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Innovation of a power source that can monitor the sun's path in order to maximize the efficiency of solar panels

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ABSTRACT:

A growing worldwide population and rising living standards are the main drivers of the soaring energy demand. But, we must immediately begin to transition to renewable energy sources as supplies of conventional fossil fuels, such as oil, continue to decline. One of the main goals of the project is to create a solar tracking panel that can rotate for better power production, taking into account the fast advancements in renewable energy technology. This cutting-edge panel is great for keeping tabs on power use since it can move to maximize energy production by following the sun's path. This research provides a detailed explanation of the design of a rotatable solar energy tracking panel. The panel integrates four main components: solar energy tracking panels, light-dependent resistors (LDRs), an Arduino, and a motor. Students of engineering and technology get an in-depth knowledge of renewable energy sources like solar power via this setup, which also functions as an advanced teaching tool.
Motor, Fossil Fuel, Energy, Linear Data Relay, Monitoring. Hey there!

INTRODUCTION

One of the fastest growing renewable energy sources is solar power, which has many advantages like being abundant, sustainable, and harvestable by a variety of methods [1]. There are several ways to put the sun's heat and light to use, such as heating, creating energy, and illuminating [2]. Passive solar technology and active solar technology are the two main ways to use the sun's energy. While mechanical and electrical equipment are used by active solar technologies to collect and store solar energy, architectural design characteristics are used by passive solar technologies to capture and distribute solar energy [3].
The quantity of accessible solar radiation is quite variable, which is one of the issues with solar energy. Factors that may influence variations include season, geographical location, and the time of day. This means that solar panels may not always get full sunshine, which might lower their efficiency and production [4]. One solution to this issue is solar tracking systems, which monitor the sun's movement across the sky and adjust the placement of solar panels appropriately [5]. Solar trackers may boost the efficiency of solar panels by 50% [6] by keeping them perpendicular to the sun's beams. In most cases, solar panels, a control system, sensors, and a motor or actuator make up a solar tracking system [7]. The control system determines the sun's position by analyzing data from the sensors. Based on the data, it instructs the motor or actuator to adjust the solar panels' positioning. Solar tracking systems are expected to become more popular due to the increasing need for alternative energy sources [10]. Solar tracking devices have been shown to enhance the output and efficiency of solar panels in several applications, including concentrated solar power plants and residential and commercial solar energy systems [9]. When it comes to renewable energy, solar power is king, and solar tracking systems are a crucial piece of technology for making solar panels even more efficient and productive. The increasing need for renewable energy sources is anticipated to drive the development of solar tracking systems [10].

LITERATURE REVIEW

Findings from the floating panel with position tracker were published in a report by the IJCRT in May 2022. The study's authors hail from JB Institute of Engineering and Technology's Mechanical Engineering Department in Hyderabad [11]. Along with the pros and downsides of floating solar photovoltaic (PV) systems, we take a look at how the sun tracker mechanism works and how it is built. This setup uses an Arduino UNO microcontroller and light-dependent resistors (LDRs) to adjust the solar panels so they face the sun at all times. Results from experiments and strategies for the project's future are also included in this article. Anyone interested in state-of-the-art technical solutions is the target audience for this study. One renewable energy source that has the

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ability to lessen our impact on the environment and cut down on our use of fossil fuels is solar power, which is seeing fast growth. The weather, the efficiency of solar energy generation, and the tilt and orientation of the panels are a few of the elements that affect this. Solar power plants work best when they have an intelligent system that follows the sun's trajectory and changes the angles of their panels accordingly. This report summarizes previous research on solar tracking systems for PV power plants and compares and contrasts different kinds of solar trackers, including their advantages and disadvantages. This paper lays forth a fresh approach to smart home system design that makes use of cloud computing and the Internet of Things (IoT) [13]. The suggested system is mainly composed of three components: a mobile app, a cloud server, and smart devices. Smart gadgets are able to connect wirelessly to a server in the cloud because of their sensors and actuators.

PROPOSED SYSTEM

A "Solar Tracking System" with many strategically positioned components was our creation. According to Table 1, the components include a 5-volt solar panel, a battery, an Arduino UNO microcontroller, two light-dependent resistor (LDR) sensors, and an SG90 servo motor. The sturdy cardboard base is fastened to the floor with heavy-duty screws, and the solar panel is attached to two plastic rods on each side. In order for the motor to rotate the whole solar panel, one end of the rod is connected to the motor while the other end is securely secured above ground. The ten thousand resistors that make up the LDR sensors provide analogue signals to the Arduino UNO microcontroller. An efficient and practical method of monitoring the sun's movement and making the most of solar energy may be yours with the help of this meticulously planned and executed project. In response to signals from the sensors, the servo motor (shown in Fig. 2) turns the solar panel in the desired direction. For optimal results, tilt the panel so that all of the light-dependent resistors (LDRs) get the same amount of sunshine and produce the same signal. The system will then come to a halt until the sun's position changes again, allowing for ideal solar energy production throughout the day. This device is very efficient and technologically sophisticated.

BLOCK DIAGRAM

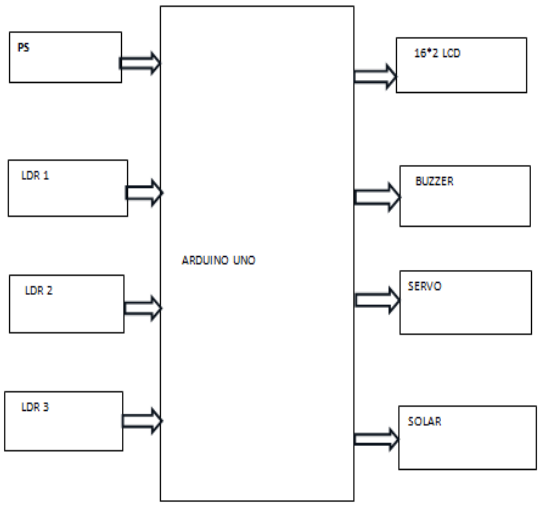

Figure 1:Block Diagram

EMBEDDED SYSTEMS

A computer system that is purpose-built to carry out a single or limited set of tasks, often under the restrictions of real-time computing, is known as an embedded system. As with other physical and mechanical components, it is often integrated into a whole device. A personal computer or other general-purpose computer, on the other hand, may be programmed to do a wide variety of functions. These days, many of the everyday items we use rely on embedded systems to function. Design engineers may improve the embedded system to decrease product size and cost while boosting reliability and performance since it is devoted to certain functions. Because of their mass production, certain embedded systems are able to take advantage of cost savings. From small, handheld gadgets like digital watches and MP3 players to massive, permanently installed systems like those managing nuclear power plants, traffic lights, and industrial controls are all examples of physically embedded systems. From simple systems using a single microcontroller chip to complex systems housing several modules, peripherals, and networks in a massive chassis or enclosure, complexity may range greatly. The phrase "embedded system" lacks a precise definition because the majority of systems have programmability in some form. While they share some components with embedded systems, such operating systems and microprocessors, handheld computers are not technically embedded systems as they enable the loading of multiple programs and the connection of peripherals. Computer hardware and software, either fixed in capability or programmable, particularly intended for a certain sort of application device—this is what's called an embedded system. Embedded

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systems may be found in a wide variety of objects, including but not limited to: vehicles, medical devices, cameras, home appliances, aircraft, vending machines, toys, and, of course, cellular phones and personal digital assistants. A programming interface is given to programmable embedded devices, and programming for embedded systems is a niche field in and of itself. Embedded Java and Windows XP Embedded are two examples of embedded-specific operating systems and language platforms. On the other hand, certain budget consumer goods include integrated application and operating system components, employ very cheap microprocessors, and have limited storage space. Instead of being loaded into RAM (random access memory), as applications on personal computers are, in this situation the program is written permanently into the system's memory.

CHARACTERISTIC OF EMBEDDED SYSTEM

- Speed (bytes/sec): Should be high speed
- Power (watts): Low power dissipation
- Size and weight: As far as possible small in size and low weight
- Accuracy (%error): Must be very accurate
- Adaptability: High adaptability and accessibility
- Reliability: Must be reliable over a long period of time

APPLICATIONS OF EMBEDDED SYSTEMS

Here, in the Embedded World, we are living. The smooth operation of the various embedded goods that surround you is crucial to your day-to-day existence. In your living room, you have a TV, radio, and CD player; in your kitchen, you have a washing machine or microwave oven; and at your office, you have card readers, access controllers, and palm devices that let you do a lot. In addition to all of this, your automobile has a plethora of built-in controls that handle functions between the bumpers, most of which you probably don't give a second thought to.

- **Robotics:** industrial robots, machine tools, Robocop soccer robots
- **Automotive:** cars, trucks, trains
- **Aviation:** airplanes, helicopters
- Home and Building Automation
- **Aerospace:** rockets, satellites
- **Energy systems:** windmills, nuclear plants
- **Medical systems:** prostheses, revalidation machine.

MICRO CONTROLLER VERSUS MICRO PROCESSOR

When comparing microprocessors and microcontrollers, what are the key differences? Any general-purpose microprocessor, such an 8086, 80286, 80386, 80486, or a Pentium from Intel, or a 680X0 from Motorola, etc., is considered a microprocessor. In addition to lacking on-chip I/O ports, these microprocessors also lack random-access memory (RAM). Because of this, they are often called general-purpose microprocessors. Designing a working system around a general-purpose CPU like the 68040 or Pentium requires the addition of extra components like as RAM, ROM, I/O ports, and timers. Though these systems are more costly and cumbersome due to the inclusion of external RAM, ROM, and I/O ports, they provide the benefit of being versatile in that the designer may choose the quantity of RAM, ROM, and I/O ports required for the work at hand. Microcontrollers are an exception to this rule. On a single chip, you'll find a microprocessor, random access memory (RAM), read/write (ROM), input/output (I/O) ports, and a timer in a microcontroller. So, since the CPU, random access memory (RAM), read/write memory (ROM), input/output (I/O) ports, and timer are all integrated into a single chip, the designer is unable to include any more memory, I/O ports, or timer into the product. Because of its set quantity of on-chip ROM, RAM, and number of I/O ports, microcontrollers are perfect for many applications where space and cost are important considerations. It is not necessary to have a 486 or even an 8086 CPU for many applications; for instance, a TV remote control. Typically, these programs will need some kind of input/output function in order to read signals and toggle bits.

ARDUINO UNO BOARD:

One board that uses the Atmega328 microprocessor is the Arduino Uno. A 16 MHz

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ceramic resonator, 6 analog inputs, 14 digital I/O pins (including 6 PWM outputs), 1 USB port, 1 power connector, 1 ICSP header, and 1 reset button are all part of it. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

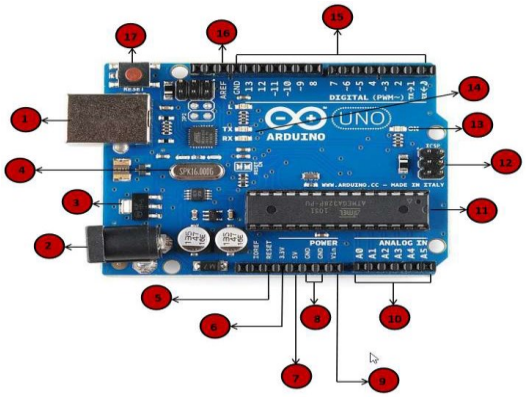

Figure 2: Arduino uno board

In contrast to all of its predecessors, the Uno does not have the FTDI USB-to-serial driver chip. As an alternative, it makes use of USB-to-serial converters coded into the Atmega16U2 (Atmega8U2 up to version R2).

HARDWARE COMPONENTS

POWER SUPPLY UNIT

The power supply for this system is shown below.

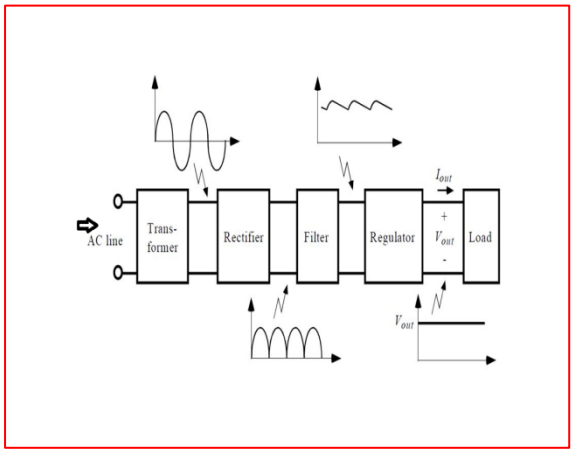

Figure 3: power supply

Diodes:

Only one path of electrical current may pass through a diode. Current may flow in either direction, as shown by the arrow in the circuit symbol. Originally termed valves, diodes are essentially an electrically enhanced version of the mechanical component.

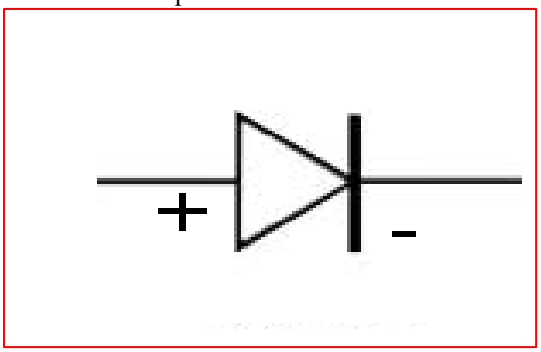

Figure 4: Diode Symbol

One kind of electrical component that restricts current flow is the diode. A voltage loss of around 0.7V will be the sole influence on the signal when the diode is "forward-biased" in this way. No current will flow through a diode that is "reverse-biased" when the current is applied in the other direction.

Rectifier

A rectifier's job is to change the phase of an alternating current (AC) waveform so that it appears as a direct current (DC) waveform. Both "half-wave" and "full-wave" rectifiers are used for rectification. Diodes are used in both devices to convert AC current into DC current. The Half-Wave Resettable The graphic shows that the half-wave rectifier is the simplest rectifier type since it only employs one diode.

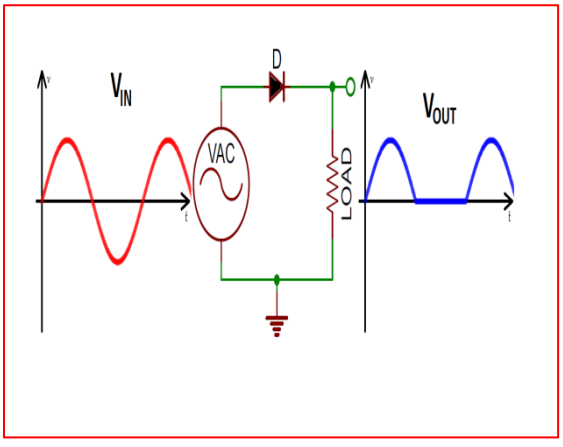

Figure 5: Half Wave Rectifier

LIQUID CRYSTAL DISPLAY

An array of color or monochrome pixels arranged in front of a light source or reflector makes up a liquid crystal display (LCD), a thin, flat display device. Two polarizing filters, with their polarity axes perpendicular to one other, and a column of

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liquid crystal molecules hanging between two transparent electrodes make up each pixel. Light would not be able to travel through them if the liquid crystals weren't interposed. To make light flow through two filters, the liquid crystal changes the polarization of the light entering the first filter.
A program's ability to communicate with the outside world depends on its input and output devices, which in turn rely on human communication. An LCD display is a typical accessory for controllers. 16X1, 16x2, and 20x2 LCDs are among the most popular types of displays that are often linked to the controllers. Which works out to sixteen characters on a single line. The first set has 16 characters on each line while the second set has 20 characters on each line. The use of "smart LCD" displays allows for the visual output of information by many microcontroller devices. Affordable, user-friendly, and capable of producing a readout utilizing the display's 5X7 dots plus cursor, LCD displays built on the LCD NT-C1611 module are a great choice. They use mathematical symbols and the usual ASCII set of characters. The display needs a +5V power and 10 I/O lines (RS, RW, D7, D6, D5, D4, D3, D2, D1, D0) for an 8-bit data bus. The only additional lines needed for a 4-bit data bus are the supply lines and six more (RS, RW, D7, D6, D5, D4). The data lines are tri-state and do not affect the microcontroller's function when the LCD display is disabled.

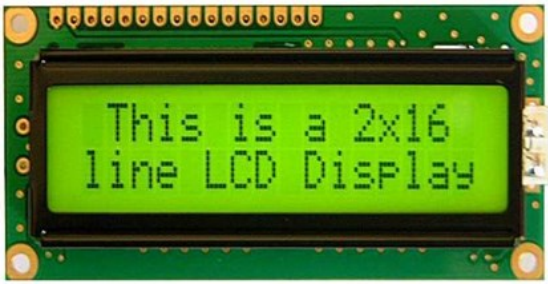
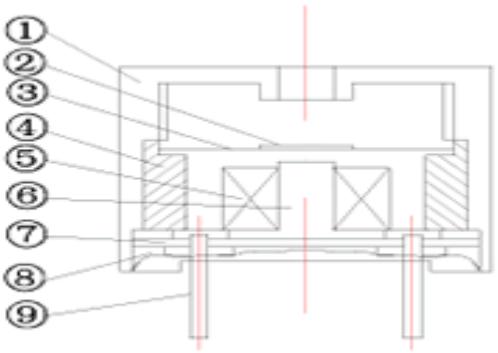


Figure 6: 2x16 LCD Display

BUZZER

In a magnetic transducer, the circuitry includes an iron core, a yoke plate, a wound coil, a permanent magnet, and a vibrating diaphragm that can be moved. The magnet's field gently draws the diaphragm up nearer the core's surface. A positive alternating current (AC) signal causes the diaphragm to move up and down, which in turn vibrates the air. This is achieved by the current passing through the excitation coil, which forms a fluctuating magnetic field. A resonator, which is composed of a cavity and one or more sound holes, may amplify vibrations in order to generate a loud sound.



ESP8266 Wi-Fi Module

This project revolves on this. Because the project relies on WIFI control of appliances, the module is a crucial part of it.
One remarkable feature of this tiny board is the integrated MCU (Micro Controller Unit), which allows for the control of I/O digital pins via a simple programming language that is almost pseudo-code like. Another benefit is that the ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability. The Chinese company Es press if Systems is situated in Shanghai and makes this gadget.
In August 2014, this chip made its debut in the ESP-01 version module manufactured by the third-party company AIThinker. The MCU can establish basic TCP/IP connections and connect to WiFi networks with the help of this little module. He was His tiny size and cheap pricing (1.7–3.5$) enticed a lot of hackers and geeks to look into it and utilize it for all sorts of projects. Because of its enormous success, Espressif now offers a wide variety of models with varying size and technological specs. Its replacement includes ESP32.

RELAYS:

Industrial controls, automotive systems, and home appliances all make extensive use of electrically controlled switches called relays. By using a relay, two independent voltage sources may be isolated from one another; in other words, a little quantity of voltage or current on one side can manage a big amount of current or voltage on the other side, and vice versa.

Inductor

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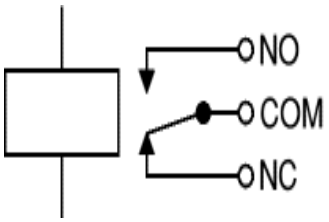


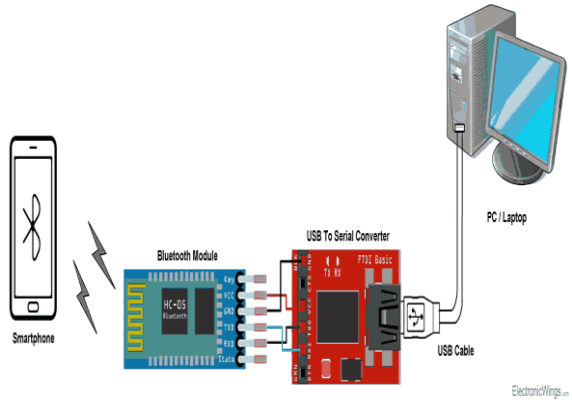
Fig 7 : Circuit symbol of a relay

DRIVING A RELAY:

Two of the SPDT relay's five pins are used by the magnetic coil, one serves as the common terminal, and the other two are typically closed and normally connected. The coil is activated when a current passes across it. At the beginning, when the coil is deenergized, the usually closed pin and common terminal will be connected. A new connection will be formed between the common terminal and usually open pin when the coil is activated, breaking this connection. Therefore, the relay will be activated whenever the microcontroller sends an input signal to it. You may drive the loads connected between the common terminal and typically open pin while the relay is on. Consequently, the high-current loads are driven by the relay, which receives 5V from the microcontroller. This means the relay may be used as a means of isolation.
The microcontroller and digital systems do not have enough current to operate the relay. In contrast to the 10 milliamps required to activate the relay's coil, the microcontroller's pin can only provide 1 or 2 milliamps. This is why the microcontroller and the relay are separated by a driver, like ULN2003, or a power transistor. By connecting ULN2003 to the relay and microcontroller, it is possible to activate many relays simultaneously.

Bluetooth communication between Devices

One use case is communicating between a smartphone and an HC-05 Bluetooth module; the other is seeing the data from the module on a PC serial terminal.
A Bluetooth terminal app is necessary for data transmission and reception on smartphones in order to connect them to the HC-05 Bluetooth module. Apps for Bluetooth terminals are available in the app stores for both Android and Windows.



Bluetooth Module Serial Interface

Therefore, in order to establish a connection between the HC-05 Bluetooth module and a smartphone, we must first connect the module to a personal computer using a serial to USB converter. We need to pair the HC-05 module with the smartphone before we can set up Bluetooth communication between the two devices.

SOFTWARES

The Arduino platform is an open-source, user-friendly hardware and software environment for prototyping. It is comprised of a programmable circuit board (also called a microcontroller) and an Integrated Development Environment (IDE) called Arduino that is pre-made for writing and uploading code to the physical board.
The main characteristics are:
• Many sensors can send signals in digital or analog formats to Arduino boards, which may then be used to activate motors, control LEDs, establish connections to the cloud, and much more.
• The Arduino IDE (also called "uploading software") allows you to command your board's operations by communicating with the microcontroller on the board.
• A separate device, known as a programmer, is not required to load fresh code into an Arduino board, in contrast to most prior programmable circuit boards. The usage of a USB connection is all that is required. • The Arduino IDE employs a streamlined version of C++, which facilitates programming learning. Last but not least, Arduino offers a standardized form factor that simplifies the microcontroller's tasks.
Now that we know what the Arduino UNO board is and how it works, we can go on to setting up the Arduino IDE. As soon as we figure this out, we can upload our software to the Arduino board.

RESULTS

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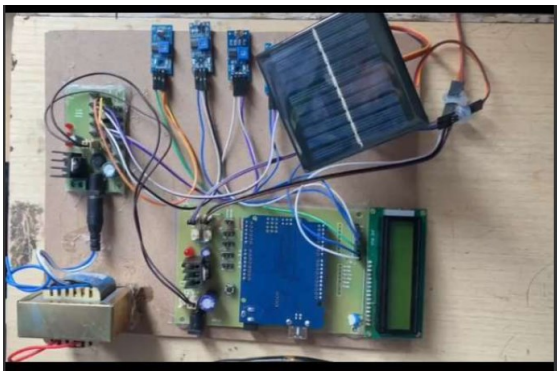

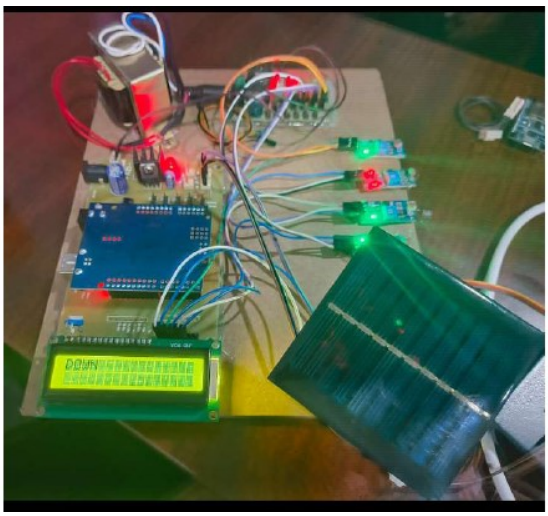

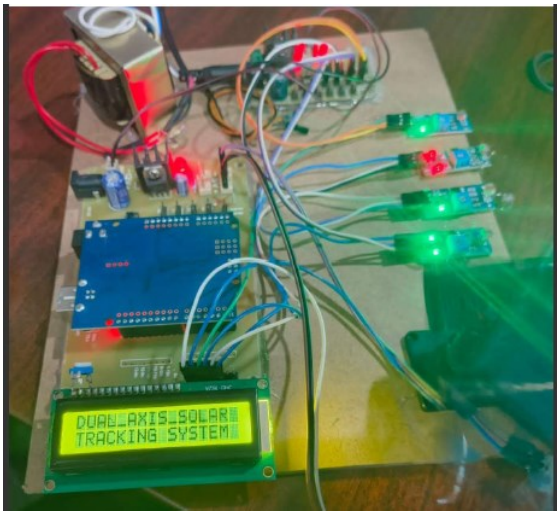

CONCLUSION

The goal of this project is to create a solar panel that can detect the sun's movement and produce electricity autonomously. The production of such a solar panel is made necessary by the increasing need for alternative energy sources, which is directly correlated to the diminishing fossil fuel and oil supplies. Motors, light-dependent resistor (LDR) sensors, an Arduino, and tracking panels are the main parts of the solar energy tracker. Its automatic day-to-night panel angle adjustments maximize energy conversion efficiency by 20% to 50% by directing sunlight directly onto the panels.

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