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Renewable mobile charger using piezoelectric transducer

Cheten Tshering* and Dawa Tshering
Electronics and Communication Engineering Department, College of Science and Technology Rinchenching: Phuntsholing, Bhutan
0214401.cst@rub.edu.bt

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Abstract

The paper propose to generate electrical energy through the mechanical stress on the screen of cellular phone. The mechanical stress applied on the touch screen of cellular phone while using is converted to electrical energy using the proposed transparent piezoelectric transducer. The location of the transducer is proposed for its attachment at the back of the cell phone screen. Though it may not generate enough power for successful running of the cellular phone, the method generates sufficient amount of power for automatic and gradual cell phone charging. The charging through such proposal increases the battery life of the cellular phone for longer use time.

Keywords: Piezoelectric transducers, mechanical stress, electrical energy.

Introduction

With the advancement of the technology, people tend to develop number of peripheral devices for transferring of small file, photos, audios, videos, and for mobile communication etc[1]. Nevertheless, now a day's most of the people use the smart phone. The functionality of the earlier Phone and the latest phone is drastically changed which results in the consumption of power increase to maximum level[2]. Basically when the power consumption by various applications and larger screen resolution comes into picture, ultimately the efficient of the phone decreases and the pressure on the battery life time increases due the amusing functionality of the smartphone[3]. For this, in this paper it basically talks about the solution of the problem of those power consumption by various application by recharging it with the help of renewable piezoelectric transducer which helps in keeping battery of cellular phone charging as and when transducer sense the mechanical pressure[4].

Background: Previously, numbers of research have been done by the researchers regarding the transformation to electrical energy from the human movement. The 'reverse electro-wetting' was propose by the Jeff Krupenkin and Ashley Tylor in which motion of conductive liquid on dielectric coated conductive substrate effects will produce electrical energy[4]. So the piezoelectric sensor has a capability to produce electrical signal whenever it senses the mechanical pressure stimulated by the human movement on it. The results of transformation of human movement to electrical energy was successfully obtained by the scientist of Hull University[5]. Many experiments was done in Japan regarding the piezoelectric sensors to convert the mechanical energy to electrical energy. They have also place the number of sensors on the floor in the crowded area to generate energy due to human movement. The piezoelectric transducers was place under a floor in Tokyo (Japan) where it was found that a person weighing approximately 62kg can produce around 0.12 watt in one second[6].

Specification of the piezoelectric transducer

The material is seen in the form of rectangular shape with silver ink screen electrodes. Lead attachment is accomplished using a riveted lug going to 12" (300mm) of 28 AWG wire. It is found that per micro-strain it can produce the 10 millivolts and when the thickness of the material increases the capacitance and area increases and decreases respectively. The elements are supplied with a thin urethane coating over the active electrodes area to prevent oxidation to the top surface of the silver ink.

Figure-1: Typical Transducer.

The polyvinylidine fluoride (PVDF) piezoelectric transducers is a comparatively different part of piezoelectric sensors. Sensors has deposited the electrically conductive nickel copper alloy on the both side and usually it is very thin in composition and it is also called piezo film. In the real time application, the connection of the piezoelectric transducer is made in such a way either using the copper tape or the epoxy conductive material. The connection cannot be made directly soldering on to the PVDF film because the PVDF cannot resist the high temperature of the soldering rode and finally it would results in damage of plastic PVDF[7].

Piezo-Film Properties: The voltage can be generated 10 times from the piezo film compare to the ceramic materials.

Nevertheless the material is very flexible and thin and it can also resist the high pressure that has been applied to it.

Other characteristics include: i. Range of the frequency (.001 Hz - 10^9 Hz)[8], ii. Small acoustical impedance (close to water and human tissue, efficient for sonar and imaging), iii. Strength of dielectric is high, iv. Fair resistive to mechanical strength, v. Inactive to various chemical and resistant to moisture.

The finger is placed on the piezoelectric sensor for few second and release the finger after the connection is made like Figure-2 and Figure-3, it is observe that the voltage is generated shown in the voltmeter as shown above. The size of the piezoelectric transducer used is: i. PZ-02, ii. Piezoelectric Film, iii. 1mm x 41mm x 0.2mm (0.62" x 1.6" x 0.008").

Piezoelectric transducer detect the pressure and convert it into electrical signal in the of AC signal which is being convert into DC signal with the help of rectifier circuit[9]. Now this DC signal is ever ready to charge the phone continuously which makes the phone more efficient and charging through such proposal increases the battery life of the cellular phone for longer use time.

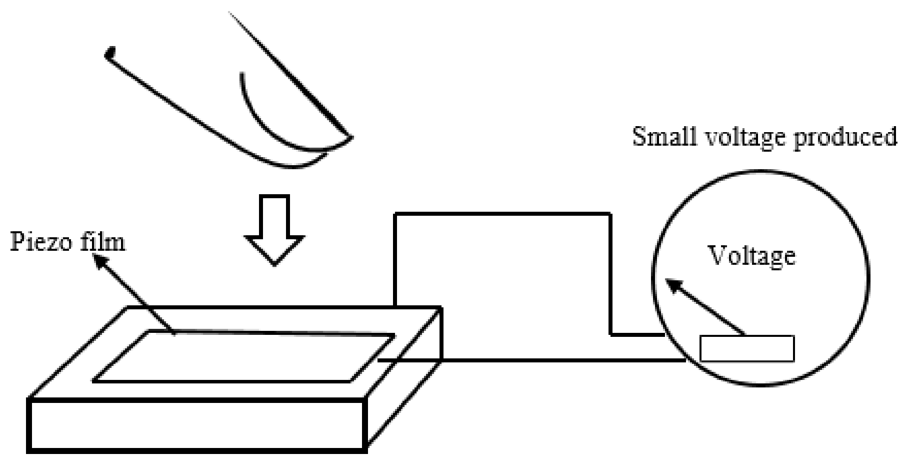

Figure-2: Transducer before pressing.

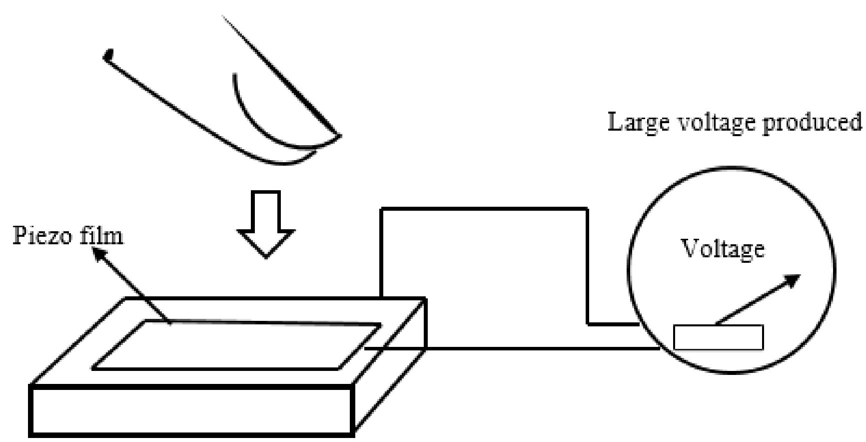

Figure-3: Transducer after pressing.

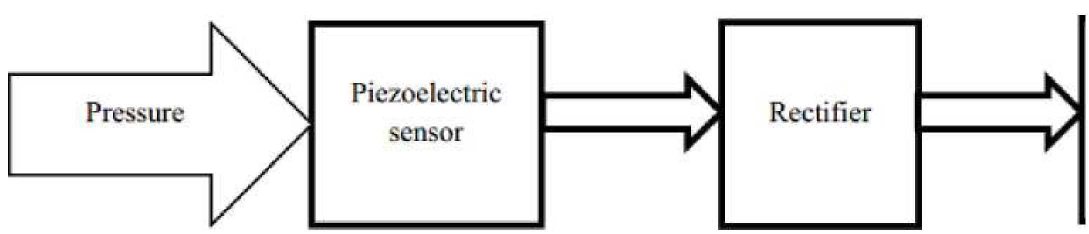

Figure-4: Block Diagram of the system.

Working: The proposed piezoelectric sensor having size of (41mm × 16mm × 0.2mm)(0.63mm × 1.6mm × .008)each producing 10 millivolts per micro strain. According to size of the cellular phone (5.9 cm X 13 cm), total of nine number of piezoelectric sensors fitted inside or back of the screen combinely producing 4500 millivolts which is sufficient to keep the mobile battery alive all the time. All the nine piezoelectric sensors are connected in series for the combination of production of power for each sensor and finally it will be converted into DC component with the help of rectifier circuit as shown in the figure 4-2 and connected to mobile battery which is supposed to be inbuilt. If user is using phone for an hour, she/he may make minimum of 400 to 500 touches on the phone screen which will produce micro strain on the PVDF piezoelectric sensor. But every touch on the screen may not produce sufficient voltage, so if we take the average touch on the screen to be 300 to 400 touches then the voltage produced will be around 3000 to 4000 millivolts (3-4V) which is sufficient to keep the mobile battery alive all the time.

The voltage amplification is going to happen with the help of modifier circuitry that consist of four subsystem after the productivity of the transducers. Rectification (DC-DC converter) - which converts pulsated DC to fixed DC, and current amplification - this increases the current value[10]. The production of around 3-4 v is obtained after 30 minutes of touches on the mobile screen. With the help of non-inverting amplifier circuit, the input voltage is being amplified and given to rectification circuit as input. From the rectification circuit the output voltage will be in the form of ripple which can be filter using the capacitor and become purely DC signal. This voltage can regulated constantly to 5V using the regulating IC 7805[10]. The output is enough to charge the mobile phone.

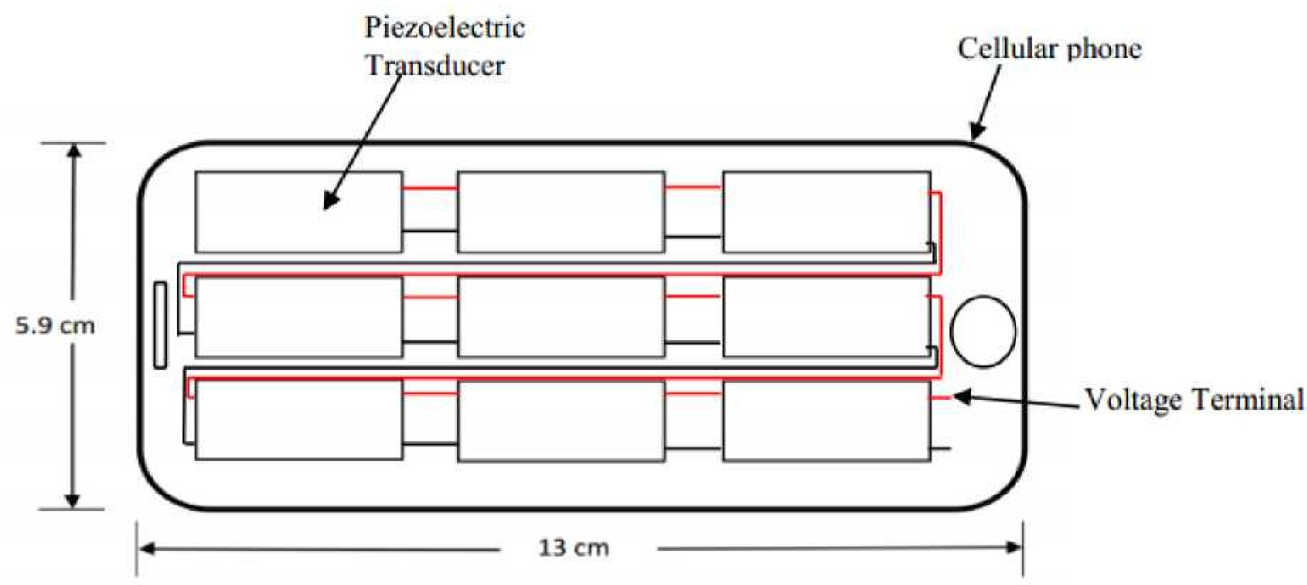

Figure-5: View of the Embadded Transducers on the back of the screen.

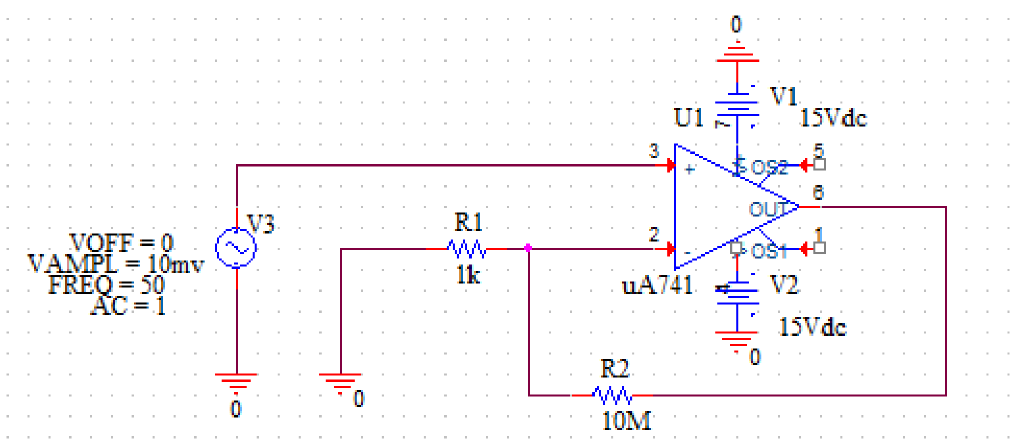

Figure-6: Non-inverting Voltage amplification circuit.

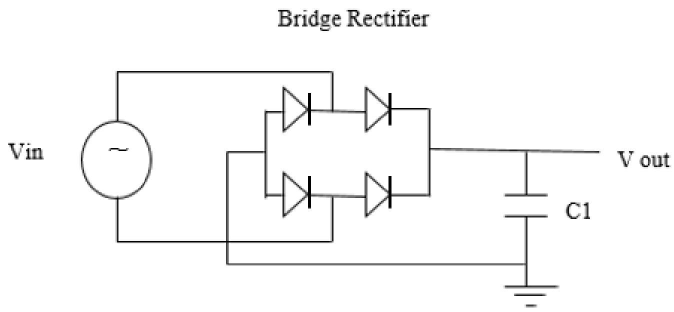

Figure-7: Rectifier Circuit.

Conclusion

The electrical signal is produce due to mechanical pressure applied on the touch screen of the smart phone and it is been use to charge the phone where it is sufficient to keep the phone alive and serve the purpose efficiently. So this can be achieved by placing the number of sensors in series connected to each other at the back of the screen.

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