Advanced Footstep Power Generation System to Charge E-Vehicles

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***Abstract*—In today's world, Electric cars are gaining a great demand with increasingly new features established in them and rising demand of eco-friendly status for each one of us. Electric cars which uses electricity to charge up their batteries, have replaced gasoline and diesel cars with features like high speed, less carbon emission, less maintenance, upon certain level with better mileage etc. but brought a great disadvantage of a big threat to non-renewable electrical energy. So, our focus is on charging electric cars via some source which exist in long and does not become costly i.e. vibrating energy which totally replaces electricity and uses vibrations present around us which are harvested economically. According to World Bank Report 450000 vehicle passes from the busiest highways which produces plenty of vibrations. Thus here we are trying to use this vibration energy with piezoelectric transducers (which converts mechanical energy to electrical energy) with springs which finally results in electrical energy. This project describes the use of piezoelectric materials in order to harvest energy from people walking vibration for generating and accumulating the energy. This concept is also applicable to some large vibration sources which can find from nature. This project also represents a footstep of piezoelectric energy harvesting model which is cost effective and easy to implement.**

Keywords---Piezoelectric sensors, Display voltage obtained, 8051 Microcontroller AT89S52, Analog to digital conversion (PCF8591), and Design Flow.

I. INTRODUCTION

Footstep step generation system basically converts force energy of foot into electric energy by using piezoelectric sensor. Piezoelectric sensor is a transducer which converts mechanical energy into electric energy which is used for different applications.Today, electricity has become a life line of human population. The concern about the gap between demand and supply of electricity has led to alternate sources of energy and its sustainable use. Linear increase of human population and energy demand led to the invention of a method to provide power from the increased population. This technology utilizes piezoelectric effect, in which the materials have the ability to generate electricity from pressure and force applied to them. The ability of some materials to generate electric potential in response to applied pressure is piezoelectricity. Energy harvesting becomes a waste if not utilized properly. Pressure exerted by moving people can be converted to electric current with the help of embedded piezoelectric crystals. It is a non-conventional energy production mechanism. Transducers are used to convert mechanical energy of footsteps into electrical energy. The system can be implemented on roads, bus stations and many public places. Piezoelectric materials act as transducers and pressure exerted by the moving people transformed into electric current.

At display, power has turned into a help for human populace. Its request is expanding step by step. Present day innovation needs an immense measure of electrical power for its different activities. Power generation is the single biggest wellspring of contamination in the entire world. At one hand, rising worry about the hole amongst request and supply of power for masses has featured the investigation of interchange wellsprings of vitality and its economical utilize. Then again, human population is increasing everywhere throughout the world and thus vitality request is expanding step by step directly. In like manner, it is a target of the present development to give a technique for electrical power generation from this regularly expanding human populace that does not adversely affect the earth. This innovation depends on a rule called the piezoelectric impact, in which certain materials can develop an electrical charge from having weight and strain applied on them. Piezoelectricity alludes to the capacity of a few materials to produce an electric potential in light of connected weight. Inserted piezoelectric material can give the enchantment of changing over weight applied by the moving individuals into electric current. Human-fuelled transport has been in presence since time immemorial through strolling, running and swimming. However current innovation has prompted machines to upgrade the utilization of human control in more effective way. In this specific circumstance, pedal power is an astounding wellspring of vitality and has been being used since nineteenth century making utilization of the most capable muscles in the body. Ninety-five Percent of the effort put into pedal power is changed over into vitality. Pedal power can be connected to an extensive variety of employments and is a straightforward, shoddy,

and helpful wellspring of vitality. Be that as it may, human dynamic vitality can be valuable in various ways however it can likewise be utilized to create power in view of various methodologies and numerous associations are as of now actualizing human controlled advances to produce power to control electronic devices.

II. METHODOLOGY

In this proposed system the use of embedded technology makes the system efficient and reliable. Microcontroller (AT89S52) allows dynamic and faster control. This project uses regulated 5V, 500mA power supply. Bridge type full wave rectifier is used to rectify the AC output of secondary of 230/12V step down transformer.

The control mechanism carries A.C ripple neutralizer, and 12V, 1.3Amp lead acid rechargeable battery, we are using conventional battery charging unit for giving supply to the circuitry and an inverter which is used to drive AC/DC loads. The battery is connected to the inverter. This inverter is used to convert the 12 Volt D.C to 230 Volt A.C. This 230 Volt A.C voltage is used to activate the loads. Liquid crystal display (LCD) makes the system user-friendly. Here we are using 16X2 LCD to display the voltage values of the rechargeable battery using AT89S52.

Human-fuelled transport has been in presence since time immemorial through walking, running and swimming. However current innovation has prompted machines to upgrade the utilization of human control in more effective way. In this specific circumstance, footstep power is an astounding wellspring of vitality and has been being used through utilization of the most capable muscles in the body. Human dynamic vitality can be valuable in various ways however it can likewise be utilized to create power in view of various methodologies and numerous associations are as of now actualizing human controlled advances to produce power to control electronic devices.

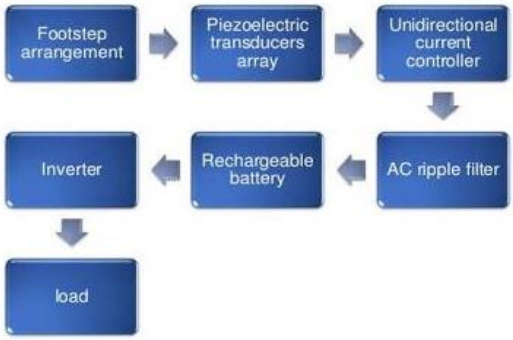

Figure 1: Flow of the system

The AT89S52 comes from the popular 8051 family of Atmel Microcontrollers. It is an 8-bit CMOS microcontroller with 8K as Flash memory and 256 bytes of RAM. Since it is similar to the trust worthy 8051 architecture these microcontrollers are as per industry standard. It has 32 I/O pins comprising of three 16-bit timers, external interrupts, full-duplex serial port, on-chip oscillator and clock circuitry.

The Microcontroller also has Operating mode, Idle Mode and Power down mode which makes it suitable for battery operated applications. Few considerable drawback of the microcontroller is that it does not have in-built ADC and does not support SPI or I2C protocols. However you can utilise external modules for the same.

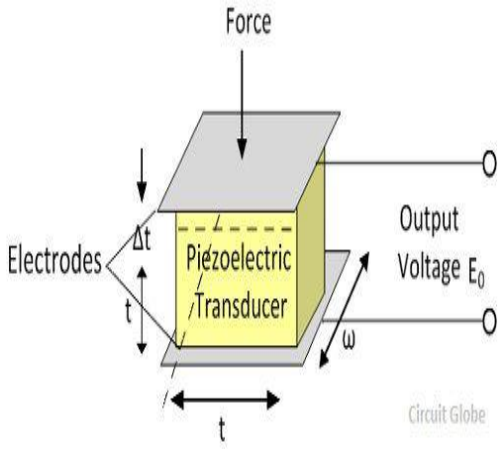

Fig 2. Piezoelectric sensor

A piezoelectric sensor is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge.

It is a sensor which converts force applied on sensor into voltage with the help of mechanical vibrations. It basically converts kinetic energy into electrical energy. Array of sensors should be connected in series to generate reasonable amount of electrical power. For example 10 piezoelectric sensors are connected in series they will generate 9 volt and 100mA current. Two types of such sensors are available in market lead zirconatetitanate (PZT) and PVDF. The output voltages of these sensors are controlled by filters.

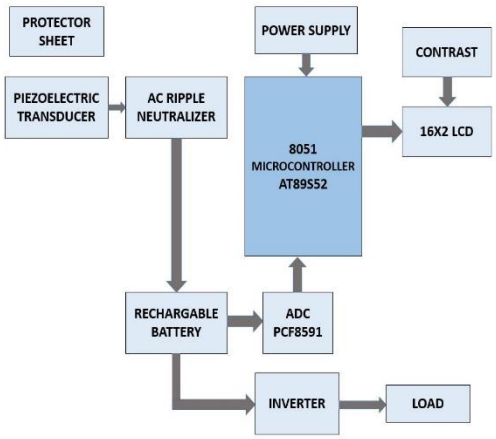

Figure 3: Block diagram of the system

III. ALGORITHM OF THE PROPOSED SYSTEM

Power on the model. Once the system is activated apply force the piezoelectric material the applied pressure is converted into electricity by the piezo transducer.

An AC ripple neutralizer is used to remove the ripple content for which we make use of a bridge rectifier and a capacitor to store the spikes of current generated. The produced power is stored in a lead acid rechargeable

battery. This stored power is used for various applications in different fields such as to charge electric vehicles, charging mobile phones, and many other public places.
An ADC module is used to convert the obtained analog voltage into digital form.The 16X2 LCD display is used to display the amount of voltage generated from the model designed.
FLOWCHART:

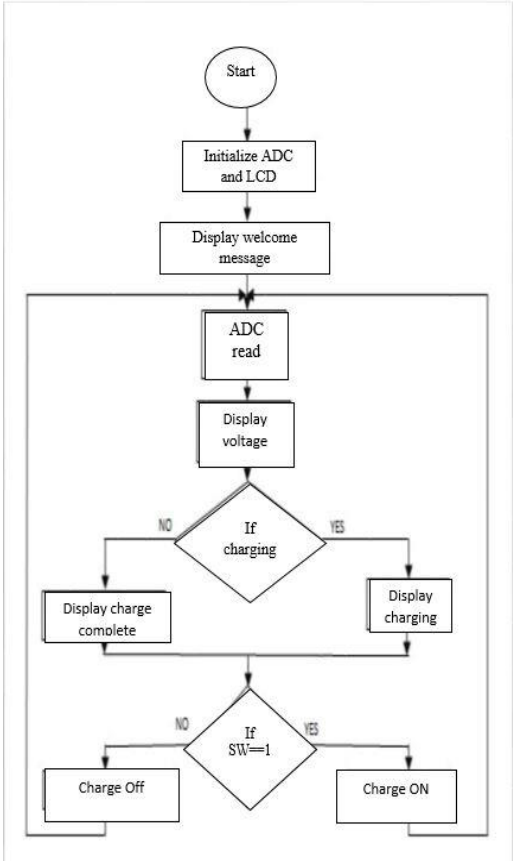

Figure 4: Flowchart of the proposed system

IV. SOFTWARE SPECIFICATION

In order to program the Atmel microcontroller we will need an IDE (Integrated Development Environment), where the programming takes place. A compiler, where our program gets converted into MCU readable form called HEX files. An IPE (Integrated Programming Environment), which is used to dump our hex file into our MCUs.

1. Keil µ vision: Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software development.When starting a new project, simply select the microcontroller you use from the Device Database and the µVision IDE sets all compiler, assembler, linker, and memory options for you.Numerous example programs are included to help you get started with the most popular embedded 8051 devices.The Keil µVision Debugger accurately simulates on-chip peripherals (I²C, CAN, UART, SPI, Interrupts, I/O Ports, A/D Converter, D/A Converter, and PWM Modules) of your 8051 device. Simulation helps you understand hardware configurations and avoids time wasted on setup problems. Additionally, with simulation, you can write and test applications before target hardware is available.When you are ready to begin testing your software application with target hardware, use the MON51, MON390, MONADI, or FlashMON51 Target Monitors, the ISD51 In-System Debugger, or the ULINK USB-JTAG Adapter to download and test program code on your target system.
2. Embedded C: Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.
   Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all device working is based on microcontroller that are programmed by embedded C
3. ISP Programmer:Burn a Program in the Microcontroller is the process of transferring a program code to the microcontroller's memory from a compiler software. Generally, this microcontroller program is written in assembly or embedded C language. And this code is converted into hex file using Kiel IDE software, which is then transferred to the microcontroller memory using burner hardware along with a dedicated software. Once the code is stored in the microcontroller, its function remains in accordance with the program.

V. ADVANTAGES AND DISADVANTAGES

A. Advantages

- Power generation is simply to walk on step.
- No need of fuel input.
- Echo friendly.
- Less maintenance cost.
- This is nonconventional system.
- No moving parts – long service life.
- Compact highly sensitive.
- An alternative way for power generation.

B. Disadvantages

- Only applicable for the particular place.
- Initial cost of this arrangement is high.
- Care should be taken for batteries in case of website and app failure.

VI. RESULT

A power harvesting system is designed and implemented using piezoelectric sensor and voltage is harvested from the pressure applied. Also the voltage status is displayed using LCD. Depending on the amount of pressure applied on the piezoelectric sensor, a good amount of voltage is generated which can be used to charge e-vehicle. A switch is provided in the model by pushing the switch ON a bulb

glows from the electric power obtained. We can display both the amount of electricity generated by the sensors and the energy stored in the battery in terms of voltage on 16X2 LCD.

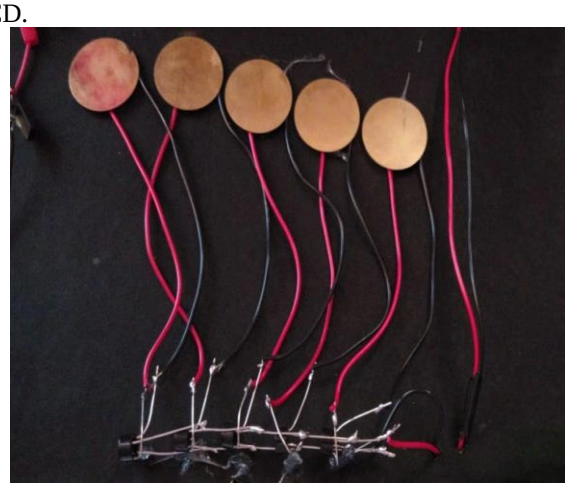

Figure 5:Piezoelctric sensor mat

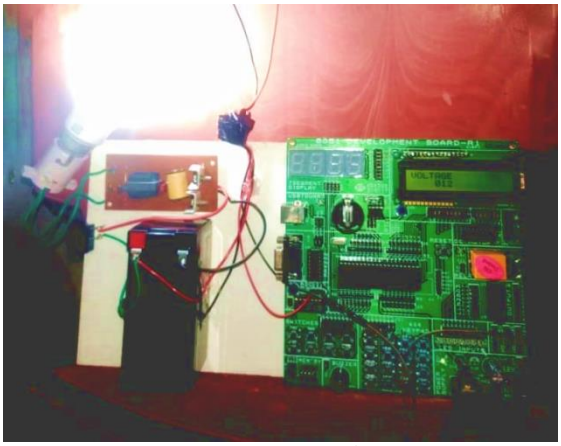

Figure 6: Hardware model of the system

The main components of the system include piezoelectric transducers,ac ripple neutralizer, 8051 microcontroller, rechargeable battery, voltage sampler, ADC, LCD display and socket for charging E-vehicles. Here in this this system, at first, the output from an array of piezoelectric sensors is fed to the ac ripple neutralizer. A constant output voltage irrespective of fluctuations will be maintained by a voltage regulator. This regulated voltage is stored in the battery and is fed to the microcontroller. The LCD which is interfaced with the microcontroller in turn displays the amount of charge stored by the battery. In this system the power generated has been used for applications such as charging E-vehicles. A buzzer is used to alert when the battery voltage falls below the required voltage for charging the microcontroller. For 8051 microcontroller 5 V is required for its working. The power is generated by simply walking over a step. The system does not need any fuel input for its functioning this is a non-conventional system in which battery is used to store the generated power. Even though the force is used to generate power, the system is applicable to particular places. Mechanical moving parts used in the system are large there by increasing the cost. The power generation using footsteps can be implemented effectively in schools, colleges, cinema theaters, shopping complexes, temples and many other buildings.

Maximum of 14 volts is generated using five piezoelectric sensors (Figure 5). The obtained voltage from the sensors as well the charges stored in the battery can be displayed on 16X2 LCD. (Figure 6).

VII. FUTURE SCOPE

Footstep arrangement is used to generate the electric power. As the power demand is increasing, this arrangement is used to generate the electrical power in order to meet the large energy demand. In this arrangement the mechanical energy is converted into electrical energy.

VIII. CONCLUSION

Footstep arrangement is used to generate the electric power. As the power demand is increasing, this arrangement is used to generate the electrical power in order to meet the large energy demand. In this arrangement the mechanical energy is converted into electrical energy. The project “FOOT STEP POWER GENERATION” is an afford-able energy solution to common people. This can be used for many applications in rural areas where power availability is less or totally absence As India is a developing country where energy management is a big challenge for a huge population. By using this project we can drive both AC and DC loads according to the force we applied on the piezoelectric sensor to charge electronic vehicles and reduce the amount of pollutants which cause a negative impact on the environment.

IX. ACKNOWLEDGMENT

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