CHAPTER ONE

INTRODUCTION

1.1 Introduction

People of all ages spend a lot of time walking. As it's indispensable in the daily life. We spend a great deal of our energy on walking. It not just tires our body, but also tends to Detroit various parts of the body like knees, ankle tendons etc. It is necessary to develop devices to reduce energy expenditure of the body while walking as it will not just aid in making the most important task of our daily life easy, but also save us from various walking related problems that can ultimately lead to surgeries. Use of external powered units can be unreliable and tend to add a lot of weight. It's neededto develop a light medium that can incorporate the idea of reducing the energy expenditure of the body without requirement of any external source of energy. Energygenerating shoes isconserving techniquewhich depend upon piezoelectric effect can be used to reduce the expenditure. In this technique the excess energy spent by the body is stored in the form ofelectric charge and utilized when required. This concept is being used for various applications. Utilizing this concept can aid us to reduce the energy expenditure of the body with minimal requirement of external equipment, as the main power source would be the potential energy of the body.

1.2 Problem Statement

In the past decade, the interest in energy harvesting technologieshas grown substantiallyTraditional power supplies such as batteries have inherent limitations including immobility,limited lifetime, maintenance difficulty, and toxic hazardsWith proliferation of wireless sensors and consumerelectronics, those problems become prominent. For example,over 1.7 billion cell phones were sold worldwide.However, the need of frequent battery charging poses a majorproblem especially for users who are in long-distance traveland who have heavy usage of their cell phones. Therefore, it ishighly desirable to develop a miniaturized portable powersource for charging consumer electronics whenever andwherever needed. A perpetual power source through theaddition of energy harvested from the environment wouldserve as a proper solution.

1.3 Objectives

- The main aim of developing the energy generating shoes is to utilize the potential energy of the human body to help us reduce energy spent on walking.
- Equipment have been developed so far that aim to reduce the energy expenditure while walking

1.4 Methodology

The way to utilize the potential energy of the body is by using a metal part at the heels to impact on the plate. The weight of the body (Potential energy) would act as the prime source of energy. This energy would be stored as electric charge by using circuit. During the process of walking this energy is transmit by using transmitter to receiver which is connected to our mobile charging plug.

1.5 Project Layout

chapter one include introduction, problem statement, Objectives, Methodology, Project Layout, chapter two include introduction , type of generated shoes power, chapter three introduction Generating power, step cycle, chapter four introduction, components, electrical circuit, project elementary chapter five conclusion and recommendation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction:

The technology could be used to power wearable electronic sensors without the need for batteries. There are two separate devices: a "shock harvester" that generates power when the heel strikes the ground and a "swing harvester" that produces be power when the foot is swinging. type of generated shoes.

2.1.1 Piezoelectric Shoes:

The piezoelectric effect—a material's capacity to convert mechanical energy into electrical energy, and the inverse—is observable in a wide array of crystalline substances that have asymmetric unit cells. When an external force mechanically strains a piezoelectric element, these polarized unit cells shift and align in a regular pattern in the crystal lattice. The discrete dipole effects accumulate, developing an electrostatic potential between opposing faces of the element. Relationships between the force applied and the subsequent response of a piezoelectric element depend on three factors: the structure's dimensions and geometry, the material's piezoelectric properties, and the mechanical or electrical excitation vector. To designate direction within a piezoelectric element, engineers conventionally define a three-dimensional, orthogonal modal space, as The various electro-mechanical operation modes identify the electrical and mechanical excitation axes: per convention, electrical I/O appears along the first-named i-axis, and its mechanical counter-part appears along the following j-axis. As and 1b show, the top and bottom of the piezoelectric material are metalized, causing the3-axis to be electrically coupled. During manufacture, the material is “poled” when a high voltage is applied across the 3-axis electrodes at elevated temperature, reordering the unit cells so they produce a voltage across the 3-axis in response to strain across axes 1, 2, or 3.5For example, 31-mode operation signifies transverse mechanical strain along the 1-axis, inducing an electric field along the 3-axis. This action is equivalent to pulling both addition to applications as sensors or input devices (such as this one), piezoelectric materials can be driven with a voltage to produce mechanical deflection, for a wide range of output-device applications[1].

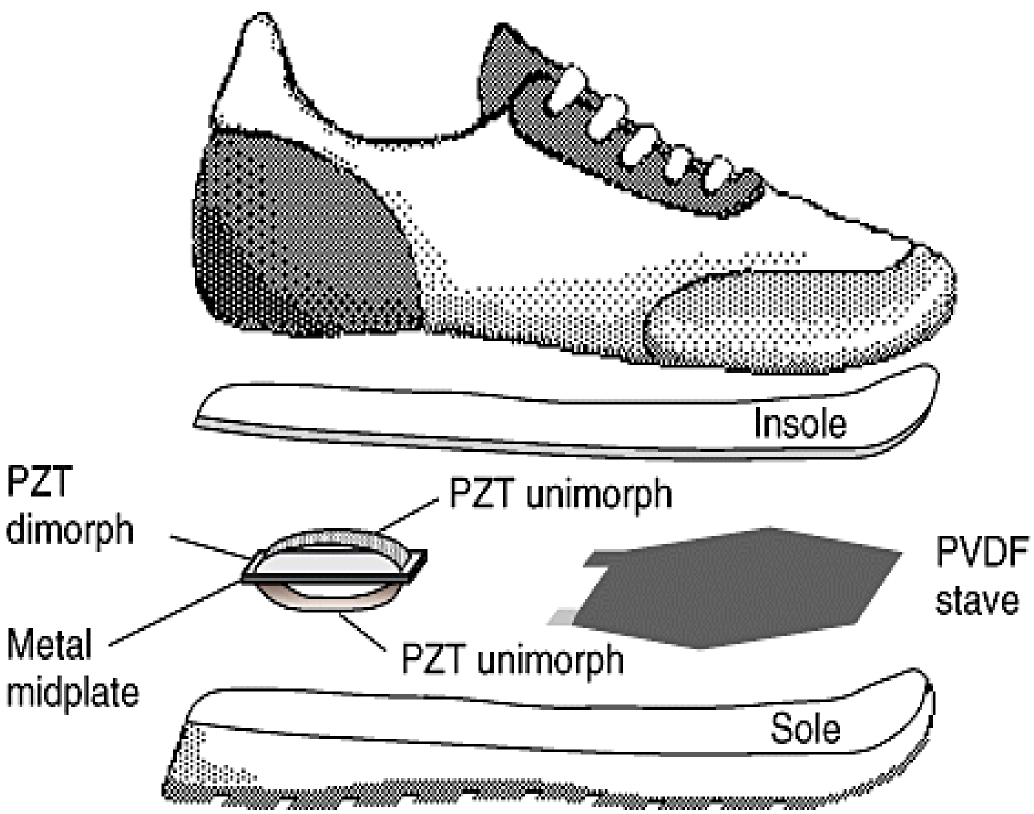

Figure 2.1: inside the piezoelectric shoes

2.1.2 Harvester Design:

The main structure of the harvester is a sandwich structure, where a multilayer PVDF film is sandwiched between two wavy surfaces of a movable upper plate and a lower plate, The multilayer PVDF film is fixed on the lowerplate, and composed of several PVDF layers which are wired in parallel for a high output current. When the upper plate is subject to a compressive force produced by foot, the upper plate moves down and the PVDF film is stretched along 1-axis simultaneously, as presented in. This leads to a piezoelectric field created inside every PVDF layer, driving the free electrons in the external circuit to accumulate on the upper and lower 3-axis surfaces (electrodes)of every PVDF layer to screen the piezo-potential. When the force is lifted, the upper plate moves up and the PVDF film is relaxed, therefore the piezo-potential diminishes, resulting in releasing the accumulated electrons. A dynamic force applied by foot on the upper plate drives the electrons in the external circuit to flow back and forth with an alternating current (AC) output. The sandwich structure is characterized by the inner wavy surfaces, where arc-shaped grooves and arc-shaped ribs exist. The specially designed surfaces enable the PVDF film to generate a large longitudinal deformation and reduce the harvester thickness, which enhances the harvesting performance and makes it possible to integrate the harvester into a shoe whose inner space is limited[2].

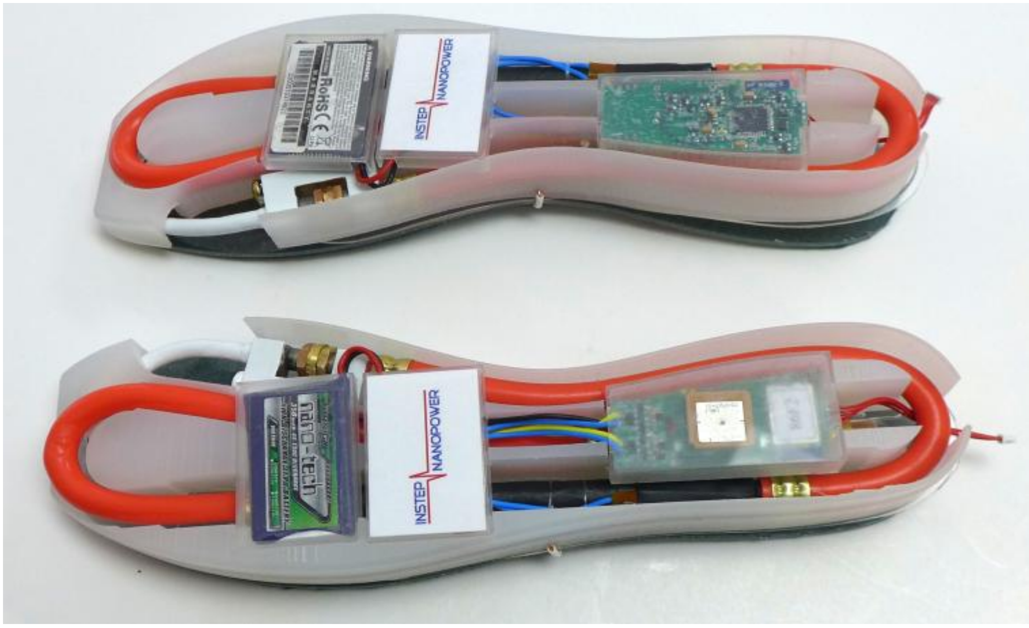

Figure 2.2: the harvester shoe design

2.1.3 Piezo Electric Crystal:

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 fiber 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 amulti-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[3].

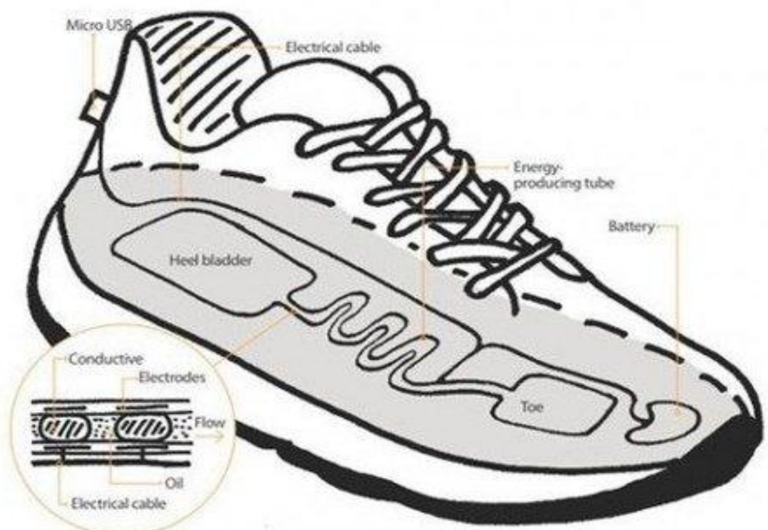

Figure 2.3: the crystal shoe design

2.1.4 Rotary Generator Conversion Shoes:

Through the use of a cam and piston or ratchet andflywheel mechanism, the motion of the heel might be converted toelectrical energy through more traditional rotary generators. The efficiency for industrial electrical generators can be verygood. However, the added mechanical friction of the stroke-to-rotary converter reduces this efficiency. A normal car engine,which contains all of these mechanisms and suffers from inefficient fuel combustion, attains 25% efficiency. Thus, for thepurposes of this section, 50% conversion efficiency will be assumed for this method, which suggests that, conservatively,17-34 W might be recovered from a “mechanical” generator.How can this energy be recovered without creating a disagreeable load on the user A possibility is to improve the energyreturn efficiency of the shoe and tap some of this recovered energy to generate power. Specifically, a spring system, mountedin the heel, would be compressed as a matter of course in the human gait. The energy stored in this compressed spring canthen be returned later in the gait to the user. Normally this energy is lost to friction, noise, vibration, and the inelasticityof the runner's muscles and tendons (humans, unlike kangaroos, become less efficient the faster they run . Springsystems have approximately 95% energy return efficiency while typical running shoes range from 40% to 60% efficiency. Indeed, shoe soles with embedded heel springs have been developed to augment human gait capacity, Volumetric oxygen studies have shown a 2-3% improvement in running economy using such spring systems over typicalrunning shoes. Similarly suggestive are the "tuned" running track experiments of McMahon. The stiffness ofthe surface of the indoor track was adjusted to decrease foot contact time and increase step length. The result was a 2–3%decrease in running times and seven new world records in thefirst two seasons of the track. Additionally, a reduction ininjuries and increase of comfort was observed. Thus, if a similar spring mechanism could be designed for the gait of normalwalking, and a ratchet andflywheel system is coupled to the upstroke of the spring, it may be possible to generate energywhile still giving the user an improved sense of comfort. In fact, active control of the loading of the generation system maybe used to adapt energy recovery based on the type of gait at any given time.Although constant-force springs are available and used in products such as clocks, the simplest mechanical springs do notprovide constant force over the fall of the heel but rather a linear increase, hence only about half of the calculated energywould be stored on the downstep.

An open question is what fraction of the spring's return energy can be sapped on the upstepwhile still providing the user with the sense of an improved "spring in the step" gait. Initial mock–ups have not addressed thisissue directly, but a modern running shoe returns approximately 50% of the 10J it receives during each compression cycle (such "air cushion" designs were considered a revolutionary step forward over the hard leather standard severaldecades ago). Given a similar energy return over the longer distance of the spring system, the energy storage of the spring,and the conversion efficiency of the generator, 12.5% of the initial 67 W is harnessed for a total of 8.4 W of available power.The idea of embedding a spring and rotary generator into the heel of a boot or shoe has not escaped the attention of variousinventors. Patents of this ilk date back to the 1920's and seem to reappear periodically in different incarnations[4].

Figure 2.4: Rotary generator shoes

2.1.4.1 Rotary generation shoes features

- **Save time consume**

Users can charge their gadget while doing daily activities such as moving, like walking or running. As we know, today's life is getting busy as time flies. Therefore, the people should optimize their time wisely. Besides, electronic gadgets play a very important role in completing or doing daily activities. Currently, the charger provided by gadget's manufacturer, users need to connect the charger to the power supply. User has to wait for their gadget to be charged. As a result, users will waste a lot of time waiting for their gadget. This project is a solution to avoid the problem

of running out of power of their gad get off to this where users can charge their electronic gadget while moving.

- **Save the environment**

This project is to develop a charger that can generate its own electricity using Electromagnetism concept (will be discuss later). It can be categorized as renewable energy which means energy that naturally replenish. The normal charger uses the power source that supplied by electric provider and almost all electric providers generate electricity from oil, charcoal and many more natural resources. So this

project can be say that environment friendly because it not causes the pollution.

- **Easy to use**

This project is designed to be easy to use by all level of citizens. The small generator (DC motor) and the circuit will be designed to suit the shoes design. Users only need
to wear the shoes and connect the device to their gadget. Small generator and the circuit implemented in the shoes will be placed carefully and maintain the comfort ability of the shoes.

- **Economical**

Due to this device generates its own electricity to charge gadget by applying mechanical force on it, users do not have to pay for electrical usage, unlike the normal charger using power supply. So, it can save a lot of money and users can still charge their gadget.

- **Healthy lifestyle**

This project also can promote a healthy lifestyle as it need mechanical force. In other words, body movement like walking or running is useful for it to be functional. Users can do daily exercise like jogging, running and playing games and at the same time charging their electronic device.

- **Guide**

visually impaired and blind One of the techniques to help the blinds in their mobility is orientation and mobility specialist who helps the visually impaired and blind people and trains them to move on their ownindependently and safely depending on their other remaining.

CHAPTER THREE

CONSTRUCTION AND APPLICATIONS

3.1 Introduction

Harvesting mechanical energy from human motion is an attractive approach for obtaining clean and sustainable electric energy to power wearable sensors, which are widely used for health monitoring, activity recognition, gait analysis and so on The harvester is based on a specially designed sandwich structure with a thin thickness, which makes it readily compatible with a shoe. Besides, consideration is given to both high performance and excellent durability. The harvester provides an average output power of 1 mW during a walk at a frequency of roughly 1 Hz. Furthermore, a direct current (DC) power supply is built through integrating the harvester with a power management circuit. The DC power supply is tested by driving a simulated wireless transmitter, which can be activated once every 2–3 steps with an active period lasting 5 ms and a mean power of 50 mW. This work demonstrates the feasibility of applying piezoelectric energy harvesters to power wearable sensors.

3.2 Generating Power

Most power plants, whether they are nuclear, hydroelectric, fossil-fuelled or wind, do essentially the same job, transforming kinetic energy, the energy of motion, into a flow of electrons, or electricity. At a power plant, ageneratoris used to make electricity. Inside a generator, a magnet called a rotor spins inside coils of copper wire called a stator. This pulls the electrons away from their atoms, and a flow of electrons is created in the copper wires. Those electrons can then be sent along power lines to wherever electricity is needed.Giant wheels called turbinesare used to spin the magnets inside the generator. It takes a lot of energy to spin the turbine and different kinds of power plants get that energy from different sources. In a hydroelectric station, falling water is used to spin the turbine. In nuclear stations and in thermal generating stations powered by fossil fuels, steam is used. A wind turbine uses the force of moving air.

3.2.1 Preference for Electricity

Energy is vital for all living-beings on earth. Modern life-style has further increased itsimportance, since a faster life means faster transport, faster communication, and faster manufacturingprocesses. All these lead to an increase in energy required for all those modern systems.Arising out of comparison of status of nations, the progress is related in terms of per capitaconsumption of electrical energy (i.e. kWH consumed per person per year). At present, this parameterfor India is about 300, for UK it is 12 to 15 times more, and for USA, it is about 30 times more.It simply means that Electrical energy is the most popular form of energy, whether we requireit in the usable thermal form (heating applications), in mechanical form (electrical motor-applications in Industries), for lighting purposes (illumination systems), or for transportation systems.

Following are the main reasons for its popularity.

- Cleaner environments for user
- Higher efficiency
- Better controllability
- Easier bulk-power, long-distance transportation of power using overhead transmission orunderground cables

- Most versatile devices of energy conversions from Electrical to other forms are available fordifferent purposes, such as thermal, illumination, mechanical, sound, chemical, etc.

3.2.2 Comparison of Sources of Power

While selecting a method of generating electricity, following factors are taken into account forpurposes of comparison:

- Initial cost: For a given rating of a unit (in the minds of planners), investment must beknown. Naturally, lower the initial cost, better it is.
- Running Cost:- To produce a given amount of electrical energy, the cost of conversionprocess (including proportional cost of maintenance/repairs of the system) has to be known.
- Limitations:- Whether a particular resource is available, whether a unit size of requiredrating is available from a single unit or from an array of large number of units, and whethera particular method of generation is techno-economically viable and is time-proven, aretypical queries related to the limitations of the concerned method.
- perpetuity, efficiency, reliability, cleanliness and simplicity.It is naturally desirable that the source must have perpetuity (= be of endless duration),high conversion efficiency, and reliability (in terms of availability in appropriate quantity).The energy conversion must be through a cleaner process (specially from the view- pointsof toxicity, pollution or any other hazardous side effects). Further, a simpler overall systemis always preferred with regards to maintenance/repairs problems and is supposed to bemore reliable.

3.2.3 Sources for Generation of Electricity

Following types of resources are available for generating electrical energy (No doubt, thislist can be extended to include some more up-coming resources. The following list, however, givesthe popular and potential resources .

Conventional methods

➢ Thermal:Thermal energy (from fossil fuels) or Nuclear Energy used for producing steamfor turbines which drive the alternators (rotating a.c. generators).

Figure 3.1: Thermal energy

➢ Hydro-electric:Potential of water stored at higher altitudes is utilized as it is passed throughwater-turbines which drive the alternators.

Figure 3.2: Hydro-electric energy

Non-conventional methods

➢ Wind power:High velocities of wind (in some areas) are utilized in driving wind turbinescoupled to alternators. Wind power has a main advantage of having zero production cost.The cost of the equipment and the limit of generating-unit-rating is suitable for a particularlocation (= geographically) are the importantconstraints. This method has exclusive advantagesof being pollution free and renewable. It isavailable in plentiful quantity, at certain places. Itsuffers from the disadvantages of its availabilitybeing uncertain (since dependent on nature) andthe control being complex (since wind-velocity haswide range of variation, as an input, and the outputrequired is at constant voltage and constantfrequency). Single large-power units cannot beplanned due to techno-economic considerations.

Figure 3.3: Wind energy

- Fuel cells:These are devices which enable directconversion of energy, chemically, into electricalform. This is an up-coming technology and has a special merit of being pollution-free andnoise-free. It is yet to become popular for bulk-power generation.

Figure 3.4: Fuel cells energy

- Photo voltaic cells:These directly convert solar energy into electrical energy through achemical action taking place in solar cells. These operate based on the photo-voltaic effect,which develops an emf on absorption of ionizing radiation from Sun.

Figure 3.5: Photo voltaic cells energy

3.3 step cycle

The gait cycle describes how humans walk and run –in other words, how we move. Having an idea of the gait cycle would help us to understand how we can implement the concept of energy generating shoes onto our feet in our gait cycle.The two phases of gait cycle

- A complete gait cycle begins when one foot makes contact with the ground and ends when that same foot makes contact with the ground again. It is made up of two phases:
- Stance phaseduring which (part of) the foot touches the ground.
- Swing phaseduring which that same foot doesn't touch the ground.

3.3.1 Stance Phase

Stance is considered the mostimportant phase, because this is when the foot and leg bear your body weight. The stance phase can in turn be divided into three stages:

- Initial Contact
- Midstance
- Propulsion

Let's take a closer look at each of these gait cycle phases.

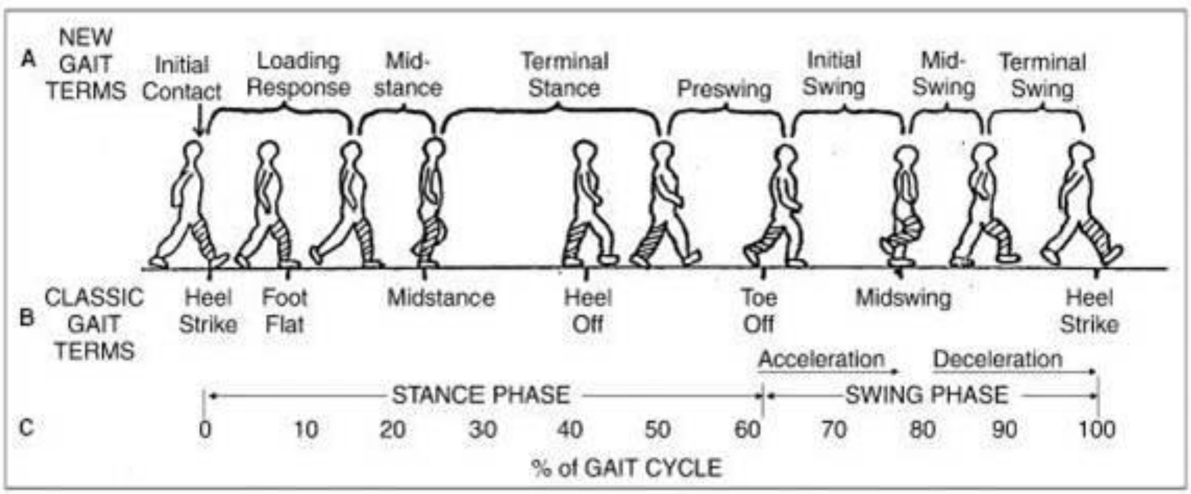

Figure 3.6: Gait Cycle

3.3.1.1 Initial Contact

Initial contact is when your foot lands on the ground. It is the cushioning phase of the gait cycle. The knee flexes just before the foot hits the ground and the foot pronates (rolls in). This causes the foot and leg to act together as shock absorbers. The initial contact phase begins when the foot makes contact with the ground, usually heel first. It ends when the forefoot makes contact with the running surface. This moment is called 'foot flat' and it marks the beginning of the midstance phase.

3.3.1.2 MidStance

During midstance the foot and leg provide a stable platform for the body weight to pass over. By now the foot should have stopped pronating. If the foot is still pronating at this time there is too much movement and instability.Also called single support phase, midstance is when the other foot is in swing phase, so all the body weight is borne by a single leg. This also means that the lower limb is particularly susceptible to injury.

3.3.1.3 Propulsion

Propulsion is the final stage of the stance phase. It begins immediately as the heel lifts off the ground. As the big toe turns upwards (dorsiflexes) the windlass mechanism comes into play, tightening the plantar fascia and helping to raise the arch of the foot. This mechanism is very important since it allows the foot to act as an efficient lever.

3.3.2 Swing Phase

The swing phase begins with 'toe off' and ends just before the foot makes contact with the ground again and a new gait cycle starts. This phase is important to set the foot and leg up in preparation for heel contact and the next stance phase.

A person’s weight is not allocated symmetrically over the plantar. As the sole is not flat but arched, the weight mainly centers on the hallex, the first metatarse and the calcaneus. When sitting, the weight of a person’s upper body rest mostly on the chair and the weight on the feet is relatively small. When standing, the whole body’s weight is put evenly on both feet. Leaning left or right changes theweight distribution over the feet. When walking, the weight distribution changes with the pace; the weight on the front and rear part of the foot alternately increases and decreases because not all parts of the sole contact the ground at once. The changesin weight distribution on the feet reflect one’s activity, and different activities have different changes of weight distribution signatures.The hardware platform consists of a pair of ordinary canvas shoes, a pair of sponge insoles, piezoelectric plate, diode, capacitor, resister, plug, transmitter, receiver and rounded metal part. The piezoelectric plate underneath the insole and it connected in series to the diode. Rounded metal part is placed exact above piezoelectric plate at some distance. Then capacitor is connected in parallel to these circuit and then resister is connect in series. Now these whole ckt is connected to a plug. Then transmitter is attached to plug. We are discussed about energy generation so finally receiver is attached to mobile in charging slot or any external storage source.

CHAPTER FOUR

CIRCUIT DIAGRAM

4.1 Introduction

Energy generating shoes systems consist of multiple components that work together or in sequence to perform some action or work. People well versed in energy generating shoescircuit and system design may purchase individual components and assemble them into a energy generating system themselves. However, many energy generating systems are designed by distributors, consultants, and other professionals who may provide the system in whole or in part.

4.2 Components

The major components of any energy generating system include:

4.2.1 servomotor

there are also called control motors and hydraulic capital un like large industry motor there are not used for continuous energy but only for prices speed and prices passion control at high torques their basic principle of operation is the same as that of other electromagnetic motors however their construction design and mode of operation are different their power ratings vary from fraction of a watt up to a few 100w. due to their low-intertie they have high speed of response. that is why they are smaller in diameter but longer in length they generally operate at vary low speeds or sometimes zero speed . they find wide applications in radar tracking and guidance systems process controllers, computer and machine tools , both dc and ac (2-phase and 3-phase)servomotor are used at present servomotors differ in application capabilities from large industrial motors in the following respects:

- they produce high torque at all speeds including zero speed
- they are capable of holding a static(i,e no motion)position
- they do not overheat at standstill or lower speeds
- due to low-inertia they are able to reverse directions quickly
- they are able to accelerate and deaccelerate quickly
- they are able to return to a given position time after time without any drift.

these motors look like the usual electric motors their main difference from industrial motors is that more electric wires come out of them for power as well as for control. the servomotor wires go to a controller and not to the electrical line through contactors. Usually, a tachometer (speed indicating device) is mechanically connected to the motor shaft. Sometimes, blower or fans may also be-attached for motor cooling at low speeds[5].

Figure 4.1 the servo motor

4.2.2 Batteries

There are four battery chemistries in common use; Valve Regulated Lead Acid (VRLA), NickelCadmium (NICAD), Nickel Metal Hydride (NIMH) & Lithium (Lithium Ion & Lithium Polymer).

- **Valve Regulated Lead Acid**

Valve Regulated Lead Acid (VRLA) batteries are widely used in industrial control applications, Uninterruptible Power Supplies (UPS), alarm & security systems and telecommunications to provide standby power in the event of mains failure. These batteries are simple to charge and maintain, requiring charger with a constant current characteristic of typically 0.1 times capacity (0.1C) for theinitial charge period followed by a constant voltage of 2.25 V/cell to complete the charge and tricklecharge thereafter, the constant voltage trickle charge is connected indefinitely to compensate for selfdischarge. This is known as a float charge system and for best performance the voltage applied should be temperature compensated at 3 mV/ºC per cell decreasing above 20 ºC and increasingbelow 20 ºC.VRLA batteries are often boost or equalize charged at the higher voltage of 2.4 V/cell for an initialeriod to speed the charging process and equalize the cell voltages to restore full capacity, this is athree step charging regime as shown in the diagram below. Manufacturer's capacity, discharge and service life data is generally given for temperatures in therange of 20 – 25 ºC. At lower temperatures the capacity is significantly reduced to around 80% at 0 ºC. At higher temperatures the service life is significantly reduced to around 40% at 40 ºC and aslow as 10% at 50 ºC. In extreme cases high temperatures can result in thermal runaway resulting inexcess gas production and battery swelling which is irrecoverable.

- **Nickel Cadmium and Nickel Metal Hydride**

Nickel Cadmium (NICAD) is an older technology typically used in portable applications and has theadvantages of high power density and high current discharge rates 20 to 30 times capacity (20-30C)typical but has the disadvantage of memory effect when the battery is not fully cycled losingcapacity. This can be overcome but requires a complex charging regime to achieve a recovery. Nickel Metal Hydride (NIMH) is a more recent evolution of NiCad and does not suffer with the samememory effect when used in a non cycled system.Both of these chemistries are best charged using a delta peak charging regime. The battery ischarged with a constant current up to 5 times capacity (5C) and the voltage monitored. The voltageon the cell will rise for the majority of the charge period. During the charge period the charge poweris applied to the battery for a period then removed to monitor the cell voltage then reapplied. This isrepeated until the battery unit achieves 95% of charge when the cell voltage will drop slightly, this isthe knee point. The charger will recognize this and revert to constant voltage trickle charging toachieve the final 5% of charge; the advantage is that the battery is fast charged to 95%. NiCad and NIMH batteries can also be charged at 0.1C permanently as the battery is able todissipate the excess charge as heat without damage to the cell structure.

- **Lithium**

Lithium batteries are also typically used in portable applications and have a higher power densitythan VRLA or Nickel batteries, they are also lighter than VRLA batteries. There are many chemistryderivatives including lithium iron phosphate, lithium manganese, lithium manganese cobalt andlithium titanate, all have similar properties. A stringent charging regime is required for lithium technologies as incorrect charging may result inirreversible damage to the battery or, in the worst case, a fire which is virtually inextinguishable as thebattery has both the fuel and an oxidant to supply oxygen.Initially these battery chemistries could only be charged at a maximum rate of 1C and discharged atno more than 5C. At the time of writing this has improved to charge rates up to 3C and dischargerates up to 35C.The general charging requirements for a lithium Ion (Li-Ion) or Lithium Polymer (Li-Po) batteries aregiven below.The battery must never be discharged below 3.0 volts per cell as this will cause irreversible damage.The battery is charged at a constant current of 1C until the cell voltage rises to 4.25 volts then at aconstant voltage until the current drawn falls to 0.05C. At this point it is deemed to be 98% charged.From this point on a trickle charge is applied at 0.05C indefinitely. The trickle charge applied is aconstant voltage 0.05 V above the battery terminal voltage, current limited to around 100 mA.During charging certain parameters are monitored to avoid damage or fire risk. These include overvoltage, over temperature & charging balance of series strings. If these parameters are found to beoutside specification then the charger is shut down.Smart battery packs are available with built in protection. Many also include a serial interface whichreports a fuel gauge indicating charge status, charge cycles, cell temperature, serial number and capacity.Due to inconsistencies in manufacture a string of cells may each have slightly different capacity.When they are charged as a complete string the charge state of each will also differ. This imbalancecan be corrected by cycling the battery through 2 or 3 balance charges to equalize the cell voltages.Balance charging is effected by the addition of a voltage monitor on each of the battery cells via abalance connector on the battery pack. The monitoring circuit measures the cell voltage anddissipates excess charge as an individual cell becomes charged allowing other cells in the string to catch up. If this is not done imbalance becomes more noticeable and the capacity of the battery is reduced.

4.2.3 Rectifier

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification, since it "straightens" the direction of current. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches. Historically, even synchronous electromechanical switches and motors have been 13 used. Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulfide) to serve as a point-contact rectifier or "crystal detector".

Power electronic circuits are used to control the power conversion from one or more AC or DC sources to one or more AC or DC loads, and sometimes with bidirectional capabilities. In most power electronics systems, this conversion is accomplished with two functional modules called the control stage and the power stage. the topology for a single source and single load converter application that includes a power processor (the power stage) and a controller (the control stage). The converter, handles the power transfer from the input to output, or vice versa, and is constituted of power semiconductor devices acting as switches, plus passive devices (inductor and capacitor). The controller is responsible for operating the switches according to specific algorithms monitoring physical quantities (usually voltages and currents) measured at the system input and or output.

Rectifiers have many uses, but are often found serving as components of DC power supplies and high-voltage direct current power transmission systems. Rectification may serve in roles other than to generate direct current for use as a source of power. As noted, detectors of radio signals serve as rectifiers. In gas heating systems flame rectification is used to detect presence of a flame.

Because of the alternating nature of the input AC sine wave, the process of rectification alone produces a DC current that, though unidirectional, consists of pulses of current. Many applications of rectifiers, such as power supplies for radio, television and computer equipment, require a *steady* constant DC current (as would be produced by a battery). In these applications the output of the rectifier is smoothed by an electronic filter (usually a capacitor) to produce a steady current.

More complex circuitry that performs the opposite function, converting DC to AC, is called an inverter.

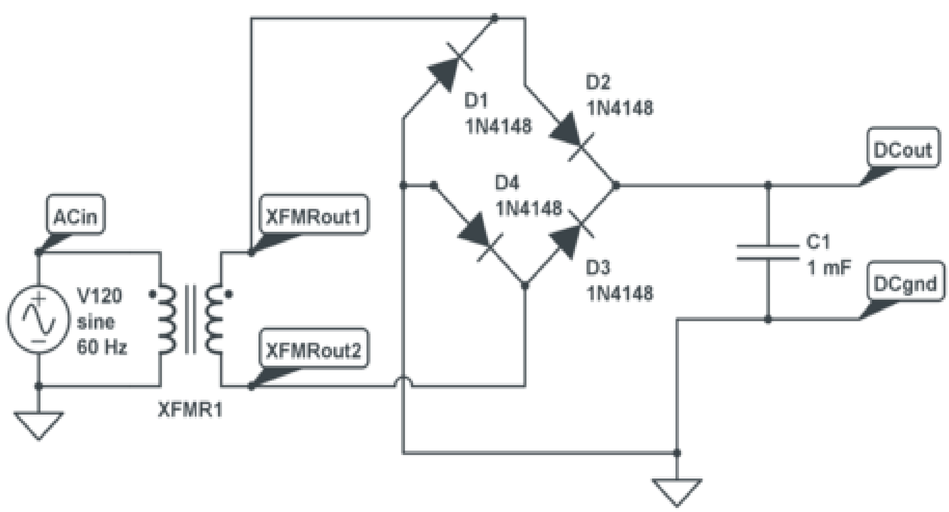

Figure 4.2: AC to DC conversion rectifier

4.2.3.1 Step-up Dc choppers

A chopper is a high speed on/off semiconductor switch. It connects source to load and disconnects the load from source at a fast speed.

4.2.4 SSHI Method

the SSHI synchronized switch harvesting on inductor methodis a method that involves an inductor connected in parallel with a piezoelectric crystal. The inductor is connected when the displacement in the crystal due to stress is maximum. The switching of the inductor causes the inversion of the piezoelectric generator voltage.

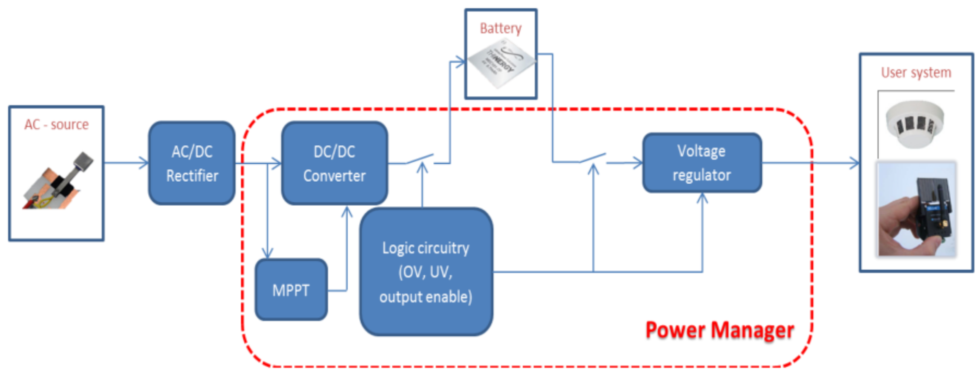

Figure 4.3: SSHI Method

4.2.5 Super Capacitor

In this method, piezoelectric-driven self-charging supercapacitor power cell (SCSPC) using MnO2 nanowires as positive and negative electrodes is fabricated in order to convert mechanical motion or stress into electrical energy. This assembly can be directly used as a power source. This system is a self-charging system. The SCSPC can be charged up to 100 mV in about 300 seconds under foot pressure of a normal weighing person.

Figure 4.4: Super Capacitor

4.2.6 Regulator

A voltage regulator is designed to automatically maintain a constant voltagelevel. A voltage regulator may be a simple Feed-forwarddesign or may include negative feedback. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more ACor DCvoltages.Electronic voltage regulators are found in devices such as computer power supplieswhere they stabilize the DC voltages used by the processor and other elements. In automobile alternatorsand central power stationgenerator plants, voltage regulators control the output of the plant. In an electric power distributionsystem, voltage regulators may be installed at a substation or along distribution lines so that all 15 customers receive steady voltage independent of how much power is drawn forElectronic VoltageRegulators. A simple voltage/current regulator can be made from a resistor in series with a Diode(or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across thediode changes only slightly due to changes in current drawn or changes in the input. When precise voltage control and efficiency are not important, this design may be fine. Feedback voltage regulators operate by comparing the actual output voltage to some fixed reference voltage. Any difference is amplified and used to control the regulation element in such a way as to reduce the voltage error. This forms a negative feed backcontrol loop; increasing the open-loop giant ends to increase regulation accuracy but reduce stability. (Stability is avoidance of oscillation, or ringing, during step changes.) There will also be a trade-off between stability and the speed of the response to changes. If the output voltage is too low (perhaps due to input voltage reducing or load current increasing), the regulation element is commanded, up to a point, to produce a higher output voltage–by dropping less of the input voltage (for linear series regulators and buckswitching regulators), or to draw input current for longer periods (boost-type switching regulators); if the output voltage is too high, the regulation element will normally be commanded to produce a lower voltage. However, many regulators have over-current protection, so that they will entirely stop sourcing current (or limit the current in some way) if the output current is too high, and some regulators may also shut down if the input voltage is outside a given range ohmthe line.

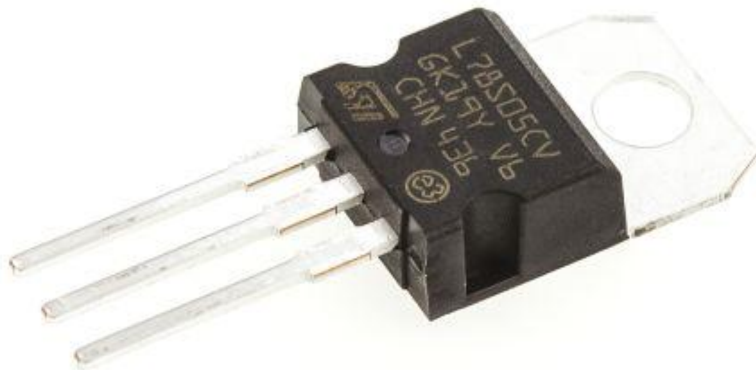

Figure 4.5: regulator

4.2.7 LED

A light-emitting diode (LED) is a Two-leadsemiconductorlight source. It is a p–n junctiondiodethat emits light when activated.When a suitable Voltageis applied to the leads, electronsare able to recombine with electron holeswithin the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gapof the semiconductor. LEDs are typically LEDSmall(less than 1Mm2) and integrated optical components may be used to shape the radiation pattern.Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light.Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were also of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and Infraredwavelengths, with very high brightness.Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displaysand were commonly seen in digital clocks. Recent developments have produced LEDs suitable for environmental and task lighting.

LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.18LEDs have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, and lighted wallpaper.

LED lights home room lighting are as cheap or cheaper than compact fluorescent z lampsources of comparable output.They are also significantly more energy efficient and, arguably, have a lot of environmental concerns linked to their disposal.Unlike a laser, the color of light emitted from an LED is neither coherent nor monochromatic, but the spectrum is narrow with respect to human vision, and for most purposes the light from a simple diode element can be regarded as functionally monochromatic.

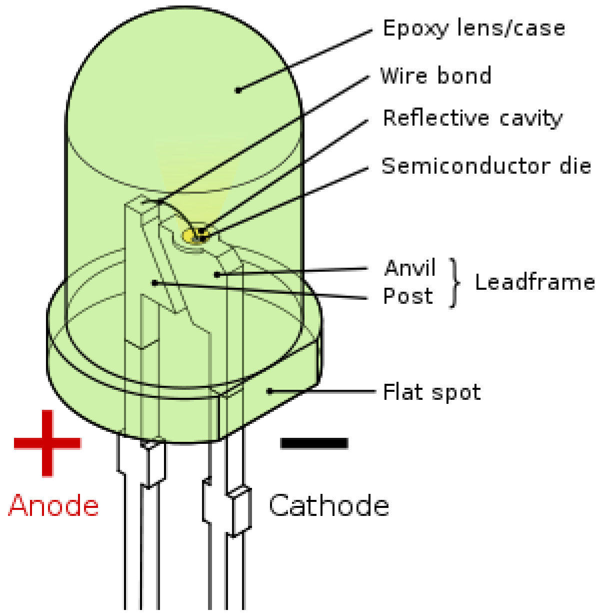

Figure 4.6: LED lamp

4.3 Electrical Circuit:

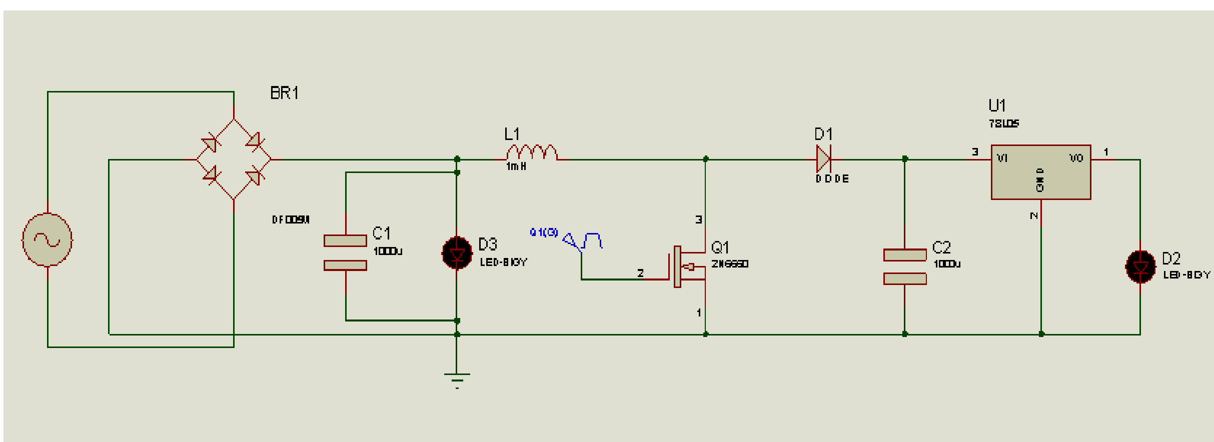

Figure 4.6: the electrical circuit

the mechanical movement that generated will walking act as the input to the circuit that servomotor convert this movement to 3v ac current that flow into the circuit tothe rectifier that turn in to dc current and reduce the frequency of the output voltage then it increased by the step up voltage to reach the impacefice value (about 30mA) that will be stored in the battery so it can charge any device (low current) from it.

4.3.1 Boost Convertor:

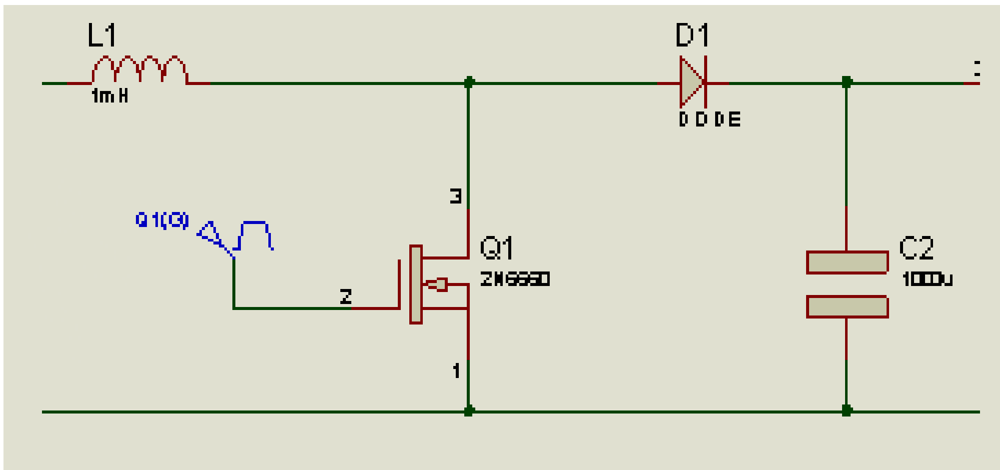

Figure 4.7: the boost convertor

itis required to convert a set voltage DC source into a variable-voltage DC output. A DC-DC switching converter converts voltage directly from DC to DC and is simply known as a DC Converter. A DC converter isequivalent to an AC transformer with a continuously variable turns ratio. It can be used to step downor step up a DC voltage source, asa transformer.DC converters arewidely used for traction motor control in electric automobiles, trolley cars, marine hoists, forklifts trucks, and mine haulers. They providehigh efficiency, good acceleration controland fast dynamic response. Theycan be used in regenerative braking of DC motors to return energy back into the supply.Thisattributeresults in energy savings for transportation systems with frequent steps. DC converters are used in DC voltage regulators; and also are used, with an inductor in conjunction, to generated DC current source, specificallyfor the current source inverter.

4.4 Project Calculation:

Table below contains volt and current values which taken from number of steps in walking about 90 steps and in running about 150 steps so the current produce in walking and running is:

Mean power	Voltage (v)	Current (1)
Walk	4	20mA
Run	6	25mA
Jump	8.7	30mA

Table (4-1) voltage and current testing

In walking =90*20=1800mA

If the mobile capacity is 1800mAH

Then time to charging mobile battery is 1800/1800=1 hour

In running 1800/(150*25)=(0.48*60)hour or 28.8 min

4.5 Project work

The main elements of the design arethe shoes that contain a mechanical part (arms) that move up and down depend on the weight of the body.the arm connected to a servomotor through a multi gears this movement excite the servo to generate power depend on the Faraday'slaw (the magnetic field that interact with an electric circuit to produce an electromotive force (EMF)—a phenomenon called electromagnetic induction).the servo motor generate lower ac voltage that needed a rectifier circuit to converted to the dc voltage that can be stored in the battery.from the battery any smaller devices can be charged.

Figure 4.8: the project design

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion:

In the design of mobile electronics, power is one of the most difficult restrictions to overcome, and current trends indicate this will continue to be an issue in the future. Designers must weigh wireless connectivity, CPU speed, and other functionality versus battery life in the creation of any mobile device. Power generation from the user may alleviate such design restrictions and may enable new products such as batteryless on-body sensors. Power may be recovered passively from body heat, arm motion, typing, and walking or actively through user actions such as winding or pedaling. In cases where the devices are not actively driven, only limited power can generally be scavenged (with the possible exception of tapping into heel strike energy) without inconveniencing or annoying the user. That said, as detailed elsewhere in this volume, clever power management techniques combined with new fabrication and device technologies are steadily decreasing the energy needed for electronics to perform useful functions, providing an increasingly relevant niche for power harvesting in mobile systems.

5.2 Recommendations:

- The project can be expanded by add more offers in mobile applications like measurement , the temperature of the body and the weight depending on multiple sensors adding to the shoes.
- Help a heart patients or HTN patients for add more tools to measure heart rate or blood pressure.

- ➢ develop the design shape and size for all ages and all activates outdoor /indoor.
- ➢Using peizo electric instead of servomotor.

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