

# Development of Self Powered Energy Harvesting System for Mobile Health Monitoring

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**Abstract:** Energy harvesting system is an emerging trend and is expected to be revolutionary in many application areas. Self powered energy harvesting is still new field of research. The term self powered wearable electronics is a working electronics small circuit into new innovative gadgets or smart wearable cloths which is suitable for everybody everywhere. Self powered wearable electronic technologies is used in many applications like Smart health monitoring, fashion and designing, sports etc. The mobile health monitoring wearable electronics gadgets require energy. Energy requirement of mobile phone is depend on number their mode of operation. The energy harvesting from human body has been provided to be an effective alternative source of energy for smart phone. Human body activities are used as a source of energy for implantable for biomedical devices.

In this research work, electrical energy is generated from mechanical energy. The human body movement converted into electrical energy. The human hand moves like a pendulum, which is used to generate small amount of electrical energy. The shaft of electromagnetic generator attaches to shoulder, while walking shoulder is also move. The movement of shoulder moves electromagnetic generator and generator generate electrical energy. This generated energy further charges the rechargeable batteries of mobile phone. The rechargeable is a source of power for different nodes of wireless sensor on human body used for human health monitoring. An effort is made to analysis the electrical energy from the movement of pendulum with the help of MATLAB and these results are verified experimentally.

**Index Terms-** Electromagnetic Generator; Energy Harvesting System; Health Monitoring; Mobile Phone; Rechargeable battery; Wearable Electronics; Wireless Sensor Network

## I. INTRODUCTION

The idea of a self-powered device is not new, first self winding watch invented in about 1770[1]. Now a day there has been enormous growth in the market of smart electronics applications. Wearable electronic systems are modern era and an emerging trend and are expected to be revolutionary in many applications. Low power rechargeable electronics devices constitute very strong growth in electronic technology.

The world going through the energy crises. There is need to search alternative energy source like renewable energy source to generate electrical energy. The renewable energy can be obtained from different sources like radiant energy harvesting, Mechanical energy harvesting or thermal energy harvesting. Alternative energy generation have rapid development due to crises of energy and industrial demand.

Energy harvesting is the process by which energy is derived from external sources, captured, and stored for small, wireless autonomous devices, like those used in wearable electronics and wireless sensor network.

Mechanical energy harvesting is one in which mechanical energy is convert into electrical energy. Mechanical energy is generated through the motion of objects. It can be either kinetic energy or potential energy [2]. Objects have mechanical energy if they are in motion and/or if they are at some position relative to a zero potential energy. In mechanical energy harvesting system mainly Electromagnetic, Electrostatics/ Capacitive or piezoelectric energy harvesting technique are used.

## II. SYSTEM UNDER STUDY

In the present research work, efforts are made to design electromagnetic generator which generate electrical energy from mechanical energy. Here electric energy is generated from movement of shaft of generator. Following Figure 1 shows the block diagram of experimental setup.

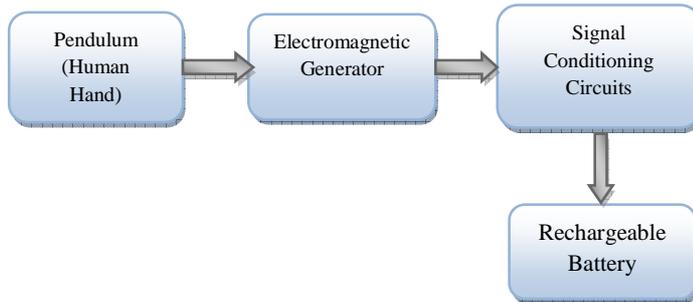


Figure 1: Block diagram of experimental setup of Electromagnetic energy harvesting system

Movement of shaft of the electromagnetic generator is a mechanical energy. The shaft of electromagnetic generator is moves while body movements. The electromagnetic generator generates electrical energy from mechanical energy. The electrical energy converted is mainly depends upon movement of pendulum, efficiency of electromagnetic generator and power dissipation of circuits. This energy need to amplify by using signal conditioning circuits. Following Figure 2 shows a Movement of shaft pendulum as energy generator.

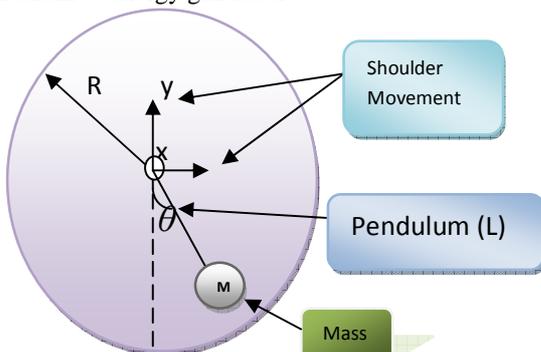


Figure 2: Movement of pendulum as energy generator

## III. EXPERIMENTAL RESULTS

For calculating the energy generated from pendulum need to calculate or identify the angle of the pendulum. By using a simulation tool like MATLAB

The generated energy can be stored in a capacitor/super capacitor or battery or combination of both. Capacitor is used when the application needs to provide huge energy spikes. Batteries leak less energy and therefore used when the device needs to provide a steady flow of energy. In future Regulator is required for two reasons: the voltage on the storage element may change dependency on the rate of power generation and usage. In addition, the electronics load may request a particular voltage to be supplied in order to minimize its power consumption. Load is the part of the system powered by the energy harvesting system. Current interest in low power energy harvesting is for independent electronic devices [3].

### Designing of Pendulum

A pendulum is one which can be considered to be a point mass suspended from string of negligible mass [4]. Consider mass of object connected to a pendulum is 'm' and length of string 'L'. The motion of the pendulum can be completely described by coordinate  $\theta$ . The angle  $\theta$  measured from y axes.

For a small angle

$$\theta = \theta_{\max} \sin(\sqrt{g/L} t)$$

The period of the motion, the total time for a complete oscillation (outward and return) is

$$T = 2\pi\sqrt{L/g}$$

### Designing of power generator

The energy generated of pendulum is depends upon periods of pendulum. The pendulum period is initially depends upon length of pendulum and gravitational fields strength g.

Velocity at the bottom of the swing

$$V = \sqrt{2g * L * (1 - \cos(\theta))}$$

The maximum height of pendulum is

$$h = L - L * \cos(\theta)$$

The total energy is  $E = m * v^2 / 2$

can be easily find out the position of pendulum and angle of pendulum. That angle  $\theta$  is used to find out the energy generated from pendulum. The figure 3 and figure 4 shows the simulation results of movement of pendulum and its time series for

different angle. The generated energy by using different formulae and its simulation are shown in below. The generated energy is very low. The generated energy is need to store in either rechargeable battery or super capacitor.

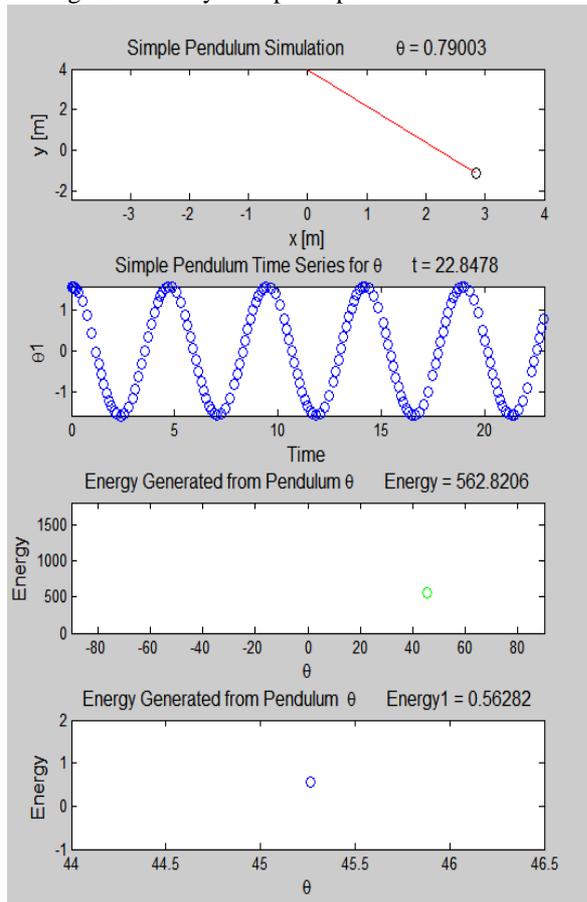


Figure 3: Movement of pendulum and its time series and energy generated

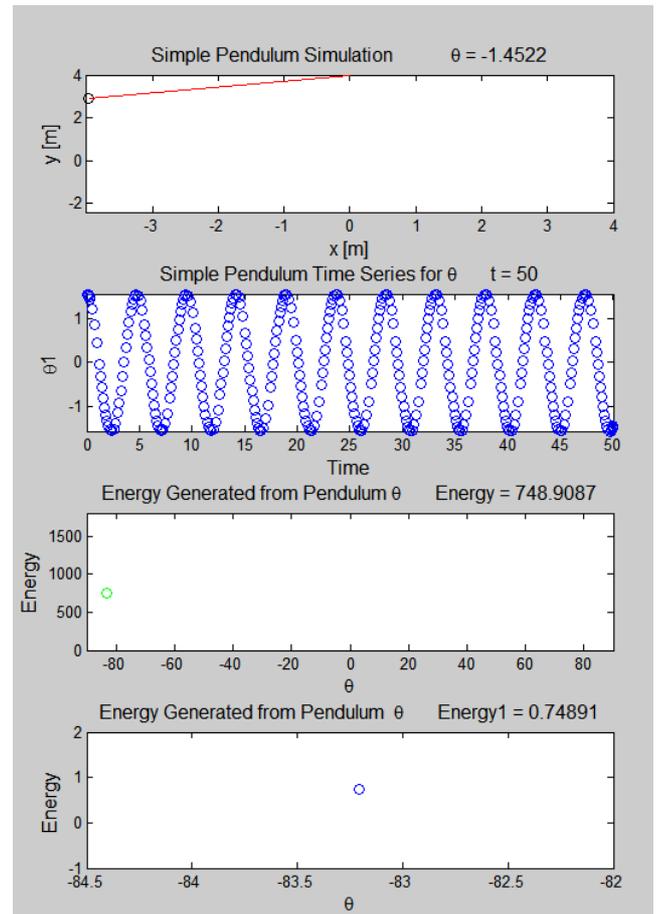


Figure 4: Movement of pendulum, its time series and energy generated

#### IV. CONCLUSION

In Wearable Electronics technology energy generation is new era of research. Human hand work like pendulum and generate Energy from its motion. There are several alternative energy sources which can be used for the same purpose. When the angle of pendulum oscillation increased, the generated electric energy also increases. As per above discussed the system designed for energy generator using a Pendulum which is used in Wearable Electronics devices. The generated power is in mill watt range. In future generated power will be amplify and stored in rechargeable battery or super capacitor. However, typically not much energy is harvested in a small device, so that use of a battery, primary or rechargeable, is beneficial from practical point of view .

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