electrical energy.

R. Jai Rajesh suggested that voltage should be produced using footstep power. The proposed device acts as a tool by using pressure to generate electricity. For public locations like bus terminals, malls, train stations, shopping centres, etc., this article is very useful. Therefore, these devices are installed in public situations where

people are walking, and they have to ride on this device in order to pass through or live. Such systems will then produce voltage about each and every move of a foot.

P.Venkatesh et al: In this paper, they have presented the design of power generation using footstep based on available piezoelectric sensors. Human race requires energy at very rapid rate for their living and wellbeing from the time of their arrival on this planet, because of this reason power resources have been worn out and enervated.

Power Generation in automobile suspension system by C Nithiyesh kumar, K Gowtham, Manikandan. Bharath kanna, Manoj Kumar. In this research paper author studied three methods of foot step power generation namely piezoelectric method, rack and pinion method and fuel piston method comparatively and found that the rack and pinion mechanism is more efficient with moderate cost of operation and maintenance.

2. Experiment

The components used is listed below to fabricate foot step power generation:

- Board
- Spring
- Nut and bolt
- Esp32 control board
- LCD
- Bread board
- Piezoelectric sensor
- Led

Fig 2: Components

• BOARD

The board is used to support and protect framed artwork by providing a rigid here we using board to apply loads on piezo electric device.

Dimensions of board: length = 450mm, width = 250mm, height =24mm

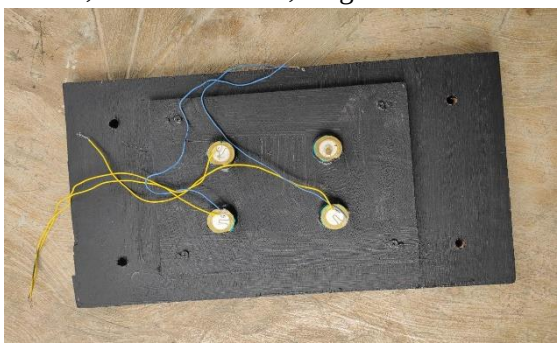

Fig 3: Board

• SPRINGS

A spring is an elastic member which deflects under load and regain its original shape and size after removal of load.

Dimensions of springs:
outside diameter = 20mm, inner diameter = 16mm, pitch =10mm
mean diameter =18mm, wire diameter = 2mm

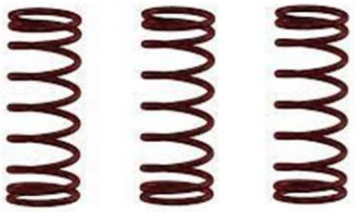

Fig 4: Springs

• NUT AND BOLT
Nut and bolt are the important elements of machines that are used to attach two different parts together without causing any type of damage.

Fig 5: Nut and Bolt

• ESP32 CONTROL BOARD
ESP32 is a series of low-cost low power system on a chip microcontroller with integrated Wi-Fi and a dual mode.

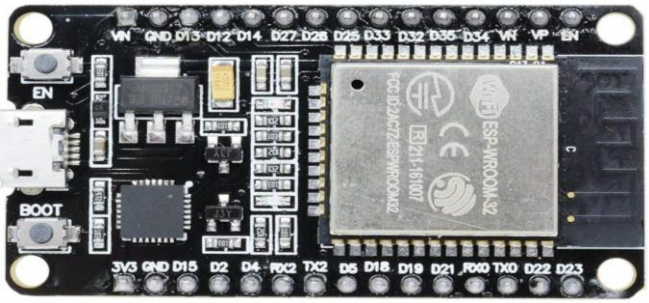

Fig 6: ESP32 Control Board

• LIQUIDE CRYSTAL DISPLAY (LCD)
LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

Fig 7: LCD

• BREAD BOARD
A bread board consists of plastic block holding a matrix of electrical socket of a size suitable for gripping thin connecting wire component wires or the pins of transistors and integrated circuits.

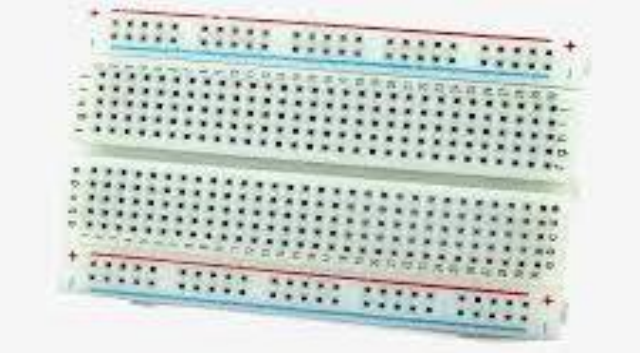

Fig 8: Bread Board

• PIEZO ELECTRIC SENSOR

A piezoelectric sensor converts physical parameters for example acceleration, strain into a electrical charge which can been measured.

Fig 9: Piezo Electric Sensor

• CIRCUIT DIAGRAM

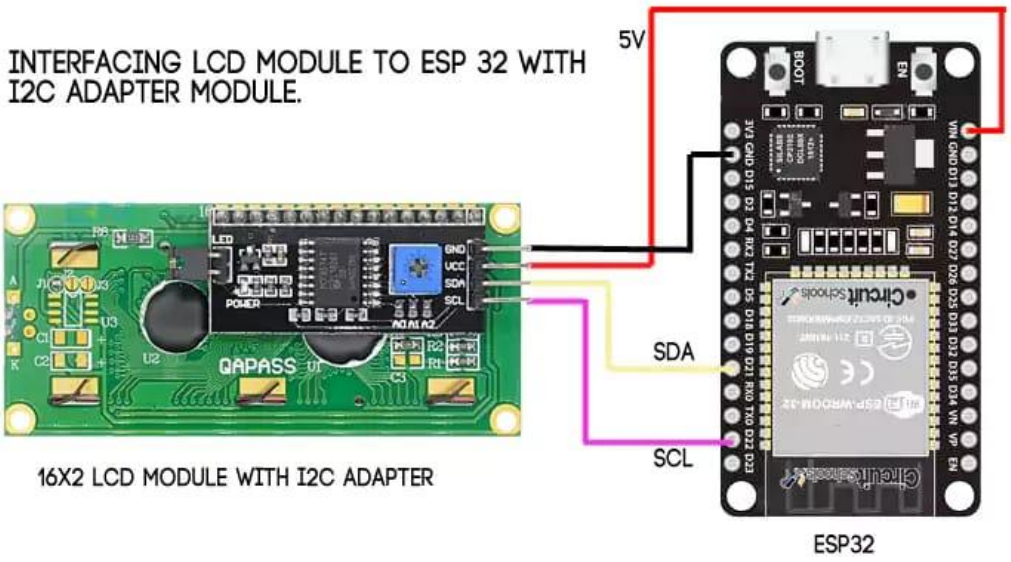

Fig 10: Circuit Diagram

In the above circuit diagram the VCC and GND pins are connected to the 5V and GND respectively and the other two data pins SDA and SCL are connected to D21 and D22 respectively. To know which are the SDA and SCL pins of your ESP 32 Board check the pin out diagram. Before getting into work, we need to find the I2C address of the I2C adapter generally it will be 0x27 for some modules it will be different so copy and paste the below code to find the I2C address in the serial monitor.

• Voltage Generation block diagram:

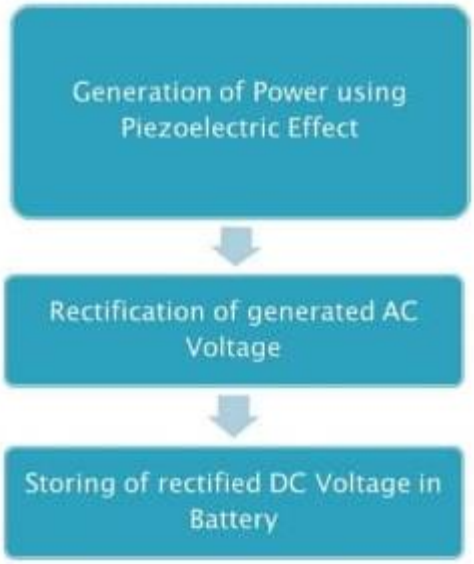

Fig 11: Flow chart for voltage generation

A working model of Footstep Power Generation is demonstrated in this project, the basic working of this model has been presented as a block diagram (Fig 11). To implement this model four piezoelectric sensor that are connected in series to increase the voltage output, this sensor generates AC voltage which is transferred to the bridge rectifier. The output voltage from the sensor is received then it is passed into the forward bias mode which will in turn charge the battery.

- Assembled Model of Footstep Power Generation Model

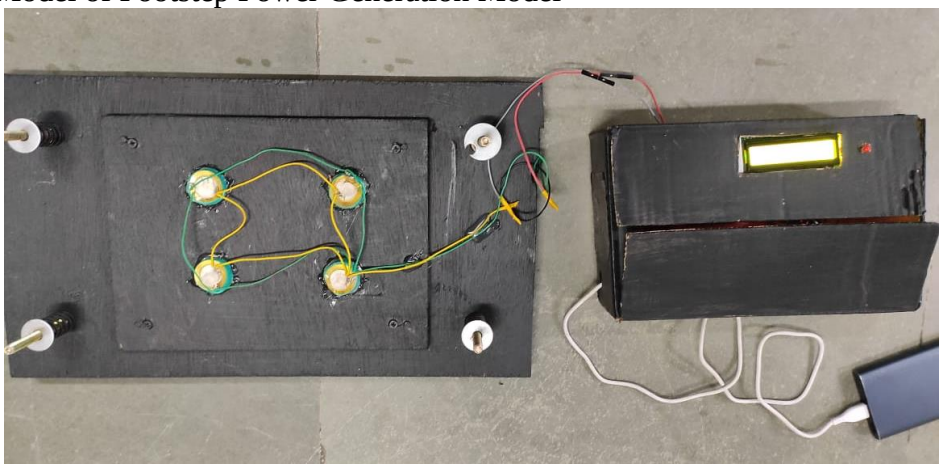

Fig 12: Assembled Model

3. RESULT AND DICUSSION

The fabricated footstep power generation prototype model is subject to testing by applying different loads and the respective voltage generated is recorded.

Sl. No	Load (Kg)	Compression of Spring (mm)	Voltage (V)
1	55	0.2	3.8
2	60	0.27	4.7
3	75	0.32	7
4	80	0.36	8.2
5	85	0.4	9.1
6	90	0.45	10.3

Table 1: Load v/s voltage

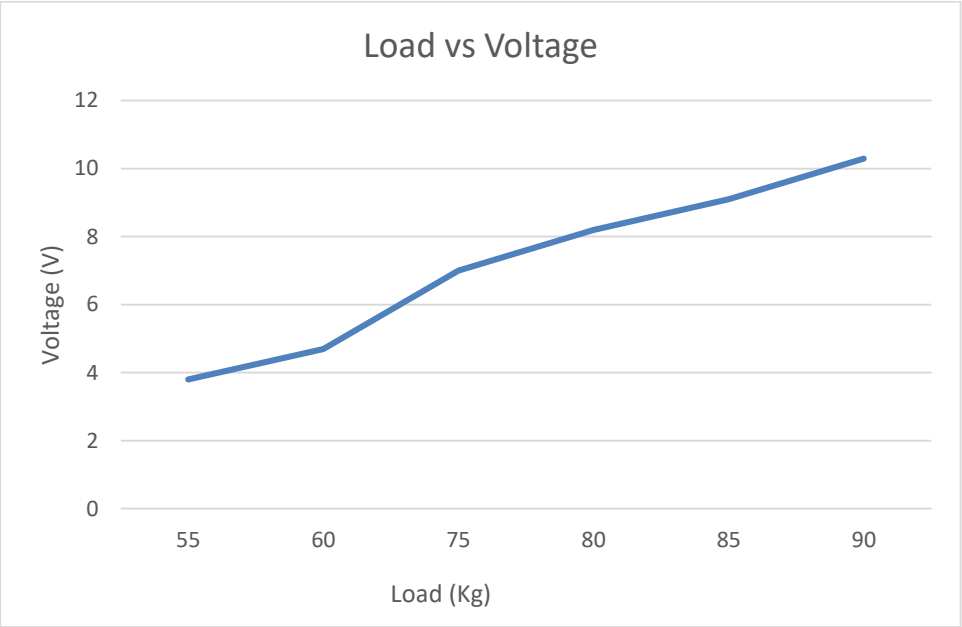

Fig 12: Load v/s voltage

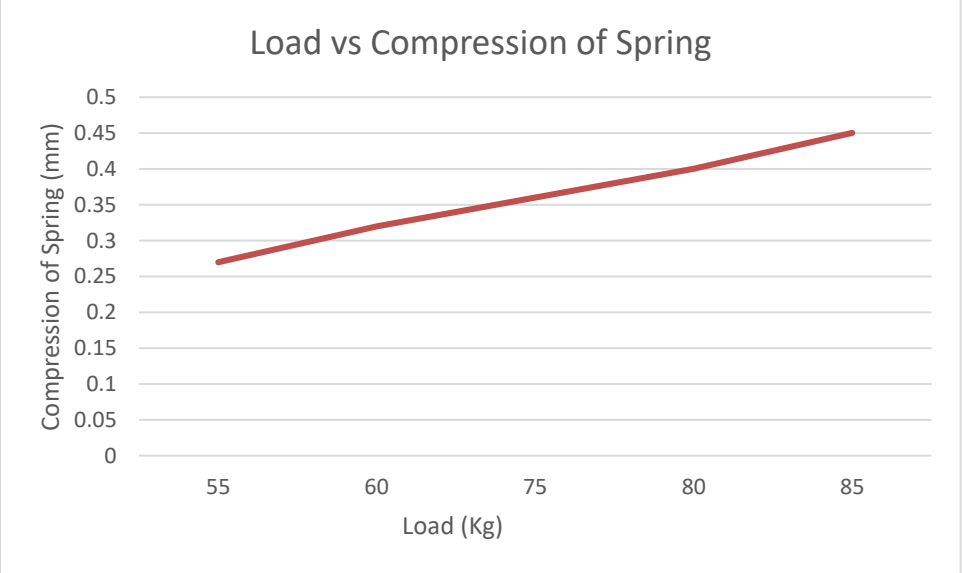

Fig 13: Load v/s Compression of spring

From table 1, it is observed that with increase in load the piezoelectric material experiences more deformation and a higher voltage is recorded.

4. CONCLUSION

- The hardware circuit formed control the system and generate power
- The circuit is programmed successfully to display the voltage generation.
- Footstep power generation functional prototype is successfully fabricated and is able to generate power on application of load.
- The fabricated prototype is tested with various loads and output voltage generated is displayed.

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