Piezo Electric Based Energy Harvesting, Supervision and Wireless Energy Transfer

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Abstract- Harvesting electrical energy fromthe mechanical energy using piezo electric sensor by embedding the piezo electric sensor in the insole of shoe. Suppose a person suppose walk or run wearing a shoe the mechanical stress from the that person placed on the piezo electric plate and that stress is converted to electric energy and stored in the battery, this is called harvesting. The harvested energy is wirelessly transmitted to the receiver through an inductive resonant method. The resonance nature ensures the strong interaction among the transmission unit and receiver unit, when the interaction among the rest of the environment is weak. The transmitted energy is used to charge the electronic devices at the receiver side.

KeyWords- Piezo Electric, Resonant Inductive Coupling , Wirelessly Energy Transmission (WET),Transmission unit, Reception unit.

I. INTRODUCTION

An embedded system combines mechanical, electrical, and chemical components along with a computer, hidden inside, to perform a single dedicated purpose. There are more computers on this Planet than there are people, and most of these computer single-chip microcontrollers that are the brains of an embedded system. Embedded systems are an ubiquitous component of our everyday lifes. We interact with hundreds of tiny computers every day that are embedded into houses, cars, bridges, toys, and our work. Therefore the world needs a trained workforce to develop and manage products based on embedded microcontrollers.

An embedded system is one kind of a computer system that is mainly designed to perform several tasks like to access, process, store and also control the data in various electronics-based systems . Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too. The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home security and traffic control systems, etc.

The progress of micro-electronics technology and wireless communication made more people to rely heavily on portable devices like smart phones, laptops, smart watch's etc., for business and as well as entertainment purposes. Especially, smart phones became very important part in our daily life. As the number of smart devices users are increasing more day by day. Especially, the smart phone users are increasing rapidly. However maintaining a smart phone continuing operation consumes lots of battery energy. It is reported that 62% of smart phones have less than 20% of residual power, 33% of smart phones go below 10% of power, 12% of smart phones run out of their power completely at the day's end.

II. OVERVIEW

The inadequate energy capacities of smart phones bring their users some troubles. To exploit the features provided by smart phone without turning off the energy consuming functionalities in the phone, it is necessary to charge whenever needed. Carrying the charging device all the time is inconvenient for the users. In addition, it is hard to identify a plug in places in forest, desert and so on. In those circumstances, using conventional energy resource is a feasible way. The energy is harvested from the available renewable resource. Charging the mobile battery by the energy produced from renewable source through wireless method is the best possible way to address the above mentioned issue. The goal of this technique is WET from piezo-electric crystal as its source.

Some of the mobile devices used finite power sources for military application are personal role radio[1] and active(batterypowered) radio frequency identification(RFID)tags[2]

The wireless energy transfer is the method transmitting the energy from power source to an electrical load over an air gap. Wireless power transmission is an interesting technological endeavor that will put an end to the searching of plug-ins all the time. It is thus envisioned that mobile phones supporting WET will be common in the future. Not only the power transmission also the healthy of the battery in terms of percentage and number of Foot steps that a person can walks

also be transferred by using a mobile Application by switching Bluetooth frequency of 2.4Ghz ISM band.

III. PROPOSED WORK

The work is harvesting energy by using the piezo electric materials. These piezo electric materials are used as a pressure sensors to generate the electricity by applying the mechanical stress on that . When stress is applied the piezo electric sensor will convert the mechanical pressure into a electrical energy and that energy is stored in the battery for future use when needed and sharing battery information and foot steps count when a person walks. By using the Bluetooth and Arduino Nano and transferring the energy for charging by inductive coupling principle Starner and Paradiso[3][4] explained that electrical power can be generated by human walking motion using piezoelectric materials. This is one of the possible techniques in replacing battery application for mobile electronics. The main objective of this research is to study and develop a prototype of piezoelectric energy harvesting device as power supply for low voltage mobile electronics.

Nilotpal manna [5] observed that the piezoelectric elements deliver good amount of power. This is highly preferable for low power devices like mobile electronics or smart watch's etc., An electric charger will be induced across the piezoelectric material if force is applied on the material. There are two types of piezoelectric materials which are piezoceramics and piezopolymers. The important material for piezo electric energy harvesting are Lead ZirconateTitanate (PZT) is an example of piezoceramics while Polyvinylidene Fluoride (PVDF) is piezopolymers. The great characteristics are large electromechanical coupling constant, PZT is rigid, heavy, flexibility, good stability, high energy conversion rate and easy to handle[6]. On the other hand, piezo polymers features smaller electromechanical coupling constant.
The piezoelectric material used in this research was PZT-5H type. The piezoelectric sensor is a disk type sensor. The total thickness and diameter of the sensor are 4 mm and 35 mm, respectively.

The designed prototype of energy harvesting circuit that mainly consists of components are
3.1. Piezo electric plates PZT-5H.
3.2. Current booster SW2808S.
3.3. Battery 1500mAh.
3.4. MEMS-ADXL345.
3.5. Arduino Nano.
3.6. Bluetooth HC-05.
3.7. Wireless Transmitter and Receiver.

Fig.1: Proposed System

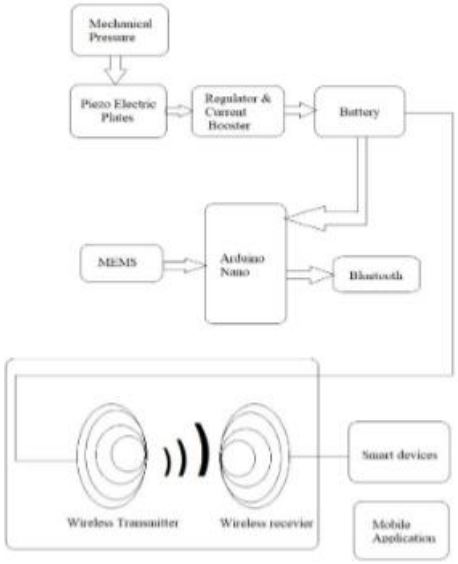


Fig.2: System Design

IV. EXPERIMENTATION

A. Piezo electric plates PZT-5H:

A piezoelectric sensor is a device that uses the piezoelectric effect, to measure change in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge. The prefix piezo is Greek for 'press' or 'squeeze'. Here six piezoelectric sensor are used as a input to the booster convertor the current from the each piezoelectric sensor is maximum voltage of 7.4V and maximum current of 40mA when a person of 59kg walks

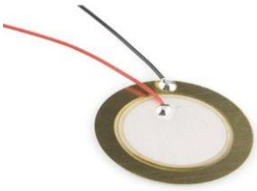


Fig.3:Piezo Electric Sensor

B. Current booster SW2808S:

This is booster or regulator for current convert the low current in mill Amperes to Amperes. This is used because we get the very less current from the piezoelectric sensor so, this booster will converts the low rated current to high rated current as well as voltage up to DC 5V-2A.

Fig.4 : Current Booster SW2808s

C. Battery 1500mAh:

This is the energy storage device for storing the power that is generated and boosted from the current booster .The battery has 3.7V and 1500mAh rating

D. MEMS-ADXL345:

This is aanalog input and produce the digital output. Which is used as a accelerometer this is used to know the count of foot steps when a person walk it is interfaced to Arduino Nano.

Fig.5: MEMS

E. Arduino Nano:

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech. This used to transfer or receive the information. The main purpose of using this is to share the information of battery health and to know for count.

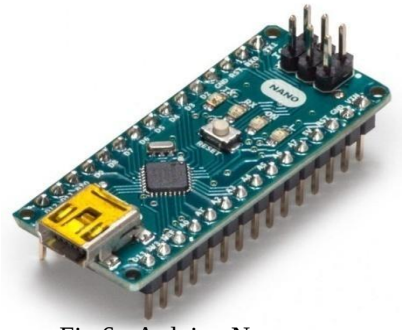


Fig.6 : Arduino Nano

F. Bluetooth HC-05:

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver . It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. This will simplify the over all design/development cycle. This is used to share the information via Bluetooth to mobile and monitor the information in the mobile application called Seria l Bluetooth terminal.

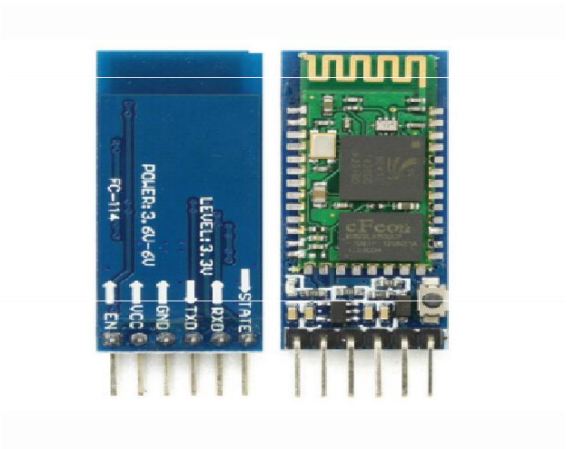


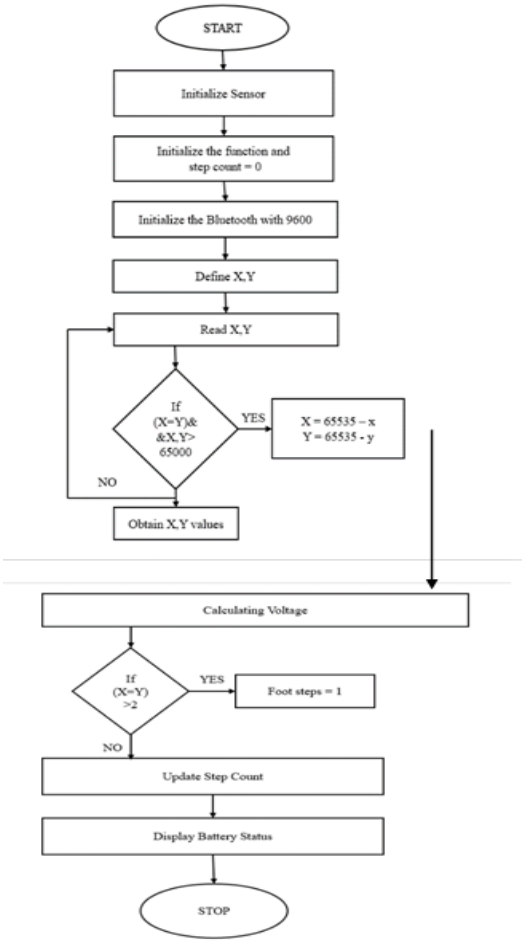
Fig.7: Bluetooth HC- 05

G. Wireless Transmitter and Receiver:

Wireless charging is based on the principle of magnetic resonance, or Inductive Power Transfer(IPT). This process of transporting an electrical current between two objects can be achieved through the use of coils to induce an electromagnetic field on both sides of transmitter and receiver.

Fig.8 : Wireless Transmitter

V. FLOW CHART



VI. RESULT

Experiment is conducted to reveal the wireless energy transmission which charges the mobile phone that is connected at receiver Side with the information in the mobile Application via Bluetooth.

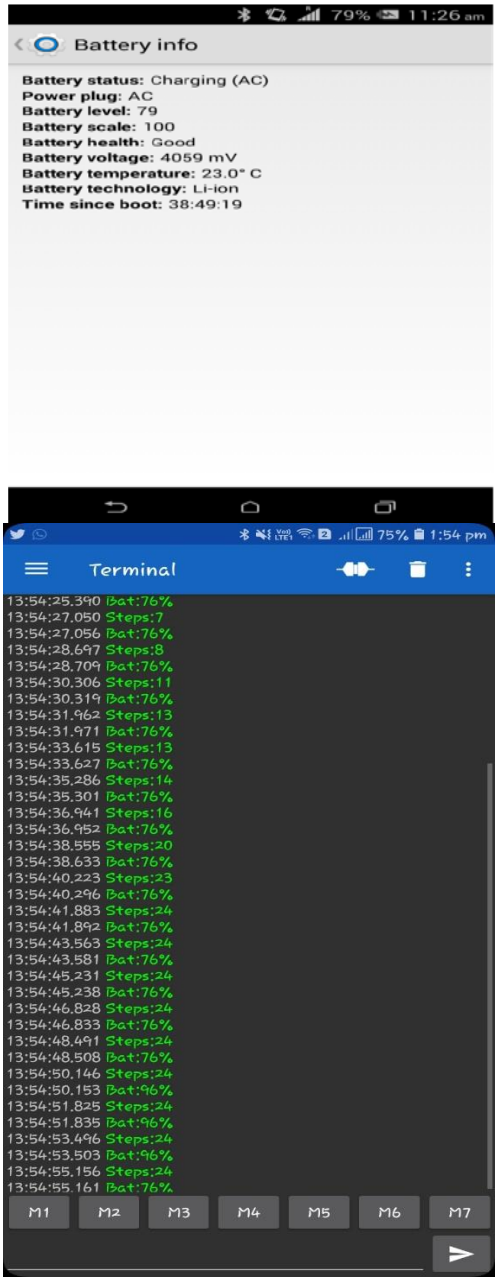


Fig.9: screenshots of mobile phone charging and information in application.

So when the receiver coil is moved beyond 2cm, resonance didnot occur. Energy transmission failed. To match the resonance.

Weight(kg)	Height(cm)
48	160
59	170
62	173
71	173
86	182

Table :Weight and Height of Officer cadets

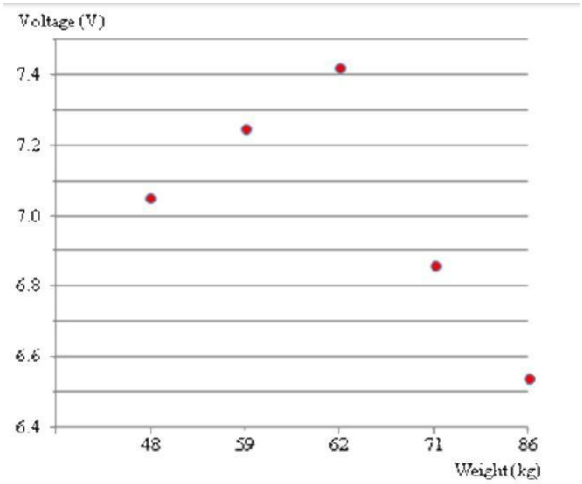


Fig.10 : Model Graph

VII. CONCLUSION AND FUTURE WORK

WET is successfully carried out with the designed transmitter and the receiver module. Both the module almost performs the same operation such as rectification, regulation and boost conversion. In addition, transmitter and receiver coils are used for transmission and reception of the energy. This system covers the maximum distance of about 2cm within which, the resonance is matched and hence, the received energy is used in mobile phone charging.

The future work includes the generation of energy from piezoelectric crystal a renewable source of energy. This ensures the sustainable and clean energy with the uninterrupted way of mobile charging for greater distance.

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