SOLSTRIDE ENERGY MANAGEMENT SYSTEM

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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.

Keywords – Foot step energy generation, Solar energy, Rack and pinion, Mechanical to electrical energy conversion

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.

I. IMPLEMENTATION

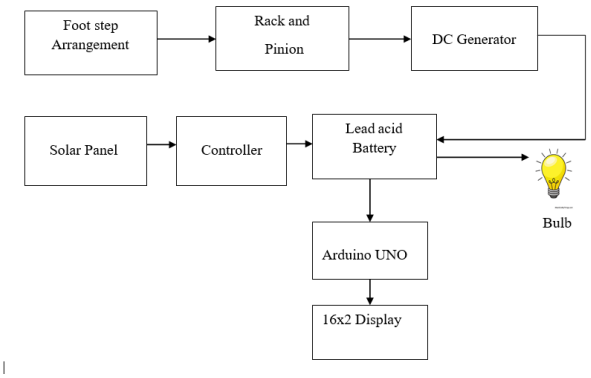

Fig.1: Block diagram of proposed system

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 toit gets compressed. The attachment of rack and pinion system beneath the wooden slab helps to convertthe 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 theload. 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.

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 amotor 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.

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.

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.

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.

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.

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.

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.

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.

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 CMOS8-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.

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 withArduino 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.

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.

II. EXPERIMENTS AND RESULTS

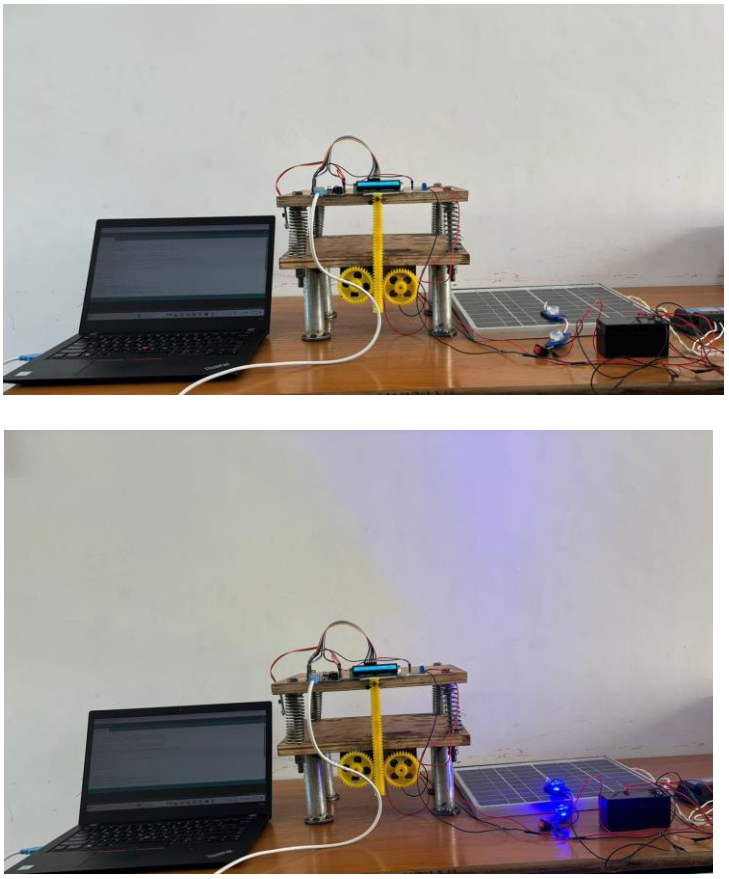

Fig 2: Prototype of Solstride Energy Management System

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. 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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