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Wireless Power Transfer System in Electric Vehicle Application

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***Abstract:** As an alternate form in the road transportation system, electric vehicle (EV) can help reduce the fossil-fuel consumption. However, the usage of EVs is constrained by the limited capacity of battery. Wireless Power Transfer (WPT) can increase the driving range of EVs by charging EVs in motion when they drive through a wireless charging lane embedded in a road. The amount of power that can be supplied by a charging lane at a time is limited. A problem here is when a large number of EVs pass a charging lane, how to efficiently distribute the power among different penetrations levels of EVs? However, there has been no previous research devoted to tackling this challenge. To handle this challenge, we propose a system to balance the State of Charge (called BSoC) among the EVs. It consists of three components: i) fog-based power distribution architecture, ii) power scheduling model, and iii) efficient vehicle-to-fog communication protocol. The fog computing center collects information from EVs and schedules the power distribution. We use fog closer to vehicles rather than cloud in order to reduce the communication latency. The power scheduling model schedules the power allocated to each EV. In order to avoid network congestion between EVs and the fog, we let vehicles choose their own communication channel to communicate with local controllers.*
***Keywords:** EV, Arduino, SOC, WPC, WPT*

I. INTRODUCTION

The reduction of fossil fuels and the need to reduce urban pollutants have made electric vehicles as an appropriate alternative to domestic combustion engines. Electric vehicles can act as a source of energy by using vehicle-to home (V2H) and vehicle-to-grid (V2G) capabilities. The V2G capability allows vehicles to act as a mobile storage device which can inject the storage energy into the grid. The V2G capability allows for active power regulation, reactive power support, load modulation, flow harmonic filtering and peak charge correction. These factors provide services such as spinning reservations and voltage and frequency control for the power grid. In addition to the aforementioned, electric vehicles can participate in electricity markets and provide many economic benefits to their power grid and owner via the correct implementation of the V2G.

However, it is important to note that the economic benefits of V2G capability depend on how to charge and discharge electric vehicles, If the charging process is not controlled, charging time periods will intersect with the peak load time of the distribution system, thereby increasing peak load, and the distribution system faces with problems such as overload, excessive loss of power and voltage violation.

A. Existing System

1. The efficient vehicle-to-fog communication protocol to address the shortcoming of existing CSMA/CA technique used in DSRC protocol.
2. The research challenges based on existing technologies with their possible future impacts.
3. The average packet drop rate in channel allocation technique is higher than our channel allocation technique when the number of EVs increases.

B. Proposed System

Our proposed power scheduling method in BSoC can balance EVs' SOC better than other two methods.

Passive metallic plate shield and active shield are proposed to minimize the leakage electromagnetic field from the wireless power transfer system in a (on-line) electric vehicle.

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II. BLOCK DIAGRAM OF TRANSMITTER&RECIEVER

A. Transmitter

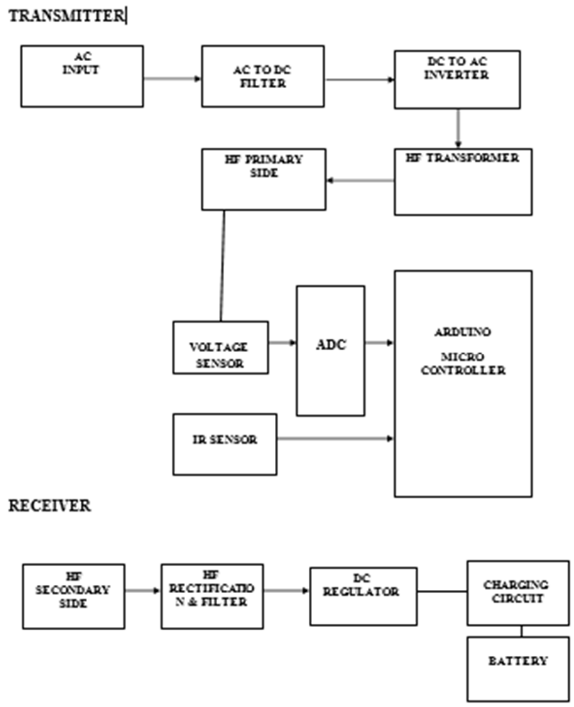

Fig. 1 Circuit Diagram of Transmitter & Receiver

B. Hardware Requirements

1) Microcontroller
2) Wireless Power Transfer
3) Ultrasonic Sensor
4) Voltage Sensor
5) Relay
6) Robo

C. Software Requirements

ARDUINO IDE&EMBEDDED C MODULES:

1) Sensor interfacing
2) Preparing power supply unit
3) Micro-controller programming
4) Reading analog data
5) Test and debug
6) Submission

III. SOFTWARE DESCRIPTION

A. ARDUINO IDE

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.
Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. 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.

Before uploading your sketch, you need to select the correct items from the Tools

> Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyACMx , /dev/ttyUSBx or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino boot loader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The boot loader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The boot loader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

B. Embedded C

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between Cextensions for different embedded systems. Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety-eight percent of all microprocessors are manufactured as components of embedded systems.

Examples of properties of typical embedded computers when compared with general-purpose counterparts are low power consumption, small size, rugged operating ranges, and low per-unit cost. This comes at the price of limited processing resources, which make them significantly more difficult to program and to interact with. However, by building intelligence mechanisms on top of the hardware, taking advantage of possible existing sensors and the existence of a network of embedded units, one can both optimally manage available resources at the unit and network levels as well as provide augmented functions, well beyond those available. For example, intelligent techniques can be designed to manage power consumption of embedded systems. Modern embedded systems are often based on microcontrollers (i.e. CPU's with integrated memory or peripheral interfaces), but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also common, especially in more-complex systems. In either case, the processor(s) used may be types ranging from general purpose to those specialized in certain class of computations, or even custom designed for the application at hand. A common standard class of dedicated processors is the digital signal processor (DSP).

Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, and largely complex systems like hybrid vehicles, MRI, and avionics. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

IV. HARDWARE DESCRIPTION

A. Arduino

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures Single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM (outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

B. Arduino Uno Interface With Sensor & Buzzer

Fig. 2 ARDUINO

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter. Arduino Uno has a number of facilities for communicating with a computer, another Arduino board, or other microcontrollers.

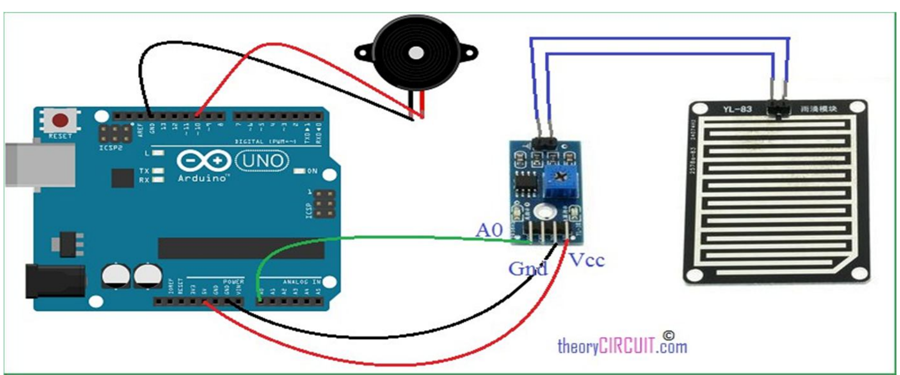

Fig. 3 Arduino UNO interface with sensor & buzzer

C. Wireless Power Transfer

Wireless power transfer (WPT), wireless power transmission, wireless energy transmission, or electromagnetic power transfer is the transmission of electrical energy without wires. Wireless power transmission technologies use time-varying electric, magnetic, or electromagnetic fields.

The term “wireless charging” usually refers to inductive charging. This technology uses a charging station that creates an alternating magnetic field. A device with the proper induction coil will receive energy from that field when it is placed nearby, making it receive power without a physical connection. An important issue associated with all wireless power systems is limiting the exposure of people and other living things to potentially injurious electromagnetic fields.

Wireless power transfer is the transmission of AC power from a power source to an electrical load, without the use of discrete human made conductors.

Fig. 4 Wireless power transfer

D. *WPT Module*

The Wireless Power Transfer and Charging Module can be used in electronic equipment's in common use for close wireless charging. This module uses an electromagnetic field to transfer electric energy between a transmitter circuit and a receiver circuit.

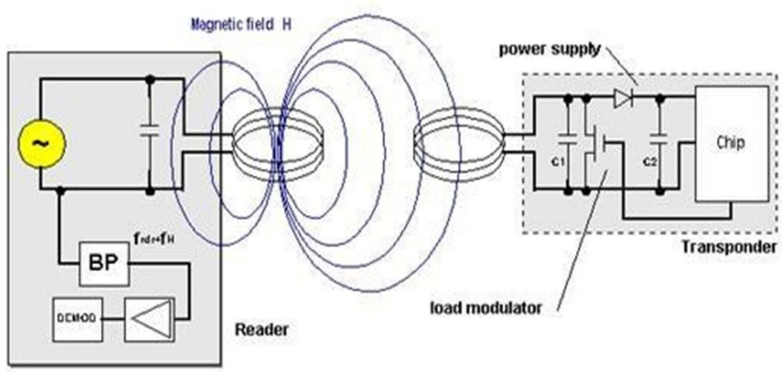

Fig. 5 WPT Module

E. *Circuit Diagram*

An induction coil creates an alternating electromagnetic field from within the transmitter circuit powered with 12V. The second induction coil takes power from the electromagnetic field and converts it back into AC current to the receiver circuit. Increase the number of turns of the receiver coil to increase the transmission distance, when low current is suitable in your application. As distance increase current capacity of receiver will drop.

V. CONCLUSIONS

In this system, we are presenting the Wireless Power Transmission. As the electric vehicle in the market is increasing. We can use the wireless charging system to charge our vehicles. This system shows the efficiency and implementation of the charging station in future technology. This paper also covers future technology like payment through RFID tags and self-serviced entry and exit gate to maintain congestion at the station. This will be helpful for those who are doing research in the field of wireless power transmission. And many had come up with the greatest invention like charging mobile wirelessly, and other electronic gadgets too. This could be the future scope for developing the charging station, as electric vehicle are increasing in demand.

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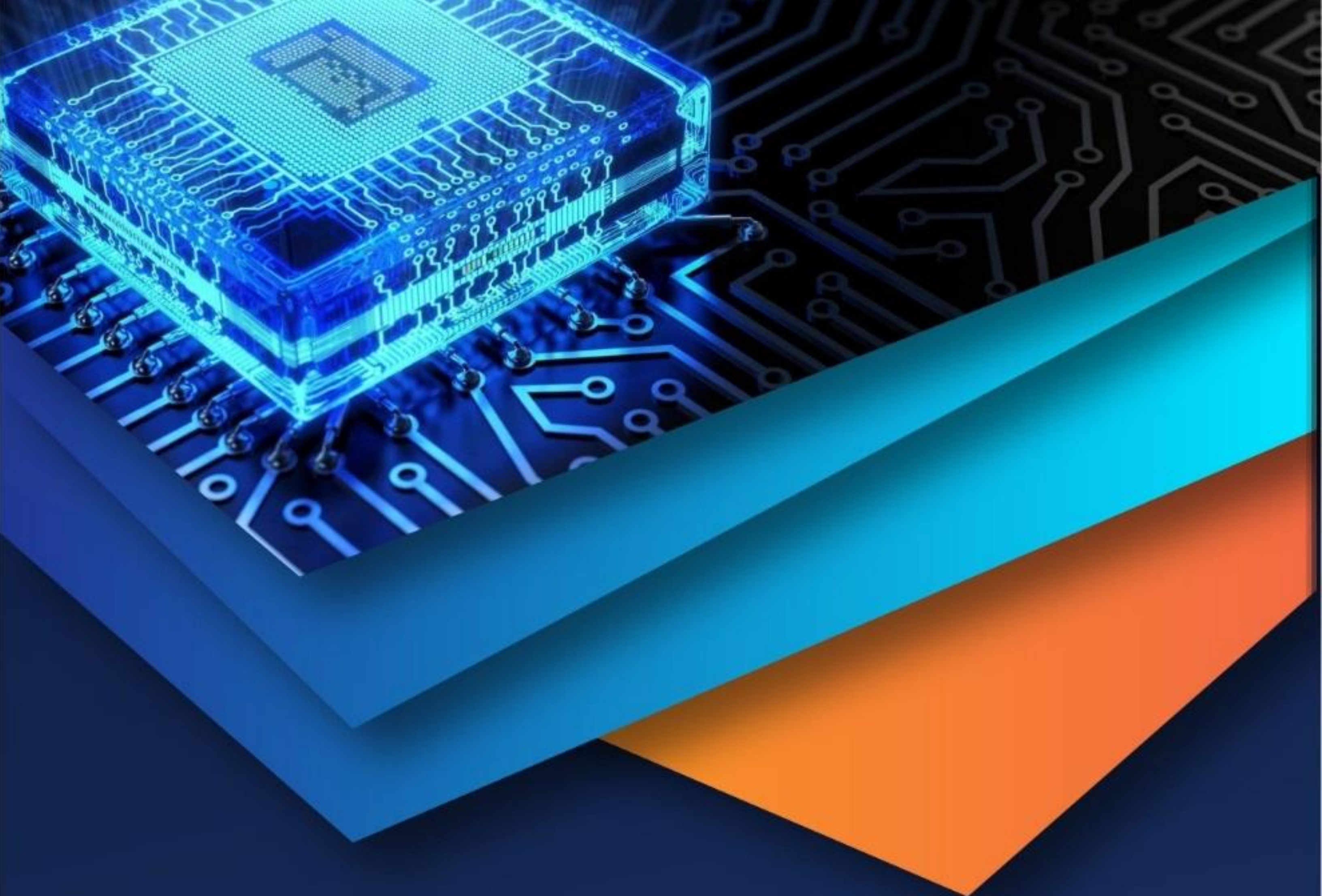

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