Arduino Based Footstep Power Generation with Battery Level Indicator

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Abstract: The footstep power generator is the technique by which electricity is generated from the mechanical energy created during the process of walking. The system makes use of piezoelectric sensors fitted under a surface which produces voltage upon the application of force. The generated energy in its raw state is alternating and can be converted to DC through a rectifier.

An essential drawback in present systems is the absence of any system of energy monitoring. Most devices show the voltage which does not necessarily tell anything about the battery life. In this project, an Arduino Uno which is based on ATmega328 chip will be used to continuously monitor the voltage level in the battery and the percentage of charge present. The value obtained is shown on the 16×2 LCD screen. It gives better efficiency, usability and safety to the system.

Keywords: Arduino UNO, Voltage sensor, 16x2 LCD, Battery

Introduction:

The growing need for electrical energy and the declining availability of natural sources of energy have led to the creation of alternative forms of energy. Renewable energy sources are receiving widespread recognition due to their environmental benefits. Energy harnessing through human movement is one way to achieve this.

Foot step energy harvesting relies on the force generated when a person walks to harness electrical energy. This technology incorporates piezoelectric sensors, which are placed under the floor where one walks. The sensors generate electrical energy when subjected to force through the piezoelectric effect.

As the electricity harvested is minimal and fluctuating, it requires conditioning. This involves the use of rectifiers and filters. The treated energy is then stored in batteries for future use. Furthermore, there is a system that monitors the level of power in the batteries.

2. Components And Software:

The proper selection of hardware components is critical to the functionality,reliability,and cost-effectiveness of the Time based Electrical=l Appliance's Control System. Each component has been carefully chosen based on criteria such as performance,compatibility,ease of use, and availability.

2.1 Arduino Uno(Microcontroller):

Central controlling component for interfacing RTC, processing user inputs, and implementing scheduling routines.

2.2 **16X2 LCD Screen** :

Functions as switch to control AC electrical appliances through microcontroller's signal**.**

2.3 Capacitor 1000/25v:

Filtering capacitor to filter out ripples from incoming power supply**.**

2.4 Capacitor 100/25v:

Smaller filtering capacitor for additional stabilizing around the voltage regulator**.**

2.5 Voltage Regulator(7805):

Converter of incoming higher DC voltage (7-12V) into 5V for the use of Arduino and LCD.

2.6 Female DC Jack:

Jack for connection of external DC power supply input.

2.7 Red LED 5mm :

Indicator Light for indicating Power ON condition and/or status/output.

2.8 Male Connector Pin 2:

Pads for connection of external sensor module to the board.

2.9 Uno Shield Board:

Base/shield for holding Arduino Uno.

2.10 1K Resistor:

Limits current to the LED to prevent it from burning out**.**

2.11 Male Bucks:

Male header pins for making connections to breadboard or other modules.

2.12 Female Bucks:

Female header pins/sockets for plugging in jumper wires or modules.

2.13 Piezo sensor:

It uses the piezoelectric effect to measure changes in pressure by converting them into an Electrical Signal.

2.14 Voltage sensor:

A Voltage sensor is an electronic device used to measure the voltage level of a power source or circuit and provide a scaled-down voltage.

2.15 Battery 12V,1a:

It is a battery with a voltage of 12 volts and a maximum output current of 1 ampere .it is used for powering devices like relays, sensors, Arduino boards etc

2.16 Voltage divider:

Scales 12V+ down to <5V so the Arduino can safely measure it.

2.17 Heat sink:

Dissipates excess heat from the voltage regulator/MOSFET to prevent thermal shutdown.

2.18 Arduino IDE (Version 2.3.7.0):

The official software used to write, compile, and upload code from your computer to Arduino Boards. This version is also known as Arduino IDE 2.x — part of the newer Arduino IDE 2 series with a modern editor, built-in debugger, and autocompletion.

3.FUNCTIONALITY:

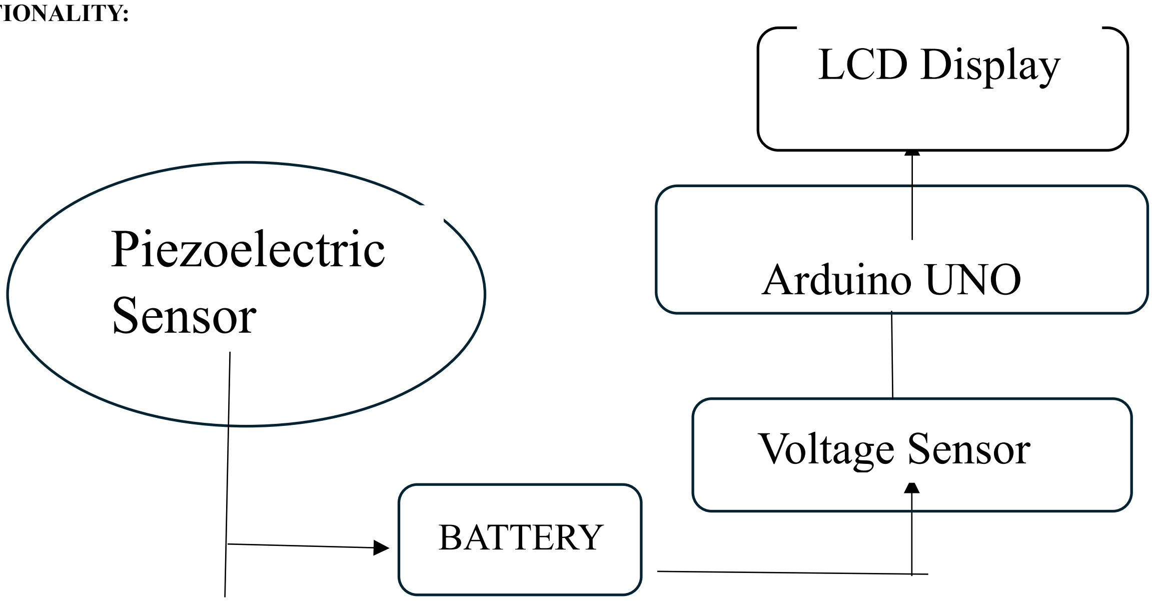

Fig: Block Diagram Of Arduino - Based Footstep Power Generation With Battery Level Indicator

1. Generation of Energy Through Steps: The piezo sensor receives mechanical stress from the foot that steps on the tiles, causing deformation within the piezo element. It produces alternating current (AC) electricity because of the piezoelectric effect.

2. AC to DC Conversion: The AC output from the piezo sensor is not consistent enough to be used to charge a battery. It must pass through the rectifier circuit and become pulsating DC, which is later made stable by the filter capacitor to produce DC voltage.

3. Battery Charging: The DC output from the circuit charges the battery through the charging circuit, allowing the battery to store and distribute the energy harvested**.**

4. Voltage Measurement: A voltage sensor is placed across the battery terminals and reduces its voltage to a level that can be handled by the analog pins of the Arduino Uno board**.**

5. Arduino Uno Board: The Arduino Uno board reads the reduced voltage of the battery using the analog pins of the microcontroller ATmega328P. In the software, this value is scaled up to actual battery voltage and further mapped into battery percentage.

6. Output Display: The value of the battery percentage is displayed on the LCD screen by the Arduino. The LCD screen constantly shows you the amount of energy harvested and stored by the system.

7.System Monitoring: In actual walking, the process is repeated continuously. The voltage that is produced in each step is measured and recorded for your monitoring of energy efficiency.

3.1 Circuit Diagram

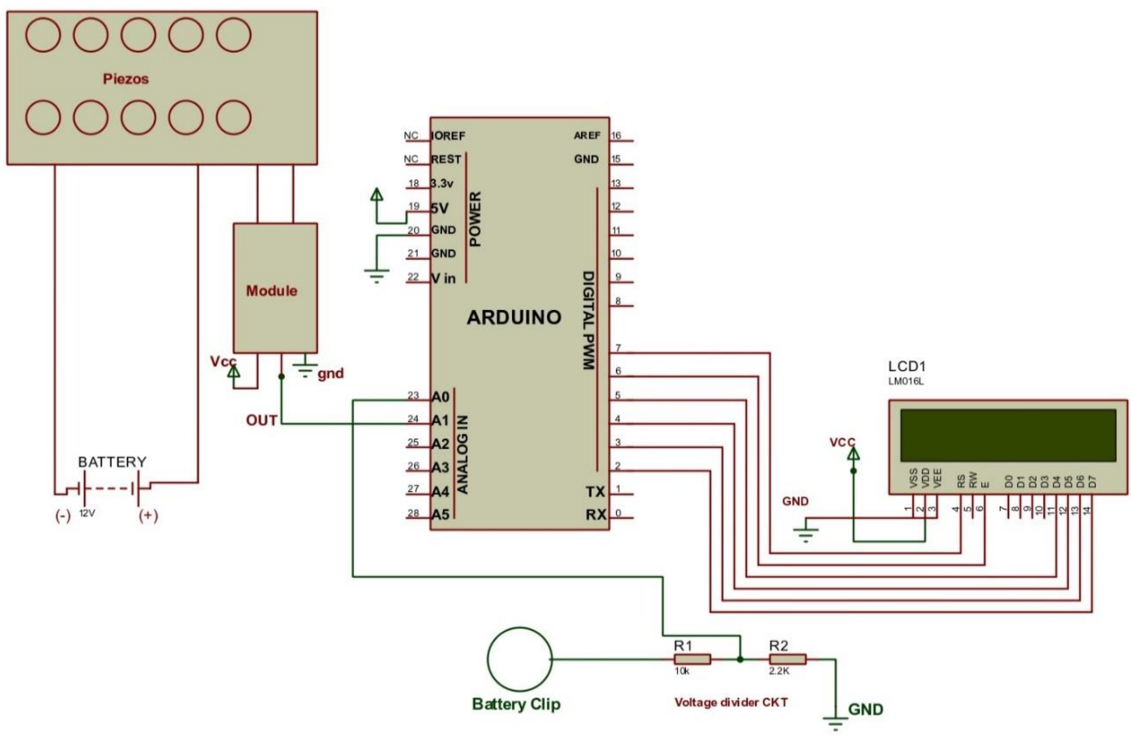

Fig: Circuit Diagram

3.2 RESULT

The system was able to display three important parameters on the 16×2 LCD screen in real time:

•Generated Voltage (from piezo sensors)

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•Battery Voltage

•Battery Percentage

The Arduino Uno continuously reads the voltage from the voltage sensor module, processes the data, and converts it into actual voltage and percentage values.

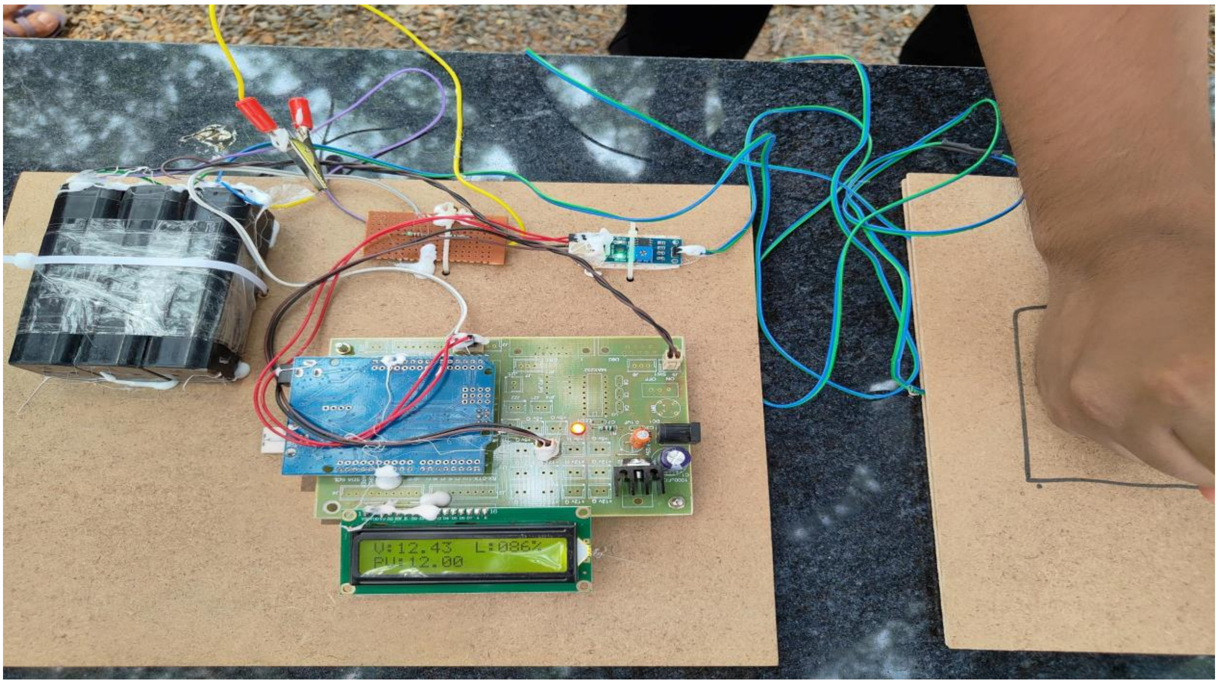

Fig: Experimental Setup

4. Conclusion:

The Footstep Power Generation System is an eco-friendly and creative method of producing electricity from various human activities. In this project, the conversion of the mechanical energy of footsteps into electrical energy takes place through the use of the Piezoelectric Effect. The combination of piezoelectric sensors with an Arduino Uno ensures the effective production, storing, and monitoring of the energy produced. Conditioning of energy production, storage in a battery, and continuous monitoring of its voltage are essential factors in ensuring maximum efficiency of energy production.

Though the amount of energy generated is limited, this system can play a significant role in powering small devices such as LED lights and other devices requiring minimal energy input. The concept can find extensive application in places that receive a lot of traffic like railway stations and malls for producing more electricity.

This project is both educational and informative in its exploration of renewable energy. It opens up a world of possibilities for future research and technological advancement towards a sustainable energy source.

4.1 Future Scope:

Integration with IOT: Incorporate ESP32/Wi-Fi/LoRa with Arduino to track energy, pedestrian flow, and battery performance in real time using cloud-based monitoring system. App development to engage public.

Mass Usage: Extend coverage to complete corridors, staircase floors, stadiums using integrated tiles forming micro-grids which can then be fed through inverters.

Combination with Other Renewable Energy Sources: Combine with photovoltaic panels installed at walkways' roof for sustained and constant power generation.

Intelligent Infrastructures: Use as a power source for self-reliant sensors such as pressure sensors, weather sensors etc. without any wiring**.**

Disaster Area Applications: Footstep power mat which is portable and can charge flashlights, radios and other essential equipment**.**

Entertainment Usage: Combine it with dance floors, gym tracks and designer floors**.**

Economical Feasibility: Economically feasible due to large scale manufacturing and cost reduction of materials.

5.References

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