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A Review on Smart Electrical Vehicle Charging Station

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Abstract - In recent years with the rapid development of the electrical vehicle (EV) of new energy industry, higher requirements are put forward for convenience, safety and reliability of the charging of electric vehicles. Wireless power charging is done by inductive coupling. Inductive coupling can done in both stationary and dynamic conditions. By re-configuring the transformer and altering high frequency, energy is being transferred with low energy loss and fewer demands on the primary circuit. Sufficient power for the battery can be transferred by the primary to the secondary without sufficient energy loss. Electric power is then transmitted to the chargeable battery which is electrically coupled to the secondary circuit through the air core transformer. In case of shuttle bus services, buses can be charged when it waits at bus station. It can also be implemented in rental taxi parking. Thus, the battery in electric buses only needs enough charge to go to the next stop. This decreases the battery size and promotes significant cost saving in electric vehicles. This technology enables efficient opportunities in charging stations, for predefined routes and planned stops reducing down the time of charging. The dynamic charging will promote the use of electric vehicles and reduce petroleum fuel consumption. Delays in traffic signals can now be provided with longer periods of charging and even when the electric vehicle is in movement. Bad weather conditions like rain and snow do not affect the charging capabilities of electric vehicles.

***Key Words*:** WCS, BMS

1. INTRODUCTION *(Size 11, Times New roman)*

Wireless charging systems can be employed in high power applications consisting of electric vehicles as well as plug in electric vehicles in stationary conditions. Wireless charging system has more simplicity, reliability and user friendliness, when compared with plug in charging systems. The main problem of WCS is that it can only be used when the car is parked or in stationary conditions like car parks, traffic signals, garages etc. The main challenges faced by stationary wireless charging are electromagnetic compatibility issues, low power transfer, large structure, less range and high efficiency. Dynamic mode of operation is used to improve the range and sufficient volume of battery storage. So this method allows the charging of battery storage devices even when the vehicle is in motion. Here the vehicles only need low volume of battery storage thus the range of transportation is able to be increased. Here the dynamic WCS have to face mainly two problems such as large air gap and coil misalignment. The coil alignment and air gap distance between the source and receiver is used to determine the power transfer efficiency. In small vehicles the air gap distance ranges from 150 to 300 mm and air gap distance increases for large passenger vehicles. Since the vehicle can be driven automatically in dynamic condition, alignment of required driving position on the transmission coil can be made possible

2. Smart Charging

Current generation charging stations do not share data (instantaneous data sharing) with energy providers, grid operators, and charging station owners. However, smart charging technology enables data communication between charging stations, EVs, and the grid. Currently, there are very few EV charging companies such as ABB, Delta, and Enel X that are investing in smart charging technology.

Smart EV charging refers to the scenario where customers are benefited from the use of cutting-edge technology such as cloud connectivity, AI, renewable energy, e-wallet, e-authentication, and power exchange with the grid. Currently, there are four broad categories of smart charging:

- Uncontrolled but with time-of-use smart charging: It is the basic smart charging type where users are encouraged to charge their EVs for a specific time of day to avoid high charges due to peak-demand.
- Unidirectional controlled charging (V1G): In this type, charging companies and EV adjust the rate of charging based on the control signal from the grid operator.
- Bidirectional smart charging: In this type, EV battery is used as a power source for home or building. The EV can be used for storing energy produced by an 'onsite-renewable generation' source. Later, the power from EV is used as back power in case of emergency or power outage.
- Vehicle-to-grid: In this type, EV batteries can send power back to the grid. Grid operators and utility companies might purchase power from EV owners in peak time and EV batteries can be used to balance the grid.

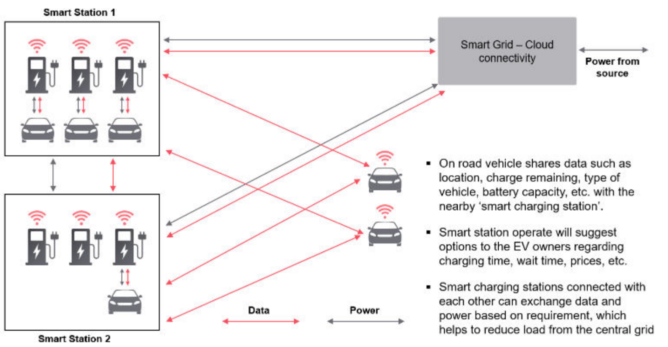

Figure -1: Smart Charging Layout

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3. Hardware Implementation

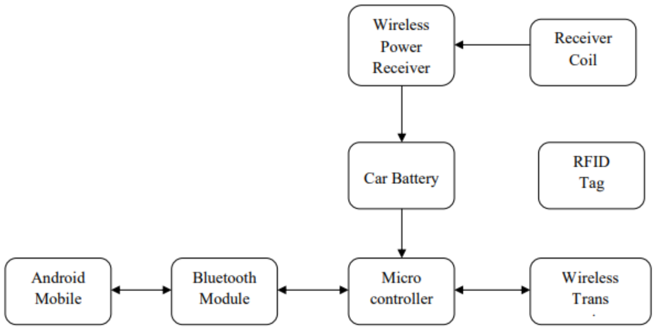

Figure -2: Car side Block diagram

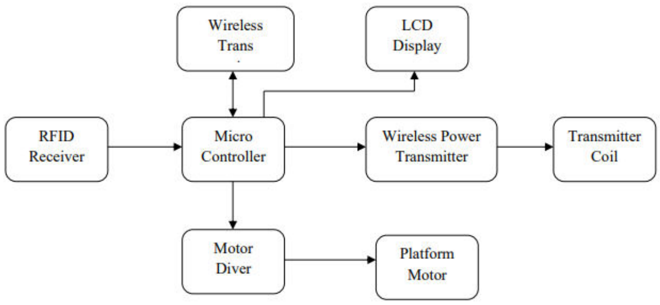

Figure -3: Charging station side Block diagram

Vehicle smartly collect all information of battery such as remaining charging, battery capacity, type of battery, type of vehicle etc. and share it to nearby charging station through wireless communication using GPS, GSM etc. Smart charging station collect all information send by the car, process it and send/suggest options to EV owners regarding to charging time, waiting time, charges and available slots etc. All Smart charging station are interconnected with each other through cloud connectivity, to exchange data and power base requirement which help to reduce load on central grid.

PCB DESIGNING

Printed circuit boards may be covered in two topics; technology and design. Printed circuit boards are called PCB in short. Printed circuit consists of conductive circuit pattern applied to one or both sides of an insulation base, depending upon that ,it is called single side PCB or double sided PCB(SSB and DSB).Conductor materials like silver, brass, aluminum and copper are most widely used. The thickness of the conducting material depends upon the current carrying capacity of circuit. Thus a thicker copper layer will have more current carrying capacity.

The printed circuit board usually serves three distinct functions:

1) It provides mechanical support for the components mounted on it.

2) It provides necessary electrical interconnections.

3) It acts as a heat sink that is it provides a conduction path leading to removal of most of the heat generated in the circuit.

3. SOFTWARE IMPLIMENTATION

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ion. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog.

Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #include statements from the top of your code.

The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board. The Arduino IDE is very simple and this simplicity is probably one of the main reason Arduino became so popular. We can certainly state that being compatible with the Arduino IDE is now one of the main requirements for a new microcontroller board. Over the years, many useful features have been added to the Arduino IDE and you can now managed third-party libraries and boards from the IDE, and still keep the simplicity of programming the board. The main window of the Arduino IDE is shown below, with the simple Blink example.

Basic programming of the Arduino Sketch − The first new terminology is the Arduino program called “sketch”. Arduino programs can be divided in three main parts: Structure, Values (variables and constants), and Functions. Let us start with the Structure. Software structure consist of two main functions:

Setup() function

The setup() function is called when a sketch starts. It is used to initialize the variables, pin modes, start using libraries, etc. The setup function will only run once, after each power up or reset of the Arduino board. Here, you can see the Serial begin (9600); statement which opens the serial port to allow the board to send output for display by the serial monitor (see "Output" sub-section below).

Loop() function

After calling the setup() function, which initializes and sets the initial values, the loop() function does precisely what its name suggests, and loops consecutively, allowing your program to change and respond. It is used to actively control the Arduino board. Here, you can see how a value is read from an analog pin (see "Understanding microcontroller pins" sub-section below), then displayed with the Serial .print (sensor Value); statement.

4. CONCLUSIONS

This Project presented a review of fast-charging technologies, explained the issues associated with fast-charging, including impacts on the battery systems regarding heat management and limitations, presented solutions, and proposed new areas of research for future solutions. Petroleum based transportation will not sustain the globe in the decades ahead, thus, advanced technologies are needed that will move the world towards sustainable electrified transportation. Slow EV battery charging times is one of the significant concerns with EVs. Widespread consumer acceptance requires that recharge times are comparable with the time it takes to fill up.

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