VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELAGAVI -590018

A Project Report on

"SOLSTRIDE ENERGY MANAGEMENT SYSTEM"

BACHELOR OF ENGINEERING

in

ELECTRONICS & COMMUNICATION ENGINEERING

Submitted by

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CERTIFICATE

This is to certify that Project Work Phase 2 entitled **"SOLSTRIDE ENERGY MANAGEMENT SYSTEM"** is a bonafied Project Work Phase 2 carried out by **DARSHAN M R** (**4YG20EC004**), **GAGANA S N (4YG20EC005), NISCHITHA SIDDAPPA G P (4YG20EC017), THEJAS GOWDA M R (4YG20EC021)** in partial fulfillment of VIII Semester to award the Bachelor Degree in **Electronics & Communication Engineering** of the Visvesvaraya Technological University, Belagavi during the year **2023-2024**. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Project Work Phase 2 Report and deposited in the department. The Report has been approved as it satisfies all the academic requirements to the Project Work Phase 2 prescribed for the Bachelor of Engineering Degree.

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Dr. M Venu Gopala Rao
Principal

Name and Signature of Examiners with Date

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We sincerely thank the **VISVESVARAYA TECHNOLOGICAL UNIVERSITY** for providing a platform to complete our Project Work Phase 2.

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DECLARATION

We, DARSHAN M R (4YG20EC004) , GAGANA S N (4YG20EC005) , NISCHITHA SIDDAPPA G P (4YG20EC017), THEJAS GOWDA M R (4YG20EC021) Students Final Semester B.E, Electronics and Communication Engineering, Navkis College of Engineering, Hassan hereby declare that the Project Work Phase 2 on **"SOLSTRIDE ENERGY MANAGEMENT SYSTEM"** has been carried out by me under the guidance of **Ms. Siddika Sabahath Anjum** Assistant Professor, Department of Electronics and Communication Engineering, in partial fulfillment of requirements for the award of degree, Bachelor of Engineering in Electronics and Communication of the Visvesvaraya Technological University, Jnana sangama, Belagavi – 590018, during the academic year 2023-2024.

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ABSTRACT

Electricity has been essential comodity in our modern day living so this project introduces a novel approach to sustainable power generation by combining footstep and solar energy. we explore an innovative approach to harnessing renewable energy through footstep power generation using a rack and pinion mechanism. The solar panel captures sunlight and converts it into electrical energy. To maximize efficiency, The electrical output from the solar panel is regulated by a solar charge controller, which manages the charging process of the lead-acid battery, preventing overcharging and ensuring efficient storage of energy. A voltage sensor continuously monitors the voltage levels, feeding data to an Arduino microcontroller. The Arduino processes this information, controlling the system's operations and providing real-time updates on the LCD display and also display the steps counts. An LED indicator serves as a quick reference for the system's operational status, signaling normal operation . The project findings highlight the feasibility and effectiveness of this integrated approach in harnessing both footstep and solar energy for enhanced power generation. This innovative system offers a promising avenue for renewable energy solutions, showcasing the potential for sustainable power generation in various settings, such as public spaces, commercial areas, and remote locations where traditional power sources may be limited.

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Chapter 1

INTRODUCTION

The Electricity has been an essential commodity in our modern day living including economic activities for nation development. In this generation of an information technology age, there are numerous inventions which are electrical in nature making everyday living more convenient. The society is so much dependent upon the use of electricity that it has become part and parcel of our life. As a result of population growth and economic development, the need for electricity has been increasing while its source has been becoming less reliable due to greater awareness of the threats posed by climate change. In no time, the supply and generation of energy are on the verge of shortage with growing energy consumption and dwindling energy resources

Currently, our country is facing concerns over resource inadequacy in its power sector, as the nation is challenged to add supply quickly enough to keep up with growing demand. In line with the issues of power shortage, one of the strategic solutions in ensuring stable and quality supply of energy is the utilization of an alternative source of energy. The increasing in depletion of fossil fuel and non-renewable energy has been demanded a critical needed for another alternative source of energy to replace the depletion and continuously supply the increasing of energy request. Energy is the ability to do work. Electricity is one of the commonly used energy and it is increasing in line with people.

The places where many people mostly gathered include malls, parks and schools. When looking at the amount of kinetic energy produced by people in these places, or even on the dance floors of nightclubs, harvesting electricity from human activity makes sense. Footstep power generation combined with a solar system represents an innovative approach to sustainable energy solutions. This integrated system leverages two distinct but complementary technologies to harness renewable energy efficiently.

Footstep power generation captures the kinetic energy generated by human footsteps, transforming it into electrical power. This is particularly effective in high-traffic areas, such as public spaces or transportation hubs, where the constant movement of people can be harnessed to contribute to the overall energy grid. The addition of a solar system enhances the reliability and versatility of the setup. Solar panels capture sunlight and convert it into electricity, providing a consistent source of power, especially during daylight hours. This

combination ensures a continuous and reliable energy supply, reducing reliance on conventional power sources and contributing to a cleaner and more sustainable energy ecosystem.

By merging these technologies, we not only tap into the power of human movement but also capitalize on the abundance of solar energy. This dual approach not only promotes environmental sustainability but also offers a practical solution for powering diverse applications in both urban and remote settings, contributing to a more resilient and eco-friendly energy landscape."

1.1 Motivation and Scope

The Motivation behind using this project is that both Footstep power generation and solar energy are sustainable and eco-friendly sources of power. Footstep power generation utilizes the kinetic energy generated by human footsteps to produce electricity, making it a renewable and clean energy source. It's often employed in crowded places like train stations or malls, where people's movement can be harnessed for power.

Solar energy, on the other hand, relies on harnessing sunlight to generate electricity. It's a clean and abundant source of energy that doesn't produce harmful emissions. Using solar power reduces reliance on fossil fuels, mitigates environmental impact, and contributes to a more sustainable energy future.

Both technologies align with the global push for renewable energy solutions, addressing concerns about climate change and reducing dependence on finite fossil fuels.

Scope

The scope of footstep power generation with integrated solar panels extends across diverse domains, presenting a promising solution for sustainable energy needs. In urban settings, this technology can be implemented in high-traffic areas, such as malls or transportation hubs, to harness the energy generated by the constant flow of people. In rural or off-grid locations, it provides a decentralized power source, reducing dependence on traditional electricity grids. Furthermore, its adaptability to various surfaces makes it applicable in both indoor and outdoor environments. The combination of footstep and solar energy not only addresses energy demands but also aligns with global initiatives for renewable energy adoption, making it a compelling subject for comprehensive exploration.

1.2 Problem statement

- The Rising population levels and shortage of electricity in various parts of the world, with a daily increase in demand of electricity is leading all of us to prefer non-conventional resources, such as solar, and wind powered mechanism.
- Most of the nation's electricity was generated by natural gas, Non-renewable sources, coal, and nuclear energy which effect the environment.
- Rising prices of oil and gases and their potential shortages have raised uncertainties about the security of energy supply in future, which has serious repercussions on the growth of the national economy.
- The main factor is increasing use of fossil fuels also causes serious environmental problems. Hence there is primary need to use renewable energy sources like solar ,wind
- The non-conventional resources are still expensive and furthermore availability of sunlight is poor especially in rainy and winter seasons, as a result it is not reliable. Consequently, an opportunity for a cheap approach needs to be implemented for generation of electricity.

1.3 Objectives

The aim is to generate electricity from footstep mechanism. This technology describes clean, continuous, secure, and does not pollute environment. The entire human strength is being wasted, which should be utilized in our vision, and energy producing platform can be very beneficial asset in crowded location. As crowd is increasing, the load implemented on footstep will generate a nonstop supply of power, which can be stored and can be applied in various applications.

- The primary objectives for footstep power generation with solar panels involve enhancing overall efficiency, adaptability, and sustainability.
- The system aims to efficiently convert mechanical energy from footsteps into electrical energy while incorporating solar panels for continuous power generation.
- Reduce dependence on non-renewable resources for power generation
- To store the generated electrical energy in batteries or capacitors for further use.
- Combine electricity generated from footstep and solar panels and enhancing overall output.

- To provide adaptable for every environmental condition.
- To provide electricity in rural areas.
- Utilize the collected energy to power devices, lighting system or contribute to buildings electrical grid.

1.4 Previous work and Current Work

Previous Work

Other people have developed piezo-electric (mechanical-to-electrical) surfaces in the past, but the Crowd Farm has the potential to redefine urban space by adding a sense of fluidity and encouraging people to activate spaces with their movement. The Crowd 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 urban landscapes athletic fields with a spectator area, music halls, theatres, nightclubs and a large gathering space for rallies, demonstrations and celebrations, railway stations, bus stands, subways. airports etc. Like Capable Of Harnessing Human Locomotion For Electricity Generation.

Current Work

The project aims to harness kinetic energy from pedestrian footsteps and convert it into electrical energy using a rack and pinion mechanism. This innovative approach focuses on providing a sustainable and renewable energy source for low-power applications in urban environments.

1.5 Organisation

- Chapter 1 contains an introduction to the proposed system, objective, problem statement, previous work and current work, organisation of the project.
- Chapter 2 contains Literature Survey.
- Chapter 3 contains Block diagram, implementation of project, Hardware and Software requirements, advantages and application.
- Chapter 4 contains Result of the proposed project.
- Chapter 5 contain Conclusion.

Chapter 2

LITERATURE SURVEY

[1]. **"Power Generation using Foot-step and P.V panel" by Mr. Chetan S Alkori et al.**, This paper uses simple drive mechanism such as rack and pinion assembly. The control mechanism carries the rack pinion; D.C generator, gears, shafts, plates and multi-meter to show output. Non-conventional energy system is very essential at this time to our nation. Non- conventional energy using foot step needs no fuel input power to generate the electrical power. In this paper the simple drive mechanism such as rack and pinion assembly mechanism is used for generating power by utilization of force which is obtained during the walking on steps is converted in to electrical energy with the help of mechanical systems

[2]. **"Design and fabrication of prototype footstep electricity generator" by Thirumalaikumaran et al.**, In this paper it generates energy by having a person walk across a moving plate. A rack and pinion gear then transforms the physical energy into mechanical energy, which is then transformed into electric energy by a DC generator. The generated electricity is used to store in a lithium ion battery. This is one of the simple to build electricity-generating systems that is also small and effective.

[3]. **"Development of a foot step power generator in converting kinetic energy to electricity" by chun Kit Ang et al.,**In this paper, a simple and yet low-cost mechanism has been proposed to enhance the performance and efficiency of energy conversion from kinetic energy to electricity energy by placing a mechanical footstep power generator on the hind foot region. A total of 45 individualswere invited to participate in the experiments and the experiment results are then compared with the theoretical results.

[4]. **"Electricity Generation Using Spring-Powered Floor Pad" by Engr. Lorinda E. Pascua** n this paper the energy can be harvested and converted into electrical energy. This research addressed the design and construction of a power generating floor pad which can be used to harvest electricity from human footsteps. The electric generating floor pad features springs mounted on its four corners. When somebody walks though the surface of the floor pad, the springs will be compressed because of the weight of the person causing it to dip down slightly. The shaft of the permanent magnet generator will rotate then rotate, thus voltage is generated. The generator can be connected to a battery

so as to store electrical energy. Test performed on the device indicates that it is capable of converting human footsteps to a useful electrical energy to power small electrical devices.

[5]. **"Foot Step Power Generation by Using Rack and Pinion Mechanism" by K. Sai Manikanta et.al.,** In this paper the proposed system generates power using a footstep force. This power generation system serves as a medium to generate electricity using non-conventional sources i.e. force, it will be stored and used. This project is useful at public places like railway stations, bridges, at every point of entry and exit. In this mechanical project, the rack is attached to the top plate where a person can press the plate and down. At the top shaft, the pinion is attached which is a mate to rack. When a person presses the plate, the pinion starts rotating at the other end of the shaft. Another gear is attached which is connected to the bottom shaft by chain drive. The chain rotates the freewheel attached to a bottom shaft, In the middle of the shaft the flywheel is attached which stores the energy in it at the other end gear is mate with generator motor which generates the energy.

Chapter 3

DESIGN AND IMPLEMENTATION OF PROJECT

3.1 METHODOLOGY

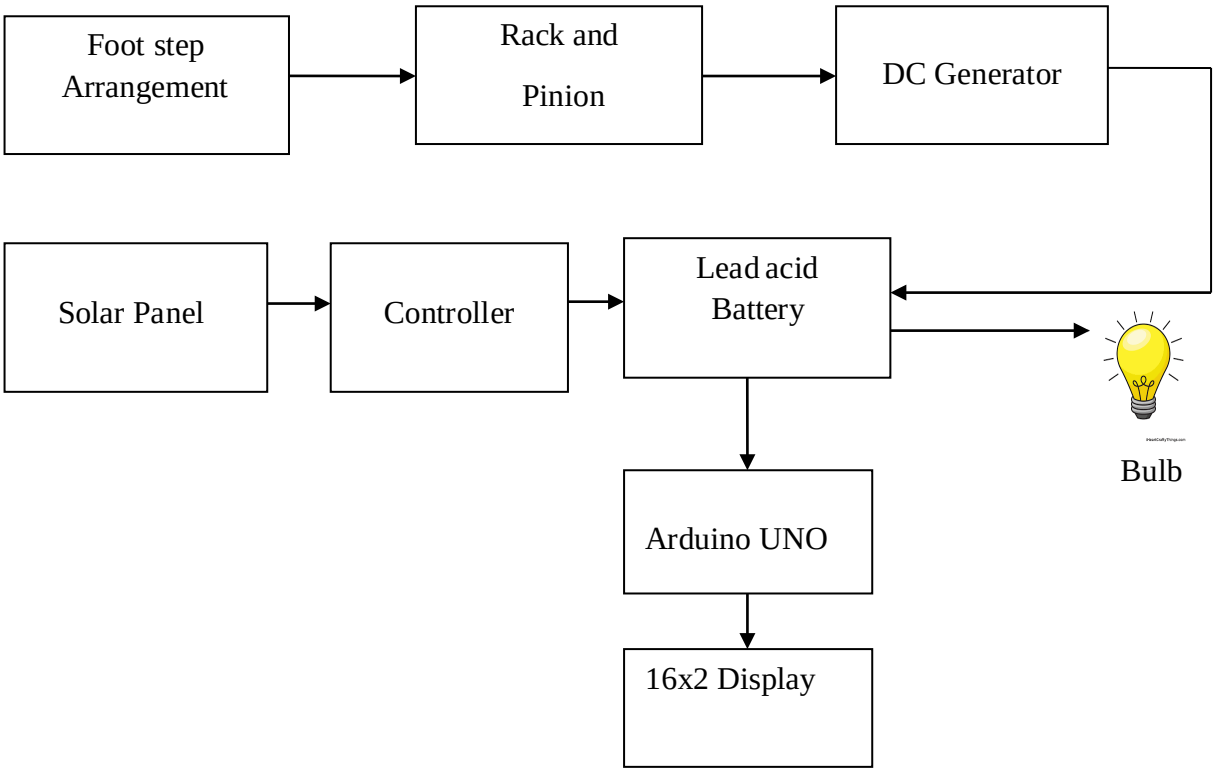


Fig 3.1 Block diagram of proposed system

- Consider the layout of the area where foot traffic will occur, and plan the placement of rack and pinion setup to capture maximum stress from footsteps.
- Place a Wooden slab on the floor to cover the area where foot traffic is expected. Ensure the wooden slab is thick and durable to withstand the weight and impact.
- When a force is applied on wooden slab by stamping on it the spring which attached to it gets compressed.
- The attachment of rack and pinion system beneath the wooden slab helps to convert the linear motion of footstep into rotational motion.
- The 3V to 4are produced by using rack and pinion arrangement with better efficiency

- Connect the rotating pinion to a DC generator to convert mechanical energy into electrical energy. Ensure the generator is capable of producing the required power output for application is used.
- Implement a maximum Power Point Tracking system to optimize energy harvesting from the generator
- Connect an LED to the DC generator's output to indicate power generation. And use the simple circuit with a resistor to protect he LED from overvoltage.
- Integrate a storage component such as a battery or capacitor to store the generated energy for later use. This ensures a continuous power supply even when foot traffic is low.
- Include a LCD display in the circuit to monitor voltage, current, and number of footsteps. This aids in assessing the systems performance and diagnosing any issues.
- Installing solar panels within to harness sunlight for combined power generation.
- Connect the load, such as a bulb, to the storage component to utilize the stored energy. Use appropriate circuitry to regulate the voltage and ensure compatibility with the load.
- The solar panel is connected to the solar charge controller regulates the voltage and current coming from the solar panels to ensure optimal charging of the batteries or energy storage system.
- It prevents overcharging, which can damage the batteries, and also protects against reverse current flow during periods of low or no sunlight.
- Implement safety features like insulation for electrical components and proper grounding to ensure user safety.
- Include a protective casing for the generator and other sensitive parts.
- The combination of the both footstep and solar the output can be increased.
- Overall we are converting mechanical energy into electrical energy.

3.2 HARDWARE AND SOFTWARE REQUIREMENTS

3.2.1 Software requirements

- Arduino IDE

3.2.2 Hardware requirements

- Rack and Pinion
- Spring
- Lead acid battery
- Solar panel
- Voltage sensor
- IR sensor
- Solar charge controller
- Ardunio Uno
- LCD display
- LED
- Bulb
- DC Generator

1 Rack and Pinion

Fig. 3.1 Rack and Pinion

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion. For example, in a rack railway, the rotation of a pinion mounted on a

locomotive or a railcar engages a rack between the rails and forces a train up a steep slope. For every pair of conjugate involutes profile, there is a basic rack. This basic rack is the profile of the conjugate gear of infinite pitch radius. Rack and pinion combinations are often used as part of a simple linear actuator, where the rotation of a shaft powered by hand or by a motor is converted to linear motion. The rack carries the full load of the actuator directly and so the driving pinion is usually small, so that the gear ratio reduces the torque required.

2 Spring

Fig. 3.2 Spring

A spring can be integrated into the system to enhance its efficiency and usability. The spring would be positioned in conjunction with the rack and pinion mechanism. As someone steps on the designated surface, their weight would depress the surface, compressing the spring. When the weight is lifted, the spring would recoil, aiding in returning the rack to its initial position. This action not only helps to reduce the force required for subsequent steps but also ensures a smoother and more continuous motion, optimizing the generation of electricity. Additionally, the spring assists in absorbing and distributing the impact force of each footstep, contributing to the longevity and durability of the system.

3 Lead acid battery

Fig. 3.3 Lead acid battery

A lead-acid battery is a type of rechargeable battery commonly used in automobiles, uninterruptible power supplies (UPS), and other applications requiring a reliable and relatively low-cost energy storage solution.

4 Solar Panel

Fig.3.4 Solar panel

A solar panel, also known as a photovoltaic (PV) panel, is a device that converts sunlight into electricity using the photovoltaic effect. This system is used additionally so that during day time large amount of electricity can be generated and stored.

5 Voltage Sensor

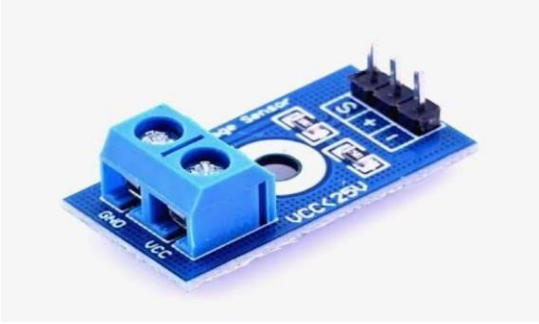


Fig. 3.5 Voltage sensor

Voltage sensors are devices used to detect and measure the voltage level in an electrical circuit. They provide information about the magnitude of the voltage present at a specific point in the circuit. Voltage sensors can come in various forms, including analog and digital sensors.They play a critical role in ensuring the safety, reliability, and efficiency of these

systems by providing accurate voltage measurements for monitoring, control, and protection purposes.

6 IR Sensor

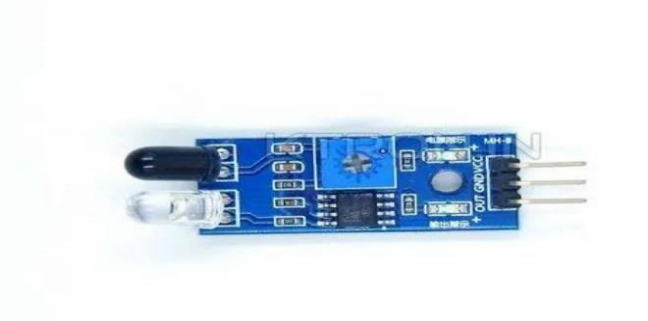


Fig 3.6 IR Sensor

The IR sensor detects motion or footstep activity to trigger the energy generation process. It sends signal to the Aduino UNO whenever motion is detected. Must be positioned strategically to capture foot traffic effectively. When someone steps on the surface the IR sensor detects the interruption in infrared light beam, triggering the energy harvesting mechanism to convert the mechanical energy from the footsteps into electrical energy. This approaches allows for the generation of renewable energy from human movement, which can be particularly useful in high-traffic areas like sidewalks, train station, or malls.

7 DC Generator

Fig 3.7 DC Generator

A DC generator is an electrical machine that converts mechanical energy into DC electrical power. It operates on the principle of electromagnetic induction, which states that when a conductor cuts through magnetic flux, an electromotive force is produced.

8 Solar charge controller

Fig 3.8 Solar charge controller

The solar charge controller regulates the voltage and current coming from the solar panels to ensure optimal charging of the batteries or energy storage system. It prevents overcharging, which can damage the batteries, and also protects against reverse current flow during periods of low or no sunlight. By integrating a solar charge controller, you can combine both solar and footstep energy harvesting to create a more reliable and sustainable power generation system. Solar charge controller is essential for maximizing the performance, efficiency, and lifespan of the solar panel system

9 Arduino UNO

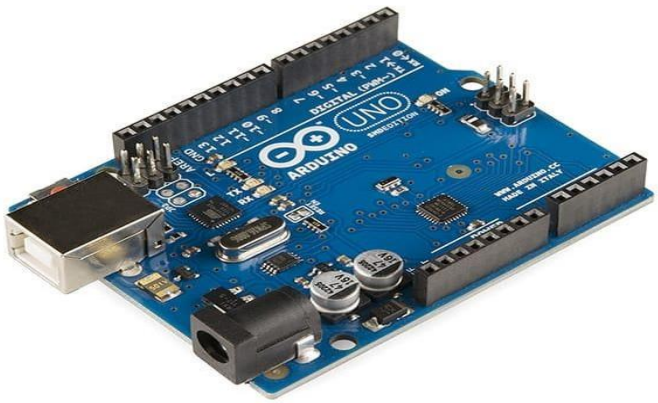


Fig 3.9 Arudino UNO

The Arduino Uno is a popular microcontroller board based on the ATmega328P microcontroller chip. The heart of the Arduino Uno, the ATmega328P is a low-power CMOS 8-bit microcontroller with 32KB of Flash memory, 2KB of SRAM, and 1KB of EEPROM. It runs at a clock speed of 16 MHz and is responsible for executing the user's program instructions. The Arduino Uno has 14 digital input/output pins (labeled D0 to D13), which can be configured as either inputs or outputs. These pins can be used to read digital sensors, control LEDs, motors, and other digital devices. The Uno has 6 analog input pins (labeled A0 to A5), which can measure voltage levels from 0 to 5 volts. These pins are used to read analog sensors such as temperature sensors, light sensors, and potentiometers. The Uno includes a voltage regulator that converts the input voltage (typically 7-12V) from the power source, such as a USB connection or a DC power adapter, to a stable 5V for powering the microcontroller and other components.

10 LCD Display

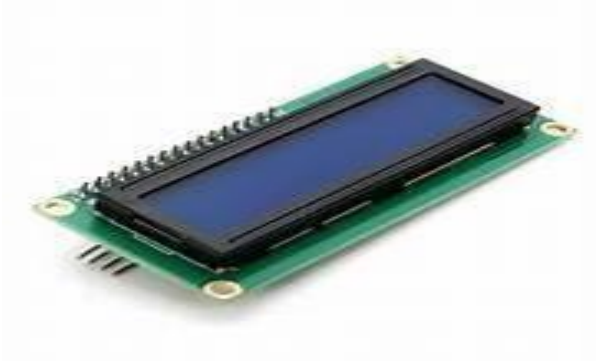


Fig 3.10 LCD Display

An LCD (Liquid Crystal Display) is a type of flat-panel display commonly used in electronic devices to provide visual information in a readable format. LCDs consist of two sheets of polarizing material with a liquid crystal solution sandwiched between them. When an electric current is applied, the crystals align to control the passage of light through the display, creating visible patterns or images. Character LCD displays are commonly used with Arduino Uno. They consist of a grid of characters (usually 16x2 or 20x4) that can display alphanumeric characters, symbols, and custom characters. Character LCDs typically have a built-in controller (such as the HD44780) that simplifies interfacing with microcontrollers like the Arduino. To use an LCD display with Arduino Uno, you typically connect it via a parallel interface or using the I2C (Inter-Integrated Circuit) protocol for communication. The

Arduino IDE provides libraries (such as LiquidCrystal library) to facilitate programming the display.

11 LED

Fig 3.11 LED

LED stands for Light Emitting Diode. It is a semiconductor device that emits light when an electric current passes through it. The light is produced when electrons and holes, the particles that carry the current, combine together within the semiconductor material. The color of the light is determined by the energy required for electrons to cross the band gap of the semiconductor.

Software requirements

Arduino IDE

- The Arduino IDE is an open-source software used to write and upload code to Arduino boards.
- The IDE application is suitable for operating systems such as Windows and LINUX.
- The IDE provides a user-friendly code editor with syntax highlighting, auto-completion, and code suggestion features, making it easier to write and debug Arduino sketches.

3.3 APPLICATIONS

The combined application of footstep power generation and solar power generation can create a more resilient and sustainable energy system.

1. Smart Cities and Urban Areas:

Implementing footstep power generation in busy urban areas, such as sidewalks or public transportation hubs, can capture the energy generated by pedestrian movement.Solar panels integrated into building structures, streetlights, or urban furniture can harness sunlight, providing an additional renewable energy source.

2. Off -Grid and Remote Areas:

In off-grid or remote areas where traditional power infrastructure is limited, a combination of footstep power generation and solar panels can provide a decentralized and sustainable energy solution. This approach can be particularly beneficial for powering essential services like healthcare clinics, schools, or community centres.

3.Green Spaces and Parks:

Incorporate footstep power generation in park pathways, combined with solar panels on nearby structures. This powers amenity like park lighting, charging stations, or water features while promoting sustainability in recreational spaces.

4. Commercial and Retail Spaces:

Utilize footstep power at entrances and high-traffic areas in shopping centres, paired with rooftop solar panels. This provides supplementary power for lighting, escalators, and other electrical needs in retail

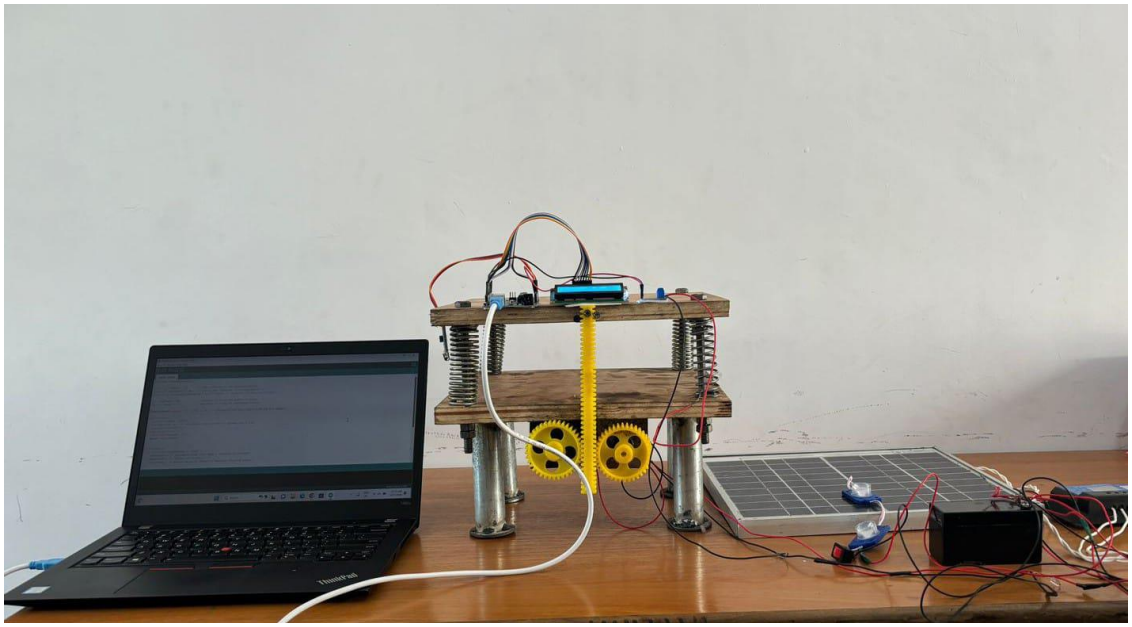
5. Educational Institutions:

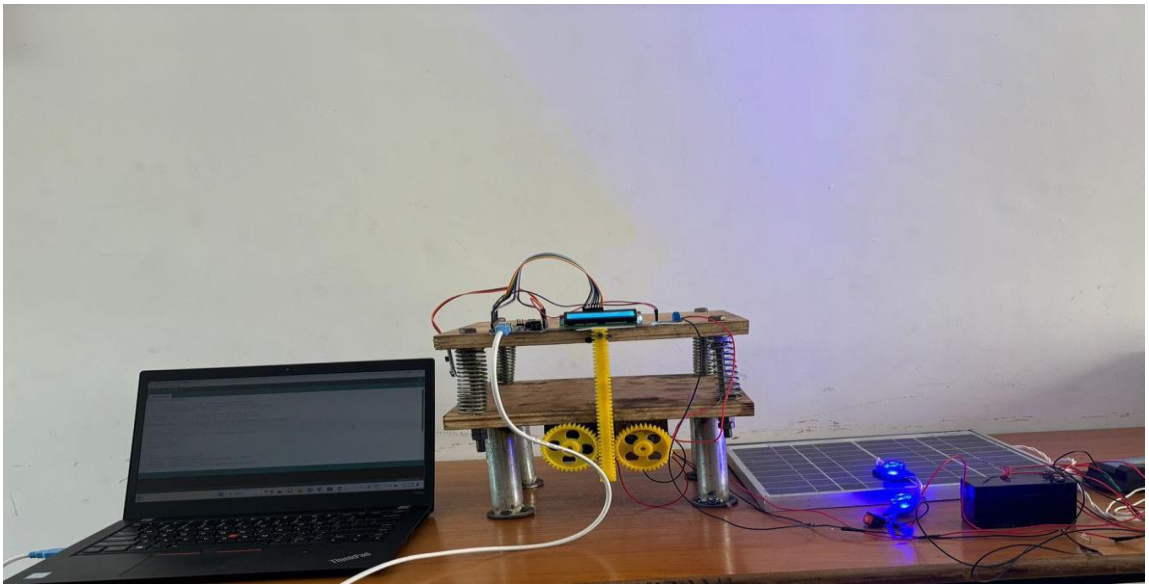
Implement footstep power generators in school hallways or entrances, coupled with solar panels on school rooftops. This combination can contribute to the energy needs of educational institutions, powering lighting, electronics, and educational displays environments

6. Smart Street Lighting: Implement footstep power generation in high-traffic areas like sidewalks, coupled with solar panels on lampposts. This combination powers energy-efficient LED streetlights, creating well-lit and energy-efficient urban environments.

Chapter 4

RESULT AND DISCUSSION





Chapter 5

ADVANTAGES

- Renewable Energy Integration.
- Long life.
- High sensitivity.
- No external power required.
- Self-generating.
- Non-conventional Energy.

Chapter 6

CONCLUSION

- The outcome of footstep power generation using a rack and pinion mechanism combined with solar panels is an environmentally friendly and sustainable energy source.
- As individuals walk on the system, their footsteps drive the rack and pinion, converting mechanical energy into electrical power.
- Additionally, solar panels can harness sunlight to generate supplementary electricity.
- This integrated approach aims to provide a continuous and renewable power source, particularly in high-traffic areas or public spaces, contributing to cleaner energy solutions.
- The combination of footstep energy and solar power provides a more consistent and reliable energy output throughout the day, complementing each other's intermittent nature.
- Footstep energy and solar power exhibit complementary patterns. Footstep energy is more prominent during peak activity hours, while solar power is available during daylight. Together they provide a more consistent power supply throughout the day.
- The combination of footstep and solar energy contributes to the long term sustainability of power generation, aligning with global efforts to transition to cleaner and more resilient energy systems.

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APPENDIX

```
int sensorPin = A0;
float voltage;
float Vref = 5.0;
#include <LiquidCrystal.h>
const int rs = 12, en = 11, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
const int irSensorPin = 6;
int count = 0;
void setup() {
 Serial.begin(9600); // initialize serial communication at 9600 bits per second
 lcd.begin(16, 2);
 pinMode(irSensorPin, INPUT);
}
  void loop() {
  int sensorReading = analogRead(sensorPin); // read the sensor value
  voltage = (sensorReading * Vref) / 201; // convert the sensor value to voltage
  Serial.print("Voltage: ");
  Serial.print(voltage);
  Serial.println(" V");
  delay(1000); // wait for a second
  lcd.setCursor(0, 0);
  lcd.print("voltage:");
  lcd.setCursor(9, 0);
  lcd.print(voltage);
  int sensorValue = digitalRead(irSensorPin);
 // Check if an object is detected
  if (sensorValue == LOW) {
```

```
// Increment count
  count++;
  delay(1000);
// Print count to serial monitor
  Serial.print("Count: ");
  Serial.println(count);
  lcd.setCursor(0, 1);
  lcd.print("Count:");
  lcd.setCursor(7, 1);
  lcd.print(count);
 }
// Add a small delay to debounce the sensor
delay(50);
 }
```

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