Prototype Electric Vehicle Charging Station

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***Abstract*- With many advantages for both the environment and the economy, electrical cars are a very beneficial technology for the transportation and power sectors today and in the future. The project at hand is a scaled-down version of a genuine electric vehicle charging station. Electric vehicle charging station prototype This charging station makes it simple for users to charge their electric vehicles. Customers who have submitted RFID cards with rechargeable balances are required to follow several critical procedures and activities. Customers charge their automobile, swipe their card, and safely complete the transaction. Our prototype electric vehicle charging station is completely automated and employs fewer people. The ATMEGA328-PU microcontroller, the brains of our project, is supplied. The human-machine interface, which uses a 20X4 LCD screen, will show all input credentials and system internal operations. The system calculates power outlet and displays current and voltage sensors. Input values from the user, such as the password and keyword, are collected via a membrane keypad. For quick and easy login purposes, we employed a little RFID card in our project. The output relay only works when the input data is accurate and valid, and it turns off after a set amount of time. For output demonstration, we also incorporated an electric car, an AC to DC SMPS, a BMS (also known as a battery management system), and a charging station and the system model's use of a li-ion battery.**

***Index Terms*- Radio Frequency Identification, Switch Mode Power Supply, Battery Management System, Lithium-ion Battery**.

I. INTRODUCTION

Combustion fuel engines emit harmful greenhouse gases and carbon dioxide that are harmful to both humans and animals, they are used in very large quantities today, which leads to very large amounts of pollution being produced. Therefore, compared to combustion-fueled vehicles, electrical vehicles operate on batteries that recharge and produce very little pollution. This means that although energy is needed to charge the batteries, which are charged using electrical energy, some pollution is still produced during the energy generation process. Although the initial cost of an electrical vehicle is high, it is very inexpensive when compared to the ongoing cost of fuel for a combustion engine vehicle. Since the development of cars with internal combustion engines (ICE) In the latter part of the 19th century, the automobile industry only undergone minor transformations. While Transportation 2.0 and a car are terms for this, while transportation 1.0 and a car are terms for a time frame or stage. When transportation and used fossil fuels as the primary fuels. To extend the range of the vehicle, the battery can also be charged on board. Electric cars all have different propulsion systems. The electricity distribution network is anticipated to be impacted by these advanced electric vehicles, which mostly rely on external charging from the utility power grid.

II. RELATED WORK

A. Arduino IDE Programming

Since our system needed programming for login purposes using an RFID card so that we could control it effectively, we had to use the integrated development environment for programming known as Arduino. We used the high level programming language known as C++. This is where all the useful commands are taken in Arduino ID.

B. Standers for EV charging station

In various parts of the world, various sorts of standards are utilized for EV charging. This section is defined in accordance with the various standards that are in use in the United States of America, various countries in Europe, and numerous other top-tier nations.

1. IEC61851(IEC-2010): In general, all conductive charging techniques are covered by the IEC 51851 standard. The four charging models that were previously described in this standard are defined by the IEC.

2. 61851-1: This specification outlines three cable and plug configurations for charging EVs:

a) Case: This is the area where the wire is not permanently tied to anything and is instead used to control the most crucial parameters, such as the battery and other sensor settings.

b) Case: A battery is charged in a charging station using a cable that is firmly linked to the charging cable.

3. IEC 61851-23: This standard specifies the specifications for DC fast charging stations with regard to electrical safety, harmonics, grid connections, and communication architecture.

III. TECHNOLOGY USED

Radio-frequency Identification (RFID)

Radio waves are used to read digital data from RFID tags or smart labels, including passwords and other sensitive information. The term "Radio-frequency Identification" (or "RFID") refers to a related technology. Barcoding and RFID are comparable in that database. But RFID has a few advantages over asset tracking systems that relied on barcodes. The most noticeable distinction is that whereas RFID tag data can be read without being in line of sight, barcodes require alignment with an optical scanner. RFID belongs to the group of technologies known as automatic identification and data capture (AIDC). With minimal to no human participation, AIDC techniques automatically recognize items, collect data about them, and input that data into computer systems.

IV. METHODS AND MATERIAL

Our project's prototype electrical vehicle charging station includes the following parts. In addition to transformers, keypads, microcontrollers, current and voltage sensors, and the Arduino IDE for programming, RFID is our primary technology.

According to their connections, the figure depicts how various components are connected. From the keypad, transformer, RFID module, and many other sources, the display receives input. The battery's output is connected to the vehicle, which charges the battery.

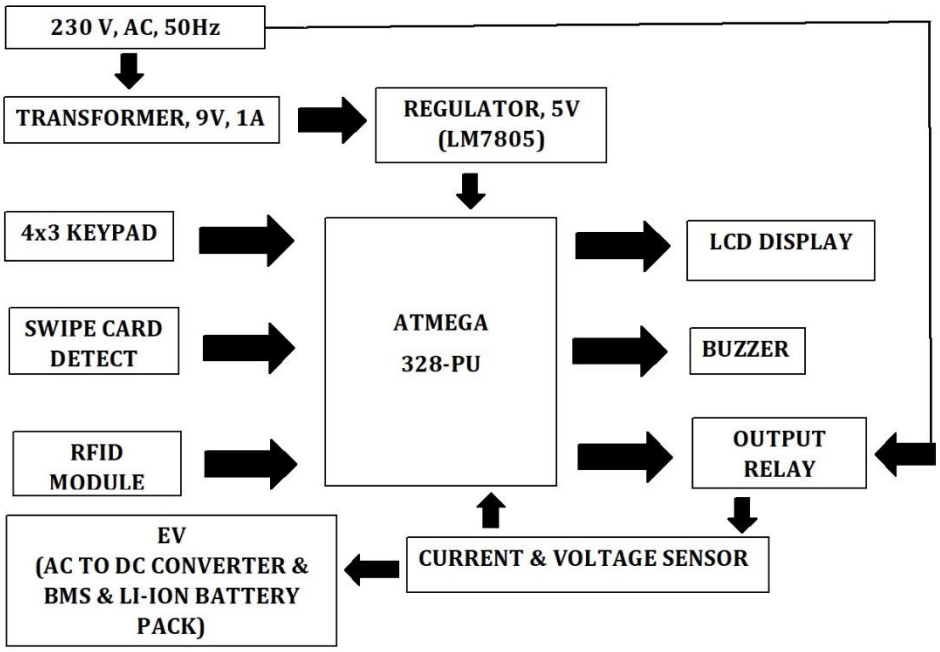

Figure: Block Diagram of EV Charging Station

A. Transformer

Transformers' primary function is to convert AC power from one voltage to another. The voltages are raised with a step-up transformer and lowered with a step-down transformer. In our project, we must employ a center-tapped transformer (9-0-9), whose purpose is to generate an output voltage that is identical to the input voltages. In our project, the transformer receives 230 volts of input power and generates 12 and 5 volts of output voltage. Whereas all of the small electronic components, such as ICs, sensors, and other devices, require 5 volts and a 12 volt output, respectively, to operate the relay that disconnects the system.

B. Rectifier and Filter

The rectifier and filter's primary functions are to convert ac supply voltages into dc supply voltages. Filters are used to create pure dc output voltage and to reduce voltage ripple. Diodes are frequently employed in rectifier apparatus, and capacitor and resistor are utilized in filters.

C. Microcontroller

In our project, a microcontroller called an ATMEGA328-PU is employed. There are 28 pins on the microcontroller. The following qualities of these components are the justification for their use.This microcontroller ICs has 32kbytes of internal read/write memory, 1kbytes of EEPROM, 2kbytes of SRAM, 23 lines of general-purpose input and output, 32 lines of general-purpose resistors, real-time counters, and timers. Only an interface can be used by the boot program to download applications into application flash memory.

D. Keypad

4x3 Keypads are employed for the purpose of receiving user input commands and inputting passwords. The keypad consists of a block of buttons. It has symbols or alphabetical letters, which are also used in calculators, digital door locks, ATMs, and combination locks.

E. Limit switch

This gadget is crucial to our project, a prototype electrical vehicle charging station. In this project, we used the limit as a debit card reader. Due to security and database concerns, we are unable to use the debit card reader in tiny models. As a result, when the limit switch is pressed, it functions similarly to scanning a debit card and sending an input command to the system. The next procedure is running.

F. Current and Voltage Sensors

The prototype electric vehicle charging station is equipped with current and voltage sensors, which has the advantage of offering an affordable and accurate solution for AC or DC current sensing in commercial, industrial, and communication systems. With so many different voltage and current sensor types on the market, ACS712 current and voltage sensors are employed. This is done in order to accurately command the microcontroller to make a choice, such as turning on the battery or system, by sensing the voltages and currents in the system.

G. BMS (Battery Management System)

BMS is another cutting-edge piece of equipment utilized in electrical vehicles to keep track of all calculations and performance related to the batteries. The battery managing system controls the battery charging, discharging, and peak period processes.

V. CHALLENGES AND PRIVACY

A. Overview of Batteries

Batteries are simply defined as devices that power electrical appliances like flashlights, cell phones, and electric cars and are made up of one or more cells with connections to the outside .There are numerous varieties of batteries on the market, including lithium-ion, lead-acid, and alkaline batteries. We have two options for battery use to charge the lead acid and lithium-ion batteries of electrical vehicles in the prototype model of the charging stations.

Lithium-ion Battery: One class of rechargeable battery is the lithium-ion battery. which store energy using the principle of reversible lithium ion reduction. Electronic devices, electric vehicles, digital cameras, smartphones, computers, and watches all use this kind of battery. Comparing this battery to other batteries, it has the benefit of charging more fast.

Lead-acid battery: In 1859, a lead-acid battery was created. Its battery may be recharged as well. Cells have a very high power-to-weight ratio while having they have very low energy-to-weight and energy-to-volume ratios yet having the ability to deliver large surge current. They are appealing due to these qualities and their low price.In place of lead-acid batteries, we utilized lithium-ion batteries because their charging times were 1/3 as long as those of lead-acid batteries. This implies that while lead-acid batteries needed 3 hours to charge, lithium-ion batteries only need 1 hour.

B. Charging Time

The amount of time it takes to charge depends on the battery's capacity and charging power. In plain English, the time rate of charge is determined by the charging level used and the voltage handling capabilities of the car's batteries and electrical charger. The following is the formula for determining charging time: Battery Capacity [kwh]/Charging Power [kw] equals Charging Time [h].

C. Safety needs for charging station

While domestic wall sockets can be used to recharge rechargeable electric vehicles and equipment, charging stations are typically, charging stations feature additional current or connecting devices to disconnect the power while EVs are charging and are open to many EVs.Two primary categories of safety sensor exist:

- Power consumption is tracked using current and voltage sensors, which also detect and respond to certain signal types like electrical or optical signals. Sensor wires contain fewer pieces that can break down, react more quickly, and may be less expensive to design and implement.
- To correctly and effectively control the battery characteristics, a battery management system (BMS) is also used. Battery management systems are used to control all battery parameters, including charging time and battery on/off.
- Additional physical "sensors wires" that deliver a feedback signal, as required by the below-mentioned schemes, are needed. These schemes also call for unique power plug fittings.

VI. CONCLUSION

The prototype electrical vehicle charging station operates correctly and without any faults, taking only the necessary amount of time. In comparison to lead-acid batteries, lithium-ion batteries required less time to charge. The entire system is monitored throughout the operation, so there are no errors or energy waste. When the battery is being charged or discharged, the BMS operates efficiently and continuously monitors all of its parameters and performance. Using an RFID card, which functions similarly to a barcode, people can quickly scan it to confirm their identity. Voltage and current sensors aid in preventing overcharging and overheating of the battery.

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