

Foot Step Power Generation using Piezoelectric Sensor

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Abstract— In day today's life the utilization of power turns to be necessary for each work. The paper proposes a novel technique for the creation of power utilizing piezoelectric sensors kept along the footpaths which can be ready to charge the battery and ready to supply the force at whatever time of our prerequisite. The footstep power generation technique through piezoelectric sensors produces electrical force by changing mechanical energy of the development of individuals on the floor to electrical energy. The benefits of piezoelectric force generation framework is that it is sheltered and secure to utilize, it doesn't make any issue or distress for the general population strolling through footpath, and it is absolutely chance free strategy. Footstep power generation technique has mechanical part and in addition electrical part, however the electrical and mechanical losses are negligible. This framework additionally has the ability to store the electrical force away battery. The power produced by this technique can be utilized for helping up the road lights, additionally for activity reason, sign boards of streets. At long last the force which will be abandoned can be given to national grid for power reason.

Key words: Piezo Sensor, LCD, Microcontroller

I. INTRODUCTION

In day to day life, Electricity is most typically used energy resource. Nowadays energy demand is increasing and which is lifeline for people. Due to this range of energy resources are generated and wasted. Electricity are often generated from resources like water, wind etc. to generate the electricity from these resources development of big plants are needed having high maintenance cost. Some other energy resources also are expensive and cause pollution. They are not affordable to common people. Electricity has become vital resources for person therefore, it is needed that wasted energy must have to utilize, walking is the most common activity done by human being while walking energy is wasted within the type of vibration to the surface. And this wasted energy are often regenerate into electricity. Using the principle called piezoelectric effect. Piezoelectric impact is that the effect during which mechanical vibrations. Pressure or strain applied to electricity material is regenerate into electrical kind. This project gives idea about how energy is used on stepping on stairs. The use of stairs in each building is increasing day by day even little building has some floors once we are stepping quantity of this wasted energy is used and converted to electricity by Piezoelectric effect. Piezoelectric impact is that the effect of specific materials to get an electrical charge in response to applied mechanical stress. Power assumes a crucial half being developed of the country. Power is characterised as set of physical marvel connected with the stream of charge. There are 2 styles of power to be specific Static power, that can be held steady and Dynamic electricity which can spill out of one potential to another. With the upgrading population AND foundation of the

forthcoming organizations and production lines there are an awning interest for the necessity of power therefore on run the machines and types of gear. Power will pour of 1 section to a different either as flash or current in metal. Power is made within the power stations by generators. These generators themselves require extensive measure of info energy to deliver power which thus relies on upon the "NON RENEWABLE" assets of vitality to create power with a specific end goal to run them. "Renewable" assets of vitality, for example, Solar Cell Panel, Wind Energy can likewise be utilized to collect power. However these sources are constrained to a specific region for eg. we can say that alternative energy are often used simply at the spot wherever the sun focus is entirely nice and continuous. Wind Energy can fundamentally be utilized as a part of the seaside territory's the place the wind pace and accessibility is all the time present. Aside from all these human movements like n"art-28">In addition step by step owing to enlargement within the expense of the assets needed to deliver power there's an awning increment within the expense of electricity, due to this reason until nowadays varied weaker section people of the final public cannot get power and don't seem to be in any case able to work even very little apparatuses.

II. PROPOSED SYSTEM

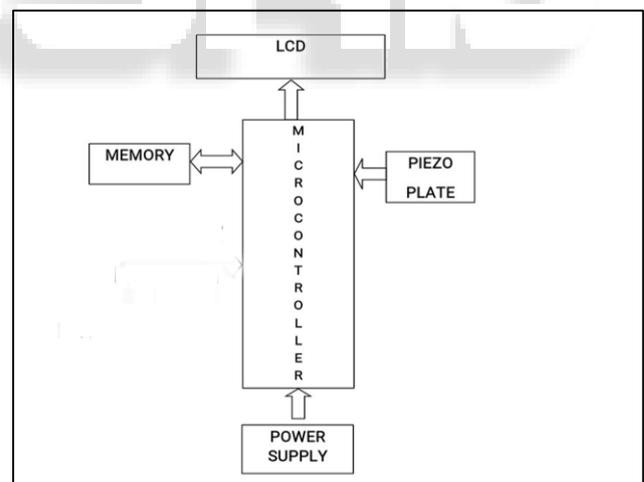


Fig. 1: Block Diagram of Foot Step Power Generation Using Piezoelectric Sensor

In the power supply section step down transformer is connected. The 12 volt AC supply is given to the transformers primary winding further that AC supply is get converted into DC with using bridge rectifier. We get 5volt dc voltage at the output voltage regulator this section having a constant reference voltage that is 2.5 volt. The other 2.5 volt is coming from the piezoelectric plate.

When the human foot step or any kind of mechanical force is applied on the piezo fibre glass that every foot step is generating some amount of voltage according to the person weight who walked from the piezo plate which we installed

on the staircase or somewhere else. First of all that generated voltage is get compared with the reference voltage 2.5 volt if the voltage generated from foot step is equal to the reference voltage or grater than the reference voltage then it count as “logic1” and if it is not then it will count as “logic0”.

Only “logic1” is count and that will generate voltage otherwise there is no counting and voltage generate as well. If all piezo are pressed simultaneously and accurately and also the “logic1” is count then one pulse is generated from the output pin of voltage regulator that pulse is further passing from the microcontrollers pin “P1.7” and it will count otherwise its unable to count.

The four combinational piezo plate are capable to generate maximum 12volt voltage. The voltage generating process is totally depend up on the piezoelectric sensors. The 24C64A memory will stores the data and it use SDA pin to write that data from memory and result is shows on the LCD the microcontroller pins DB0-DB7. The microcontroller READ the data from memory WRITE pin showing the data on LCD. The foot step on LCD and the voltage range is showing on LCD and the voltage range is showing on the multimeter.

Piezoelectric material converts pressure into electrical energy. The pressure can be either from weight of moving vehicles or from the weight of people walking on it. The produced output is in the variable form .so bridge circuit is used to convert variable voltage into linear voltage. An AC filter is used to filter out this output voltage and it is stored in rechargeable battery. Two possible connections were tested-parallel and series connections for producing 12v output. Inverter is connected to battery and battery connection provide AC load. The voltage produce across the time can be displayed on LCD

The piezoelectric material converts the pressure, stress applied to the material into electrical energy. The source of stress is from the weight of the people stepping on the stairs. As the output voltage from a single piezo-film was extremely low, thus combination of few piezoelectric is used. Two types’ possible connections can be done parallel connections and series connections. The output of the piezoelectric material is not a regulated one, so variable to linear voltage converter circuit rectifier is used. Ac ripple neutralizer is the circuit used to reduce the ripples from the piezoelectric output. The AC ripple neutralizer consists of rectifier and ripple filter. Again AC ripples are filtered out using ripple filter and it is used to filter out any further variations in the output and then it can be pass through regulator in order to regulate. The output of the voltage regulator is given to the unidirectional current controller. Unidirectional current controller means it allows flow of current in only one direction.

III. HARDWARE DESCRIPTION

A. Microcontroller 89s52

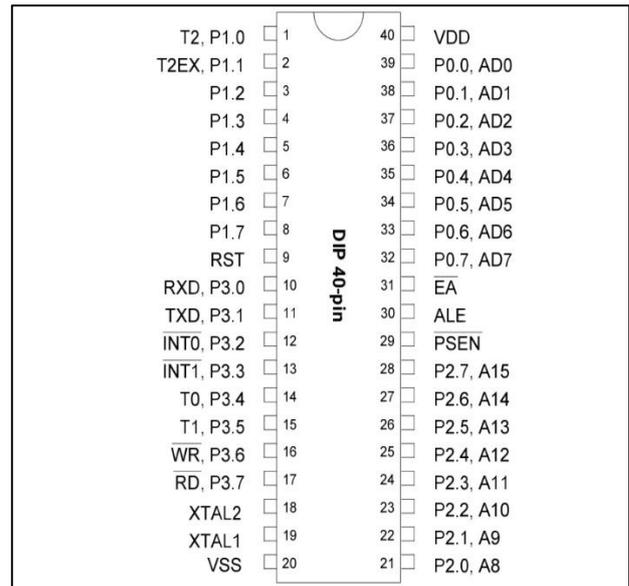


Fig. 2: Microcontroller Pin Diagram

1) General Description

The W78E054D/W78E052D/W78E051D series contains 16K/8K/4K bytes Flash EPROM programmable by hardware writer; a 256 bytes RAM; four 8-bit bi-directional (P0, P1, P2, P3) and bit-addressable I/O ports; an additional 4-bit I/O port P4; three 16-bit timer/counters; a hardware watchdog timer and a serial port. These peripherals are supported by 8 sources 4-level interrupt capability. To facilitate programming and verification, the Flash EPROM inside the W78E054D/W78E052D/W78E051D series allows the program memory to be programmed and read electronically. Once the code is confirmed, the user can protect the code for security.

The W78E054D/W78E052D/W78E051D series microcontroller has two power reduction modes, idle mode and power-down mode, both of which are software selectable. The idle mode turns off the processor clock but allows for continued peripheral operation. The power-down mode stops the crystal oscillator for minimum power consumption. The external clock can be stopped at any time and in any state without affecting the processor. The W78E054D/W78E052D/W78E051D series contains InSystem Programmable (ISP) 2KB LDROM for loader program, operating voltage from 3.3V to 5.5V.

B. Piezoelectric Sensors



Fig. 3: Pizoelectric Sensor

The piezoelectric material is the device which convert mechanical energy into electrical energy. Piezoelectric sensors are versatile tools for the measurement of various processes. They are used for quality assurance, process control, and for research and development in many industries. Pierre Curie discovered the piezoelectric effect in 1880, but only in the 1950s did manufacturers begin to use the piezoelectric effect in industrial sensing applications. Since then, this measuring principle has been increasingly used, and has become a mature technology with excellent inherent reliability.

Piezoelectric effect-

They also use piezoelectric crystal. The piezoelectric crystal exhibit the piezoelectric effect. This piezoelectric effect having two properties. First one is the direct piezoelectric effect which means that material has ability to convert mechanical strain into electrical charge. Second one is the converse effect, in which the applied electrical potential converted into mechanical strain energy. That means material used as power harvesting medium

The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to 10^6 N/m^2 .^[citation needed] Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This gives piezoelectric sensors ruggedness, an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate or tourmaline) are extremely stable at high temperatures, enabling sensors to have a working range of up to 1000°C . Tourmaline shows pyroelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezoceramic materials. Gautschi in *Piezoelectric Sensorics*(2002) offers this comparison table of characteristics of piezo sensor materials vs other types:^[3]

C. Liquid Crystal Display (LCD)



Fig. 4: LCD Display

An LCD consists of two glass panels, with the liquid crystal material sandwiched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed. Polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarizer are pasted outside the two glass panels.

When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific

direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating / highlighting the desired characters. The LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.

The LCD's don't generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range. Changing the display size or the layout size is relatively simple which makes the LCD's more customer friendly.

IV. ADVANTAGE

- Power generation is simply on step.
- No need fuel input.
- This is non-conventional system.
- No moving parts-long service life.
- Self-generating-no external power required.
- Compact yet highly sensitive.
- Reliable, economical, eco-friendly.
- Less consumption of non-renewable energies.
- Power also generated by running or exercising on the step.
- Extremely wide dynamic range, almost free of noise.

V. FUTURE SCOPE

Utilization of wasted energy is very much relevant and important for highly populated countries in future.

1) Flooring Tiles-

Japan has already started experimenting the use of piezoelectric effect for energy generation. They implement piezoelectric effect on the stairs of the bus. Thus every time passenger steps on the tiles; they trigger a small vibration that can be stored as energy.

The flooring tiles are made up of rubber which can absorb the vibration. This vibration generates when running or walking on it. Under these tiles piezoelectric material are placed. When the movement is felt by the material they can generate the electricity. This generated energy is simultaneously stored into the battery. Generated electricity we can use the lightning of lamp or street light. Energy is generated by step of one human being is too less but if number of steps increases ultimately energy production also increases

2) Dance floors-

Europe is another one of the country which started experimenting use of piezoelectric crystal for energy generation in night clubs. Floor is compressed by the dancer's feet and piezoelectric materials makes contact and generate electricity. Generated electricity is nothing but 220 watt. It depends on impact of the dancer's feet. If constant compression of piezoelectric crystal causes a huge amount of energy.

3) Foot path-

This project is very beneficial on foot paths, Market, gardens because these are the areas where peoples came for to do their daily activities such as to buy some stuff or jogging or anything else we can easily generate the electricity over there

because due to the human foot the piezo plates are pressed one after other and due to that the process of generating electricity is fast.

4) Schools/colleges /Offices-

The foot step power generation using piezoelectric sensor if this project we installed in such areas for example schools, colleges, offices where peoples are working around the clock this is very helpful for that particular school or college to generating electricity.

5) Human Counting-

To counting human being in such area where so many peoples are gathered. This project is done efficient work over there this is new invention we done in this project.

VI. RESULTS

V-I characteristics (as in Figure 5) of both the piezoelectric material under consideration were studied to understand the output corresponds to the various pressure and strain applied on them. Voltmeters and ammeter are used for measuring the voltages developed across the piezoelectric materials and amount of current flowing them respectively. As different observed pressure and strain are tested on the piezoelectric material, different voltage readings were noted corresponding to the different pressure and strain. In this way, the energy can be stored in the capacitor by charging the capacitor, and the capacitor may be discharged on the basis of requirement. However the energy harvesting capacity of this circuit is not very much appreciable. To overcome this problem, after bridge rectifier stage, one may use a DC to DC converter. An improvement by a factor of seven in energy harvesting has been shown by the addition of DC-DC converter. In parallel with the piezoelectric element, it contains a switching device. The DC voltage will be stored in 6V battery, the number of battery used is 2 in number. The 6V each DC of the battery is converted into AC by power transistor T-1 (NPN). The output of the transistor is fed to the inverter transformer which will convert 12 V to 220V which will light up. The number of press or number of jumps on a wooden plank is shown on the 0-99 counter.

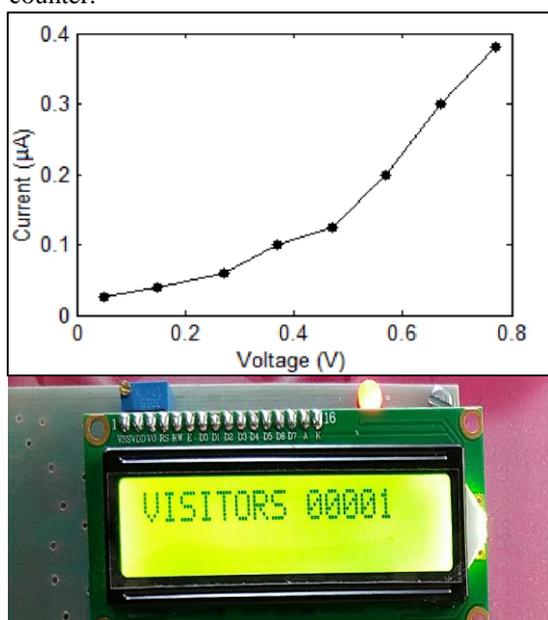


Fig. 5: Visitor Foot Count

VII. CONCLUSION

A piezo tile capable of generating 12 V has been devised. Comparison between various piezo electric material shows that PZT is superior in characteristics. Also, by comparison it was found that series- parallel combination connection is more suitable. The weight applied on the tile and corresponding voltage generated is studied and they are found to have linear relation. It is especially suited for implementation in crowded areas. This can be used in street lighting without use of long power lines. It can also be used as charging ports, lighting in buildings, Street lights, at railway stations etc.

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