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Solar Locomotive EV Charging Station

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Abstract

The vehicle population is increasing day by day and is expected to exceed the human population in the upcoming years. This would also result in the consumption of fossil fuels and in the extinction of the non-renewable resources. Hybrid and electric vehicles are gaining popularity, making the improvement in charging station infrastructure a necessity. Superchargers and mega-chargers have set a benchmark for fast charging of high-capacity vehicle batteries. Commercial charging stations are available but only at places with high EV expectancy regions. India's mobility mantra of "Shared, connected and Electric" with 100% EV by2030 seems to be quite ambitious, but with increased awareness amongst the consumers and aiding government policies, this goal can be achieved. Ministry of power and Department of Heavy Industry Ministry has invited proposals with a target of 1000 EVCS and Tata power has proposed to build around500 EVCS by 2020. In mega-cities, multi-level parking stations, malls, multiplexes are available with large parking capacity for vehicles. These places are most likely to be parked with EVs in upcoming days and automated parking and charging stations can be implemented there with the proper infrastructure to support their charging. Even rooftop can be utilized to install solar generation plants of suitable capacity to ensure dc fast charging. India receives around 5000 trillion kWh per year energy with an average of 4-7 kWh sq. per day. A grid connected solar enabled automated charging station will simplify the charging of autonomous vehicles. The driverless cars will function as pickup cars taking the user to the desired estimation with additional features such as carpooling. A rooftop solar installation for domestic purpose can be utilized for charging EVs and can also serve as commercial stations.

KEYWORDS: Electric vehicle charging station, automation.

1. Introduction

The vehicle population is increasing day by day and is expected to exceed the human population in the upcoming years. This would also result in the consumption of fossil fuels and in the extinction of the non-renewable resources. The automotive sector would be the major culprit for this extinction. Hybrid and electric vehicles have been a suitable replacement and have been so far managed to keep the usage of fossil fuels under control. Britain aspires to completely ban the sales of gasoline- and diesel-powered passenger cars by 2035 which is a step in the right direction but needs proper resources and infrastructure to support these EVs. A proper working infrastructure includes an automated charging station

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with maintained power quality, automated parking system, fast charging support, etc.Type 1 and Type 2 AC charging have been more prominent but recent developments have shown that DC charging can be equally effective. Solar though being an intermittent source of energy but with the usage of a proper power condition in the unit can provide a reliable supply. This can be visualized using MATLAB Simulink tool. A grid-connected solar micro-system helps in using excess solar generation during the peak hours of solar irradiations to charge EVs and also to export the power back to the grid to earn revenues. For designing a universal charging station, proper standardization of the battery capacity and charging connectors is to be made. Maintaining proper DoD of the battery helps to increase the battery life. Proper Battery Management System (BMS) is equally important. EVCS can also operate as an exchange station to support battery swapping [3]. Qualcomm has already proved that charging while driving is possible, even while the vehicle is traveling at up to 70 mph. The technology is being profoundly known as Dynamic Electric Vehicle Charging (DEVC) and is expected to be implemented in major highways. Basically the EV batteries do not get filled, but they are also not losing any power. But installing such a system in actual practice a mighty task. Volterio, a famous EVCS designing company is coming up with technological solutions to implement a smart automated charging system starting from domestic applications to major commercial stations. This will boost the usage of EVs amongst the consumer and the EVCS will start replacing gas stations in upcoming years.

2. Proposed System

In proposed system our aim is to increase the electric charging station by solar and wind mill setup. In future increasing electric vehicles leads to this charging station busy. Wind mill and solar generates the power and that will be stored in battery which maintained in the power station. LCD display will display which parking slot available for the vehicle charging. Once our vehicle is connected to the charging point, voltage and current sensor will monitor the flow of current and voltage. In case any short circuit or heavy voltage emits from the base station, immediately sensor detects the parameter and cut off the electric unit. Every user uses the RFID tag for charging the vehicle; it’s like a debit card for charging the electric vehicle. Total units consumed and total amount will be displayed in the LCD.

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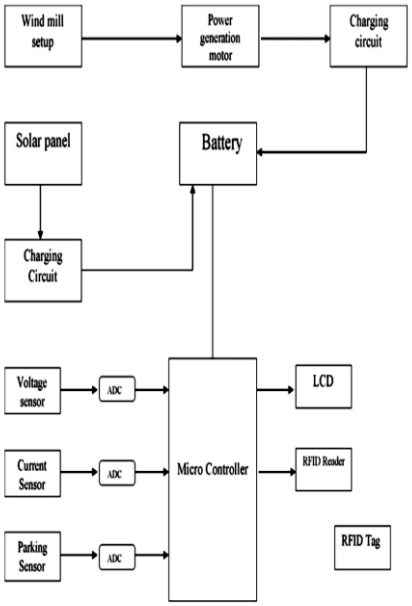

Figure 1 Block diagram of proposed system

2.1 Arduino

The Arduino Uno is an open source microcontroller board based on the Microchip ATmega328p microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards and other circuits. The board has 14 digital I/O pins, 6 analog I/O pins, and is programmable with the Arduino IDE.

Figure 2 Arduino

2.2 Solar Panel

A Solar cell panel, solar electric panel, photo-voltaic (PV) module or solar panel is an assembly of photo-voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy to generate direct current electricity. A collection of PV modules is called a PV panel, and a system of PV panels is called an array.

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Figure 3 Solar Panel

2.3 Voltage Sensor

Voltage sensors are used to monitor or measure, calculate and determine the supply of voltage. With the help of this sensor, we can determine the AC or DC voltage level. The input of this sensor can be voltage. While the output can be output switches, analog voltage signal, a current signal, audible signal, etc.

Figure 4 Voltage Sensor

2.4 Current Sensor

A current sensor is **a** device that detects and converts current to an easily measurable output voltage, which is proportional to the current through the measured path. There are a wide variety of sensors, and each sensor is suitable for a specific current range and environmental condition.

Figure 5 Current Sensor

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2.5 Parking Sensor

Parking sensors, also known as proximity sensors, are devices that are located on the bumpers of a vehicle in order to assist the driver when parking. They measure proximity to an approaching object, either in-front or behind, and alert the driver if they get too close.

2.6 ADC

Analog to Digital Converters (ADC) translate analog electrical signals for data processing purposes. With products matching performance, power, cost, and size needs, Analog Devices offers the industry's largest A/D converter portfolio. As the world's leading provider, these data converters enable accurate and reliable conversion performance in a range of applications such as communications, energy, healthcare, instrumentation and measurement, motor and power control, industrial automation, and aerospace/defense.

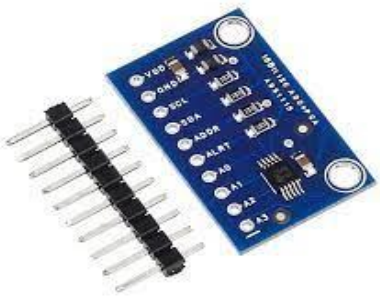

Figure 6 ADC

2.7 LCD

A 16 × 2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols.

Figure 7 LCD

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2.8 RFID

Radio Frequency Identification (RFID) refers to a wireless system comprised of two components: tags and readers. The reader is a device that has one or more antennas that emit radio waves and receive signals back from the RFID tag. Tags, which use radio waves to communicate their identity and other information to nearby readers, can be passive or active. Passive RFID tags are powered by the reader and do not have a battery. Active RFID tags are powered by batteries.

Figure 8 RFID

3. Advantages

- Pollution level will decrease.
- Compared to other fuels, this cost is very low.
- Fraudulent can be avoided in fuel charging station.
- No need to worry about quality and quantity.

4. Disadvantages

- Due to increasing of vehicles air pollution level increased in future.
- Day by day fuel price increased.
- Some fuel station is misused in their fuel quality.

5. Applications

- Using this development we can easily identify the slot and parking details for EV charging
- Here we are using the renewable energy so that the pollution is reduced.
- Easley identify stations parking slots.

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6. Conclusions

EVCS modelling is discussed in brief. Fault analysis is a key aspect that should be taken care of. Automation will play a crucial role in future where autonomous vehicles will be having widespread application and availability. This paper mainly focuses on the major impact that solar will have on automotive and locomotive applications. EV contribute as a significant load on the power system, solar powered EVCS can be viable solution especially to confront load curve issues which may arise due to charging of EV's during peak load period. EVCS on malls, theatres, college campuses, IT industries, etc. will help the employees, staffs and consumers to charge their vehicles during working hours. Revenues can be generated by parking, charging, exchanging batteries and also sending excess generation back to the grid. The plant payback period can be roughly estimated to 3 years which has quite a potential business scope. EVCS and exchange stations will become as much popular as gas stations, a suitable infrastructure and atmosphere is to be created. Fast charging is equally important in this busy world with digital payment gateway and online historical data analysis. MPPT based solar tracker will enable maximum energy output. Though inductive and conductive charging would mean high investment on infrastructure, but the charging rates can be drastically increased and can enable anywhere and everywhere travelling for the consumers. Carpooling service will be more common and government can operate such services at nominal prices. Various OEMs and automobile manufacturing companies' interest in advancement of charging infrastructure with unparalleled luxury will be motto moving ahead. Government norms and schemes will lead to a shared, connected, electric and green mobility mantra.

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