WALKING POWER HARVESTING WITH PIEZO ELEMENTS

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INTRODUCTION:

Wearable sensors are becoming smaller and increasingly widely used, resulting in an increasing need for independent and compact power supplies. Electrochemical batteries, the most common power supplies for wearable sensors, cannot meet the need because of their limited energy storage capacity and potential environmental and health risks, emerging as a critical bottleneck for wearable sensors. This has driven the development of wearable energy harvesters, which harvest the mechanical energy dissipated in human motion to provide renewable and clean energy. Several concepts of wearable energy harvesters based on different mechanisms have been studied, such as electromagnetic, electrostatic, thermoelectric, nano-triboelectric and piezoelectric. Piezoelectric energy harvesters and nano-triboelectric generators can convert mechanical energy into electric energy directly, thus their structures are more compact and simpler in comparison to those of other types.

Harvesting mechanical energy from human motion is an attractive approach for obtaining clean and sustainable electric energy to power wearable sensors, which are widely used for health monitoring, activity recognition, gait analysis and so on. This paper studies a piezoelectric energy harvester for the parasitic mechanical energy in shoes originated from human motion. The harvester is based on a specially designed sandwich structure with a thin thickness, which makes it readily compatible with a shoe. Besides, consideration is given to both high performance and excellent durability. The harvester provides an average output power of 1 mW during a walk at a frequency of roughly 1 Hz. Furthermore, a direct current (DC) power supply is built through integrating the harvester with a power management circuit. The DC power supply is tested by driving a simulated wireless transmitter, which can be activated once every 2–3 steps with an active period lasting 5 ms and a mean power of 50 mW. This work demonstrates the feasibility of applying piezoelectric energy harvesters to power wearable sensors.

ABSTRACT :

Man has needed and used energy at an increasing 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 were the railway station, temple etc., are overcrowded all round the clock. When 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 sources has many applications as in agriculture, home application and street lighting and as energy source for sensor 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 walk. The idea is to convert the weight energy to electrical energy. The power generating floor

intends to translate the kinetic energy to electrical power. Energy crisis is the main issue of world these days .the motto of this research work is to face this crisis some how. Though it won't meet the requirement of electricity but as a matter of fact if we able to design a power generating on floor, we can consume that energy in various applications.

KEYWORDS:

Energy harvesters, wearable sources, regulator 7805 , node MCU ,piezo electric sensor ,Wireless transmitter and receiver .

Energy harvesting:

It is also known As power **harvesting** or **energy** scavenging or ambient power) is the process by which **energy** is derived from external sources (e.g., solar power, thermal **energy**, wind **energy**, salinity gradients, and kinetic **energy**, also known as ambient **energy**), captured, and stored for small, wireless .

Wearable sources:

Wearable sources like the vast majority of other portable electrical technologies, require batteries, and the device's power requirements drive the battery form factor. Of course, we (consumers) all want products that are smaller, thinner, and have a longer-lasting battery life. There are scores of battery options for which battery technology can best fit wearables' requirements.

Some of the more common types of wearable batteries include:

1) Alkaline

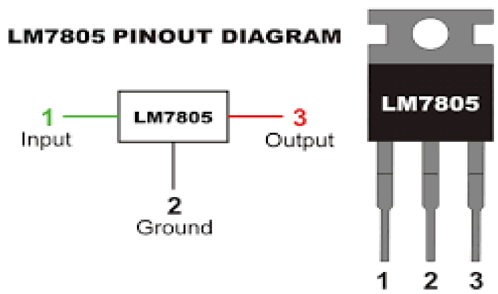
2) Nickel-Metal-Hybrid (nimh or Ni-MH)

3) Lithium-Ion (Li-Ion) and Lithium-Ion Polymer (lipo, LIP, Li-poly)

Regulator

7805:

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

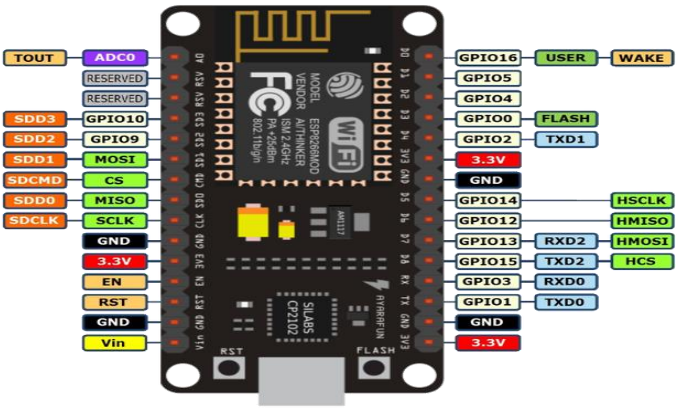


7805 IC Rating:

- Input voltage range 7V- 35V
- Current rating $I_{c} = 1A$
- Output voltage range $V_{Max=5.2V}$,$V_{Min=4.8V}$

Node MCU:

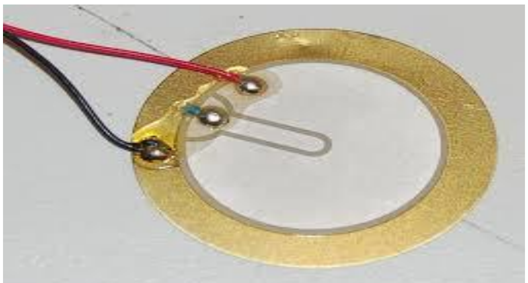
Development Kit/Board consist of ESP8266 wifi chip. ESP8266 chip has GPIO pins, serial communication protocol, etc. Features on it.**ESP8266** is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. The features of ESP8266 are extracted on Node MCU Development board. Node MCU (LUA based firmware) with Development board/kit that consist of ESP8266 (wifi enabled chip) chip combines Node MCU Development board which make it stand-alone device in IOT applications.



The Node MCU (Node Micro Controller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SOC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (wifi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only $2 USD a piece. That makes it an excellent choice for IOT projects of all kinds.

The piezoelectric effect :

It was developed as a research discipline in physics by the brothers Jacques and Pierre Curie in the mid-1800s. The word "piezo" is Greek for pressure and "piezoelectric" means electricity obtained from pressure as well as pressure obtained from electricity. It's a dual conversion process.



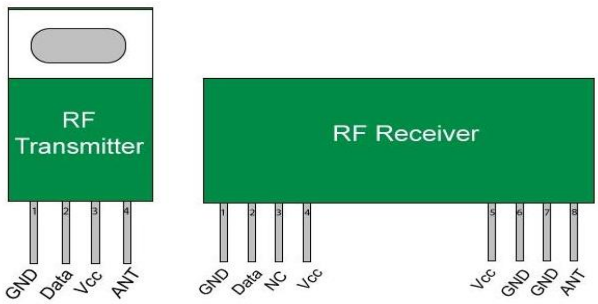
A sensor that utilizes the piezoelectric effect, to measure changes in acceleration, strain, pressure, and force by converting them into electrical charge is called as a piezoelectric sensor. Piezo is a Greek word which means 'press' or 'squeeze'. Piezoelectric effect causes the occurrence of electric dipole moments in solids due to the pressure applied to certain solid materials such as piezoelectric crystals, ceramics, bone, DNA, and some proteins that generates electric charge.

This generated piezoelectricity is proportional to the pressure applied to the solid piezoelectric crystal materials

Wireless transmitter and receiver:

In generally, the wireless systems designer has two overriding constraints: it must operate over a certain distance and transfer a certain amount of information within a data rate. The RF modules are very small in dimension and have a wide operating voltage range i.e. 3V to 12V.

Basically the RF modules are 433 MHz RF transmitter and receiver modules. The transmitter draws no power when transmitting logic zero while fully suppressing the carrier frequency thus consume significantly low power in battery operation. When logic one is sent carrier is fully on to about 4.5mA with a 3volts power supply. The data is sent serially from the transmitter which is received by the tuned receiver. Transmitter and the receiver are duly interfaced to two microcontrollers for data transfer.

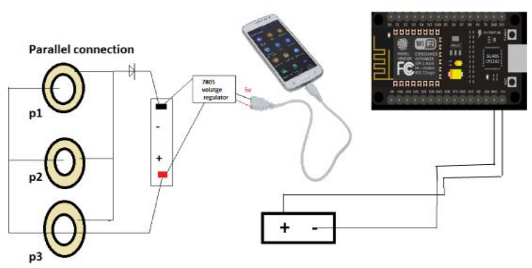


Features of RF Module:

- Receiver frequency 433mhz
- Receiver typical frequency 105Dbm
- Receiver supply current 3.5ma
- Low power consumption

- Receiver operating voltage 5v
- Transmitter frequency range 433.92mhz
- Transmitter supply voltage 3v~6v
- Transmitter output power 4v~12v

CIRCUIT DIAGRAM :



The about figure represents the main circuit diagram of the project

PROGRAM CODE :

```
#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>

#include <BlynkSimpleEsp8266.h>


// You should get Auth Token in the Blynk App.

// Go to the Project Settings (nut icon).

char auth[] = "aa5d0129d4ff45d58363c9577012a289";


// Your WiFi credentials.

// Set password to "" for open networks.

char ssid[] = "steps";

char pass[] = "123456789";

int state=LOW;

int lastState=LOW;

int count=0;

int led=D0;

WidgetTerminal terminal(V1);


void setup()

{

Serial.begin(9600);

pinMode(D1, INPUT);

pinMode(led,OUTPUT);

state=digitalRead(D1);

Blynk.begin(auth, ssid, pass);


}


void loop()

{

  Blynk.run();


  if (state==HIGH && lastState==LOW){

count++;

Serial.println("My Total Steps : ");

terminal.print("My Total Steps");

Serial.println(count);

terminal.println(count);

}
```

```
lastState=state;

state=digitalRead(D1);

}
```

CONCLUSION :

As an initial step, if this concept is implemented in our state, the results can be easily viewed because the Konkan railway itself has 91tunnels.

Implementation of this concept can reduce the amount of fossil fuel import. It can save the country's environment from deterioration.

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