International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 134-138www.ijaem.net ISSN: 2395-5252

Power Generation Using Piezoelectric Sensor

J. Henry Rodricks [*1], K. G. Padmasine [*2]
[*1*2]*Department of Electronics and Instrumentation, Bharathiar University, Coimbatore-641046, Tamil Nādu, India*

Date of Submission: 28-03-2023 Date of Acceptance: 07-04-2023

ABSTRACT: This power generator provides the free power source using some amount of pressure or force. This device uses the piezoelectric sensor to generate power. The sensor measure changes in pressure, acceleration, strain or force and convert the to an electrical charge. This piezoelectric sensor has to be converted into DC voltage to store. This device can be used in more vibration and pressure produced areas (e.g.: buses, platforms). This is the upcoming power generator which is planned to be executed.

I. INTRODUCTION

In today's world everything became digital, any digital device requires dc power to work on. Some uses battery and some uses power supply. But there are some renewable resources available on this world like solar, wind, hydropower. In this way another power generator has come, but not yet known to everyone. That is piezoelectric power generator. Man has needed and used energy at an increasing rate for the sustenance and well-being since time immemorial. Due to this a lot of energy resources have been exhausted and wasted. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India where the railway station, temples etc., are overcrowded all round the clock. When the flooring is engineered with piezo electric technology, the electrical energy produced by the pressure is captured by floor sensors and converted to an electrical charge by piezo transducers, then stored and used as a power source. And this power source has many applications as in agriculture, home application and street lighting and as energy source for sensors in remote locations. This paper is all about generating electricity when people walk on the Floor. Think about the forces you exert which is wasted when a person walks. The idea is to convert the weight energy to electrical energy The Power generating floor intends to trans- late the kinetic energy to the electrical power. Energy Crisis is the main issue of world these days. The motto of this research work is to face this crisis somehow. Though it won't meet the requirement of electricity but as a matter of fact if we are able to design a power generating floor that can produce 100W on just 12 steps, then for 120 steps we can produce 1000 Watt and if we install such type of 100 floors with this system then it can produce 1MegaWatt. Which itself is an achievement to make it significant.

The proposed system works as a medium to generate power using force. This project is very useful in public places. So, these systems are placed in public places where people walk and they have to travel on this system to get through the entrance or exists. Then, these systems may generate voltage on each and every step of a foot.

II. SYSTEM DESIGN

1. PIEZOELECTRIC SENSOR

A piezoelectricsensor is a device that measures changes in pressure, force, acceleration, or temperature by converting them into an electrical charge. The sensor consists of a piezoelectric material, typically a crystal or ceramic, which produces a voltage when subjected to mechanical stress. When pressure or force is applied to the piezoelectric material, it deforms slightly, causing a separation of positive and negative charges within the crystal lattice. This separation of charges generates an electrical signal, which can be amplified and measured by an external circuit. Piezoelectric sensors are commonly used in a variety of applications, such as in the automotive industry for airbag deployment and engine control, in medical devices for measuring blood pressure and flow, and in industrial settings for monitoring vibration and detecting leaks.

One of the advantages of piezoelectric sensors is that they are highly sensitive and can

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detect even small changes in pressure or force. The terminals are shown in the figure below.

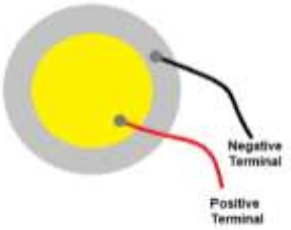

Figure.1 Piezoelectric Sensor

2. NODE MCU ESP8266

NodeMCU is an open-source development board that runs on the ESP8266 Wi-Fi SoC (System on Chip). The board is based on the Lua scripting language and is designed to make it easy to develop IoT (Internet of Things) applications. NodeMCU is a low-cost alternative to traditional microcontroller boards and is widely used in home automation, robotics, and other IoT projects. The NodeMCU board includes a USB interface for programming and debugging, as well as a built-in Wi-Fi module that allows it to connect to the internet and communicate with other devices. It also has a variety of input/output pins for connecting to sensors, motors, and other components. NodeMCU can be programmed using the Lua scripting language or using the Arduino IDE (Integrated Development Environment) with the ESP8266 board package. It also has a large community of developers and enthusiasts who have created libraries and examples to make it easier to get started with NodeMCU development.

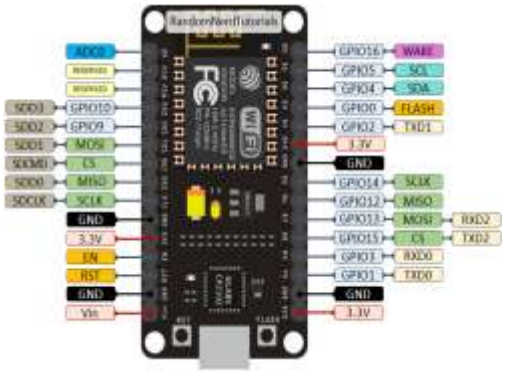

Figure.2 Node MCU ESP8266

3. BMS MODULE

The TP4056 is a popular charging module used for charging single-cell lithium-ion batteries. It has a maximum charging current of 1A and provides protection against overcharging, over-discharging, and overcurrent.The TP4056 charging module consists of a charging IC (TP4056), a battery connector, and a few other passive components such as resistors and capacitors. The charging IC regulates the charging current and voltage to ensure safe charging of the lithium-ion battery.The module also includes a charging indicator LED that lights up when the battery is being charged and turns off when the charging is complete. Additionally, it has a protection circuit that automatically terminates the charging process if the battery voltage exceeds the maximum safe limit.

Overall, the TP4056 charging module is a simple and effective solution for charging single-cell lithium-ion batteries with current protection. It is commonly used in DIY projects, portable devices, and other applications that require a reliable and efficient charging solution for lithium-ion batteries.

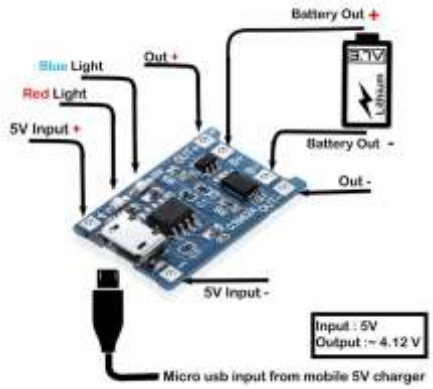

Figure.3 BMS Module

4. VOLTAGE SENSOR

A 25V voltage detector sensor module is a device that can detect the presence or absence of voltage in a circuit up to 25 volts. It is commonly used in electronics projects and electrical applications to monitor the voltage level and trigger an action or alarm when the voltage reaches a certain threshold.The voltage detector sensor module typically consists of a voltage divider circuit, a comparator, and a LED indicator. The voltage divider circuit reduces the voltage level to a value that can be measured by the comparator. The comparator compares the voltage level with a pre-set threshold voltage, and if the voltage level is higher than the threshold, the LED indicator is turned on.The voltage detector sensor module is easy to use and can be connected to a microcontroller or other electronic devices for further processing. It is commonly used in battery-powered applications to monitor the battery voltage level and prevent over-discharging, which can damage the battery. It can also be used in power supply circuits to detect voltage fluctuations and

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trigger a shutdown mechanism to protect the connected devices.

The voltage sensor module works on the voltage divider principle. A voltage divider is a circuit made of two resistors connected in series. An input voltage is connected to the circuit. The applied voltage is then passed on between the two resistance and division takes place in direct accordance with the resistances. The output analog voltage is taken from the second resistor and measured. The general equation of the output voltage isVout= Vin*R2/R1+R2. The equation shows that the output voltage is directly proportional to the input voltage and the ratio of the R2 resistor to the sum of R1 and R2 resistors.

Figure.4 Voltage Sensor

5. AC TO DC CONVERTER

The W04M is a bridge rectifier component that is capable of converting AC voltage to DC voltage. It has a maximum voltage rating of 400V and a maximum current rating of 1A. The "M" in the part number indicates that it is a surface mount device (SMD). The "W04M" designation indicates the specific model number of the rectifier. The "W" likely stands for "rectifier diode," while the "04" indicates the maximum voltage rating of the device (in this case, 400 volts). The "M" could signify the manufacturer or a specific series of rectifiers.The rectifier is a four-diode bridge configuration, which means that it uses four diodes to rectify the AC input voltage. The diodes are arranged in a bridge configuration to ensure that the DC output voltage is always positive, regardless of the polarity of the AC input voltage.The bridge rectifier is made up of four diodes that are arranged in a bridge configuration. This allows for full-wave rectification, which means that both the positive and negative halves of the AC input waveform are rectified to produce a DC output.When the AC input voltage is applied to the rectifier, the diodes conduct in pairs during alternate half-cycles. During the positive half-cycle, diodes D1 and D4 conduct, while during the negative half-cycle, diodes D2 and D3 conduct. The output voltage is the sum of the voltages across the two conducting diodes.Its compact size and surface mount package make it ideal for use in small electronicdevices.

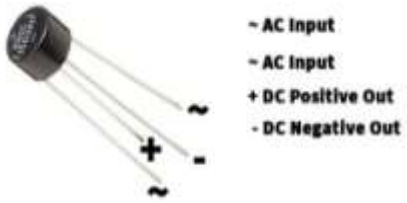

Figure.5 Bridge Rectifier

6. LITHIUM-ION BATTERY 3.7V

A lithium battery with a voltage rating of 3.7 volts is a common type of rechargeable battery that uses lithium-ion technology. These batteries are often used in portable electronics such as smartphones, tablets, laptops, and digital cameras.Lithium-ion batteries are popular because they have a high energy density, which means they can store a lot of energy in a small space. They also have a low self-discharge rate, which means they can hold their charge for a long time even when not in use.It's important to note that lithium batteries can be dangerous if mishandled or damaged. They should always be used and stored according to the manufacturer's instructions and should never be punctured or exposed to extreme temperatures.

Figure.6 Lithium-Ion Battery

III. METHODOLOGY

In the existing system, the foot step power generation system uses lcd display to show the battery percentage which is stored. Instead, the battery level indicator circuit using LED. This will reduce the power consumption for the circuit. The piezoelectric material converts the pressure applied to it into electrical energy the source of pressure from the weight of people walking over it the output of piezoelectric material is not a steady one. So, a bridge circuit is used to convert these variable voltages into a linear one.Node MCU - ESP8266 is used for power monitoring through mobile phone by detecting the consumed power using voltage sensor. The piezoelectric sensors are placed parallel

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according to spread the pressure to all sensors at the same time. The output is connected to a cable in the use to charge our electronics gadgets.In this Piezoelectric power generator, the power is obtained by applying force. But this has only AC power out. So, AC to DC rectifier circuit using bridge rectifier is used here. Even though it gives only minimum amount of power, we store it in battery for emergency purpose or for any other purpose. Lithium-ion battery is used to store the charges by use of BMS. The battery level is indicated by battery level indicator circuit. The power stored in abattery is used directly by turning ON the switch.

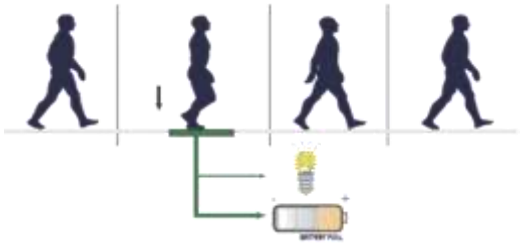

Figure.7 Working Principle

IV. BLOCK DIAGRAM

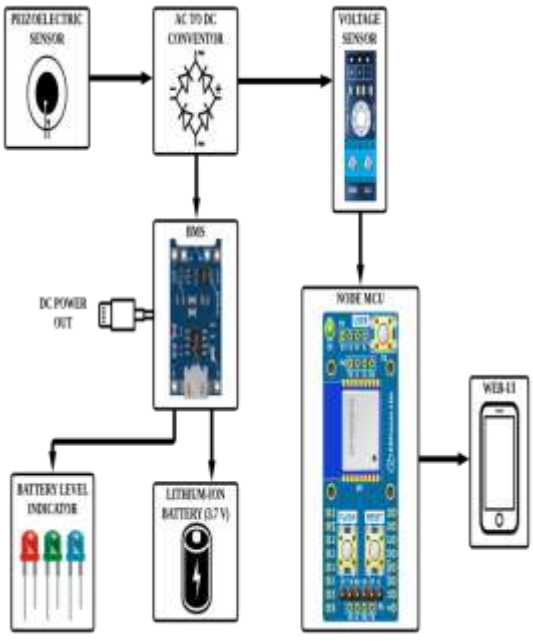

Figure.8 Block Diagram

V. RESULTS AND DISCUSSION

The amount of power generated by a piezoelectric generator is typically low, and is dependent on the amplitude and frequency of the mechanical vibrations. In addition, piezoelectric generators have a limited lifespan and can become less efficient over time.The piezoelectric material underconsideration were studied to understand the output corresponds to the various pressureand strain applied on them. Voltmeters and ammeter are used for measuring thevoltages developed across the piezoelectric materials and amount of current flowingthem respectively. As different observed pressure and strain are tested on thepiezoelectric material, different voltage readings were noted corresponding to thedifferent pressure and strain. If this project is implemented, we will not only be able to solve the energy crisis, but we will alsobe weight contributing to the creation of a healthy global environmental change.

Power Description:

S.NO	PRESSURE(Pa)	VOLTS (V)
1.	10	0.012
2.	20	0.094
3.	50	2.300

The given graph represents the relationship between the weight of the person walking on thepiezoelectric sensor and the amount of electricity generated according to the weight.

VI. CONCLUSION

Piezoelectric sensors are devices that can generate electricity by converting mechanical vibrations into electrical energy. While piezoelectric materials have been used for many years in sensors and actuators, recent advances in technology have made it possible to use them for power generation. Piezoelectric power generation has its advantages and disadvantages, it has the potential to become an important source of renewable energy in the future. As technology continues to improve, it is likely that piezoelectric generators will become more efficient and cost-effective, making them a viable option for a wide range of applications.

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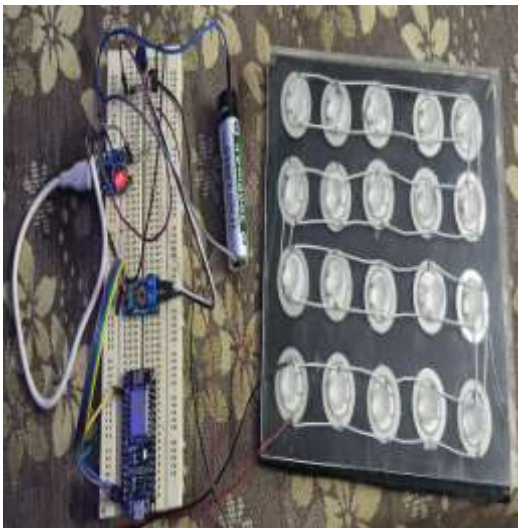

Figure.9 Hardware system design

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