

FOOTSTEP POWER GENERATION USING PIEZOELECTRIC SENSORS

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INTRODUCTION

The country's population grew day by day, and the power demand is also increased. And the big solution is to turn the energy back to useful state. Energy is nothing but the ability to do the work. In day to day life. Electricity can be generated from resources like water, wind, solar etc. to generate the electricity from these resources development of big plants are needed having high maintenance cost. Some other energy resources are also costly and cause pollution.

When people walk on the floor or that of tiles, electrical energy is generated by using people weight. The control mechanism operate piezoelectric device, this piezoelectric device convert mechanical energy(pressure) into electrical energy Using the principle called piezoelectric effect. Piezoelectric effect is the effect in which mechanical vibrations. Piezoelectric effect is the effect of specific materials to generate an electric charge in response to applied mechanical stress.

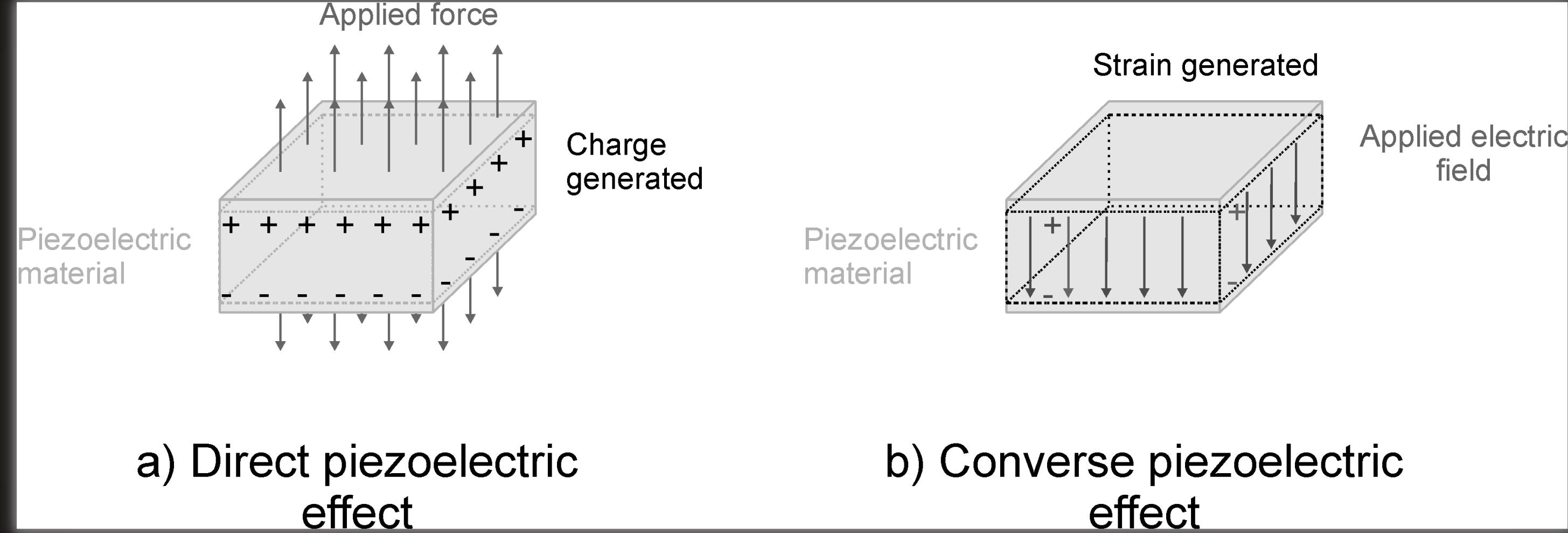
POWER GENERATION METHOD AND WORKING

This system introduces power generation using non-conventional energy which does not need any input to generate electrical output. In this conversion of ground force energy into electrical energy takes place.

Piezoelectric ceramics belongs to the group of ferroelectric materials. These materials are the crystals and they do not need electric field being applied.

The piezoelectric placed under insulating material like hard rubber and pressure created by foot step and water fall pressure will produce electrical energy . The property of Piezoelectric Material has two axis, mechanical axis & electrical axis. When we apply pressure in mechanical axis, it generates power in its electrical axis. Piezo means the generation of the electrical polarization of a material as a response to mechanical strain. This phenomenon is known as direct effect





a) Direct piezoelectric effect

b) Converse piezoelectric effect

PIEZOELECTRIC MATERIALS

Piezoelectric material Normal piezoelectric materials comprise tourmaline, topaz, cane sugar, salt Rochelle, quartz. The man-made piezoelectric substance comprises titanate of barium and titanate of zirconate. There are also some materials in the usual and artificial classification

USUAL AND ARTIFICIAL CLASSIFICATION

Usual piezoelectric material	Artificial piezoelectric material
Rochelle Salt	Zinc Oxide (ZnO)
And another entry	3
And another entry	5
Silk	Lead titanate (PbTiO ₃)
Tendon	Potassium niobate (KNbO ₃)
TB-1	Piezoelectric ceramics Barium titanate
Dentin	Langasite (La ₃ Ga ₅ SiO ₁₄)
DNA	Sodium tungstate (Na ₂ WO ₃)

The Fig. represents the block diagram. The key building blocks of the energy production system include the following

- Microcontroller
- Piezoelectric Transducer
- Ripple Neutralizer
- Current Controller(Uni)
- Battery(Lead Acid)
- Analog to Digital converter
- Inverter module
- Wifi module
- IoT cloud network.

The output power from a single piezo sensor is remarkably low therefore a combination of few Piezo sensors is used. The piezo sensors can be installed in two possible combinations:

- Series connection
- Parallel connection

When the sensors are connected in a series combination, it emanates an increased voltage output but that voltage is not on a linear scale. On the other hand, when a parallel combination is implemented it did not produce a satisfactory upsurge in the voltage output.

When a piezoelectric material is subjected to stress T, it produces Polarization P which is linear function of,

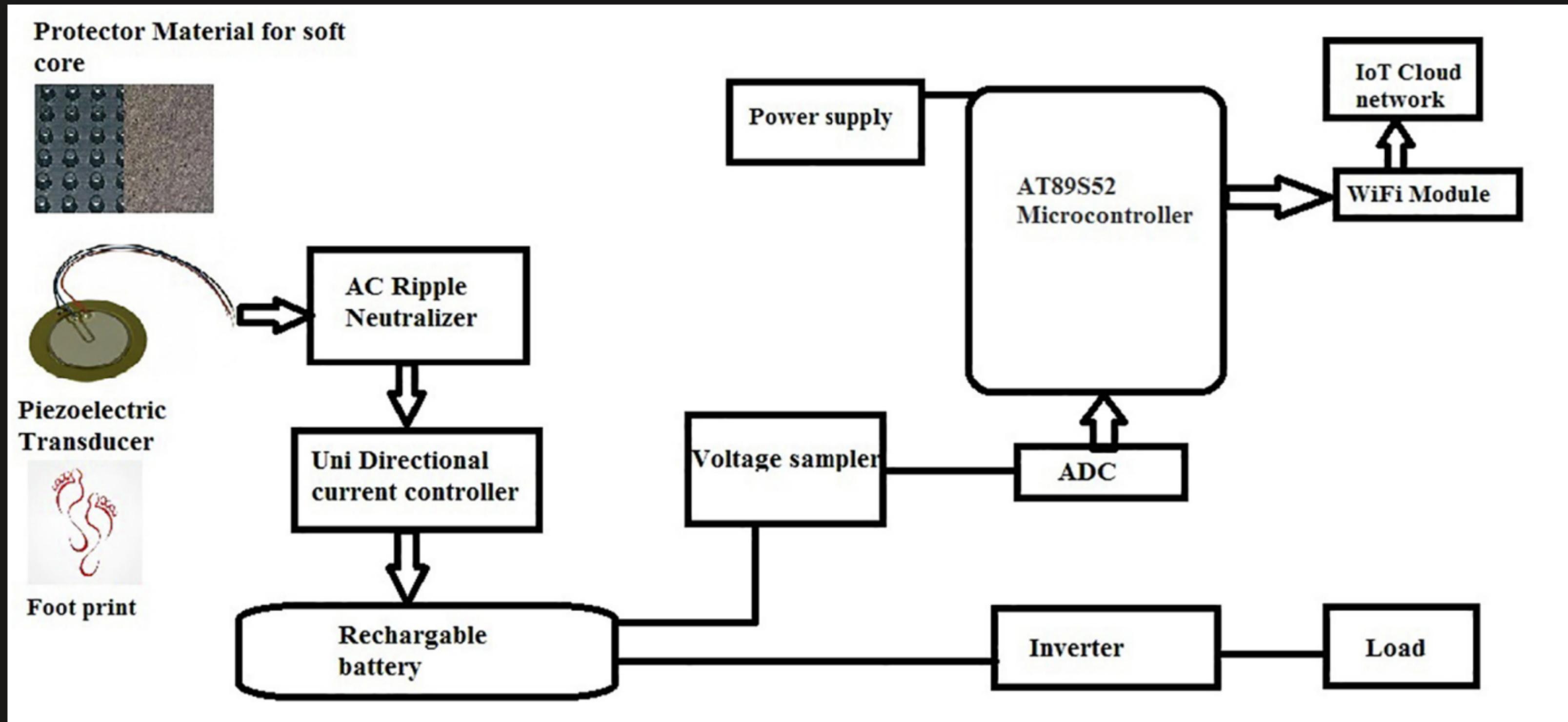
T: $P = dT$ (d : piezoelectric strain constant)

For a dielectric substance, the relationships of electrical displacement D with electric field strength E is given by $D = \epsilon E$.

Basic Piezoelectric Effect equation:

$$D_n = d_{nj} T_j + \epsilon^T_{nm} E_m \quad (m, n=1, 2, 3; I, j=1, 2, \dots, 6)$$

BLOCK DIAGRAM



CONTENT

- MICRO CONTROLLER

To evaluate the number of batteries tender when we put our footsteps on a piezoelectric material

- PIEZOELECTRIC TRANSDUCER

To measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge.

- AC RIPPLE NEUTRALIZER

It is used to remove the ripples from the output of the rectifier and smoothens the o/p of the D.C

- BATTERY

Lead acid batteries have high reliability due to their capability to withstand overcharge, over discharge & shock, charge acceptance, low self-discharge and large electrolyte volume.

- ADC (Analog to digital converter)

It is a device that converts analog to digital symbols. It alters an analog input like voltage or current to a digital output, which is related to the magnitude of the voltage or current.

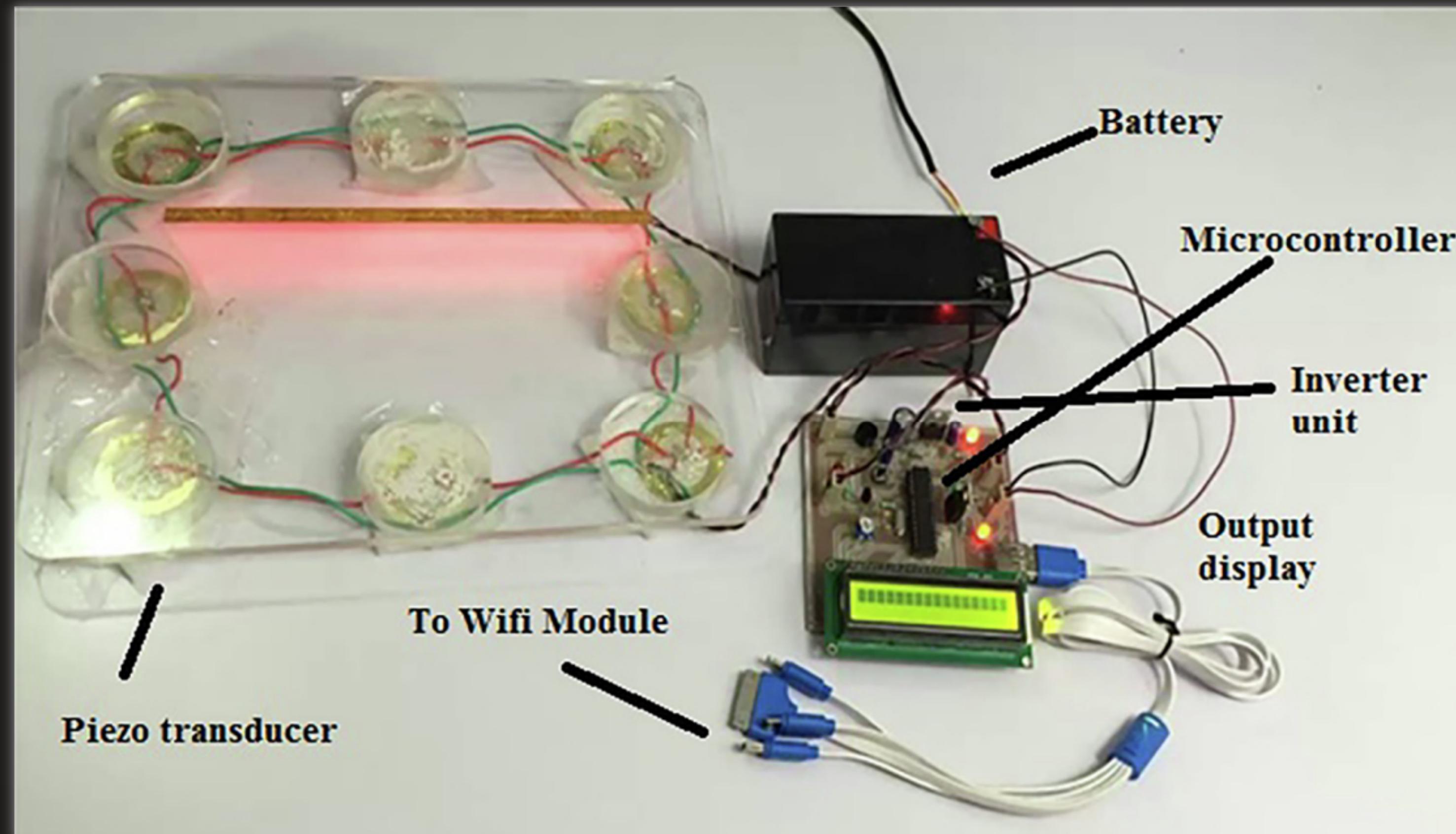
- INVERTER MODULE

It is an electric device that transforms direct current to alternate current

- CURRENT CONTROLLER(UNI DIRECTIONAL)

The main function of the diode is, it allows the flow of current in only one direction while blocking current in the reverse direction.

- The output voltage has been monitored through the wifi module which is interfaces with the IoT cloud net work. The user can monitor the data using the mobile Applications



EXPIREMNTAL DATA

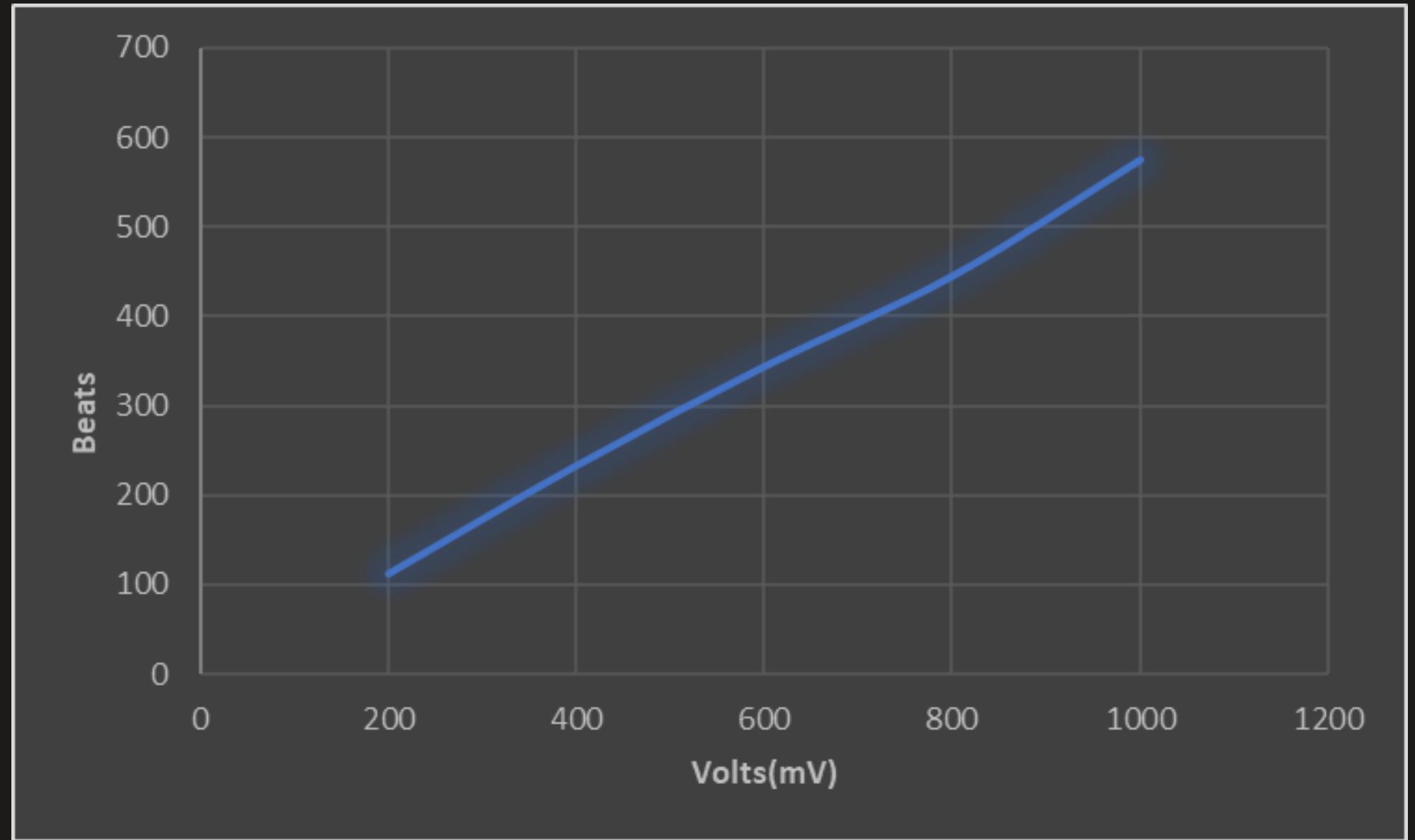
Piezo sensor measurements of 60 kg on average Piezo sensor.

Readings for an average of 60 kg weight Piezo sensor	Volt (mV)	Ampere (mA)	Output in watts (mW)
1	0. 612	0.063	0.039
2	0.560	0.065	0.036
3	0.520	0.064	0.033
4	0. 540	0.065	0.035
5	0. 560	0.064	0.036
Average	0.555	0.063	0.035

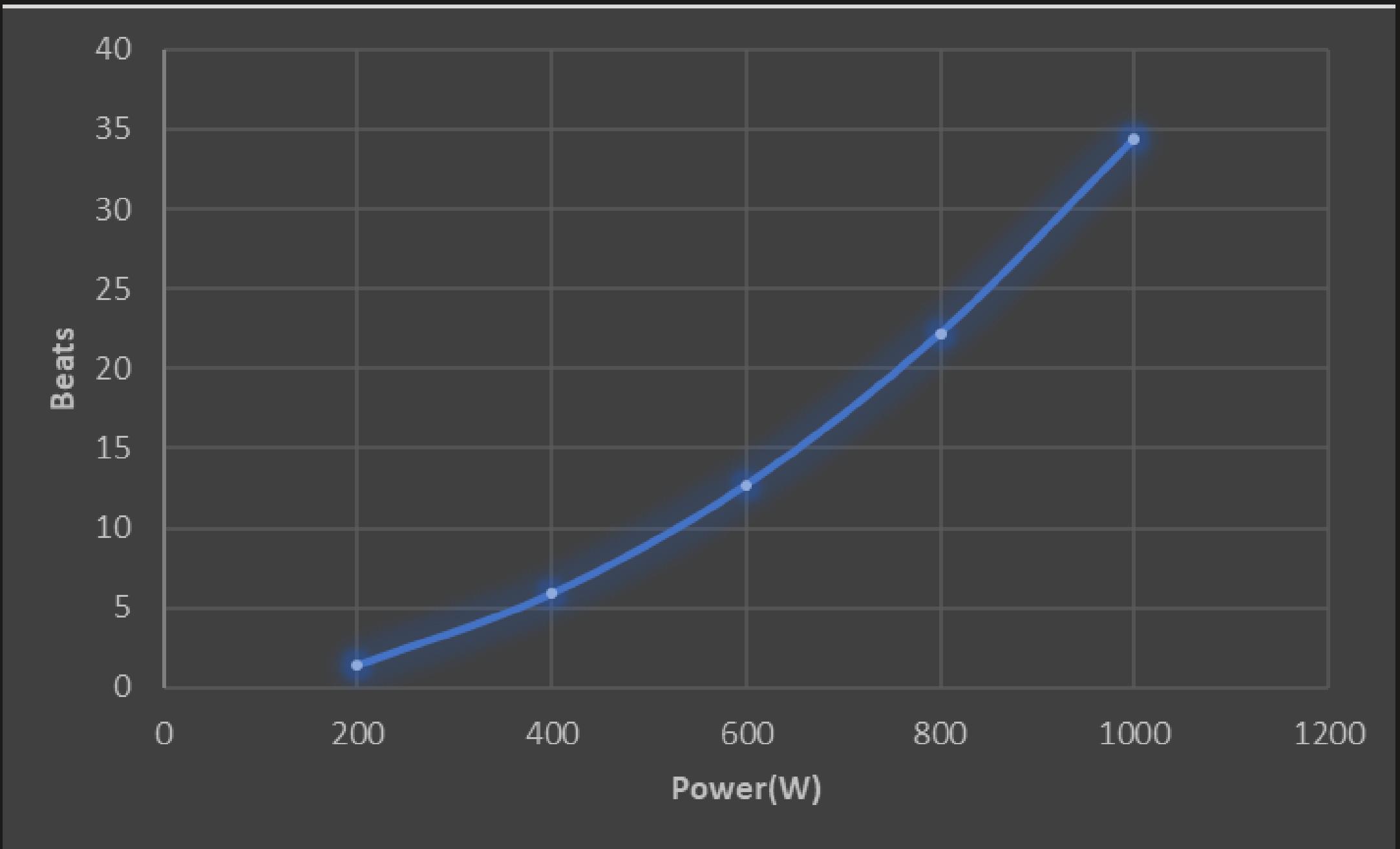
Power produced per foot beat to average 60 kg performer weight.

Beats	Volt (mV)	Ampere (mA)	Output in watts (mW)
200	111.00	12.60	1.42
400	222.00	25.22	5.89
600	333.00	37.87	12.69
800	444.00	50.41	22.18
1000	555.00	63.45	34.37

BEATS VS VOLTS(V)



BEATS VS POWER(W)



ADVANTAGES

- Zero side effect on human body.
- Can be easily used in malls, roadways, or area with frequent locomotion.
- Easy to install.
- The output is proportional to number of steps.
- User friendly and easy-to-go utility.
- It can be used to charge large number of devices such as:
 1. Mobile Phones
 2. Electric Torch
 3. Smartwatches

CONCLUSION

Thus, we have shown a design of a system capable of harnessing human locomotion energy; and have implemented it around a basic application of charging a mobile device.

The described system can be built independently and delivers off the grid power for public/private usage. Lastly, this project is an attractive approach for obtaining clean sustainable energy and is highly consumer friendly.

THANK YOU!

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