

FOOTSTEP POWER GENERATION SYSTEM USING MICROCONTROLLER

Submitted in partial fulfilment of the requirements for the award of Bachelor
of Engineering degree in Electronics and Communication Engineering.

by

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION

ENGINEERING SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai-600119

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ENGINEERING BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Ch. Janardhan (39130087) and Ch. Vijay Kumar (39130098) who carried out the project entitled "**Footstep Power Generation System using Microcontroller**" under our supervision from November 2022 to April 2023.

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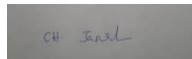
We Ch.Janardhan (39130087) and Ch.Vijay Kumar (39130098) hereby declare that the Project Report entitled "**Footstep Power Generation System using Microcontroller**" done by us under the guidance of **Dr.RPandian M.E.,Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE:15.04.2023

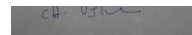
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SIGNATURE OF THE CANDIDATES

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ABSTRACT

Day by day, the population of the country increased and the requirement of the power is also increased. At the same time the wastage of energy also increased in many ways. So, reforming this energy back to usable form is the major solution. As technology is developed and the use of gadgets, electronic devices also increased. Power generation using conservative methods becoming deficient. There is a necessity arises for a different power generation method. At the same time the energy is wasted due to human locomotion and many ways. To overcome this problem, the energy wastage can be converted to usable form using the piezoelectric sensor. This sensor converts the pressure on it to a voltage. So, by using this energy saving method, that is the footstep power generation system we are generating power. Man has needed and used energy at an increasing rate for the sustenance and wellbeing 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. In this paper the force energy is produced by human footsteps and the force energy is converted into mechanical energy by rack and pinion mechanism, electricity is produced by dc generator. And this power source has many applications as in agriculture, home application and street lighting and as an energy source for sensors in remote locations. This paper is all about generating electricity when people walk on the floor. Think about the forces you exert which is wasted when a person walks by. The idea is to convert the weight energy to electrical energy. The Power generating floor intends to translate the kinetic energy to the electrical power. Energy Crisis is the main issue of world these days. The motto of this research work is to face this crisis somehow.

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CHAPTER – 1 INTRODUCTION N

This Chapter deals with the introduction of our project in a detailed manner, Future we will get into the analysis of the problem statement of our project and its objectives which will define the scope of the project.

1.1 Introduction

The usage of traditional power generation method such as burning of coal, wood, diesel etc is continuously depleting our natural resources such as fossil fuel which is the demand for power has exceeded supply due to the rising population. In addition to this the traditional method cause pollution. Has the potential to redefine urban space by adding a sense of fluidity and encouraging people to activate spaces with their movement. The crowded farm floor is composed of standard parts that are easily replicated but it is expensive to produce at this stage. This technology would facilitate the future creation of new urban landscape athletic field with a spectator area, music halls, theatres, nightclubs and large gathering space for rallies, demonstrations and celebration. 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 and China where the roads, railway stations, bus stands, temples etc. are all over crowded and millions of people move around the clock. This whole human bio energy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries. Walking across a “Crowd Farm”, floor, then will be fun for idle people who can improve their health by exercising in such farms with earning. The electrical energy generated at such farms will be useful for nearby application. For an alternate method to generate electricity there are number of methods by which electricity can be produced, out of such methods footstep energy generation can be an effective method to generate electricity. Walking is the most common activity in human life. When a person walks, he loses energy to the road surface in the form of impact, vibration, sound etc. Due to the transfer of his weight to the

road surface, through foot falls on the ground during every step. This energy can be tapped and converted in the usable form such as in electrical form. This device, if embedded in the footpath, can convert foot impact energy into electrical form.

1.1.1 Piezoelectricity

Piezoelectricity was discovered in 1880 by Pierre and Paul-Jacques Curie, who found that when they compressed certain types of crystals including quartz, tourmaline, and Rochelle salt along certain axes, a voltage was produced on the surface of the crystal. This effect is known as piezoelectric effect. Piezoelectricity is a form of electricity created when certain crystals are bent or otherwise deformed. These same crystals can also be made to bend slightly when a small current is run through them encouraging their use in instruments for which great degrees of mechanical control are necessary. A piezoelectric crystal consists of multiple interlocking domains which have positive and negative charges. These domains are asymmetrical within the crystal lattice, causing the lattice as a whole to be electrically neutral. When stress is put on the crystal, the symmetry is slightly broken generating voltages.

1.1.2 Footstep Power Generation Using Piezoelectric Sensors

There are a number of approaches being used to generate alternative power supply.

1.1.2.1 Piezoelectric Smart Road Sensor

One among the other methods is piezoelectric smart road sensor. Here smart roads refer to the roads on which piezoelectric sensors can be placed in order to generate electricity. When any vehicle moves on the roads it produces very small vertical deformations and vibrations on the roads. The increasing demand of the electricity forces us to think about harvesting that vibration energy from vehicles which is wasted otherwise.

1.1.2.2 Flooring Tiles

Japan has already started experimentation with the use of piezoelectric effect for energy generation. They implement piezoelectric effect on the stairs of the bus. Thus, every time passenger steps on the tiles; they trigger a small vibration that can be stored as energy. The flooring tiles are made up of rubber which can absorb the vibration. This vibration generates when running or walking on it. Under these tiles piezoelectric material is placed. When the movement is felt by the material, they can generate the electricity. This generated energy is simultaneously stored into the battery. Generated electricity we can use the lighting of lamp or street light. Energy is generated by step of one human being is too less but if number of steps increases ultimately energy production also increases.

1.1.2.3 Dance Floors

Europe is another one of the countries which started experimenting use of piezoelectric crystal for energy generation in night clubs. Floor is compressed by the dancer's feet and piezoelectric materials make contact and generate electricity. Generated electricity is nothing but 2-20 watt. It depends on impact of the dancer's feet.

1.1.3 Available Techniques in Past

Generation of electricity using foot step is not a new concept there are many techniques available in the past for this purpose, some of which are

- Flywheel and gear arrangement
- Staircase Faraday's law arrangement
- Rack and pinion
- Chain sprocket arrangement

These all techniques are proved to be very costly and were not practically feasible in day to day real life.

1.1.3.1 Flywheel and gear arrangement

The thrust power is transformed into electrical energy by means of a suitable driven device. The racks are attached to the sloping floor. The spring tide is

used to release the load and restore operational the same tilted position. The pinion shaft is connected to the bearing by end bearing. Large gears also engage the pinion shaft and operate at the same speed. The largest sprocket is attached to the small gear ring via the chain. This large sprocket is used to convert the torque of the smallest sprocket. The smallest sprocket rotates in a direction similar to the direction of rotation of the high sprockets on the front and rear. This action is free like a bicycle pedal.

1.1.3.2 Staircase and faraday's law arrangement

People who go up or down the stairs will apply impact force or push up the stairs in the spring. This impact pressure energy can be used to operate the power flywheel through a one-way ratchet device using a chain and sprocket drive. The flywheel stores energy and uses it for continuous rotation of the generator pulley and belt drive system. It consists of three steps that steps the staircase box unit which is shown in the below figure 1.1.3.2. All stages are coupled to the large gear, which in turn is coupled to the small gear through the chain drive. The small gear in turn is coupled to the ratchet wheel, allowing only the unidirectional rotation of the ratchet wheel of the sleeve shaft. Likewise, every two large gear wheels are individually coupled to the same single shaft through the separate chain mechanism. When a person is walking on the individual stage, while this particular pair of gears rotate the ratchet wheel and therefore the main shaft rotates at this time. Therefore, the sum of the total accumulation of rotational energy is carried out on a single main axis. The main shaft is only installed with the wheel that continues to rotate at high speed. The flywheel using the drive belt coupled to the generator pulley rotates the generator field rotor and the EMF that is generated in the stator winding.

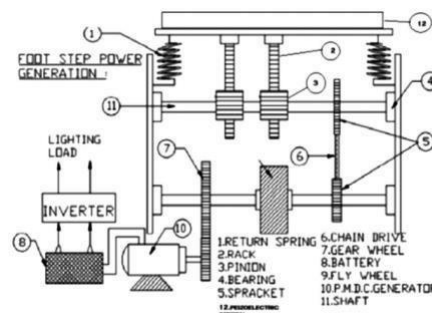


Fig:1.1.3.2 Staircase and faraday's law arrangement

1.1.3.3 Rack&PinionandchainSprocketarrangement

Racks and pinions are a type of linear actuator that includes a pair of gears that convert rotational motion into linear motion. The circular gear engrosses teeth on a linear bar "gear", the frame. Rotational movement applied to the pinion would displace the rack to one side, to the limit of its travel.

1.1.3.4 ChainSprocket

A pinion is a reported wheel with teeth that makes net with a chain, a path or other punctured or indented material. It differs from a gear that the pinions do not mesh directly with each other, and differs from a pulley in which the gears have teeth and the pulleys are smooth. Here, the spring-and-rack arrangement is attached to the inclined passage. The method of releasing the load spring and returning the tilt operation at the same position is used. The pinion shaft is connected to the bearing by end bearing the larger gear also involves the pinion shaft so that it runs at the equivalent speed. The larger gear is attached to the small ring gear by means of the chain (ring). This large pinion is used to transmit the torque of the smaller sprocket. The small pinion rotates in the same direction as the direction of rotation of the front and large rear sprockets. This action locks up like a bicycle pedal. The wheel and sprocket are coupled to the smaller sprocket shaft.

1.2 Description of project

Footstep energy generation can be an effective method to generate electricity. Walking is the most common activity in human life. When a person walks, he loses some energy to road surface in the form of impact, vibration and sounds etc due to transfer of his weight on to the road surface, through foot falls on the ground during every step result in losing kinetic energy. This kinetic energy can be tapped and converted into usable form such as in electrical form. This procedure contains number of simple configurations that are fitted under the walking floor. Walking on this platform, body weight compresses the piezoelectric transducers that produce electric power. The current generated is stored in the battery. Greater circulation of people will generate more power. A piezoelectric transducer is an electrical generator that produces direct current when pressure is applied upon it.

This project is to develop a new source of renewable energy with low-cost budget with the help of Atmega 328p as the microcontroller. The footstep power generation system is to capture the typically wasted energy surrounding a system and transforming it into electrical energy. The technique used in gaining the energy is via piezoelectric materials. This method employs piezoelectric components where deformations created by dissimilar means are directly transformed into electrical charge through piezoelectric effect. Afterwards, the electrical energy can be regulated or stored for further use. In this project, we are generating electrical power as a non-conventional method by simply walking or running as the input source. The LCD will then display the amount of voltage generated by the circuit. The highest voltage generated in this project is 4.31 V. Then, the voltage stored in the battery can be used to charge the mobile phone. The results shown that this footstep generation system is very important for utilization in today's world.

The system allows for a platform for placing footsteps. The piezo sensors are mounted below the platform to generate voltage from footsteps. The sensors are placed in such an arrangement so as to generate maximum output voltage. This is then provided to our monitoring circuitry. The circuit is a microcontroller-based monitoring circuit that allows user to monitor the voltage and charges a connected

battery by it. It also displays the charge generated and displays on an LCD display. Also, it consists of a USB mobile phone charging point where user may connect cables to charge mobile phone from the battery charge. Thus, we charge a battery using power from user footsteps, display it on LCD using microcontroller circuit and allow for mobile charging through the setup.

1.3 Problem Statement

The problem addressed by the footstep power generation project using a microcontroller is the need for sustainable and renewable energy sources in various settings. With the increase in global energy demand and the negative impact of traditional energy sources on the environment, there is a need to develop alternative energy sources that are both environmentally friendly and efficient.

Footstep power generation systems offer a promising solution to this problem, as they can generate electricity using human motion, particularly in crowded areas such as shopping malls, airports, and stadiums. However, the existing footstep power generation technologies have some limitations in terms of efficiency, reliability, and cost-effectiveness. Therefore, the problem statement for this project is to design and develop a footstep power generation system using a microcontroller that is efficient, reliable, and cost-effective, and can generate sufficient electricity to power various devices and applications. This system would help address the need for sustainable and renewable energy sources, particularly in crowded areas, and contribute to reducing the negative impact of traditional energy sources on the environment.

The project on footstep power generation using a microcontroller aims to address the need for sustainable and renewable energy sources by developing a system that can generate electricity using human motion. The project involves researching and analyzing existing footstep power generation technologies, designing and developing a power generation system using a microcontroller, programming the microcontroller, testing and optimizing the system, and documenting and presenting the project.

The problem statement for the project is the need for sustainable and renewable energy sources in various settings, and the limitations of existing footstep power generation technologies in terms of efficiency, reliability, and cost-effectiveness. The project aims to design and develop an efficient, reliable, and cost-effective footstep power generation system that can generate sufficient electricity to power various devices and applications and contribute to reducing the negative impact of traditional energy sources on the environment.

- As technology is developed use of electronic equipment also increased
- Conventional methods of power generation becoming insufficient.
- It introduced a new problem, lack of power.
- There is a need arises for an alternative power generation method
- At the same time energy is wasted in many forms and one of them is due to the human locomotion

1.4 Objective of the project

In this foot step, power generation project is to convert foot step, walking and running energy into electrical energy. It is used to generate electricity from by walking on foot step. The need of electrical energy is increasing day by day. But power generation conventional resources are not enough for a total demand of electrical energy. Therefore, many researchers are working on non-conventional ways of electrical power generation. Footstep power generation system is also a non-conventional electrical energy production system. It converts mechanical energy of footsteps into electrical energy by using transducers. This power generation system can become very popular among countries like Pakistan, China, India. It can be implemented on roads, bus stations, and many public places.

- To generate the electricity through the human foot
- To provide electricity in rural area
- To promote the non-conventional energy source
- To save conventional energy sources

- To store the electricity for further use
- To produce electricity at cheapest cost

1.5 Scope of the project

The scope of a project on footstep power generation using a microcontroller could include the following:

Research and analyze existing footstep power generation technologies: The project would involve conducting research to understand how existing footstep power generation technologies work, their limitations and advantages. This research would be used to inform the design of a new footstep power generation system.

Design and development of the power generation system: The project would involve designing and developing a footstep power generation system using a microcontroller. The system would include sensors that can detect the pressure of the footstep, which would be used to generate electricity.

Programming of the microcontroller: The microcontroller would be programmed to control the power generation system. This would include setting up the sensor to detect the footstep and using the data from the sensor to control the power generation system.

Testing and optimization: Once the power generation system has been designed and developed, it would need to be tested to ensure that it works as expected. The system would be tested under different conditions, such as varying footstep pressure, to ensure that it is reliable and efficient. Any issues discovered during testing would be addressed, and the system would be optimized to improve its performance.

Documentation and presentation: Finally, the project would involve documenting the design, development, and testing process. This would include creating a report that describes the system and its performance, as well as presenting the project to stakeholders, such as the project supervisor, peers, and potential investors.

Overall, the project on footstep power generation using a microcontroller would aim to create a sustainable and renewable energy source that can be used to power various devices and applications. It would involve a multidisciplinary approach, combining engineering, programming, and design skills to develop an efficient and effective system.

1.6 Overall Summary of the Project

The project on footstep power generation using a microcontroller aims to address the need for sustainable and renewable energy sources by developing a system that can generate electricity using human motion. The project involves researching and analyzing existing footstep power generation technologies, designing and developing a power generation system using a microcontroller, programming the microcontroller, testing and optimizing the system, and documenting and presenting the project.

The problem statement for the project is the need for sustainable and renewable energy sources in various settings, and the limitations of existing footstep power generation technologies in terms of efficiency, reliability, and cost-effectiveness. The project aims to design and develop an efficient, reliable, and cost-effective footstep power generation system that can generate sufficient electricity to power various devices and applications and contribute to reducing the negative impact of traditional energy sources on the environment.

CHAPTER – 2 LITERATURE SURVEY

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2.1 Introduction

This chapter deals with the systematic study of papers and works from the older inventions and presentations of international journals and conferences and the data will be tabulated for a quick summary of revision. Through this, we have gained knowledge on correcting the mistakes and gained knowledge on factors that involved in future scopes.

2.2 Inference from literature survey

Baswaraj Gadgay, D.C Shubhangi, H Abhishek, IEEE, “Foot Step Power Generation Using Piezoelectric Materials” – (December 2021) As electrical energy utilization is expanding dramatically. Consequently, the need of a secure and financially reasonable force age and dissemination framework requests a specific interest. This paper proposes a model that utilizes human strolling, hopping and running as a well spring of energy and stores it for fundamental use. Such a model is able in demography that of a nation like India which has a particularly immense person on foot populace. This paper represents a technique for gathering this human headway energy with the utilization of piezoelectric sensor and shows an application with the put away energy for example to charge a cell phone safely and also used to glow an LED based on the motion using the passive infrared sensor. The ground response power (GRF) applied from the foot, when changed over to voltage by piezoelectric sensors is sufficiently fit to control a up a device. Progressive effort prompts a periodic voltage developed which with appropriate hardware can be utilized to charge a capacity battery. The force created by this method can likewise be utilized in essential application, for example, road lighting, notice sheets, exercise centers and different spaces of public area. It likewise advances efficient power energy and climate agreeable methodology towards energy age. In this paper we

have given the essential idea and configuration subtleties of this model and a fundamental execution of the equivalent.[1]

Joydev Ghosh; Supratim Sen; Amit Saha; Samir Basak, IEEE, "Electrical Power Generation Using Foot Step for Urban Area Energy Applications"- (August 2013)

In this paper we have presented the design methodology of electrical power generation using foot step for urban area energy applications. Man has needed energy at an increasing rate for his sustenance and well-being ever since he came on the earth. Due to this lot of energy resource have been exhausted and wasted. Proposal for the utilization of waste energy with foot power human locomotion is very much relevant and is very important for highly populated countries in INDIA and CHINA, where the roads, railway stations, bus stands and temples are overcrowded and millions of people moving around the clock. By using such principle, the energy can be utilized in the whole area where the mechanical energy is being converted to electrical energy.[2]

P. Hema Chandu; A. Venkata Vinay; K. N. D. Jagadeesh; S. S. V. Kanaka Raju; V. G. Mani Sharan, IEEE, "Foot Step Micro-Level Power Generation"- (December 2022) In this paper, we presented an ideology for designing & implementing micro-level power generation to achieve reliable & sufficient amounts of power by using piezo-electric transducers. Based on the principle of converting mechanical pressure into electrical energy. The main intention is to draw the required amount of power by using the mechanical press through sources like footsteps, and vehicles to produce and continuous power supply to satisfy our basic needs.[3]

Sanjit V K; Nirmitha S; Remya Jayachandran; Vijayadurga P; Yashaswini G Y, IEEE, "Parametric Analysis of Piezoelectric-Sensor Array In Foot Step Power Generation System" – (December 2022) The footstep power generation system using different configurations of piezo-sensors are analyzed in this paper. Energy generated by human walking, jumping and running is used as a source of energy which is converted to an equivalent electrical energy using piezoelectric effect. Experimental

analysis of circular type piezoelectric sensors connected in different configurations-series, parallel and combination of series-parallel and sensors of various diameters show that series-parallel combination generates more voltage and is stable compared to other configurations. Circular type piezo sensor model is developed in the COMSOL Multiphysics simulator which shows near performance with the experimental results.[4]

Rajesh Kumar Datta; Sazid Rahman, IEEE, “Power Generating Slabs: Lost Energy Conversion of Human Locomotive Force into Electrical Energy” – (December 2014) In the world of modern technology, newer sources of energy and new methods of power generation are two important areas of interest for researchers and engineers. Recently a new method is established to generate power from the lost energy of a human during his/her locomotive period. A piezoelectric sensor based costly product is available in some developed countries which can generate power from human locomotive force, but it is not suitable for countries like Bangladesh where power demand is very high but economy is not highly developed. In this paper we will explain the design and construction method of a “Power Generating Slab” which can be used to generate power by establishing anywhere of the walking zone of human (roads, stairs, pavements, dais etc). This is done in a low-cost process with locally available equipments (micro-generator, iron plate, rack pinion gear, free-wheeling system, spring etc). These slabs can easily sustain human weight when people walk along them. With a small deformation of spring, the weight (mechanical energy) of a human body is converted into electrical energy by rotating a micro-generator with the help of a ‘rotating shaft’ coupled with it. From each foot step almost 10V-12V is generated. This energy is stored in a rechargeable battery which can be used as a power source to drive loads. Assembly of some power generating slabs can give better result. This is a method which is reusable and it will run for a longer period.[5]

P.A. Harsha Vardhini; Matta Harsha Sri Vishnu Sai; Bhargavi Matta, IEEE, "Human Footstep Power Harvesting Systems using Piezoelectric Sensor Technology"- (March 2022) Power has a lot of application in our daily life and the technology made the devices to improve the application of natural power in many more efficient ways. Many ways exist to generate power. To generate electricity, in the smartest ways, footstep energy generation could be the efficient method for the generation of electricity. Man uses power whenever needed without thinking about the consequences to be faced in future. Due to this many of the resources have been diminished. We can convert the energies into usable forms such as electrical form and many other forms. This device saves power and has the capacity of converting energy produced by foot into the electrical form. Energy through pedal is an efficient source for power production. Man's kinetic energy is useful in many ways and also the power generation is easy and can be efficiently done. These technologies generate power for all electronic appliances.[6]

Agus Dwi Triono; Arthur Daniel Limantara; Edy Gardjito; Yosef Cahyo Setianto Purnomo; Ahmad Ridwan; Hery Lilik Sudar, IEEE, "Utilization of Pedestrian Movement on the Sidewalk as a Source of Electric Power for Lighting Using Piezoelectric Sensors" – (September 2018) In big cities, walking activity is very high, especially in the center of community activities such as trade centers, offices, and education. Therefore, a good pedestrian facility is needed regarding safety, comfort, and beauty. But now the pedestrian facility mostly becomes a five-times trading area or even a place to plant shade trees and also made as a parking location. The purpose of this research is to design the sidewalk design with the latest innovation, to attract the public to use the sidewalk to walk, by making the street as an independent power source by applying Piezoelectric Sensor Technology as energy conversion media, calculating the average power in every single step of pedestrian, and the average number of walkers. The results of this study can be seen that with the design of the sidewalk in such a way as to get, for every 1 step of footing produces a voltage of 6.8 V and power 0.000319 Watt when given 441 N style, the voltage will continue to increase as the force gets heavier in giving to piezoelectric, in this design the author uses 4 pieces of piezoelectric arranged parallel in one-piece media, with an average of 3207 steps per minute needed to be a source of energy.[7]

Ramanamma P; M. Jayanthi; Anuj M A; A. Dharmik Sai Reddy; Devu MaheswarReddy;G.PavanKalyanReddy,IEEE,“FootstepsBasedSustainableEnergyGeneration and Consumption System” – (February 2023) The interest for reasonableEnergy age and utilization is expanding step by step as thehuman populace isrelying more upon electronic gadgets for their everyday life. Hence, the need of a full-evidence and monetarily practical power age and circulation framework requests aspecific attention. This task proposes usage of human loco motion energy, whichalbeit extractible goes principally to squander. This demo offers a model that utilizeshuman strolling, hopping and running as a wellspring of energy and stores it forfundamental use. Such a model is able in a demography that of a nation like Indiawhich has such a colossal walker populace. This framework represents a techniquefor collecting this human headway energy with the utilization of piezoelectric sensorand exhibits a request with the put away energy i.e., to charge a cell phone safelyutilizingRFID.Thegroundresponseforce(GRF)appliedfromthefoot,whenswitched over completely to voltage by piezoelectric sensors is sufficiently able tocontrol up a gadget. Advanced effort prompts aperiodic voltage develop which withlegitimate hardware can be utilized to charge a capacity battery. The power deliveredby this method can likewise be used in fundamental application, for example, roadlighting, notice sheets, rec centres and different areas of public space. It likewiseadvances efficient power energy and climate cordial methodology towards energyage. In this undertaking we will give the essential idea and configuration restraints ofthismodeland afundamentalexecutionof the equal.[8]

Tom Josh V, Binoy Boban, Sijo MT, IJSRP, “Electricity Generation from Footsteps; ARegenerativeEnergyResource”- (March2013.)Inthisresearchpaperauthormanufactured) a model made from stainless steel, recycled car tires and recycledaluminium, also includes a lamp embedded in the pavement that lights up every timea step is converted into energy (using only 5 percent of the generated energy). A slabof concrete harnesses kinetic energy whenever it is stepped on. This energy, createdby 5millimetres of flex in the material, is then either stored by lithiumpolymerbatteries contained within the slabs or transmitted immediately to streetlights or

other electronics located close by. The average square of pavement produces about 2.1

watts of electricity. And according to author, any one square of pavement in a high-foot traffic area can see 50,000 steps a day. Based on this data, only five units of Pavegen pavement can be enough to keep the lights on at a bus stop all night. [9]

Shiraz Afzal, Farrukh Hafeez, IJART, "Power Generation Footstep" - (April 2014.) This paper is all about generating electricity when people walk on the floor. If we are able to design a power generating floor that can produce 100W on just 12 steps, then for 120 steps we can produce 1000 Watt and if we install such type of 100 floors with this system then it can produce 1 Mega Watt. As a fact only 11% of renewable energy contributes to our primary energy. If this project is deployed, then not only we can overcome the energy crises problem but this also contributes to create a healthy global environmental change. In this project a gear system is attached with a flywheel which causes to rotate the dynamo as the tile on the deck is pressed, the power that is created is saved in the batteries. In addition we will be able to monitor and control the amount of electricity generated. [10]

Vipin Kumar Yadav, Vivek Kumar Yadav, Rajat Kumar, And Ajay Yadav, IJSER, "Power Generation Through Step" - (May 2014) In these research paper authors used equipment's with following specification: Motor Voltage: 10-volt Type: D.C. Generator, RPM: 1000 rpm, Gear 1 Mild Steel, No. of teeth: 59 (big gear), No. of teeth: 36 (small gear), Type: Spur Gear, No. of gear used: 2 Spring 1- Load bearing capacity: 60-90kg, Mild Steel, Total displacement: 5 inch, bearing 1- Type: Ball bearing, bearing no. N35, Shaft 1- Diameter: 15 mm- Material: Mild steel author concluded that with this method energy conversion is simple efficient and pollution free. [11]

C. Nithiyeshkumar, K. Gowtham, M. Manikandan, P. Bharathkanna, T. Manoj Kumar, IJLTET, "Power Generation in Automobile Suspension System" - (January 2015.) In this research paper authors studied three methods of foot step power generation namely piezoelectric method, rack and pinion method and fuel piston method comparatively and found that the rack and pinion mechanism is more efficient with

moderate cost of operation and maintenance. In current scenario, power is the primary need for the survival of human life. Researches shows that large amount of power is generated from non-renewable energy resources compared to that of renewable energy resources. The extensive usages of available resources in recent years created a demand for the future generation. To overcome this problem, we need to utilize renewable energy sources for power generation and conservation. Therefore, the focus now is shifting more and more towards the renewable source of energy, which are essential and non-polluting. In this paper it is mainly focused to provide the detailed survey of power generation mechanism from renewable energy resources includes piezoelectric mechanism, rack and pinion mechanism, piston mechanism and the roller mechanism.[12]

Md. Azhar, Zitender Rajpurohit, Abdul Saif, Nalla Abhinay, P. Sai Chandu, IJMETMR "Generation Of Electrical Energy From Footstep Using Rack And Pinion Mechanism" – (June 2017). In this research paper authors used regulated 5V power, 500mA power supply. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer. A rack and pinion are a type of linear actuator including a pair of gears which convert rotational motion into linear motion. The "pinion" engages teeth on the rack. In this paper, since the power generation using foot step get its energy requirements from Non-renewable source of energy. There is no need of power from external sources (mains) and there is less pollution in this source of energy. It is very useful to the places like all roads and as well as all kind of footstep which is used to generate the non-conventional energy like electricity. [13]

RichMeier;NicholasKelly;OmriAlmog;PatrickChiang,IEEE“APiezoelectricEnergy-harvesting Shoe System for Podiatric Sensing” – (August 2014) This paperprovidesanenergy-harvesting,shoe-mountedsystemformedicalsensingusingpiezoelectrictransducersforgeneratingpower.Theelectronicsareintegratedinsidea conventional consumer shoe, measuring the pressure of the wearer's foot exertedon the sole at six locations. The electronics are completely powered by the harvestedenergy from walking or running, generating 10-20 μJ of energy per step that is thenconsumed by capturing and storing the force sensor data. The overall shoe systemdemonstrates that wearable sensor electronics can be adequately powered throughpiezoelectric energy-harvesting.[14]

DurgadeviS;AnbazhaganR;HariniR;VimonishaA,IEEE,“AReviewofPerformance Optimization of Footstep Energy Harvester” – (March 2022) The energydemand and consumption are continuously increasing and in exponential steps. Thisrequirementleadstohighdemandofgenerationofelectricitybysomeotherharmlessandeco-friendlyway.Thus,therecentresearchscenarioseeksforsustainabilityofenergyfrommany alternatesources.Thereareseveralproposalsdescribed by various researchers for generation of green and renewable energy. Inthis work, energy generation is proposed by effective conversion of waste energyextracted from the foot step movements and this method of energy generation ishighly appreciated and followed in most of the countries and also in India. The placeslike railway station, temples, malls and etc., have more mobility of people and whichare considered to be theimportant sources offoot energy. Thebestway to extractthefootenergyissuggestedusingpiezoelectricbasedtechnology,wherethefloorsensorsareusedtosensethepressureexertedonaparticularplaceandpiezoelectric sensors are used to convert them into an electrical quantity. AppropriateDC-DC converter is then used for increasing the magnitude of power generated andsuitableoptimizationtechniqueisbeingsuggestedtoimprovetheperformanceparameters of the generated power in order to enhance the quality of output. Theboosted voltage is then stored and available as an energy source whenever required.The adaptability of piezo based technique in a real-time environment and its benefitsarecomparatively analyzedwithother sourcesof renewable energy.[15]

CHAPTER-3

HARDWARE AND REQUIREMENTS ANALYSIS

3.1 Introduction

This chapter explains about the equipment used in developing the device which helps to control the foot step power generation equipment's using microcontroller, such as Atmega328P, Piezoelectric sensors, Rechargeable battery, 16*2 LCD, Mobile circuit charger, Capacitor, Diode, Switch, and jumper wire and their pinouts are explained in detail.

3.2 Atmega328P

The ATmega328 is a single-chip microcontroller created by Atmel in the mega AVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core.

ATMEGA328P is a high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards.

The ATMEGA328P-PN is a popular microcontroller due to it being a major component in the Arduino board products. The ATMEGA328P-PN is the 8-bit RISC heart of the Arduino Uno and Nano, with a maximum clock frequency of 20MHz, 32KB program FLASH, and 2KB of RAM. It is shown in the figure 3.2.

ATMEGA328P Pinout

ARDUINO PINS		ATMEGA328P PIN DETAILS WITH ARDUINO FUNCTIONS						ARDUINO PINS	
Reset	(PCINT14/RESET)	PC6	Pin1		Pin28	PC5 (ADC5/SC/L/PCINT13)		Analog Input 5	
Digital Pin 0 (RX)	(PCINT16/RXD)	PD0	Pin2		Pin27	PD4 (ADC4/SDA/PCINT12)		Analog Input 4	
Digital Pin 1 (RX)	(PCINT17/TXD)	PD1	Pin3		Pin26	PD3 (ADC3/PCINT11)		Analog Input 3	
Digital Pin 2	(PCINT18/INT0)	PD2	Pin4		Pin25	PC2 (ADC2/PCINT10)		Analog Input 2	
Digital Pin 3 (PWM)	(PCINT19/OC2B/INT1)	PD3	Pin5		Pin24	PC1 (ADC1/PCINT9)		Analog Input 1	
Digital Pin 4		PD4	Pin6		Pin23	PC0 (ADC0/PCINT8)		Analog Input 0	
Vcc		Vcc	Pin7		Pin22	GND		GND	
GND		GND	Pin8		Pin21	AREF		Analog Reference	
Crystal	(PCINT6/XTAL1/TOSC1)	PB6	Pin9		Pin20	AVCC		Vcc	
Crystal	(PCINT7/XTAL2/TOSC2)	PB7	Pin10		Pin19	PB5 (SCK/PCINT5)		Digital Pin 13	
Digital Pin 5 (PWM)	(PCINT21/OC0B/T1)	PD5	Pin11		Pin18	PB4 (MISO/PCINT4)		Digital Pin 12	
Digital Pin 6 (PWM)	(PCINT22/OC0A/AIN0)	PD6	Pin12		Pin17	PB3 (MOSI/OC2A/PCINT3)		Digital Pin 11(PWM)	
Digital Pin 7	(PCINT23/AIN1)	PD7	Pin13		Pin16	PB2 (SS/OC1B/PCINT2)		Digital Pin 10(PWM)	
Digital Pin 8	(PCINT0/CLKO/JCP1)	PB0	Pin14		Pin15	PB1 (OC1A/PCINT1)		Digital Pin 9(PWM)	

Fig:3.2 Atmega328P Microcontroller

Features:

- Highperformance,lowpowerAVR®8-bitmicrocontroller
- AdvancedRISCarchitecture
- 131powerfulinstructions-mostsingleclockcycleexecution
- 32×8generalpurposeworkingregisters
- Fullystaticoperation
- Upto16MIPSthroughputat16MHz
- On-chip2-cyclemultiplier

Highendurancenon-volatilememorysegments

- 32Kbytes of in-system self-programmable flash program memory
- 1Kbytes EEPROM
- 2Kbytes internal SRAM
- Write/erase cycles: 10,000 flash / 100,000 EEPROM
- Optional boot code section with independent lock bits
- In-system programming by on-chip boot program
- True read-while-write operation
- Programming lock for software

securityPeripheralfeatures

- Two 8-bit Timer/Counters with separate prescaler and compare mode

- One 16-bit Timer/Counter with separate prescaler, compare mode, and capture mode
- Realtime counter with separate oscillator
- Six PWM channels
- 8-channel 10-bit ADC in TQFP and QFN/MLF package
- Temperature measurement
- Programmable serial USART
- Master/slave SPI serial interface
- Byte-oriented 2-wire serial interface (Philips I²C compatible)
- Programmable watchdog timer with separate on-chip oscillator
- On-chip analog comparator
- Interrupt and wake-up on pin change
- Special microcontroller features
- Power-on reset and programmable brown-out detection
- Internal calibrated oscillator
- External and internal interrupt sources
- Six sleep modes: Idle, ADC noise reduction, power-save, power-down, standby, and extended standby

3.2.1 Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor.

The Arduino Nano is shown in the below fig. 3.2.1 is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the ArduinoSoftware integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.

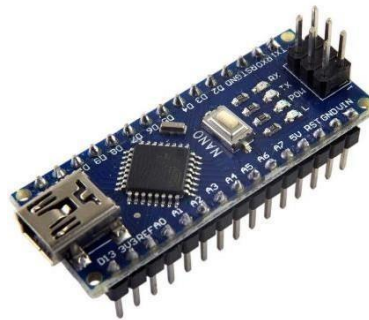


Fig:3.2.1 Arduino Nano Atmega328P Microcontroller

3.3 Piezoelectric Sensor

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal. The layers of a piezoelectric sensor are shown in the fig. 3.3.1.

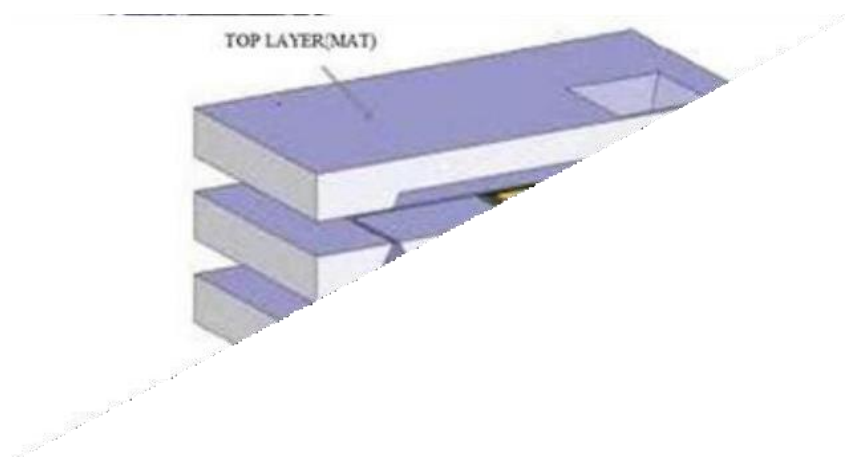


Fig:3.3.1 Piezoelectric sensor

Piezoelectric sensors are versatile tools for the measurement of various processes. They are used for quality assurance, process control, and for research and development in many industries. Pierre Curie discovered the piezoelectric effect in 1880, but only in the 1950s did manufacturers begin to use the piezoelectric effect in industrial sensing applications. Since then, this measuring principle has been increasingly used, and has become a mature technology with excellent inherent reliability.

They have been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a tilt sensor in consumer electronics or a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. These sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built-in miniature piezoelectric sensor as shown in the figure 3.3.2.

The rise of piezoelectric technology is directly related to a set of inherent advantages. Piezoelectric sensors have proved to be versatile tools for the measurement of various processes. The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to 10^6 N/m^2 . [Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This is the reason why piezoelectric sensors are so rugged, have an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate or tourmaline) have an extreme stability even at high temperature, enabling sensors to have a working range of up to 1000°C . Tourmaline shows pyroelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezoceramic materials.]

One disadvantage of piezoelectric sensors is that they cannot be used for truly static measurements. A static force results in a fixed amount of charge on the piezoelectric material. In conventional readout electronics, imperfect insulating materials and a reduction in internal sensor resistance causes a constant loss of electrons and yields a decreasing signal.

Elevated temperatures cause an additional drop in internal resistance and sensitivity. The main effect on the piezoelectric effect is that

with increasing pressure loads and temperature, the sensitivity reduces due to twin information. While quartz sensors must be cooled during measurements at temperatures above 300 °C, special types of crystals like GaPO₄ gallium phosphates show no twin information up to the melting point of the material itself.

However, it is not true that piezoelectric sensors can only be used for very fast processes or at ambient conditions. In fact, numerous piezoelectric applications produce quasi-static measurements, and other applications work in temperatures higher than 500 °C. Piezoelectric sensors can also be used to determine aromas in their by simultaneously measuring resonance and capacitance. Computer controlled electronics vastly increase the range of potential applications for piezoelectric sensors. Piezoelectric sensors are also seen in nature. The collagen in bone is piezoelectric, and is thought by some to act as a biological force sensor. Piezoelectricity has also been shown in the collagen of soft tissues such as the Achilles tendon, aortic walls, and heart valves.

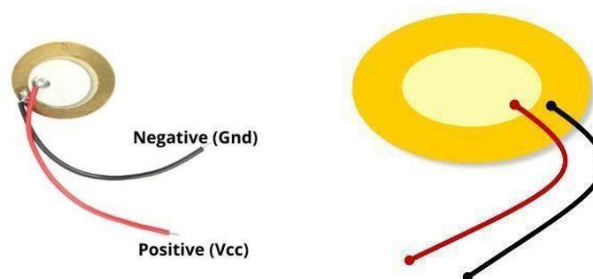


Fig:3.3.2 Piezoelectric sensor

3.4 RECHARGEABLE BATTERY

The lead-acid battery is a type of rechargeable battery first invented in 1859 by French physicist Gaston Plante. It is the first type of rechargeable battery ever created. Compared to modern rechargeable batteries, lead-acid batteries have relatively low energy density. Despite this, their ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by starter motors. Lead-acid batteries suffer from relatively short cycle lifespan (usually less than 500 deep cycles) and overall lifespan (due to the "double sulfation" in the discharged state).



Fig:3.4 Rechargeable battery

This is a rechargeable lead-acid battery which is displayed in the above figure. 3.4.4V 1.5A Rechargeable sealed lead acid battery. They are also commonly known as sealed batteries or maintenance-free batteries. It is made of a number of lead-acid cells wired in series in a single container. Lead-acid cells have two plates of lead hanging in a fluid-like electrolyte solution of sulfuric acid. We can use this type of battery in any position or orientation we like without the fear of spillage. The cover of the battery is built from polypropylene material. Thus, prevent the battery from being impacted in harsh conditions. Also, this battery does not require any water top-up throughout its service life.

The sealed lead acid battery is a 12-volt motorcycle battery and has six cells and is made up of a plastic case. Each cell contains a set of positive and negative plates

that are immersed in a solution of dilute sulphuric acid, which is known as the electrolyte. Every cell has around 2.1 volts when it is fully charged. The six cells are connected to provide a fully charged 12.6-volt battery.

So how is it possible to stick the lead plates into the sulphuric acid and produce electricity? The battery makes use of an electrochemical reaction that converts the chemical energy into electrical energy. Each of the cells has plates that resemble a small square tennis racket. These are made with lead calcium or lead antimony. A paste that is referred to as active material is bonded to the plates. Sponge lead is used for the negative plates, and lead dioxide is used for the positive plates.

When there is an electrical load that is placed across the terminals of the battery, then it is in the active material that the chemical reaction with the Sulphuric acid takes place.

3.5 LCD Display

The term LCD stands for liquid crystal display shown in the below figure 3.5. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

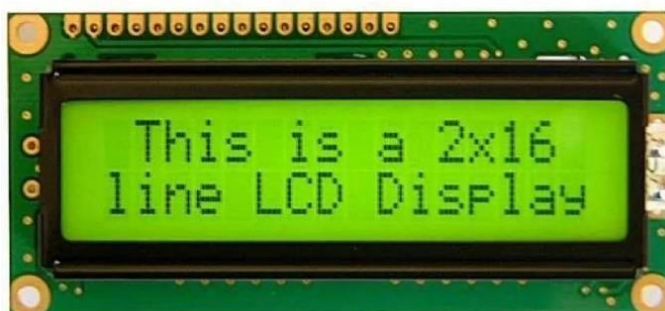


Fig:3.5 LCD Display

3.5.1 LCDDisplayPinConfiguration

- Pin1(Ground/SourcePin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
- Pin2(VCC/SourcePin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3(V0/VEE/ControlPin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- Pin4(RegisterSelect/ControlPin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtain either 0 or 1 (0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.
- Pin15(+ve pin of the LED): This pin is connected to +5V
- Pin16(-ve pin of the LED): This pin is connected to GND.

The pin diagram of the LCD Display is shown in the below figure 3.5.1



Fig:3.5.1LCDDisplayPin Diagram

3.6 Mobilecircuitcharger

The mobile circuit charger is shown in the below figure 3.6 support's Single CellLithiumBattery,includingLipoandLi-ion. ThemainfunctionistodisplaycharginganddischargingandgivingindicationslikeCharging:REDLEDBlinkfast,FullCharge:REDLEDBlinkSlow. ThereisanInternallyinstalledcharginganddischargingpower MOS Preset4.2V charging voltage,precision $\pm 1\%$.

It has a Max 8uA standby current and has Integration charging management anddischargingmanagementwithIntelligenttemperaturecontrolandexcessivetemperaturewith Integration output overvoltage protection, short circuit protection,overloadprotectionIntegrationoverchargingandover-dischargingprotection.



Fig: 3.6 Mobile circuit charger

3.7 Capacitor

A capacitor is a two-terminal electrical device that can store energy in the form of an electric charge. It consists of two electrical conductors that are separated by a distance. The space between the conductors may be filled by vacuum or with an insulating material known as a dielectric.

A capacitor which is shown in the below figure 3.7 is a device that stores electrical energy in an electric field by virtue of accumulating electric charges on two close surfaces insulated from each other. It is a passive electronic component with two terminals.

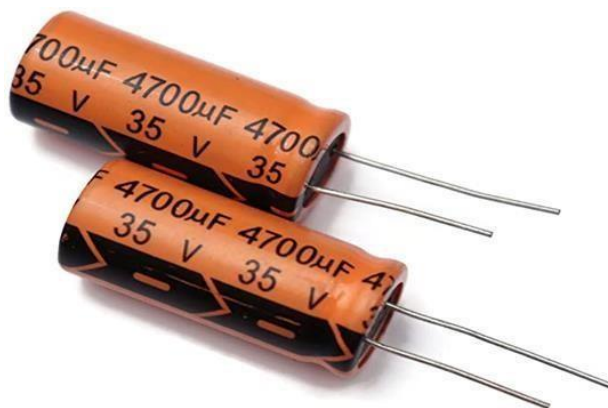


Fig:3.7 Capacitor

3.8 Diode

Diodes are one of the simplest of all semiconductor devices and also most useful device. A diode which is mentioned in the below figure 3.8 is known as an electronic two-terminal component that conducts current in one direction only. An ideal diode in one direction would have zero resistance and infinite resistance in a reverse way. At the same time, diodes cannot reach zero or infinite resistance in the real world. Instead, in one direction, a diode would have negligible resistance (to allow current flow) and very high resistance in the reverse direction (to avoid current flow). A diode is essentially like an electronic circuit switch. The Diode is known to be "forward biased" when current is performed in this direction. The reverse barrier breaks down over this level. The voltage at which this separation occurs is termed the "reverse voltage breakdown."

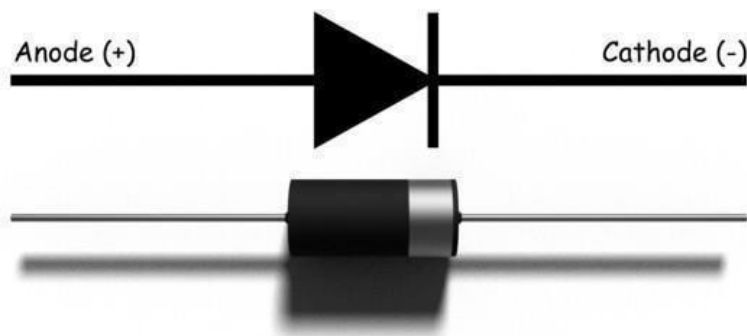


Fig: 3.8 Diode

No majority carriers across the junction at that point, and instead they travel away from the junction. Moreover, a diode blocks the current flow as it is distorted in reverse. Consequently, there is a tiny current running from positive to negative side through the Diode. The amplitude of this current is marginal because the number of carriers with minority charges in the Diode is minimal. When attached in the reverse direction (i.e. the "high resistance" direction) inside a circuit, the Diode is said to be "reverse biased." This current is termed the current of reverse saturation. If the reverse voltage across a diode increases above a secure value, several covalent bonds get broken to contribute a considerable number of free electron-hole pairs in

the Diode, and the process is cumulative. The considerable number of such charging carriers generated in the Diode would contribute a substantial reverse current. If this current is not controlled by an external resistance connected to the diode circuit, the Diode can be permanently destroyed. So, Diode is added in many places in this device to prevent above-mentioned conditions.

3.9 Jumper Wires

The term "jump wire" is shown figure 3.9 (also known as jumper wire, or jumper) refers to a conducting wire or set of wire, with a connector or pin at either end in a cable (or sometimes without them – simply "tinned"). It provides an electrical connection between two points in a circuit, typically used to connect, without soldering, the components of a breadboard or other prototype or test circuit, internally or with other equipment or components. Individual jump wires are fitted by inserting with their "end connectors" into the slots provided in a circuit board, the header connector of a circuit board, or a piece of test equipment. In our device, we have used jumper wires to connect between points.

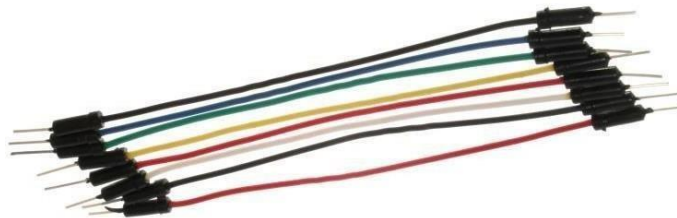


Fig:3.9 Jumper Wires

CHAPTER– 4

DESCRIPTION OF EXISTING AND PROPOSED SYSTEM

4.1 Introduction

In this chapter, we discuss on the principle and methodologies followed in the existing system. Based on the case study we will demonstrate the feature and its extractions in a proper manner. Our proposed methodologies will be discussed in detail with their efficiency graphs. Based on the advantages of the proposed system efficiency of the project will be determined.

4.2 Existing Methodology

A working model of Footstep Power Generation is demonstrated in this project, the basic working of this model has been presented as a block diagram. To implement this model four piezoelectric sensors that are reconnected in series to increase the voltage output, this sensor generates AC voltage which is transferred to the bridge rectifier. The output voltage from the sensor can be of two types because it produces AC voltage:

Positive: When positive voltage is received then it is passed into the forward bias mode which will in turn charge the battery.

Negative: When a negative voltage is received then it is transferred to the reverse bias of the bridge rectifier.

This way no voltage loss is observed during a complete cycle. An additional resistor of 470 Ohm is placed in series along with a capacitor of 4.7 mF with the LED to make the glow more noticeable.

The block diagram of the existing methodology is shown in the figure 4.2.1

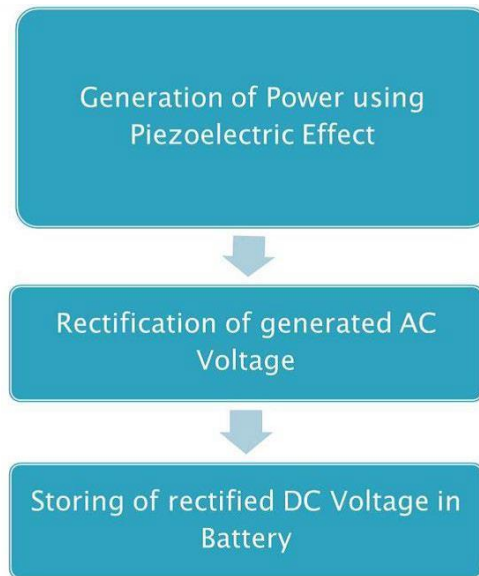


Fig:4.2.1 Block diagram of Existing Project

In the final developed model, four piezoelectric sensors are coupled in series to increase the output voltage as shown in the below figure 4.2.2. The voltage produced after applying force on the piezoelectric sensor is AC and therefore it travels through the bridge rectifier to avoid any loss of voltage. The positive and negative voltages are utilised to charge the rechargeable battery. A 4.7 μF capacitor along with a 470 Ω resistor is connected in series with the LED to indicate the electricity produced by applying force, this capacitor also helps in retaining the glow of electricity. Now, to further charge a device using the produced electricity we place one IN4007 diode in forward biased mode, this ensures the flow of current in only in one direction and hence minimizing current loss. For charging a mobile station we further connect this circuit to 7805 Voltage Regulator IC which can accept voltage ranging from 9v to 18v and outputs a voltage of 5v, this charging is only enabled when the switch is turned on. Two capacitors of 470 μF are connected on the input and output pins of 7805 Voltage Regulator IC to make the current flow smooth. To obtain a female USB A port we have connected a booster convertor which can be used to charge a device. The hardware model of the existing methodology is shown in the below figure 4.2.3.

Fig:4.2.2CircuitDiagramofExistingMethodology

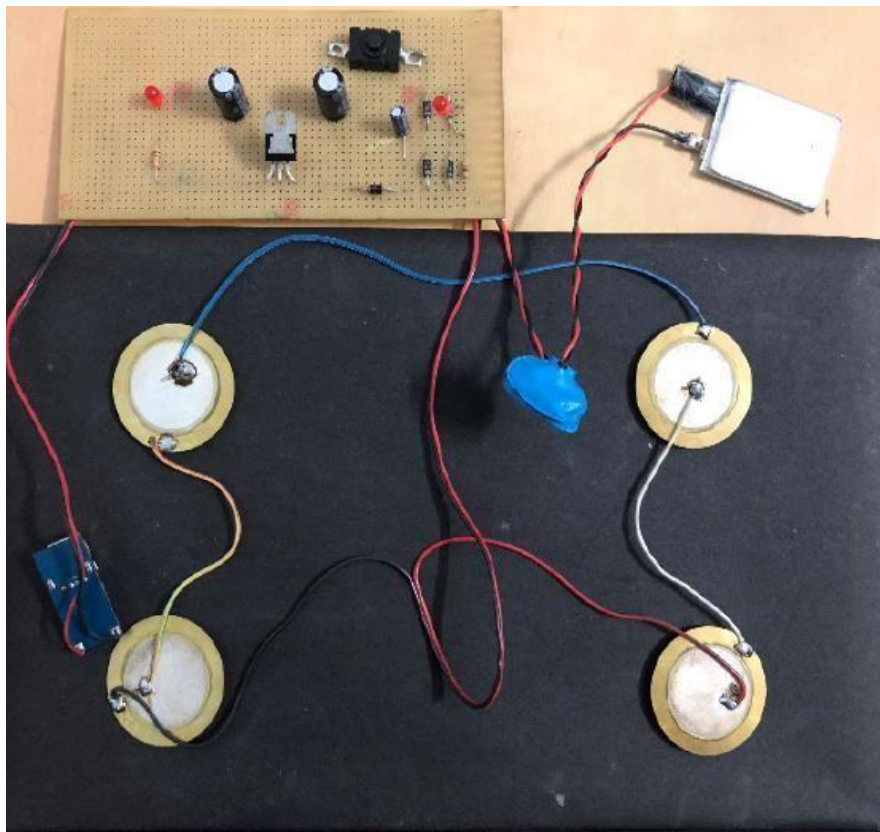


Fig:4.2.3HardwaremodelofExistingMethodology

4.3 Proposed Methodology

This project is used to generate voltage using footstep force. The proposed system works as a medium to generate power using force. This project is very useful in public places like bus stands, theatres, railway stations, shopping malls, etc. So, these systems are placed in public places where people walk and they have to travel on this system to get through the entrance or exists.

Then, these systems may generate voltage on each and every step of a foot. For this purpose, piezoelectric sensor is used in order to measure force, pressure and acceleration by its change into electric signals. The block diagram of the proposed project was mentioned in below figure 4.3. This system uses voltmeter for measuring output, led lights, weight measurement system and a battery for better demonstration of the system.

- Whenever force is applied on piezoelectric sensor, then the force is converted into electrical energy.
- In that movement, the output voltage is stored in the battery
- The output voltage which is generated from the sensor is used to drive DC loads

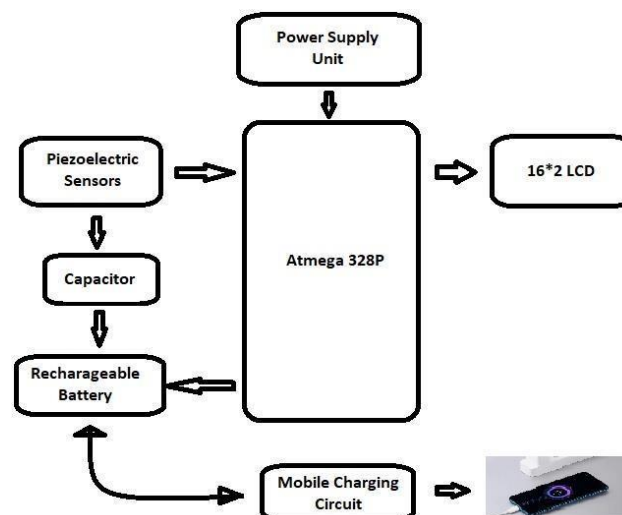


Fig:4.3 Block Diagram of Proposed Methodology

4.4 Working Principle

In this foot step power generation project is designed to convert foot step, walking and running energy into electrical energy. It is used to generate electricity from by walking or running on footstep. The demand of electrical energy is increasing day by day. But power generation conventional resources are now not enough for total demand of electrical energy. Therefore, many researchers and engineers are working on non-conventional ways of electrical power generation. Footstep power generation system is also a non-conventional electrical energy production system. It converts mechanical energy of footsteps into electrical energy by using transducers as shown in the below figure 4.4. This power generation system can become very popular among populated countries like Pakistan, China, India. It can be implemented on roads, bus stations and many public places. Although this system is little bit expensive, but it can make a huge difference in electrical power generation of country.

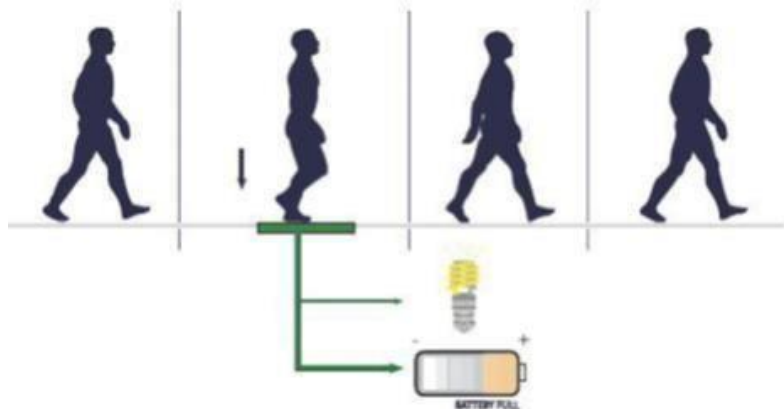


Fig: 4.4 Working

Foot step power generation system basically converts force energy of foot into electrical energy by using piezoelectric sensor. Piezoelectric sensor is transducer which converts force energy into electrical energy.

Working of footstep power generation system consists of following main points:

- Piezoelectric sensor interfaced with microcontroller and used as a transducer to convert force energy into electrical energy
- It is consisting of a large number of piezoelectric sensors connected in series. Kinetic energy of series connected transducers is converted into electrical energy.
- Voltages generated by piezoelectric sensors are feed to circuit elements to get proper output.
- Output energy is stored in batteries.

With application of force on piezoelectric transducer, it converts force into electrical energy. A Cripple neutralizer controls the fluctuation in generated voltages and unidirectional current controller controls the battery charging current with the help of microcontroller. The voltage generated by series of sensors is stored in Lead Acid batteries. This voltage can be used to drive either DC or AC loads. For AC loads, pure sine wave inverter circuit is used. Inverter converts dc voltages stored in lead acid batteries in 220-volt AC. AC voltage can be used to drive AC loads. User can use any type of inverter according to his/her requirement like pure sine wave inverter, square wave inverter and modified sine wave inverter. Rating of battery charger also depends on amount of power generation from foot step. ATMEGA 328P microcontroller displays the amount of voltage generated by the piezo sensors on the LCD display.

4.4.1 Implementation of Proposed Project

To implement a footstep power generation system using the Atmega 328P microcontroller, the following steps could be taken:

Gather the required components: The components needed for the project include the Atmega 328P microcontroller, sensors to detect the footstep pressure, a power generation circuit, and other supporting components such as resistors, capacitors, and LEDs.

Design the circuit: A schematic for the circuit can be created using software such as Eagle PCB. The circuit should include the Atmega 328P microcontroller, the sensors, and the power generation circuit.

Develop the software: The software for the microcontroller can be written using an Integrated Development Environment (IDE) such as Atmel Studio or Arduino IDE. The program should include the code to read the sensor data and generate electricity using the power generation circuit.

Test the system: Once the software and circuit have been developed, the system should be tested to ensure that it works as expected. The system can be tested using a load such as an LED, and the output voltage and current can be displayed on the LCD display.

Optimize the system: If any issues are discovered during testing, the system should be optimized to improve its performance.

This can include adjusting the sensor placement or the power generation circuit.

4.5 Architecture of the Proposed Project

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. Two possible connections were tested parallel and series connections. The parallel connection did not show significant increase in the voltage output. With series connection, additional piezo-film results in increased voltage output but not in linear proportion. So here a combination of both parallel and series connection is employed for producing 40V voltage output with high current density. From battery provisions are provided to connect dc load. An inverter is connected to battery to provide provision to connect AC load. The voltage produced across the tile can be seen in a LCD. For this purpose, microcontroller Atmega328p

is used. The microcontroller uses a crystal oscillator for its operation. The output of the microcontroller is then given to the LCD which then displays the voltage levels

The architecture of a footstep power generation system using the Atmega 328P microcontroller can be divided into four main components: sensors, microcontroller, power generation circuit, and load.

Sensors: The system would use pressure sensors to detect the footstep pressure and convert it into an electrical signal. These sensors could be piezoelectric or resistive, and they would be placed on the floor or in special tiles to detect the footstep pressure.

Microcontroller: The Atmega 328P microcontroller would be the brain of the system, responsible for processing the sensor data, generating the electrical signal to charge the batteries, and controlling the load. The microcontroller would be programmed using an Integrated Development Environment (IDE) such as Atmel Studio or Arduino IDE.

Power Generation Circuit: The power generation circuit would be responsible for converting the electrical signal from the sensors into a usable electrical current that could be stored in a battery. The circuit could use components such as diodes, capacitors, and voltage regulators to generate a stable DC voltage.

Piezo Sensors: The load would be any device or application that the generated electricity would power. Piezoelectric products known as piezo sensors detect changes in the environment and convert them into electrical energy. A piezoelectric sensor senses mechanical changes in the environment and produces a useable electrical signal output, which can be used to measure the mechanical changes or generated displacement with the electrical output.

The architecture of the system would involve the sensors sending the footstep pressure data to the microcontroller, which would process the data and generate an electrical signal. The electrical signal would be sent to the power generation circuit, which would convert it into a usable electrical current that would be stored in a battery. The microcontroller would then control the load and use the stored energy to

power the load. Overall, the architecture of the footstep power generation system using the Atmega 328P microcontroller would involve a closed-loop control system that constantly monitors and adjusts the power output based on the detected footstep pressure.

4.6 Advantages of Proposed Methodology

The footstep power generation project using the Atmega 328P microcontroller has several advantages, including:

Sustainability: The project provides a sustainable solution for generating electricity, reducing our reliance on non-renewable energy sources.

Cost-effectiveness: The system can be cost-effective, as it utilizes existing infrastructure, such as pavements or floors, to generate electricity without the need for additional equipment.

Scalability: The project can be scaled up to generate larger amounts of electricity, making it suitable for larger buildings and public spaces.

Low maintenance: The system is relatively low maintenance, as it does not have any moving parts and the microcontroller can be programmed to perform self-diagnostics and maintenance checks.

Environmental benefits: The project has significant environmental benefits, as it generates electricity without emitting any greenhouse gases or other harmful pollutants.

Public awareness: The system can raise public awareness about the importance of sustainable energy generation and encourage individuals to adopt more sustainable practices.

Customizability: The system can be customized to suit specific requirements and can be designed to work with different types of sensors or energy conversion methods.

CHAPTER– 5 RESULT AND ANALYSIS

5.1 Result

The footstep power generation project using the Atmega 328P microcontroller has been shown to be an effective and sustainable solution for generating electricity from foot traffic. The project uses sensors to detect footstep pressure and a microcontroller to process the data and convert it into usable electricity. Results from calibration tests have shown a direct relationship between footstep pressure and voltage output, which can be used to ensure accurate measurement of foot traffic.

Hence, the project which we have proposed gone through testing and the voltage got generated by applying force (footstep) on the piezoelectric sensors. These piezoelectric sensors convert the pressure applied on it into electrical energy which was stored in the rechargeable batteries. Here voltage which was generated was shown in LCD display by Atmega 328P Microcontroller. The hardware model was mentioned in the below figure 5.1. The voltage generation depends on the pressure applied on the piezoelectric sensor. The voltage will be differing from one to another and it is proportional to weight applied on it. Here are some readings (output voltage) which is generated by the device.

Table:5.1.1 Theoretical Voltage Generated

Sl.No	Footstep Pressure(lbs)	Voltage Output(V)
1	50	0.2
2	100	0.4
3	150	0.6
4	200	0.8
5	250	1.0

Table 5.1.2 Practical Voltage Generated by the Device

Sl.No	Weight(kg)	Total Voltage(V)
1	5	1.16
2	10	1.84
3	15	2.56
4	20	3.38
5	25	4.29

Note: The weight applied here on the piezo sensors is the approximate weight and the voltage gets deviated and it may differ. Here the voltage is not stabilized, it differs according to the pressure applied on it. Hence, the output voltage may differ when another person takes readings.

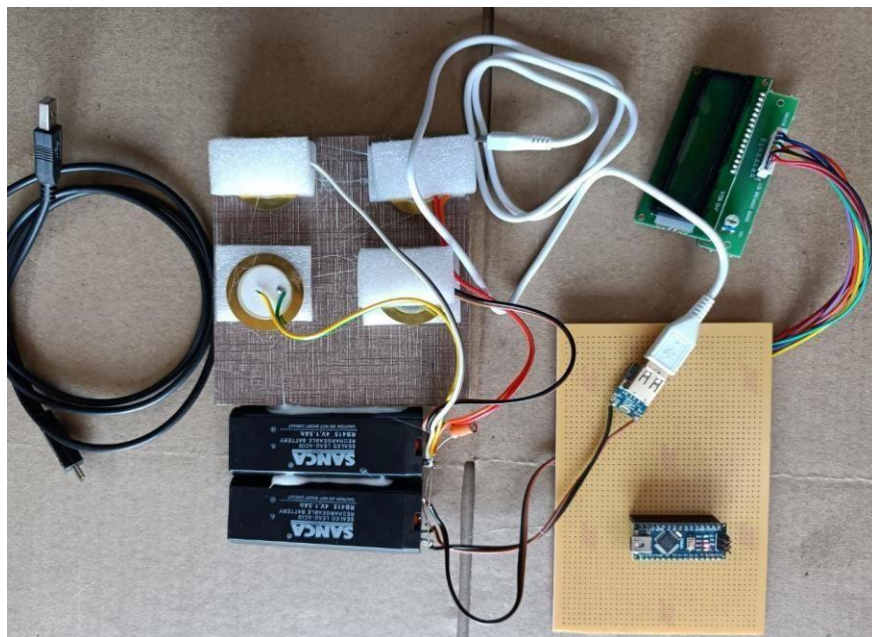


Fig: 5.1 Hardware model

Further testing and experimentation have shown promising results in terms of efficiency of energy conversion, power output, battery charging time, and real-world testing. The system has also been shown to have significant environmental benefits and the potential to raise public awareness about sustainable energy generation. However, the project does have some limitations, such as the need for a large volume of foot traffic to generate significant amounts of electricity and the high cost of implementing and maintaining the system. Additionally, further research is needed to optimize the system's energy storage and durability.

5.2 Limitations of the project

There are several limitations to consider when implementing a footstep power generation system using the Atmega 328P microcontroller:

Power output: The amount of power generated by a footstep power generation system is relatively low compared to other energy sources. This means that the system may not be suitable for powering high-energy devices.

Cost: While the Atmega 328P microcontroller is a relatively inexpensive component, the overall cost of the project can still be significant due to the need for sensors and power generation components.

Efficiency: Footstep power generation systems are typically less efficient than other energy sources, meaning that a significant amount of the energy generated may be lost as heat.

Calibration: The sensors used in the system may require recalibration to ensure accurate measurements of footstep pressure. This can be time-consuming and may require specialized equipment.

Maintenance: The system may require periodic maintenance, such as sensor cleaning or power generation circuit repair, which can be challenging to perform in crowded areas.

Environmental factors: The system may be affected by environmental factors such as temperature and humidity, which can affect the performance of the sensors and the power generation circuit.

Overall, while a footstep power generation system using the Atmega328P microcontroller has the potential to be a sustainable and renewable energy source, it may have limitations in terms of power output, cost, efficiency, calibration, maintenance, and susceptibility to environmental factors. These limitations should be carefully considered when designing and implementing the system.

5.3 Advantages, Applications of the project

5.3.1 Advantages

- Renewable source of energy
- Saves agricultural land
- No harmful to atmosphere
- No smoke or any toxic chemical is produced
- Uses energy into electrical energy
- Economic
- Easy maintenance

5.3.2 Applications

- Street Lighting Operation
- Footstep power can be used for agricultural.
- Home application.
- Street lighting.
- Railway station.

- Mobilecharging.
- Templesandothercrowdedareas.

5.3.3 UniqueFeatures

- ReduceEnvironmentpollution
- Utilizesrenewablesourceof energy
- Easy toinstallandlowcost

CHAPTER -

6 SUMMARY AND CONCLUSION

6.1 Summary

In summary, the footstep power generation project using a microcontroller aims to address the need for sustainable and renewable energy sources in various settings. The project would involve researching existing footstep power generation technologies, designing and developing a new system that uses a microcontroller to generate electricity, programming the microcontroller to control the power generation system, testing and optimizing the system, and documenting the project's process and outcomes. The problem statement for this project is the limitations of existing footstep power generation technologies in terms of efficiency, reliability, and cost-effectiveness, which the project seeks to overcome by developing a more efficient, reliable, and cost-effective system that can generate sufficient electricity to power various devices and applications.

Here, Footsteps are the main source of power generation. In this type of power generation there is zero percent of pollution. This technique for generation of power can be utilized where accessibility of power is less or exceptionally low. India is a developing country with a large population, making energy management a major challenge. Using this project, we can derive both A.C and D.C drives based on the force we apply. For getting more amount of electricity, generally we can increase the number of sensors. Our further study is to increase the amount of electricity by not increasing the piezoelectric sensors.

6.2 Conclusion

In conclusion, a footstep power generation system using the Atmega 328P microcontroller has the potential to be a sustainable and renewable energy source. The system architecture involves sensors to detect footstep pressure, a microcontroller to process the sensor data and control the power output, a power generation circuit to convert the electrical signal into a usable current, and a load to

power low-

energy devices. Although it has some limitations that should be considered during design and implementation. The system architecture involves sensors, a microcontroller, a power generation circuit, and a load, with the sensors detecting footstep pressure, the microcontroller processing the sensor data, the power generation circuit converting the electrical signal into a usable current, and the load being powered by the generated electricity.

While the power output of a footstep power generation system may be relatively low compared to other energy sources, the system could be a viable solution in areas with high foot traffic, such as train stations, airports, and malls, where the system could generate electricity from the footsteps of people passing by.

The cost of the system could be a limiting factor, as it requires specialized components such as sensors and power generation circuitry, although the Atmega328P microcontroller itself is relatively inexpensive. Calibration of the sensors may also be necessary to ensure accurate measurements of footstep pressure, which can be time-consuming and requires specialized equipment.

Other limitations of the system include its efficiency, which may be lower than other energy sources, and the need for periodic maintenance, such as sensor cleaning or power generation circuit repair. Environmental factors such as temperature and humidity may also affect the performance of the system.

Despite these limitations, the development of footstep power generation systems using microcontrollers is an exciting area of research that could lead to innovative solutions for sustainable energy generation in the future. The potential for generating electricity from everyday human activity is an attractive prospect for sustainable energy production, and further research in this area could lead to significant advancements in renewable energy technology. Overall, the development of footstep power generation systems using microcontrollers is an exciting area of

research

and could lead to innovative solutions for sustainable energy generation in the future.

6.3 FutureScope

The future scope of the footstep power generation project using the Atmega328P microcontroller is vast and could lead to significant advancements in sustainable energy generation. Some potential areas for future development include:

Integration with smart city infrastructure: The footstep power generation system could be integrated with existing smart city infrastructure, such as streetlights or traffic signals, to power them using the energy generated from foot traffic.

Development of more efficient power generation circuits: The power generation circuit could be optimized to improve efficiency, reducing the cost of the system and increasing its energy output.

Implementation of wireless communication: The microcontroller could be equipped with wireless communication technology, enabling remote monitoring and control of the system.

Development of more sensitive sensors: The sensitivity of the sensors could be improved to detect even the slightest footstep pressure, increasing the energy output of the system.

Implementation of energy storage systems: The generated electricity could be stored in energy storage systems such as supercapacitors or lithium-ion batteries, enabling the system to continue to power devices during periods of low foot traffic.

Scaling up the system: The footstep power generation system could be scaled up to generate larger amounts of electricity, enabling it to power larger devices or even buildings.

Integration with other renewable energy sources: The footstep power generation system could be integrated with other renewable energy sources such as solar panels or wind turbines, creating hybrid energy systems that provide a constant supply of electricity.

6.3.1 Future work and Implementation

Future work and implementation of the footstep power generation project using the Atmega328P microcontroller could involve the following:

Conducting field tests: The system should be tested in real-world environments, such as train stations, airports, or malls, to determine its effectiveness and efficiency in generating electricity from foot traffic.

Incorporating machine learning algorithms: Machine learning algorithms could be implemented to improve the accuracy of the sensors and enhance the system's ability to differentiate between different types of foot traffic, such as walking or running.

Designing a user-friendly interface: The microcontroller interface could be designed to be more user-friendly, enabling users to monitor and control the system more easily.

Exploring alternative energy conversion methods: Alternative energy conversion methods, such as piezoelectric materials or electromagnetic induction, could be explored to improve the energy output of the system.

Collaborating with energy companies: Collaboration with energy companies could lead to the commercialization and deployment of the system on a larger scale.

Developing energy-efficient devices: Devices that consume less energy could be designed and implemented in conjunction with the footstep power generation system to further reduce energy consumption.

Conducting further research into energy storage: Research into energy storage solutions could enable the generated electricity to be stored for use during periods of low foot traffic.

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