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SEG framework to introduce a sound wave oriented source for wireless recharging of devices

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Abstract: As per the increasing demands of portability of devices and great rise in their usage, the need of longer power availability and portable power supply is needed for continuous usage of such devices at any point of its usage. One time charging of such devices has the capability of providing power supply for a limited period of time. Thus, recharging of such devices is required after that period, but for portability of devices, there is need of a portable node or resource to recharge such devices. Though, the efforts to increase the power retaining capacity of the devices is also a major scope area of research, but here in this work, the emphasis is given on recharging of devices and gadgets through natural and globally available resource i.e. sound waves. An investigative study on sound waves has shown the way to the foundation of a new energy source for wireless charging of small or handheld devices or gadgets. In this work, a framework for Sound Electro Generator (SEG) has been introduced to support the recharging of devices through sound waves is proposed.

Keywords: Piezoelectrics, nano technology, uBeam transmitter, ultrasound waves.

I. INTRODUCTION

In current era, it is noteworthy that, usage of electronic devices especially mobile and laptop computers are important to fulfill the needs of the commercial, academic, research and development activities. A quanta usage of portable devices is in daily practice of almost every man. It has been noted that around 94 percent of people are carrying mobile phones with them and around 34 percent of the people carry laptops with them. The statistics stating portability of few of the commonly used portable devices can be seen as depicted in Fig. 1 [1].

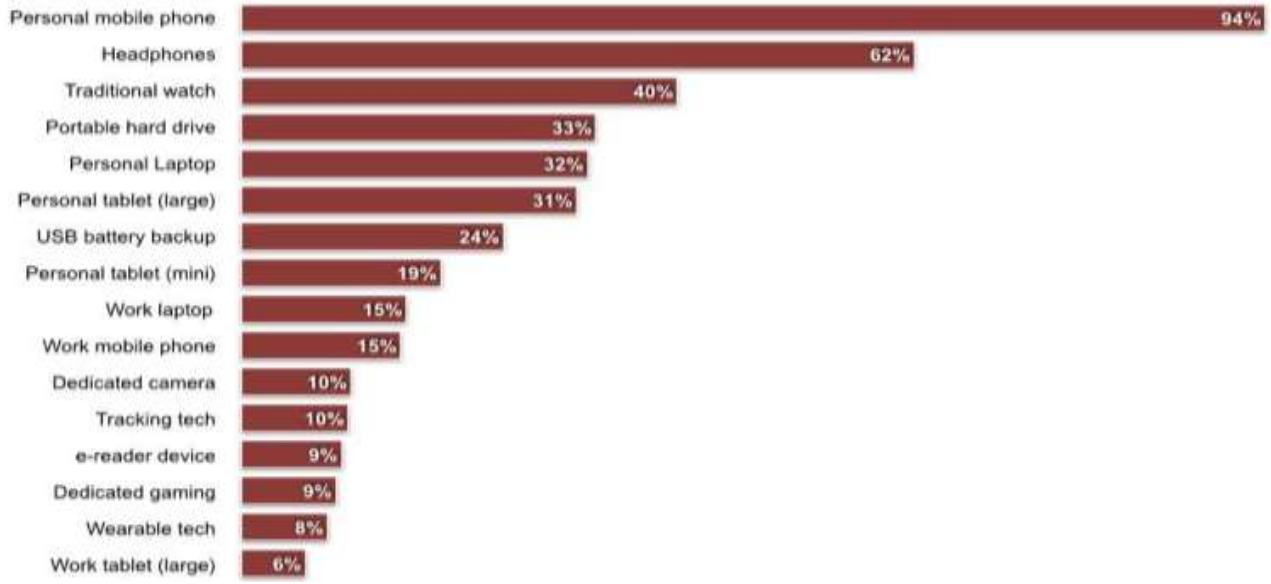

Fig. 1. Statistics of devices carried by people every day

Thus, there is a need to find a natural source of recharging such portable devices that could be made available regardless of the place, location and power supply points. It is known that sound is simply the vibration of air particles, and thus it possesses kinetic energy and potential energy both. This mechanical energy could be converted into the desired form of energy for the target devices. But the conversion of the mechanical energy into electric energy requires specific devices like piezoelectric transducers. It has been found that the piezoelectrics can convert sound waves produced by the user or surrounding elements, into the energy required to run the electronic gadgets. Since ultrasound, which is safe, silent and highly energetic, is found to be perfect to refer as the wireless source of energy. The paper describes the framework to utilize sound waves as the oriented source for wireless recharging of devices. In this paper, the relevant problem definition is stated in Section II and Section III describes the concepts and properties of sound waves. The proposed solution of the problem is presented in section IV and Section V concludes the paper.

II. PROBLEM DEFINITION

With the continuing increment in the usage of portable electronic devices everyday by every person, the battery consumption is increasing with the same. Also, recharging of these devices is required very frequently with such heavy usage. But, for recharging of these devices and gadgets, power supply points are needed, but till now, power supply points are fixed and non-portable due to infeasibility of wireless transmission of current flow. Thus, there is need to find a source for power supply, sufficient to recharge such portable electronic devices.

III. SOUND WAVES CONCEPT AND PROPERTIES

Sound has a huge impact on our day to day lives. Sound is a series of compressed air, characterized by sound molecules close together, and followed by rarefied air, in which the molecules are farther apart. As, longitudinal waves are made up of areas where the wave is compressed together, and other areas where it is expanded, thus, sound waves are analogous to the longitudinal waves and carries all its properties. A longitudinal wave, particles of the medium are displaced in a direction parallel to energy transport and hence in sound waves too. Speed, frequency and loudness are the three fundamental characteristics of sound. The speed of sound in air is 340 m/s at 15°C , and it depends on the temperature of the air [2][3][4] as per the relation stated in equation 1..

$$\mathbf{v = 331.5m/s + 0.6T} \qquad \text{…Equation 1}$$

Where, v is velocity of sound (m/s) and T is temperature (°C)

Sound can also travel through solids and liquids, not just gases.
The value of wavelength or frequency of sound can be calculated using the equation 2:

$$\mathbf{v = f \lambda} \qquad \text{…Equation 2}$$

Where, f is frequency (hz) and λ is wavelength (m)

Commonly known classification of sound waves on the basis of frequency range is depicted in Table 1.

Table 1. Classification of sound waves

Name	Freq Range (Hz)	Characteristics
Infrasonic	0 - 20	Very low frequencies of sound that the human ear can't detect, but you may feel the rumbling of the waves through your body.
Sonic (Audio)	20 - 20 000	Normal range for human ears
Ultrasonic	20 000 +	Beyond normal hearing for humans, although some animals like dogs can hear partly into this range. Used in Ultrasonography.

In an electronic signal, high values represent high positive voltage. When this signal is converted to a sound wave, you can think of high values as representing areas of increased air pressure. When the waveform hits a high point, this corresponds to molecules of air being packed together densely. When the wave hits a low point the air molecules are spread more thinly. Fig. 2 illustrates a speaker creating sound waves, where the black dots represent air molecules. As the loudspeaker vibrates, it causes the surrounding molecules to vibrate in a particular pattern represented by the waveform. The vibrating air then causes the listener's eardrum to vibrate in the same pattern.

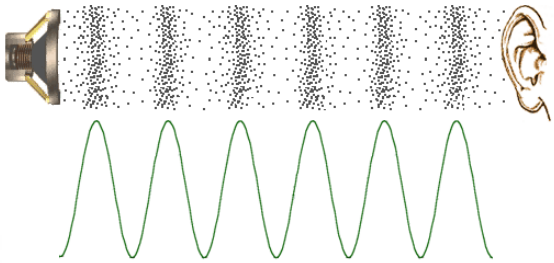

Fig. 2. Sound Waves - Variations in Air Pressure and Corresponding Waveform

Note that air molecules do not actually travel from the loudspeaker to the ear (that would be wind). Each individual molecule only moves a small distance as it vibrates, but it causes the adjacent molecules to vibrate in a rippling effect all the way to the ear.

Fig. 3. Sound Waves as the Source of Energy

IV. PROPOSED SOLUTION

Here, in this paper the framework of Sound Electro Generator (SEG) has been introduced to harness the sound waves to generate sufficient electricity to charge handheld devices. For this, ultrasound waves are expected to provide optimal results as per requirement. To extract sufficient power from ultrasound that could charge electronic gadgets, uBeam transmitters are searched to meet the need of harnessing the power of ultrasound waves. The uBeam transmitter acts as a directional speaker and focuses ultrasound to create a hotspot of energy such that a receiver attached to an electronic device picks up that energy and converts it into electricity. The work has been mainly aimed to explore the feasibility and design of the wireless and self recharging micro and nano chips. Figure 4 depicts the basic components of Sound Electro Generator (SEG).

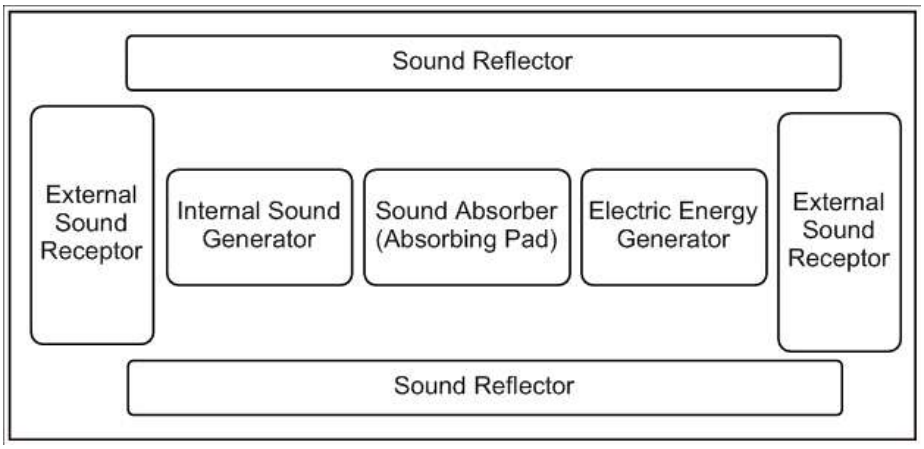

Fig. 4. Components of Sound Electro Generator (SEG)

SEG Components Description:

- External Sound Receptor: External Sound Receptors are introduced to receive the sound waves approaching from external sources or from noise in the external environment.
- Sound Reflector: Sound Reflectors are introduced to reflect and to utilize the sound waves generated by the Internal Sound Generator or received from the External Sound Receptor at maximum extent.
- Internal Sound Generator: Internal Sound Generators are introduced to generate the effective sound waves in SEG. The speakers are suitable for sound generation.
- Sound Absorber: Sound Absorber is introduced as an absorbing pad to absorb the sound waves received from External Sound Receptor as well as Internal Sound Generator.
- Electric Energy Generator: Electric Energy Generator are introduced to convert the sound waves into electrical energy sufficient to recharge any electronic device, depending upon the intensity or loudness of the sound waves received by the absorber.

CONCLUSION

The proposed framework is expected to eliminate the need of carrying the massive amount of wires and chargers with portable electronic devices and hence enhances their portability. The future work in this direction majorly needs to find the best suitable materials for External Sound Receptor, Sound Reflector, Internal Sound Generator, Sound Absorber and Electric Energy Generator of SEG. The proposed solution is expected to support a great scope for self recharging of highly usable devices like mobile phones and laptops.

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