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CHARGING SYSTEM BY WALKING

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Abstract: In today's hectic lifestyle, health has **been seriously hampered due to sedentary work. With the extend use of technology, it has been the vital function to develop something new in both software and hardware. A worn out battery or a lost charges are the two difficulties every electronic device user undergoes through. To overcome this we, have proposed a new technology to adopt charging of these portable electronic devices with the help of human walking. Our project represents an idea of walking based wearable piezoelectric device that provides an alternate means for powering mobile phone batteries. Since, the mechanism of the device is based on walking movements; the device promotes human metabolism as well as physical fitness. Hence, it can be seen as an e-health gadget that encourages walking exercise as a means to charge mobile phone batteries. Walking is the best and common activity in day to day life. Piezoelectric materials have the capability of absorbing mechanical energy from surroundings, especially vibrations and transform it into electric energy that can be used as power supply in real time to other appliances like mobile phones, power banks, and various small handy devices.** **Keywords: Piezoelectric disc, Energy harvesting, Portable units, DC conversion unit, Alternate energy source, Biomechanics**

I. Introduction

The busy lifestyle of today's world has made people neglect their health. As people are working very hard, and have a sedentary lifestyle, they are falling prey to many health and coronary problems. Researchers have shown that walking is one of the most important and health enhancing exercise. Development of technology has made us lazier and physically unfit. Here we propose a walking based mobile phone charging device that enhances physical exercise from the user and also provide for alternate source of energy. Also, mobile phones have become an integral part of one's life. Charging mobile phone is a time consuming process. It requires user constraints in charging mobile phones. The increase in energy consumption in mobile phones is in alarming rate. A problem arises when such an enormous use of mobile phones is not completely supported by their fast discharging batteries. Charging mobile phone requires user attention, it requires appropriate socket and electrical connectivity. Particularly for tourists, mountaineers and villages, it provides specific constraints in charging mobile phones. These difficulties are encountered in charging mobile phone from time to time.

The world's energy consumption is at an all the time high with the demand continuously increasing. With the advent use of portable machines in this technological world; it has become a major issue of power source. The situation brings up several challenges that need to be addressed.

1.) Power supply.

2.) Battery discharging.

3.) Availability of power source.

Development of technology has made us lazier and physically unfit. Here we propose a walking based mobile phone charging device that enhances physical exercise from the user and also provide for alternate source of energy. Also, mobile phones have become an integral part of one's life. Charging mobile phone is a time consuming process. It requires user constraints in charging mobile phones. The increase in energy consumption in mobile phones is in alarming rate. A problem arises when such an enormous use of mobile phones is not completely supported by their fast discharging batteries. Charging mobile phone requires user attention, it requires appropriate socket and electrical connectivity.

In Biomechanics, the ground reaction force, GRF is the force exerted by the ground on the body in contact with it. For example, a person standing motionless on the ground exerts a contact on it which is equal to the person's weight and at same time an equal and opposite GRF is exerted by the ground on the person. Thus, as the human starts walking, this GRF increases which generates power in greater amount.

The utilization of waste energy of foot power with human locomotion is very much relevant for

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highly populated countries where the roads, railway stations, bus stands, temples, etc. The human bio-energy being wasted if it can be made possible for utilization it will be very useful energy sources.

Literature survey : Real Time Battery Charging System by Human Walking Phagna Esha Singh1 , Siddhakar Bhumi2 , Rami Monika3 U.G. Student, Department of Biomedical Engineering, Government Engineering College, Gandhinagar, Gujarat, India1

Power Generation Using Piezo Electric: Footstep Power Generation Using Piezo Electric Transducers Kiran Boby, Aleena Paul K, Anumol.C.V, Josnie Ann Thomas, Nimisha K.K Dept of EEE, MACE, Kothamangalam

Man has needed and used energy at an increasing rate for the sustenance and well-being since time immemorial. Due to this a lot of energy resources have been exhausted and wasted. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India where the railway station, temples etc., are overcrowded all round the clock .When the flooring is engineered with piezo electric technology, the electrical energy produced by the pressure is captured by floor sensors and converted to an electrical charge by piezo transducers, then stored and used as a power source. And this power source has many applications as in agriculture, home application and street lighting and as energy source for sensors in remote locations. The piezoelectric material converts the pressure applied to it into electrical energy. The source of pressure can be either from the weight of the moving vehicles or from the weight of the people walking over it. The output of the piezoelectric material is not a steady one. So a bridge circuit is used to convert this variable voltage into a linear one. Again an AC ripple filter is used to filter out any further fluctuations in the output. The output dc voltage is then stored in a rechargeable battery. As the power output from a single piezo-film was extremely low, combination of few Piezo films was investigated.

Construction

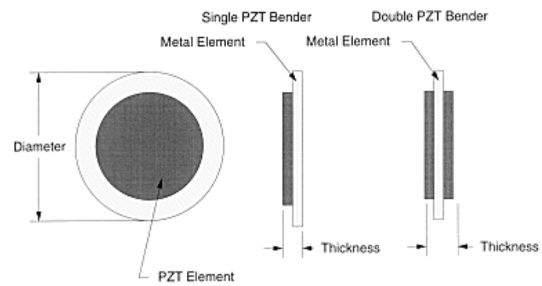

Fig 1.1 Piezoelectric disc

The piezoelectric effect is understood as the linear electromechanical interaction between the mechanical and the electrical state in crystalline materials with no inversion symmetry. The piezoelectric effect is a reversible process in that materials exhibiting the direct piezoelectric effect (the internal generation of electrical charge resulting from an applied mechanical force) also exhibit the reverse piezoelectric effect (the internal generation of a mechanical strain resulting from an applied electrical field). For example, lead zirconate titanate crystals will generate measurable piezoelectricity when their static structure is deformed by about 0.1% of the original dimension. Conversely, those same crystals will change about 0.1% of their static dimension when an external electric field is applied to the material.

A piezoelectric transducer has very high DC output impedance and can be modeled as a proportional voltage source and filter network. The voltage V at the source is directly proportional to the applied force, pressure, or strain. The output signal is then related to this mechanical force as if it had passed through the equivalent circuit.

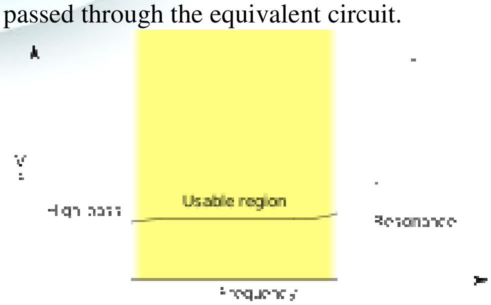

Fig 1.2 Frequency response of a piezoelectric sensor; output voltage Vs applied force

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A detailed model includes the effects of the sensor's mechanical construction and other non-idealities. The inductance L_m is due to the seismic mass and inertia of the sensor itself. C_e is inversely proportional to the mechanical elasticity of the sensor. C_0 represents the static capacitance of the transducer, resulting from an inertial mass of infinite size. R_i is the insulation leakage resistance of the transducer element. If the sensor is connected to a load resistance, this also acts in parallel with the insulation resistance, both increasing the high-pass cutoff frequency.

In the flat region, the sensor can be modeled as a voltage source in series with the sensor's capacitance or a charge source in parallel with the capacitance

LM 317 DC-DC Convertor:

Fig 1.3 Part pinout of LM317T showing its constant voltage reference.

As linear regulators, the LM317 and LM337 are used in DC to DC converter applications.

Linear regulators inherently waste power, the power dissipated is the current passed multiplied by the voltage difference between input and output. In use an LM317 commonly requires a heat sink to prevent the operating temperature rising too high. For large voltage differences, the energy lost as heat can ultimately be greater than that provided to the circuit. This is the trade-off for using linear regulators which are a simple way to provide a stable voltage with few additional components. The alternative is to use a switching voltage regulator which is usually more efficient but has a larger footprint and requires a larger number of associated components.

In packages with a heat-dissipating mounting tab, such as TO-220, the tab is connected internally to the output pin which may make it necessary to electrically isolate the tab or the heat sink from other parts of the application circuit. Failure to do this may cause the circuit to short.

Voltage regulator

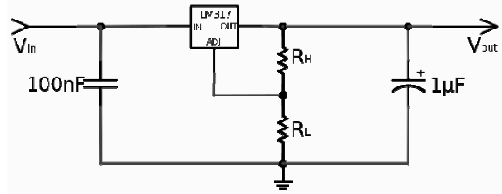

Fig 1.4 Schematic of LM317 in a typical voltage regulator configuration, including decoupling capacitors to address input noise and output transients.

The LM317 has three pins: INput, OUTput, and ADJustment. The device is conceptually an op amp with a relatively high output current capacity. The inverting input of the amp is the adjustment pin, while the non-inverting input is set by an internal bandgap voltage reference which produces a stable reference voltage of 1.25 V.

A resistive voltage divider between the output and ground configures the op amp as a non-inverting amplifier so that the voltage of the output pin is continuously adjusted to be a fixed amount, the reference voltage, above that of the adjustment pin. Ideally, this makes the output voltage:

$$V_{out} = V_{ref}\,(1 + R_L/R_H)$$

Note that V_{ref} is the difference in voltage between the OUT pin and the ADJ pin. V_{ref} is typically 1.25 V during normal operation.

Because some quiescent current flows from the adjustment pin of the device, an error term is added:

$$V_{out} = V_{ref}\,(1 + R_L/R_H) + I_Q R_L$$

To make the output more stable, the device is designed to keep the quiescent current at or below 100µA, making it possible to ignore the error term in nearly all practical cases.

LM2596 DC-DC Converter

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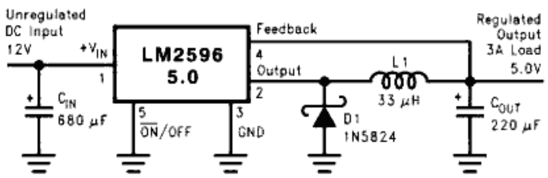

Fig 1.5 Schematic diagram of LM2596 DC-DC Convertor

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while stepping up current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

Fig. 1.6 : DC-DC converter circuit diagram.

Switching converters (such as buck converters) provide much greater power efficiency as DC-to-DC converters than linear regulators, which are simpler circuits that lower voltages by dissipating power as heat, but do not step up output current.

Buck converters can be remarkably efficient (often higher than 90%), making them useful for tasks such as converting a computer's main (bulk) supply voltage (often 12V) down to lower voltages needed by USB, DRAM, the CPU (1.8V or less), etc.

Electrolytic capacitor 100uf/50v

All electrolytic capacitors (e-caps) are polarized capacitors whose anode (+) is made of a particular metal on which an insulating oxide layer formed by anodization, acting as the dielectric of the electrolytic capacitor. A non-solid or solid electrolyte which covers the surface of the oxide layer in principle serves as the second electrode (cathode) (-) of the capacitor.

Due to their very thin dielectric oxide layer and enlarged anode surface, electrolytic capacitors have—based on the volume—a much higher capacitance-voltage (CV) product compared to ceramic capacitors or film capacitors, but a much smaller CV value than electrochemical supercapacitors.

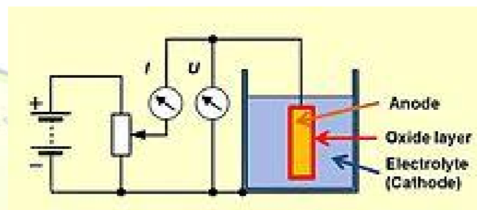

Fig 1.7 Basic principle of anodic oxidation (forming), in which, by applying a voltage with a current source, an oxide layer is formed on a metallic anode

Electrolytic capacitors use a chemical feature of some special metals, earlier called "valve metals", on which by anodic oxidation (forming) an insulating oxide layer originates and serves as dielectric.

The anodically generated insulating oxide layer is destroyed if the polarity of the applied voltage changes.

1N 4007 Diode

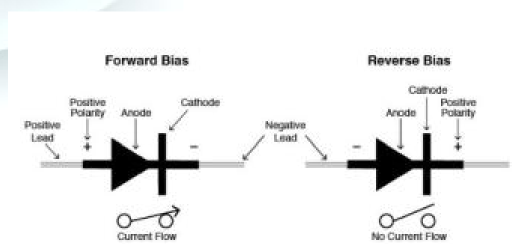

Fig1.8 Schematic diagram of Diode

A rectifier diode is used as a one-way check valve. Since these diodes only allow electrical current to flow in one direction, they are used to convert AC power into DC power. When constructing a rectifier,

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it is important to choose the correct diode for the job; otherwise, the circuit may become damaged. Luckily, a 1N4007 diode is electrically compatible with other rectifier diodes, and can be used as a replacement for any diode in the 1N400x family.

A diode allows electrical current to flow in one direction -- from the anode to the cathode. Therefore, the voltage at the anode must be higher than at the cathode for a diode to conduct electrical current.

In theory, when the voltage at the cathode is greater than the anode voltage, the diode will not conduct electrical current. In practice, however, the diode conducts a small current under these circumstances. If the voltage differential beco0mes great enough, the current across the diode will increase and the diode will break down.

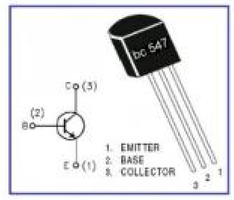
Some diodes -- such as the 1N4001 -- will break down at 50 volts or less. The 1N4007, however, can sustain a peak repetitive reverse voltage of 1000 volts.

When the voltage at the anode is higher than the cathode voltage, the diode is said to be "forward-biased," since the electrical current is "moving forward." The maximum amount of current that the diode can consistently conduct in a forward-biased state is 1 ampere. [3] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day."Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for.

The maximum that the diode can conduct at once is 30 amperes. However; if the diode is required to conduct that much current at once, the diode will fail in approximately 8.3 milliseconds.

When the maximum allowable consistent current amount is flowing through the diode, the voltage differential between the anode and the cathode is 1.1 volts. Under these conditions, a 1N4007 diode will dissipate 3 watts of power (about half of which is waste heat).

BC 547 Transistor



BC547 is mainly used for amplification and switching purposes. It has a maximum current gain of 800. Its equivalent transistors are BC548 and BC549.

In Forward biased condition, the collector is connected to high positive voltage with respect to base i.e. V_{CB} is very high. So C-B junction is reverse biased. $V_{CB} >> V_{BE}$. The base is connected to low positive voltage with respect to emitter i.e. V_{BE} is low. When we increase $V_{BE} \geq 0.7V$ (the value 0.7V is a typical value of potential barrier voltage) the Transistor is forward biased. Now large number of electrons in emitter layer is repelled by negative terminal of V_{BE} and they flow towards B-E junction. They cross the junction and enter into small base layer. Here some electrons combine with holes. Also some of them are attracted by positive terminal of V_{BE} and remaining maximum number of electrons flow into collector layer, crossing the second junction i.e. C-B junction.

The resident electrons of collector are repelled by these (guest) electrons and thus, then all the electrons are present in collector layer are attracted by positive terminal of V_{CB}. Thus, all these electrons complete their journey back into emitter layer and produce conventional currents in the transistor as shown in the above circuit. Thus, as per Kirchhoff Current Law, we can write, $I_C + I_B = I_E$. Now when V_{BE} is still increased, more electrons are repelled by negative terminal of V_{BE}. So base-emitter junction is more and more forward biased. Thus the base current (I_B) increases, which in turn increases Ic. Hence, we can say that collector current (I_C) is the function of base current (I_B). But there is a typical value of V_{BE} for each transistor, at which the collector current I_C no longer remains the function of base current Ib. Also collector current is directly proportional to the base current. In all this process, maximum number of electrons from emitter layer flow into collector layer. So collector current is

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almost equal to emitter current. Hence we say that, collector current is proportional to emitter current.

In Reverse Biased condition, both the junctions are reverse biased as the batteries are connected in opposite direction. Due to V_{CB} battery, the collector-base junction is reverse biased. Similarly, due to V_{EB} battery, the base-emitter junction is also reverse biased. So charges cannot flow and current in the Transistor is practically zero. This method is not useful as the Transistor is in “cut-off” state since current is zero.

Resistor 1K 1/4W

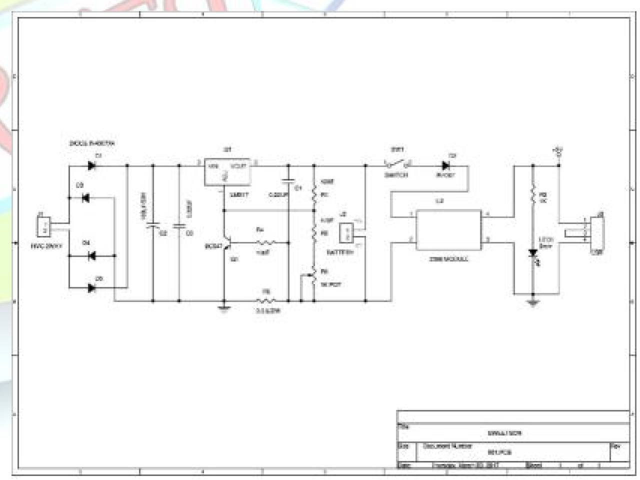
Fig 1.9 Schematic diagram of resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

WORKING

One of the most suitable methods for obtaining the energy from surrounding is using piezo electric crystal. Piezo electric crystal is one of small scale energy sources. The piezo electric crystals when subjected to vibration they generate a very small voltage, commonly known as piezoelectricity. It has a crystalline structure that converts an applied vibration into a electrical energy. Piezoelectric fibre composite can be connected in series with the capacitors and resistors to reduce or smooth a high voltage input produced by PFCB. For test purposes, the finger tapping was used to flick the tip of the piezo electric crystal of metal disc type, in order to provide the initial disturbance. The testing was done using a multi-meter, and oscilloscope, connected to each other properly to obtain voltage readings as the tapping is done. The first test for voltage output depended on time variation and was conducted without any mass placed on it. This was followed by a second test with the foot step of different masses that were placed on the piezo electric metal disc to observe the output voltage levels. As the more mass that is added on the tip, The more time passes until vibration of the sensor stops. The voltage from the piezo electric metal disc increases depending on the mass and force applied to the tip of the sensor. The following fig 2 shows the block diagram of our project. Each block is explained in detail.

CIRCUIT



Due to the vibrations, a piezoelectric crystal generates the electrical power. The produced output voltage is in the form of AC. Then it can be converted to DC by passing it through Rectifier circuit. The converted DC voltage can be fed into Boost converter. As shown in the figure, the bridge rectifier circuit is working in positive half cycle.

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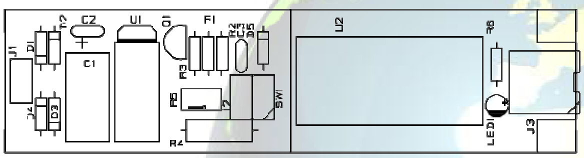
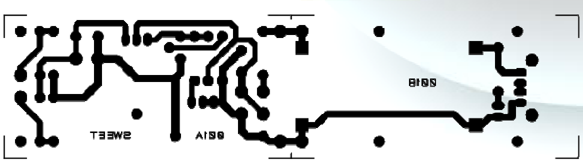
A boost converter (step-up converter) is a power converter with an output DC voltage greater than its input DC voltage. It is a class of switching-mode power supply (SMPS) containing at least two semiconductor switches (a diode and a transistor) and at least one energy storage element. Filters made of capacitors (sometimes in combination with inductors) are normally added to the output of the converter to reduce output voltage ripple.

Upper comparator has a threshold input (pin 6) and a control input (pin 5). Output of the upper comparator is applied to set (S) input of the flip-flop. Whenever the threshold voltage exceeds the control voltage, the upper comparator will set the flip-flop and its output is high.



LEGEND LAYER TOP (VIEW FROM COMP.SIDE)
CADDLINE SYSTEMS PVT LTD C1-83. Ph:24897060,23716934

To change the output of flip-flop to low, the voltage at the trigger input must fall below + (1/3) Vcc. When this occurs, lower comparator triggers the flip-flop, forcing its output low. The low output from the flip-flop turns the discharge transistor off and forces the power amplifier to output a high. These conditions will continue independent of the voltage on the trigger input. Lower comparator can only cause the flip-flop to output low.



SOLDER LAYER (VIEW FROM COMP.SIDE)
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From the above discussion it is concluded that for the having low output from the timer 555, the voltage on the threshold input must exceed the control voltage or + (2/3) VCC. This also turns the discharge transistor on. To force the output from the timer high, the voltage on the trigger input must drop below +(1/3) VCC. This turns the discharge transistor off.

A voltage may be applied to the control input to change the levels at which the switching occurs. When not in use, a 0.01 nano Farad capacitor should be connected between pin 5 and ground to prevent noise coupled onto this pin from causing false triggering.

It is basically a power bag which stores the charge generated by the piezoelectric and charge the other portable electronic devices.

COMPONENTS USED

Item	Reference	Part	Quantity
1	C1,C3	0.22UF	2
2	C2	100uF/50V	1
3	D1,D2,D3,D4,D5	IN4007	5
4	J1	RMC 2WAY	1
5	J2	BATTERY	1
6	J3	USB	1
7	LED1	3mm	1
8	Q1	BC547	1
9	R1	120E 1/4W	1
10	R2	1K 1/4W	1
11	R3	470E 1/4W	1
12	R4	100E 1/4W	1
13	R5	1K POT	1
14	R6	0.5 E/2W	1
15	SW1	SWITCH	1
16	U1	LM317	1
17	U2	2596 MODULE	1

APPLICATIONS

[1] Mobile phone

[2] Electronic Torch

[3] Cell Charger

ADVANTAGES

[1] Can be used anywhere.

[2] Portable charging.

[3] No side effect on human body.

[4] Non Bulky

[5] Can be used in different shoes.

[6] Gives the power supply in real time .

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[7] The extra power generated can be stored and utilized for future purpose.

CONCLUSION

5V output is obtained while walking which is later boosted up by the DC to DC boost converter .This boost converter gives the 8-9V voltage output ,which can be used to charge the mobile phone (requiring 3.7V) in real time .Thus, in all we conclude that with this process, we can extract the energy from the human feet, convert it into electric energy and use it in real time application of charging the devices.

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