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Solar based Electrical vehicle charging system with dual battery.

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Abstract : the proposed system aims to enhance the Electric Vehicle (EV) charging experience by leveraging intelligent processes and dynamic charging technology. One of the primary challenges with EV adoption is ensuring convenient, efficient, and fast charging. Many potential EV drivers experience anxiety, worrying about running out of battery power, particularly on long trips. Additionally, drivers may be reluctant to wait for long charging times during travel. These challenges highlight the need for innovative solutions that can make EV charging more effective and seamless. To address this, dynamic wireless charging systems are being explored. These systems allow for power transfer while the vehicle is in motion, offering a significant advantage over traditional stationary charging methods. Through the use of wireless power transfer (WPT) technology embedded in the roadway or via charging pads, EVs can receive power while driving, eliminating the need for frequent stops to charge and reducing range anxiety. This technology could make long-distance travel with electric vehicles more practical and less time consuming. The system described in this proposal further enhances the charging process by incorporating two batteries into the vehicle, a main battery and a secondary battery. The switching between these batteries will occur automatically based on the charging level of the main battery. When the main battery's charge drops below a certain threshold, the secondary battery will be activated to take over the power supply, ensuring uninterrupted driving. This battery management system would not only provide a continuous power supply but also optimize the use of the vehicle's energy resources, thereby enhancing the vehicle's overall performance and longevity. By combining dynamic wireless charging with intelligent battery management, this approach can address the major concerns of EV owners—extended driving range, reduced charging times, and increased overall vehicle efficiency. This system represents a significant step toward making electric vehicles more practical and widely adopted.

Index Terms **- Electric Vehicle (EV), Charging experience, Range anxiety, Wireless power transfer (WPT), Dynamic charging, Long distance travel, Battery management system, Main battery, Secondary battery, Energy optimization.**

I. INTRODUCTION

The transportation sector accounts for over 35% of all CO2 emissions. Currently, electric vehicles are poised to become the future of transportation systems, with a significant increase in their demand. Governments are also backing the electric vehicle initiative alongside major companies. The transportation industry is responsible for more than half of total oil consumption and a quarter of CO2 emissions, contributing to the greenhouse effect. Electric vehicles (EVs) are seen as an effective part of a sustainable transportation system, as they help reduce reliance on crude oil and lower emissions from transportation, leading to their rising popularity. However, the widespread adoption of EVs poses significant challenges related to recharging. As electric vehicles become more common across various uses, including delivery services, corporate fleets, and personal travel, it will be essential to maintain battery charge without sacrificing vehicle range. Despite the significant advancements in battery capacity and driving range in recent years, the availability of charging solutions is crucial for the broader acceptance of electric vehicles.

II.PROBLEM STATEMENT

Individual vehicles have gotten to be an unavoidable portion of our life. But most of these vehicles utilize petrol or diesel as fuel and thus there's colossal outflow of nursery gasses which causes worldwide warming which has gotten to be a major issue these days. Electric Vehicles are an awfully promising trust to diminish outflows of destructive gasses. Charging of electric vehicles through rechargeable battery which can as it were be charged when the vehicle is stopped. Hence, the concept of sun powered based remote-control exchange is proposed, where a vehicle can be charge.

III.METHODOLOGY

1. The main control system for this project is the microcontroller.
2. The solar panel will capture energy from sunlight and transfer this power to the electric vehicle via a transmitting coil.
3. This energy will be received in the vehicle and utilized for charging the vehicle's battery.
4. The system will automatically switch between the main battery and the secondary battery depending on the charging level.
5. This switching process will be facilitated by a relay module, which is controlled by the microcontroller according to the battery status.
6. An LCD display will be used in the vehicle to show the battery level.

A.Block diagram

The block diagram depicts the procedure of delivering electric charge to the robot via a coin, outlining the series of actions involved in the energy transfer process.

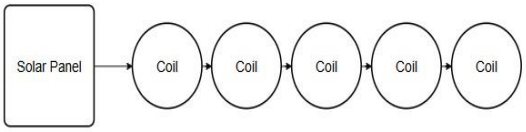

Fig 1: Energy transmission

Solar Panels: These serve as the main source of energy, converting sunlight into electricity.
Solar Charge Controller: This device manages the voltage and current from the solar panels, ensuring the batteries charge efficiently while preventing overcharging and potential damage.
Main Battery: The primary battery pack stores the electrical energy produced by the solar panels and provides power to the electric motor for vehicle operation.
Backup Battery: The secondary battery offers extra storage and can supply power when the main battery is drained, ensuring uninterrupted functionality.
Battery Management System (BMS): This system tracks the charge level and health of both the main and backup batteries, swapping between them as necessary to enhance performance and lifespan.
Vehicle Load: This term encompasses the various electrical components and systems in the vehicle, including the electric motor, lighting, and auxiliary systems.
Dual Battery System: This configuration involves the combination of both main and backup batteries, enabling efficient power distribution and providing redundancy.

The block diagram illustrates the operation of the robot, which utilizes a dual battery system with automatic shifting. This setup guarantees effective power management and smooth functioning by automatically alternating between the batteries.

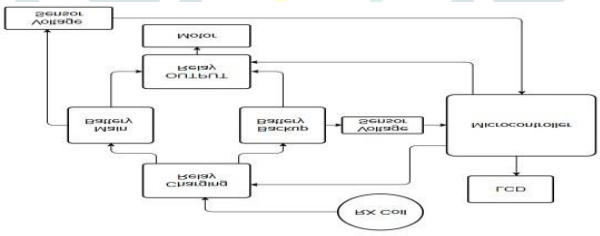

Fig 2: Block diagram of the modal

RX Coil: This component is integral to the wireless charging system, receiving energy transmitted from an external power source.

Charging Relay: This relay regulates the power flow from the RX Coil to both the Main Battery and Backup Battery, ensuring efficient charging.

Main Battery: The primary battery accumulates electrical energy generated from the solar panels or received from the RX Coil, powering the vehicle's propulsion system and essential functions.

Backup Battery: This secondary battery offers supplementary energy storage, ensuring the vehicle maintains a continuous power supply even if the main battery runs low.

Voltage Sensors: These sensors track the voltage levels of both the main and backup batteries, providing real-time data to the microcontroller for effective power management and charging control.

Microcontroller: This central processing unit oversees the overall system operation, controlling the charging relay, monitoring voltage levels through the sensors, and ensuring optimal power distribution. It also interacts with the LCD display to present system status and battery information.

OUTPUT Relay: This relay governs the power supply from the batteries to the motor, switching between the main and backup batteries as required to maintain continuous operation.

Motor: The motor receives electrical energy stored in the batteries, driving the vehicle.

LCD Display: This display serves as a user interface, presenting pertinent information such as battery levels, charging status, and other system parameters.

B.Hardware

1. Microcontroller (Atmega328)
2. Solar Panel
3. LCD Display (16X2)
4. Battery
5. Relay
6. Switch
7. Motor
8. wheel
9. Voltage sensor
10. Cooper Coil
11. Connecting wire

C. **Arduino UNO**

The Arduino Uno stands out as one of the most favored microcontroller development boards for creating various electronic projects. It is built on the ATmega328P microcontroller and is part of the broader Arduino ecosystem, which is an open-source platform offering both hardware and software tools for developing interactive applications. Unlike its predecessors, the Uno does not utilize the FTDI USB-to-serial driver chip. Instead, it incorporates the Atmega8U2 programmed to function as a USB-to-serial converter. This additional microcontroller comes with its own USB bootloader, enabling advanced users to reprogram it.

Fig 3:Arduion Uno

The Arduino Uno SMD is a microcontroller board that utilizes the ATmega328 chip. It includes 20 digital input/output pins (with 6 capable of PWM output and 6 serving as analogy inputs), a 16 MHz resonator, a USB interface, a power jack, an in-circuit system programming (ICSP) header, and a reset button. This board comes equipped with everything necessary to support the microcontroller; just connect it to a computer using a USB cable or supply power through an AC-to-DC adapter or battery to begin.

Fig 4: AC-to-DC adopter

The Uno stands out from earlier models because it does not rely on the FTDI USB-to-serial driver chip. Instead, it incorporates the Atmega8U2, which acts as a USB-to-serial converter. This additional microcontroller includes its own USB bootloader, enabling advanced users to reprogram it.

Key Components

Transformer: The transformer steps down (or sometimes steps up) the input AC voltage to a lower AC voltage, appropriate for the device you are powering.

Rectifier: The rectifier (usually a diode bridge) converts the AC voltage into pulsating DC. This is where the conversion from alternating current (AC) to direct current (DC) takes place.

Filter Capacitor: The filter smooths out the pulsating DC produced by the rectifier, turning it into a more consistent and stable DC output.

D.Schematic & Reference Design

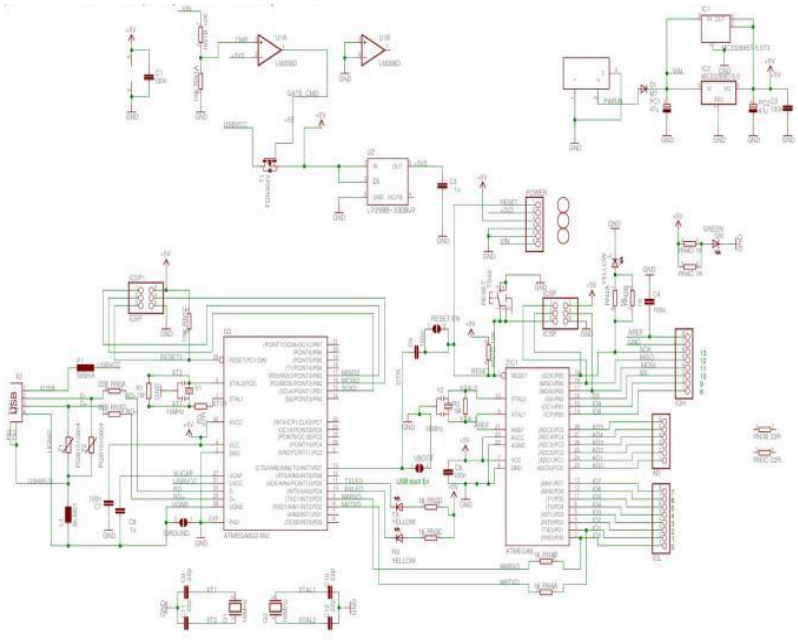

Fig 5: Schematic of Arduino Uno

The schematic for the Arduino Uno includes access to 6 PWM (Pulse Width Modulation) pins, which are useful for controlling analog devices like motors and servos. PWM enables electrical engineers to modify the brightness of LEDs, the speed of motors, and other devices by changing the pulse's duty cycle.

It features 14 digital input/output pins, 6 of which can also serve as PWM outputs, 6 analog inputs, a 16 MHz ceramic resonator, a USB interface, a power jack, an ICSP header, and a reset button. In total, there are 28 pins available.

Among these, 14 are digital pins that encompass both TX (Transmission) and RX (Receiver) pins, alongside 6 analog pins, 3 ground pins, 1 Analog Reference (AREF) pin, 1 Reset pin, as well as 1 Vin pin, 1 3.3V pin, and 1 5V pin. The boards operate at a resolution of 10 bits (0-1023).

The UNO R4 Minima, on the other hand, can accommodate resolutions of up to 14 bits, allowing for a more accurate representation of analog values. The bitstream specifies how the internal resources, interconnections, and I/O of the FPGA operate. Choosing the correct configuration mode to program the FPGA is a crucial aspect to think about when assigning pins.

E. Microcontroller: (ATmega328 SMD)

1. Operating voltage: 5 V
2. Input voltage (recommended): 7-12 V
3. Digital I/O pins: 20 (of which 6 provide PWM output)
4. Analog input pins: 6*
5. DC current per I/O pin: 40 mA
6. DC current for 3.3V pin: 50 mA
7. Flash memory: 32 KB (ATmega328) of which 0.5 KB used by bootloader
8. SRAM: 2 KB (ATmega328) 9. EEPROM: 1 KB (ATmega328)
10. Clock speed: 16 MHz.
11. The Arduino Uno has 20 total available I/O lines; all of them can function as digital I/O lines, and six of them can be used as analog inputs.

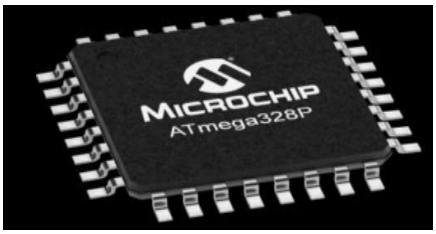

Fig 6: ATmega328 SMD

The ATmega328 SMD (Surface-Mount Device) is a surface-mount variant of the widely used ATmega328 microcontroller, frequently found in Arduino applications. This smaller, more compact version of the through-hole ATmega328 is utilized in boards such as the Arduino Uno. The SMD variant is intended for situations where space is constrained or where a more streamlined and efficient assembly process is required. The ATmega328 SMD (Surface-Mount Device) is a surfacemount version of the popular ATmega328 microcontroller, commonly used in Arduino projects. This more compact variant of the through-hole ATmega328 is employed in boards like the Arduino Uno. The SMD version is designed for scenarios where space is limited or a more efficient and streamlined assembly process is needed.

F. LCD Display 16X2

The term LCD refers to liquid crystal display. This type of electronic display module is utilized in a wide variety of applications, including various devices and circuits such as prototypes, mobile phones, calculators, computers, and television sets. These displays are primarily favored for use with multi-segment light-emitting diodes and seven-segment displays. The key advantages of using this module include low cost, easy programmability, the ability to create animations, and no restrictions on displaying custom characters or special symbols.

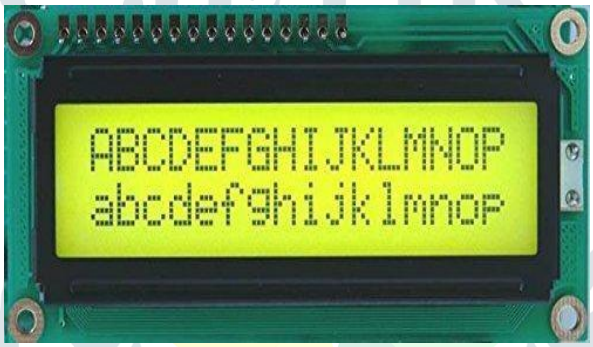

Fig 7: LED Display

G. Registers of LCD

A 16×2 LCD consists of two registers: the data register and the command register. The RS (register select) is primarily used to switch between the two registers. When the register is set to '0', it refers to the command register. Conversely, when the register is set to '1', it is referred to as the data register.

H. Solar Panel Details

Fig 8: Solar Panel

A solar panel is an apparatus that transforms sunlight into electrical energy via a method known as solar energy conversion. Solar panels consist of numerous solar cells, which serve as the essential components of the panel. Each solar cell is constructed from semiconductor materials, primarily silicon, which capture sunlight and convert it into electrical power.

I.Battery

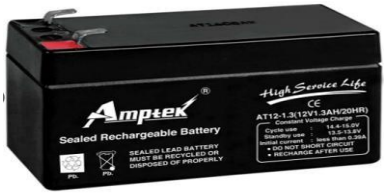

Fig 9: Battery

A 12 V battery is a kind of rechargeable or nonrechargeable battery frequently used in different applications, such as in cars, power systems, and electronic devices. The term indicates the voltage that the battery supplies, which is 12 volts. Below is a summary of the essential components of a 12 V battery.

Limited capacity: While 12 V batteries are efficient for many applications, they have limited storage capacity compared to higher-voltage systems. They are suitable for low- to mediumpower applications.

Weight and Size: Lead-acid 12 V batteries can be heavy, especially in large-capacity models, which can limit their use in portable applications.

Maintenance: Lead-acid 12 V batteries require maintenance (such as checking the electrolyte levels) to ensure longevity, though sealed versions require less maintenance.

J. Relay

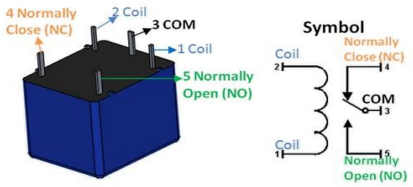

FIG 10: Relay

Relays are the most utilized switching devices in the field of electronics. There are two key parameters associated with a relay: the first is the Trigger Voltage, which refers to the voltage necessary to activate the relay and switch the contact from Common → NC to Common → NO. The second parameter is the Load Voltage & Current; this indicates the maximum voltage or current that the NC, NO, or Common terminal of the relay can handle, with a maximum of 30V and 10A for DC in our example. Ensure that the load you are using stays within this specified range.

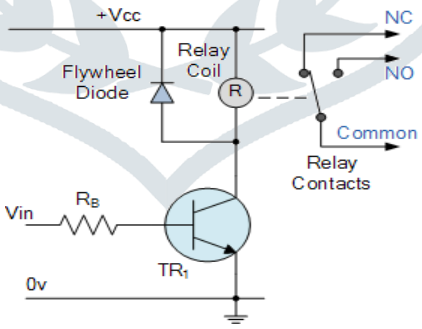

Fig 11: Relay block diagram

A transistor operates most effectively as a switch when it is arranged in a common emitter setup, which requires the emitter of the BJT to be directly linked to the "ground" line. In this context, "ground" signifies the negative line for an NPN transistor and the positive line for a PNP transistor.

When using an NPN in the circuit, the load should be connected to the collector, enabling it to be activated or deactivated by controlling its negative line.

k. Voltage Sensor

A voltage sensor is a device used to measure and keep track of the voltage level in an object. It can assess both alternating current (AC) and direct current (DC) voltage levels. The input to this sensor may be voltage, while its output can include switches, analog voltage signals, current signals, or audible alerts. Sensors are essentially devices that can detect or respond to specific types of electrical or optical signals. This particular sensor primarily involves a voltage divider circuit. In this circuit, a resistor acts as the sensing component. The voltage can be divided between two resistors, forming a reference voltage and a variable resistor, to create the voltage divider circuit.

L. Arduino IDE(SOFTWARE)

i. The Arduino IDE is a free software tool primarily designed for writing and compiling code for Arduino modules.

ii. As the official software for Arduino, it simplifies code compilation, making it accessible for individuals without technical expertise to start learning.

iii. It is easily accessible on operating systems such as MAC, Windows, and Linux, and it operates on the Java Platform, which includes built-in functions and commands essential for debugging, editing, and compiling code within the environment. iv. There is a variety of Arduino modules available, including, but not limited to, the Arduino Uno, Arduino Mega, Arduino Leonardo, and Arduino Micro.

v. Each module features a microcontroller on the board that is programmed and receives information in the form of code. vi. The primary code, referred to as a sketch, generated within the IDE ultimately produces a Hex File that is transferred and uploaded to the controller on the board.

vii. The IDE environment consists of two main components: the Editor and the Compiler, where the former is utilized for writing the necessary code and the latter is used for compiling and uploading the code to the specified Arduino module.The IDE environment is mainly distributed into three sections.

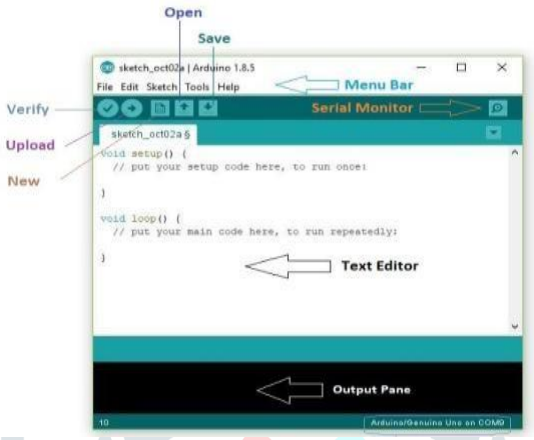

Fig 12: software display

The horizontal strip at the top is referred to as the Menu Bar, which includes five distinct options listed below.

File – Here, you can create a new window for coding or access an already existing one. The table below illustrates the various subdivisions under the file option.

File	
New	This is used to open new text editor window to write your code
Open	Used for opening the existing written code
Open Recent	The option reserved for opening recently closed program
Sketchbook	It stores the list of codes you have written for your project
Examples	Default examples already stored in the IDE software
Close	Used for closing the main screen window of recent tab. If two tabs are open, it will ask you again as you aim to close the second tab
Save	It is used for saving the recent program
Save as	It will allow you to save the recent program in your desired folder
Page setup	Page setup is used for modifying the page with portrait and landscape options. Some default page options are already given from which you can select the page you intend to work on
Print	It is used for printing purpose and will send the command to the printer
Preferences	It is page with number of preferences you aim to setup for your text editor page
Quit	It will quit the whole software all at once

TABLE I: Instruction table to Arduino Uno.

IV. Results

We are utilizing two batteries in the electric vehicle for more advanced operations. The system will automatically switch between the primary and secondary batteries depending on the charging level of each battery. A voltage sensor is employed to monitor the voltage of the batteries. After measuring the voltage, the microcontroller will manage the relay module according to the battery status. The relay will activate, selecting the appropriate battery for charging. The user will be able to view this status through an LED connected to the relay module.

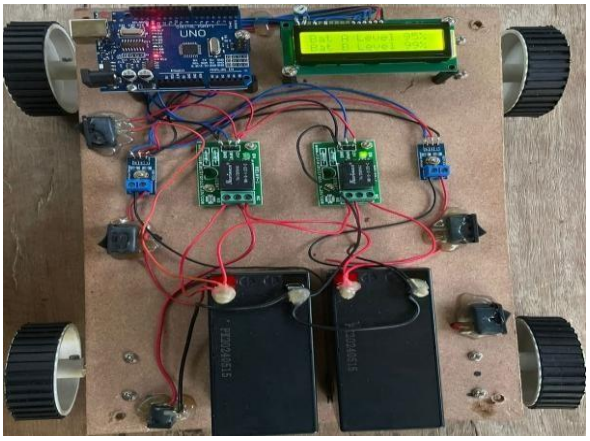

Fig 13: Using Primary battery

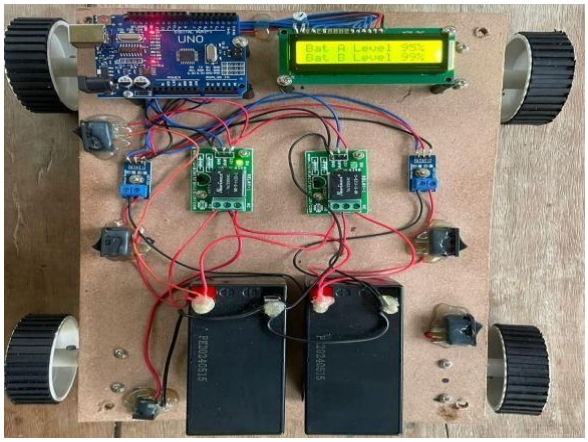

Fig 14: Using secondary battery

A.Two Battery Setup: The vehicle is equipped with two batteries, a primary battery and a backup battery, to improve performance and prolong operational range. This configuration guarantees that there is always a supplementary energy source on hand.

B.Automatic Battery Switchover: The system features a mechanism that automatically toggles between the primary battery and the backup battery. This transition takes place based on the charge levels of each battery to ensure optimal efficiency and prevent interruptions.

C.Voltage Monitors: These monitors continuously check the voltage levels of both the primary and backup batteries. They deliver real-time information regarding the charge status of each battery, enabling accurate and timely decision-making.

D.Microcontroller Unit: The core of the system, the microcontroller (such as an ATMEGA8U2-MU), processes data collected from the voltage monitors. It determines when to switch between the primary and backup batteries based on their charge levels. The microcontroller is programmed to manage the relay module accordingly.

E.Relay System: The relay system, governed by the microcontroller, manages the physical switching between the primary and backup batteries. When the microcontroller indicates that one battery is running low, it commands the relay to transition to the other battery, ensuring an uninterrupted power supply.

F.LED Status Lights: LEDs connected to the relay system offer a visual indication of the system's status. When the relay switches from one battery to another, the respective LED illuminates, showing which battery is currently in operation. This allows users to easily keep track of the battery status and the functioning of the switching mechanism.

Fig 15: Desktop view of code without error

This Arduino sketch is intended to automatically alternate between a main battery and a secondary battery according to their voltage readings. The setup keeps track of both batteries and transitions to the backup battery when the primary battery's voltage falls below a specified limit (3.6V) and switches back to the primary battery when the backup battery voltage declines below a lower limit (3.0V).

V. Conclusion

An important step toward environmentally friendly, sustainable transportation options is the integration of solar energy with twin battery systems in EV charging infrastructure. By using solar electricity and guaranteeing a steady supply of energy, even during periods of low sunlight, this method improves the dependability, effectiveness, and durability of charging systems. With one battery storing solar energy and the other powering the car, the dual battery arrangement enables ideal power management. In addition to lowering greenhouse gas emissions and encouraging grid independence, this technology has longterm financial advantages due to lower operating costs. Though technological developments and legislative incentives may help, issues including high initial costs, reliance on the weather, and the requirement for frequent maintenance still exist.

Furthermore, scalability permits the growth of solar-powered.

VI. ACKNOLAFGEMENT

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