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Smart Solar Charging Station for Electric Bike

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ABSTRACT

This paper describes the design and execution of a Smart Solar Charging Station (SSCS) that includes advanced monitoring and control functions. To optimize the charging process and improve user interaction, the system incorporates a solar charge controller, batteries, an Arduino Mega microcontroller, a voltage sensor, a split-core current sensor, a relay module, and a display unit.

The solar charge controller effectively manages the power produced by the photovoltaic panels and regulates battery charging. The Arduino Mega serves as the central processing unit, coordinating the functioning of different sensors and actuators while running control algorithms to assure peak performance

The SSCS's key features include integrated sensors that monitor solar panel voltage, battery voltage, and charging current in real time. The split-core current sensor makes non-intrusive

KEYWORDS: Solar panels, solar charge controller, batteries, arduino mega, split core current sensor, lcd display, voltage sensor.

INTRODUCTION

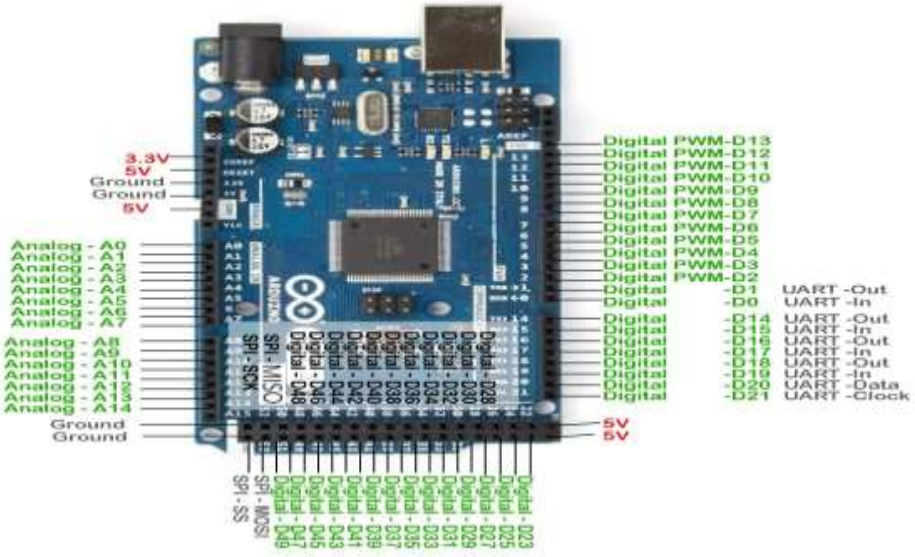
Introducing the Smart Solar Charging Station, which harnesses renewable energy to provide efficient charging on the move. Our station captures and stores solar energy using solar panels, a smart solar charge controller, and high-capacity batteries. It ensures precise monitoring and control by incorporating an Arduino Mega and voltage and current sensors. Furthermore, the relay module allows for uninterrupted power distribution, making it an environmentally beneficial and intelligent choice for meeting long-term energy requirements.

ARDUINO MEGA 2560

The Arduino Mega 2560 is a microcontroller board built around the ATmega2560. It features 54 digital input/output pins, 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connector, a power jack, an ICSP header, and a reset button. It is typically used for projects that require a high number of inputs and outputs, as well as complicated functionalities.

This board has almost everything required to support the microcontroller. So, to power this board, connect it to a PC by a USB connection, battery, or AC-DC adapter. This board can be shielded against unexpected electrical discharge by installing a base plate.

The Mega 2560 R3 board's SCL and SDA pins link to the AREF pin. In addition, two latest pins are situated near the RST pin. One pin is the IOREF, which allows the shields to alter the voltage provided by the Arduino board. Another pin is not related and is stored for future use. These boards operate with every existing shield, but can adjust to newer shields that use these added.



SOLAR PANELS

A solar panel is a device that turns sunlight into electricity via photovoltaic (PV) cells. PV cells are composed of materials that emit excited electrons when exposed to light. Electrons move through a circuit, producing direct current (DC) electricity that can be utilized to power devices or stored in batteries. Solar panels are often referred to as solar cells, solar electric panels, or PV modules.

Solar panels are typically organized in groupings termed arrays or systems. A photovoltaic system consists of one or more solar panels, an inverter that converts direct current (DC) to alternating current (AC), and sometimes other components such as controllers, meters, and trackers. The majority of panels are installed in solar farms.

Solar panels convert sunlight into electricity that people may utilize. There are two types of solar panels: thermal, which collect heat, and photovoltaic, which generate energy. Heat from solar panels is frequently used for room heating and hot water. Solar panels harvest renewable energy. In the twentieth century, some people used the heat of the sun to generate steam for a steam engine that powered a generator. Nowadays, producing electricity from sunlight is less expensive. This is a solid-state method of creating energy, which means it contains no moving parts.

Home solar panels are frequently installed on rooftops. Commercial or industrial installations frequently rely on ground-mounted trackers. The trackers point at the panel

BATTERIES

Lead-acid batteries are frequently used because they are less expensive than newer technologies, even when surge current is not an issue and other designs may provide higher energy densities. In 1999, lead-acid battery sales accounted for 40-50% of the value of all batteries sold worldwide (excluding China and Russia), equating to a manufacturing business worth approximately $15 billion.[8] Large-format lead-acid batteries are commonly used for backup power supply in cell phone towers, high-availability emergency power systems such as hospitals, and stand-alone power systems. Modified versions of the conventional cell can be employed in various roles to improve storage times and reduce maintenance requirements. VRLA (valve-regulated lead-acid) batteries, which include gel-cells and absorbed glass-mat batteries, are commonly used in these applications.

SOLAR CHARGE CONTROLLER

4-Stage PWM Controller: - Features an innovative 4-stage charging state, including bulk, absorption, float, and equalization, to safeguard the battery and extend its life.

Support Multiple Battery Types: - Compatible with lead acid, lithium iron, and phosphate battery types. Select a battery type, and the controller will detect the 12V/24V/36V/48V system voltage. Note: The battery voltage and panel voltage should be the same.

Installation: Connect the controller to the battery first, then the load, and finally the solar panel. Follow this connecting sequence to ensure that the product works.

Multiple Protections: - Your battery is fully protected by multiple sophisticated protections against reverse polarity, overcharging, short-circuiting, reverse current, overload, low voltage, and over discharge.

SPLIT CORE CURRENT TRANSFORMER

This is the SCT 013 000 100A Non-Invasive AC Current Sensor Split Core Clamp Meter Sensor. SCT-013-000 is a Non-Invasive AC current sensor, which is a current transformer capable of measuring AC current up to 100 amps.

Current transformers (CTs) are sensors that measure alternating current. They are very effective for assessing building-wide electricity consumption (or generation). The split-core type, such as the SCT-013-000 CT in the image, is ideal for DIY use. This SCT 013 000 can be clipped directly onto either the live or neutral wire entering the building, eliminating the need for high voltage electrical installation.

VOLTAGE SENSOR

Hall Effect-based non-invasive current measurement, no shunt resistor or wire break required, based on the WCS1700 sensor, accuracy voltage measuring

DC voltage: 100V; DC current range: +/- 50A; Energy and battery capacity measurement in Wh and Ah with auto saving.

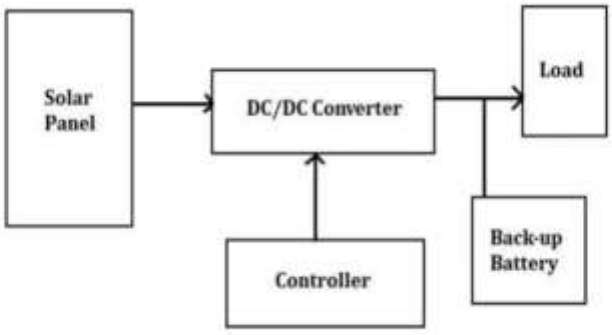
Measured values can be supplied into any microcontroller or data acquisition system. Data is also available on the serial connection, default Baud Rate 9600, configurable.

Current measurement sensitivity is 33mV/A, voltage measurement sensitivity is 25mV/V, diameter 9.0mm conductor through hole for current measurement, may be configured as Modbus Slave RTU via TTL RS485 Converter, default slave ID 1, programmed typical applications include Test and Measurement Systems.

LCD DISPLAY

To use a Lenovo Tab as a display for an Arduino Mega, connect the Arduino to the tablet via USB or a wireless communication technique like Bluetooth or Wi-Fi. You'd need to build a program for both the Arduino and the tablet to communicate and display the appropriate data. You could create an Android app that receives data from the Arduino and displays it on the tablet's screen.

BLOCK DIAGRAM

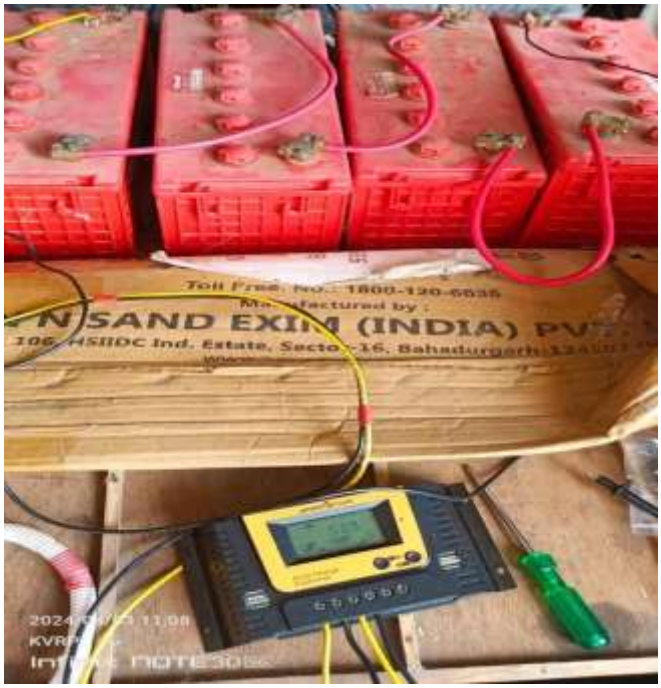


WORKING PROCEDURE

CONCLUSION

In conclusion, the implementation of a smart solar charging station incorporating a solar charge controller, mega station, batteries, voltage and current sensors, and an eBike48V/40Ah load offers a sustainable and efficient solution for powering electric bikes. By harnessing solar energy and utilizing advanced control and monitoring systems, this charging station optimizes energy utilization, reduces dependency on grid electricity, and promotes eco-friendly transportation. Its versatility and scalability make it a viable option for both urban and remote areas, contributing to a cleaner and greener future.

PROTOTYPE MODEL



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