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Human Machine interface for wireless device charging

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Abstract – Energy harvesting from human motion is an attractive method of obtaining clean and sustainable energy . The person exercising on the treadmill, frequent joggers can wirelessly charge electronic devices like cell phone. It operates on the principle of utilizing the mechanical energy which is converted to electrical energy for charging devices. The force created by the person while running on treadmill is converted to electrical energy by piezoelectric generators placed at the bottom of the shoes and stored in rechargeable battery. For the wireless charger the transmitter uses induction coil to create an alternating magnetic field in the receiver coil which will transfer the power to the cell phone by converting this magnetic field to electric current for charging. The charge stored in the battery is used to power up the microcontroller and temperature sensor and GSM module as well.. The system is augmented by interfacing to a temperature sensor that can sense the human body temperature and transmit the same to cell phone via GSM module. The paper presents microcontroller based circuit for wireless device charging through human machine interaction

***Key Words*: Microcontroller, Wireless, charger, GSM, temperature sensor**

1. INTRODUCTION

Energy harvesting usually means the conversion of natural energy sources into usable electrical energy, such as, solar, thermal, wind or vibration energy, etc. In the last few years, scientists and engineers have realized the energy harvesting from ambient vibration energy by using a piezoelectric devices, which generates electrical charges at the surface due to applied a strain/stress/force. Piezo electricity is the total amount of charge due to mechanical strain applied on it. The recent advancements in micro electro-mechanical systems technology have created a demand for portable electronics to grow rapidly. It also becomes more necessary for the portable devices to carry power supply of their own along with them [7].

1.1 Energy Conversion

A cost effective piezo electric membrane (such as Lead Ziroconate Titanate (PZT) ceramic material) consists of multiple layers with piezoelectric (polycrystalline structure) sensitivity [4,6] higher than those of the natural single crystal materials. Here, a piezoelectric membrane is considered with two layers: a bottom non-active layer (a thick brass layer, i.e. core) and a generating layer of durable piezoelectric material attached to the upper side of the non-active layer.

Fig-1. describes the applied forces/oscillating vibrations inside the PZT membrane. The resulting strain on the PZT membrane generates a low frequency AC voltage signal along the electrode layer. The core is designed to increase the bending moment around, which moves the other layers. The feasibility of harvesting energy from mechanical vibrations in dynamic environment using PZT membrane and conversion of generated AC to DC voltage capable for charging a battery for various uses

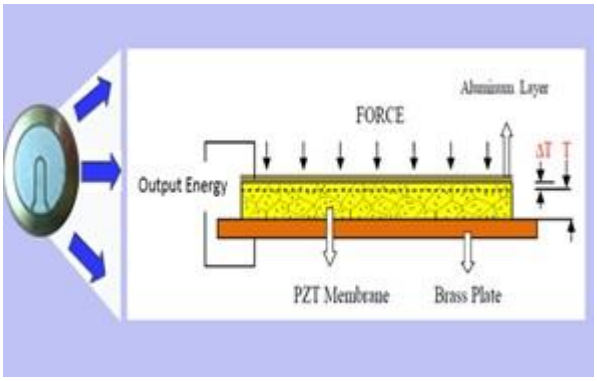

Fig-1: Arrangement of PZT membrane (active layer) and Brass plate (core layer) with applied force.

2. LITERATURE SURVEY

Piezoelectric Transducer

The piezoelectric transducer used is a piezoelectric ceramics which belongs to the group of ferroelectric materials. Ferroelectric materials are crystals which are polar without an electric field being applied. A disc structure is more efficient in this project since the output depends on the pressure applied and their size is convenient for fitting inside a shoe. To charge a 12v battery that we need in this project the piezoelectric discs were arranged in series batches of then these into parallel batches in order to obtain adequate amount of current for battery charging as tabulated in Table. 1

Rechargeable Battery

A12v/1.2Ah lead acid battery is used to supply power to the microcontroller development board and the GSM module. This battery output is also given to the inverter that powers the magnetic coils.

Arduino uno board

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator

GSM Module

The GSM module used here is SIM900A. It has the following features Dual-Band 900/ 1900 MHz, GPRS multi-slot class 10/8GPRS mobile station class B, Compliant to GSM phase 2/2+Class 4 (2 W@850/ 900 MHz), Class 1 (1 W @ 1800/1900MHz), Control via AT commands (GSM 07.07,07.05 and SIMCOM enhanced AT Commands),

Temperature Sensor

The temperature sensor used here is LM35. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature [8]

LCD and Keypad

A 16X2 LCD means it can display 16 characters per line and there are 2 such lines. The character present in LCD is displayed in 5x7 pixel matrix. It has a set of commands each meant for doing a particular job to display. It has 8 data pins which are bi-directional data/command pins. A keypad is a set of buttons arranged in a "pad" which usually bear digits, symbols and usually a complete set of alphabetical letters. Here we are using 4x3 matrix keypad. To identify a pressed key, the microcontroller grounds all rows by providing 0 to the output latch, and then it reads the columns.

Relay

A single channel 5v relay module arduino compatible is used and it has the following features Digital, Switching capacity available by 10A in spite of small size design for high density P.C. board mounting technique, TTL level control signal, max. allowable voltage 250VAC/110VDC, max. allowable power force C(800VAC/240W), indication LED for Relay's Status. It can be powered by the arduino board and configured through the digital pins of the arduino. The output is used to control the power given to the coil.

Inverter

A high frequency oscillator like Royer oscillator is used as shown in the Fig.2. The 12vDC from the battery provides a constant D.C voltage to the input of the oscillator and it is converted into a high frequency A.C power, which is fed to the transmitter coil. This high frequency A.C current energizes the transmitter coil and produces an alternating magnetic field. When the phone is fully charged this inverter power is cut-off using a relay.

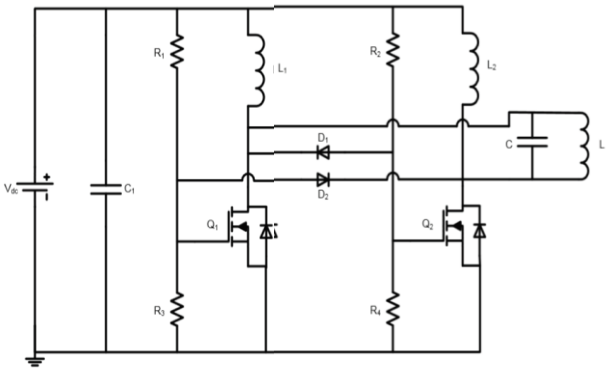

Fig-2: Modified Royer oscillator

RECEIVER

The receiver coil can be embedded inside the phone or an external coil can be used. For external coil, its output is fed to a rectifier then a voltage regulator (IC LM 7805) (Fig.3.) to maintain a constant limited voltage to the phone [10].

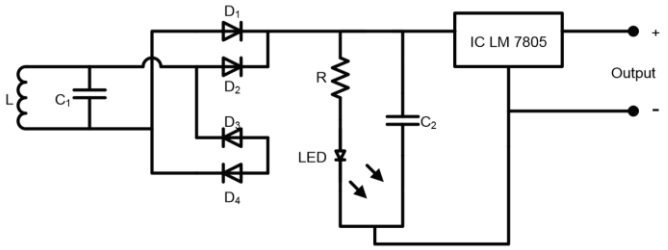

Fig-3: Receiver circuit

3. METHODOLOGY

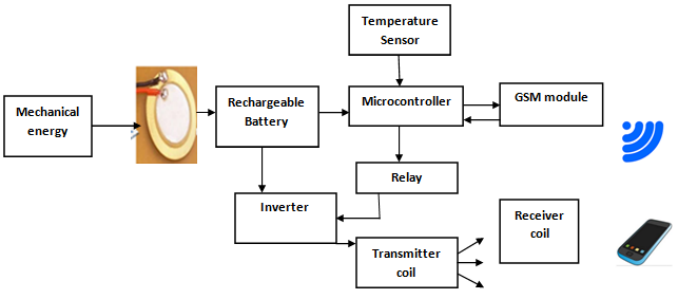

Fig-4: Block diagram of the wireless charging system

The force produced when a person is walking or running is sensed by piezoelectric effect. Force energy is converted into electrical energy proportional to the amount of force applied to the piezoelectric generator as illustrated in the Fig-5.. This AC voltage thus produced is passed through a rectifier to produce DC voltage which is then used to charge a battery. This battery power was used to supply power to the microcontroller development board GSM module and the temperature sensor. This battery output is also applied to

the inverter that powers the magnetic coils as illustrated in the block diagram of Fig4.

Because of its features this arduino board allows us to interface different sensors and other devices like the GSM module that is used in this project. The arduino is interfaced with the GSM module which allows it to communicate with the mobile phone. An application was designed to monitor the charging state of the phone, a sms is then sent to the GSM module once the phone is fully charged. Through the GSM module the program in the arduino will allow the sms to be read and isolated from the AT commands and the GSM number.

The arduino will compare the sms received from the GSM module with its given sms programmed into it, if the sms is similar then it will cut off the connection between the inverter and the transmitter coil using a relay which is controlled by the arduino. By doing this the power that is used to charge the phone will be cut-off, thus avoiding wasting of energy.

The user can sense the body temperature using the temperature sensor on board the system. A switch is used to initiate the sensor part of the system. When the switch is pressed the arduino will run a subroutine program which reads the temperature sensor value and sends it to the mobile phone that is using the system. A GSM module is used to send this text with the information.

Wireless power transfer [11] is accomplished by wireless charging which uses magnetic coils. A strong coupling between electromagnetic resonant coils is used to transfer energy wirelessly between them. The size of the transmitter coil can be according to ones preference, the receiver coil however should be small enough to fit inside a phone.

4. RESULTS & DISCUSSION

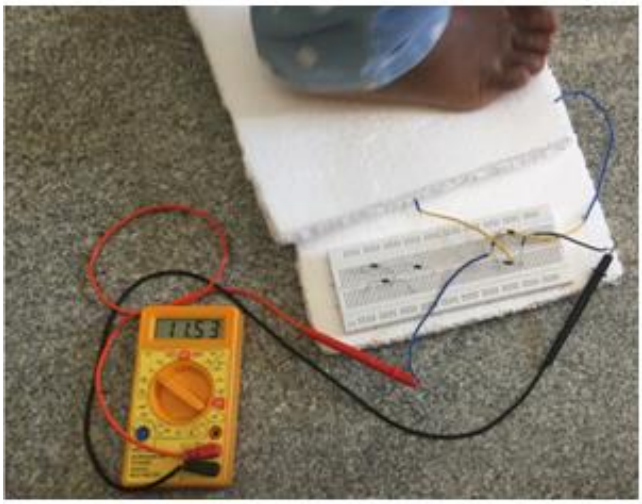

Fig-5: Voltage and current reading of piezo-electric output

Table -1: Piezo electric output for series and parallel combination

COMBINATIONS	VOLTAGE READING	CURRENT READINGS
1 PIEZO-ELECTRIC	3.3V	0.13mA
SERIES (2) PIEZO-ELECTRIC	6v	0.1775mA
PARALLEL(2) CONNECTION	4V	0.325mA
SERIES(2) AND PARALLEL(2)	6V	0.42mA
SERIES (4)PARALLEL(3)	9V	0.70mA
SERIES(8) AND PARALLEL(6)	14V-16V	13.0-40mA

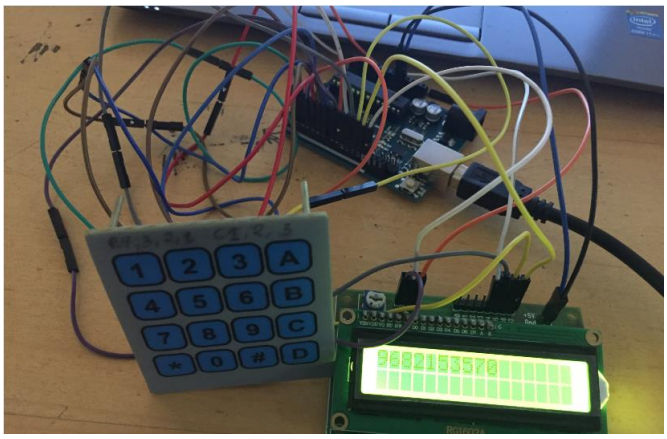

Fig-6: Interfacing LCD and keypad with arduino

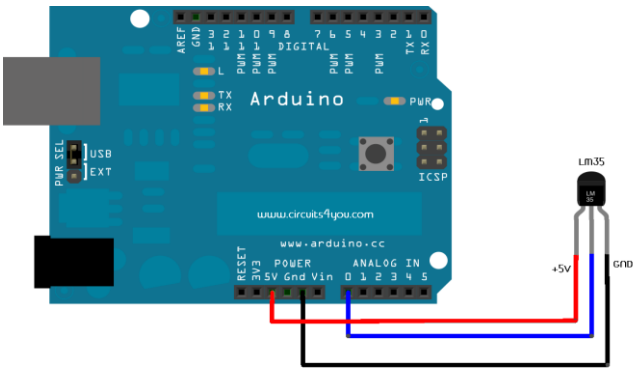

Fig-7: Simulation of Interfacing of Temperature sensor with aurdino board

CONCLUSIONS

A prototype of the system to convert the mechanical energy into electrical energy and use it for various applications in addition to wireless charging of the mobile phone is designed and developed using microcontroller. The model can be miniaturized using micro- electronic mechanical technology to make it portable device which can be future extension of this project

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REFERENCES

[1] Joses Paul P, Samuel Desmond Tutu R, Kevin Richards W and Maria Jerome V "Piezoelectric Wireless Power Transfer-A Mobile Charging" IEEE2015, pp.334-339.

[2] Rajendra Sarangi, Chiranjeev Chandrasekaran and Jyoti Kolap "Contactless Wireless Charger Using inductive coupling". IEEE2005, pp.405-408.

[3] Wenzheng Xu, Weifa Liang, Xiaola Lin, and Guoqiang Mao" Efficient Scheduling of Multiple Mobile Chargers for Wireless Sensor Networks". IEEE2016, Vol 65, pp.7670 - 7683.

[4] Nilotpal Manna. "Study on Piezoelectric Elements for Energy Harvesting" IEEE 2014, pp.334-338

[5] Warsuzarina Mat Jubadi and Siti Faridatul Aisyah Mohd Sahak "Heartbeat Monitoring Alert via SMS" .IEEE2009, vol 01pp.1-5.

[6] Dariusz Grzybek . "Piezoelectric generator for the power supply of the monitoring system". IEEE2014, pp.135-138

[7] Mr.A.Adhithan, K.Vignesh, M.Manikandan "Proposed Method of Foot Step Power Generation Using Piezo Electric Sensor" IARJSET.2015.2406

[8] Salomi S. Thomas, Mr. Amar Saraswat, Anurag Shashwat and Dr.Vishal Bharti "Sensing Heart beat and Body Temperature Digitally"

[9] Priya L, Hariprasad R and Raghul R "real time monitoring of vital signs using wireless technique"

[10] Himangshu Pal, Somedutta Ghosh, Rituparna Chatterjee, Rajat Mahapatraand Somenath Chatterjee "Piezoelectric Energy harvesting devices for Recharging Cell-phone Batteries"

[11] Ismail Yasar, Lei Shi, Kevin (Hua) Bai, Xi Rong, Yang Liu and Xuntuo Wang "Mobile Phone Mid-range Wireless Charger Development via Coupled Magnetic Resonance"IEEE 2016