



# SIMULATION OF ENERGY HARVESTING USING PIEZOELECTRIC SENSORS FOR MEASURING HUMAN BODY TEMPERATURE

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**Abstract:** The project is about energy extraction from the piezoelectric material and utilizing the generated energy for measuring temperature and heartbeat of human beings.

The piezoelectric sensor are placed in the shoes. When a person uses the shoes for walking or jogging, a pressure is applied on the piezo sensor which generates the energy. The generated AC voltage is rectified using bridge rectifier circuits. Rectified input is given to the Arduino, which has been coded to measure temperature and heartbeat of human body by using LM35 and Photo plethysmography (PPG) sensors.

**Key words:** Piezoelectric sensor, Photo plethysmographysensor.

## I. INTRODUCTION.

As the interest of energy is expanding step by step, so a definitive answer for manage such issues is simply to carry out the inexhaustible wellsprings of energy. Humans are utilizing the environmental friendly power which are sun based, wind and so forth however we actually couldn't fulfill our force needs, in view of that we need to create power through every single imaginable ways. The target of this work is to deliver through strides as a wellspring of

sustainable power that we can get while strolling or remaining on to the specific courses of action like pathways, steps, plate structures and these frameworks can be introduced uncommonly in the more populated regions.

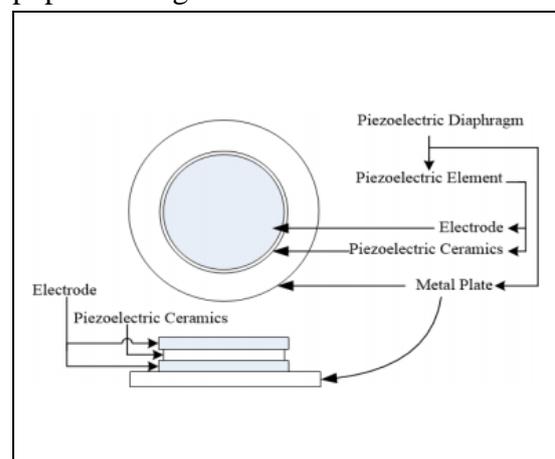


Fig.1.1 Piezoelectric sensor

Piezoelectric material descends from the family of ferroelectric material which are crystals that are distinguished by the polarity without having an applied electric field. The piezoelectric effect is very Common in piezo ceramics such as PbTiO<sub>3</sub>, PbZrO<sub>3</sub>, PVDF and PZT . Lead Zirconated Titanate (PZT) is the most famous material in the ceramic piezoelectric category.

The energy that is created by ground power response power produced because of

human stride and this energy is centered on a variety of piezoelectric sensor; which further given to the Arduino which has been coded to measure human body temperature with the help of LM35 and heart beat using PPG(photoplethysmograph) sensors.

## II. RELATED WORK.

- Foot step generation using piezoelectric materials[1],is about technique for gathering this human headway energy with the utilization of piezoelectric sensor and shows an application with the put away energy for example to charge a cell phone safely and also used to glow an LED based on the motion using the passive infrared sensor. The ground response power (GRF) applied from the foot, when changed over to voltage by piezoelectric sensors is sufficiently fit to control up a device. Progressive effort prompts a over to voltage by piezoelectric sensors is sufficiently fit to control up a device. Progressive effort prompts a periodic voltage develop which with appropriate hardware can be utilized to charge a capacity battery. The force created by this method can likewise be utilized in essential application.

- Generation and storage of electrical energy from piezoelectric materials [2].The electrical energy generation and storage from piezoelectric materials are focused and discussed in this paper. This kind of materials is able to directly convert mechanical energy into electrical one, which can be later stored by utilizing energy harvesting technique/circuit. The energy conversion from ambient vibration is indeed nowadays fascinating research area.This paper focuses how to extract energy from piezoelectric materials to be stored in the energy storage device such as battery, in order to later supply electronic/electrical device/equipment. The simulation in MATLAB Simulink is presented and experimental results are also carried out in order to confirm the

effectiveness of energy extraction. Consequently, this work may be practical for energy supplying of low power devices.

- Internet of Things (IoT) communication protocols [3] is fast becoming a disruptive technology business opportunity, with standards emerging primarily for wireless communication between sensors, actuators and gadgets in day-to-day human life, all in general being referred to as “Things”. This offers the capability to measure for understanding environment indicators. This paper addresses the internet of things (IoT) as the main enabling factor of promising paradigm for integration and comprehensive of several technologies for communication solution, Identification and integrating for tracking of technologies as wireless sensor and actuators.

- Remote Patient’s Health Monitoring by Using ZigBee Protocol[4] describes about Remote health care monitoring system (RHCMS) has drawn considerable attentions for the last decade. As the aging population are increasing and at the same time the health care cost is skyrocketing there has been a need to monitor a patient from a remote location. Moreover, many people of the World are out of the reach of existing healthcare systems. To solve these problems many research and commercial versions of RHCMS have been proposed and implemented till now. In these systems the performance was the main issue in order to accurately measure, record, and analyze patients’ data. With the ascent of wireless network RHCMS can be widely deployed to monitor the health condition of a patient inside and outside of the hospitals. In this work we present a ZigBee based wireless healthcare monitoring system that can provide real time online information about the health condition of a patient.

- Development of enhanced

piezoelectric energy harvester induced by human motion[5], Published paper, which describe the structure, the piezoelectric effect, the working principle of piezoelectric sensors firstly. Analysis the impedance characteristics and impedance matching circuit of the piezoelectric transducer. On this basis, design the measurement circuit of the piezoelectric sensor, give the matter which is paid more attention when design the circuit and several important conclusions. finally give the analyzed and prospects of the application of piezoelectric sensors.

- Wearable sensors for measuring sweat reate[6] present a new frontier in the development of monitoring techniques. They are of great importance in sectors such as sport and healthcare as they enable physiological signals and biological fluids, such as human sweat, to be continuously monitored. Until recently this could only be carried out in specialized laboratories using cumbersome and often expensive devices. Sweat monitoring sensors integrated onto textile substrates are not only innovative but they also represent the first attempt to use such an idea in a system that will be worn directly on the body. This study outlines the development of a wearable sweat-rate sensor integrated onto a textile.

- Adaptive piezoelectric energy harvesting circuit for wireless remote power supply[7]. It describes an approach to harvesting electrical energy from a mechanically excited piezoelectric element. A vibrating piezoelectric device differs from a typical electrical power source in that it has a capacitive rather than inductive source impedance, and may be driven by mechanical vibrations of varying amplitude. An analytical expression for the optimal power flow from a rectified piezoelectric device is derived, and an "energy harvesting" circuit is proposed which can achieve this optimal power flow. The harvesting circuit consists of an AC-

DC rectifier with an output capacitor, an electrochemical battery, and a switch-mode DC-DC converter that controls the energy flow into the battery. An adaptive control technique for the DC-DC converter is used to continuously implement the optimal power transfer theory and maximize the power stored by the battery.

- Analysis of the characteristic of piezoelectric sensor and research of its application[8], which describe the structure and piezoelectric effect, the working principle of piezoelectric sensors firstly. Analysis the impedance characteristics and impedance matching circuit of the piezoelectric transducer. On this basis, design the measurement circuit of the piezoelectric sensor, give the matter which is paid more attention when design the circuit and several important conclusions. Finally give the analyzed and prospects of the application of piezoelectric sensor..

### III. SOFTWARE AND LANGUAGE.

Arduino program to measure human body temperature and heart beat:

Arduino code:

```
#include <LiquidCrystal.h>
#include <TimerOne.h>
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);

int val;
int tempPin = A0; // temperature Sensor Pin
int HBSensor = 4; // Sensor Pin
int HBCount = 0;
int HBCheck = 0;
int TimeinSec = 0;
int HBperMin = 0;
int HBStart = 2;
int HBStartCheck = 0;

void setup() {
  // put your setup code here, to run once:
  lcd.begin(20, 4);
  pinMode(HBSensor, INPUT);
  pinMode(HBStart, INPUT_PULLUP);
  Timer1.initialize(800000);
  Timer1.attachInterrupt(timerIsr);
  lcd.clear();
  lcd.setCursor(0,0);
```

```

lcd.print("Current HB : ");
lcd.setCursor(0,1);
lcd.print("Time in Sec : ");
lcd.setCursor(0,2);
lcd.print("HB per Min : 0.0");
lcd.setCursor(0,3);
lcd.print("Body Temp : ");

}

void loop() {
if(digitalRead(HBStart) == LOW){
//lcd.setCursor(0,3);
//lcd.print("HB Counting ..");
HBStartCheck = 1;}
if(HBStartCheck == 1)
{
if((digitalRead(HBSensor) == HIGH) &&
(HBCheck == 0))
{
HBCount = HBCount + 1;
HBCheck = 1;
lcd.setCursor(14,0);
lcd.print(HBCount);
lcd.print(" ");
}
if((digitalRead(HBSensor) == LOW) &&
(HBCheck == 1))
{
HBCheck = 0;
}
if(TimeinSec == 10)
{
HBperMin = HBCount * 6;
HBStartCheck = 0;
lcd.setCursor(14,2);
lcd.print(HBperMin);
lcd.print(" ");
//lcd.setCursor(0,3);
//lcd.print("Press Button again.");
HBCount = 0;
TimeinSec = 0;
}
}

val = analogRead(tempPin);
float mv = (val/1024.0)*5000;
float cel = mv/10;
lcd.setCursor(14,3);
lcd.print(cel);
lcd.print(" ");
delay(100);

}

void timerIsr()
{

```

```

if(HBStartCheck == 1)
{
TimeinSec = TimeinSec + 1;
lcd.setCursor(14,1);
lcd.print(TimeinSec);
lcd.print(" ");
}

```

**Simulation model:**

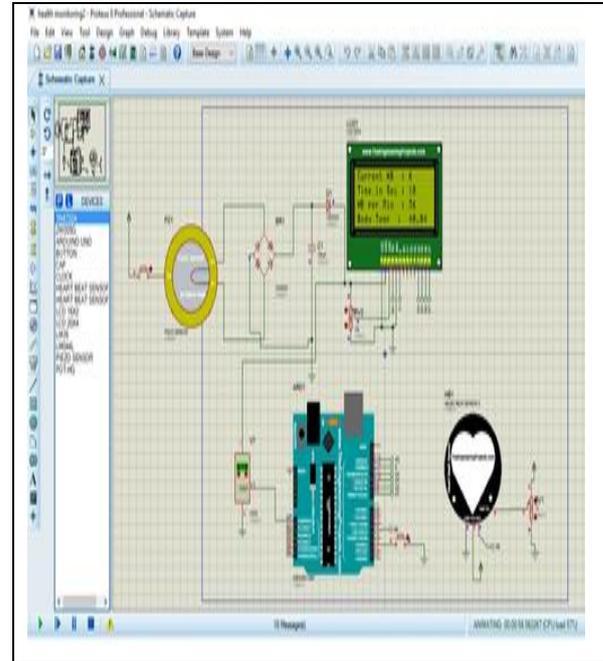


Fig.3.1 Simulation model

**IV. BLOCK DIAGRAM.**

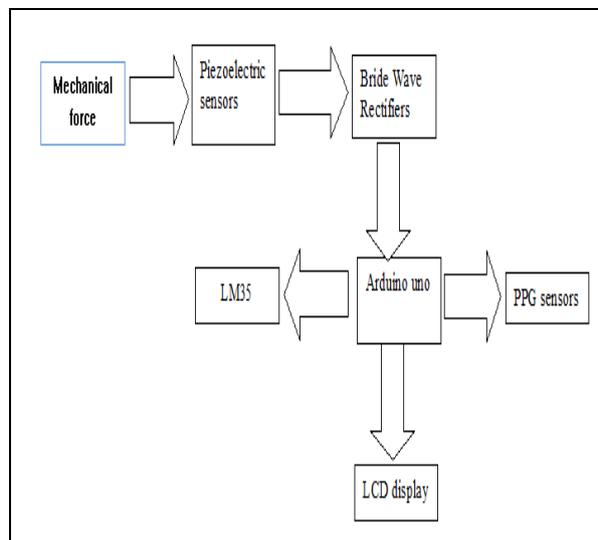


Fig.3.1-Block diagram

**V. Result and Discussions.**

**Simulation Result:**

Simulation to show the harvesting of energy using Piezo-sensors:

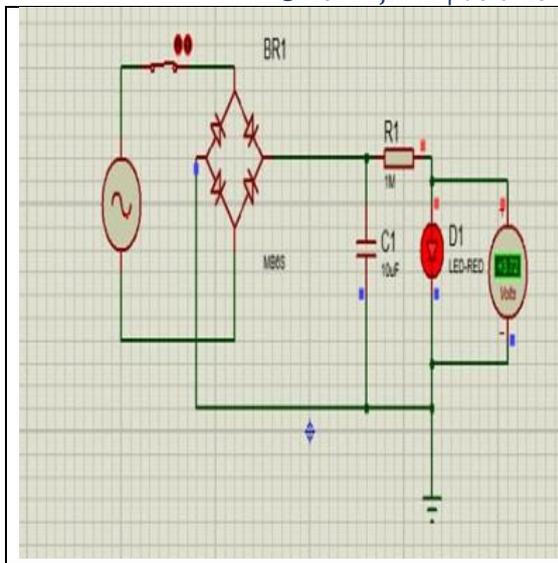


Fig.5.1 simulation model of glowing LED

By using the mechanical pressure the piezo-sensor is harvesting the energy of 5v, which is AC the bridge rectifier is used convert the generated AC voltage into DC.

**Simulation to measure the temperature and heart beat by using the energy harvested from Piezo-sensor:**

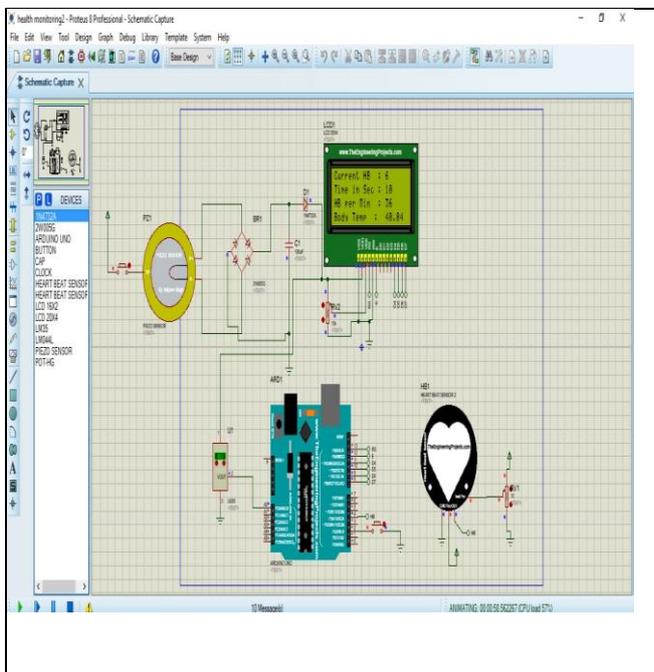


Fig.5.2-simulink to measure temperature and heart beat

The Arduino is coded so as to measure the temperature continue sly and to measure the heartbeat when button is pressed the measured data is displayed using LCD display.

**Advantages:**

- The piezoelectric transducer has a good frequency response.

- It is the renewable source of energy generation.
- It is easy to handle because of its small dimension.
- It has rugged construction.
- It is available in the desired shape.
- LM35 does not require any external calibration circuitry.

**Disadvantages:**

- Piezo sensors has high temperature sensitivity.
- The piezo sensors are used for dynamic measurement only, not suitable for static conditions.
- LM35 requires a negative bias voltage to measure negative temperature.
- As piezo-sensor can produce current in arranged the charging time of the battery is high.

**Applications:** The energy produced can be used to different applications such as:

- Mobile charging systems
- Street light.
- EV charging systems.

**VI. CONCLUSION.**

According to the report of NIH report 24.8% of death is due to the cardio vascular disease .There may be no symptoms or signs. Nonetheless, it damages the body and eventually damages may cause problems like heart diseases. Therefore its important to regularly monitor your blood pressure, especially if it has ever been above or below the normal rage(70bpm for males and 75bpm for females). Temperature being important factor for the heart patient, it is highly necessary to know the health status our body. Project is concerned about measuring temperature and heartbeat of human body by using the energy produced by the piezoelectric sensor which is the renewable sorce of energy.

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