



Auto-Controlled Wireless Charging System for In-Motion EVs

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Abstract— Electric vehicle – to – vehicle (V2V) charging is an innovative approach where electric vehicles (EVs) can share energy. If a vehicle's battery is discharged, it can request a nearby car to wirelessly charge it. The following vehicle transmits power through a wireless charger, converting into AC, which is received by the second vehicle's receiving coil. The AC power is then converted to DC to charge the battery. This concept can be useful in emergencies. In the prototype, two small vehicles are built for demonstration. One vehicle serves as the power transmitter, while the other as a power receiving coil. Both vehicles are controlled by a controller chip and feature low-speed DC motors for motion. The system also includes a sensor that automatically stops the following vehicle when it gets too close to prevent collision, ensuring safe operation during charging.

Keywords— Electric vehicles, Microcontroller chips, Control keys, Power transmitting coil, Power receiving coil, DC motors, 12v – 7.5Ah rechargeable battery, 8v – 2Ah rechargeable battery, Distance detecting circuit etc.

I. INTRODUCTION

As fossil fuel declines day by day it is essential to choose alternative vehicles, out of many methods, battery-operated electric vehicle is the best solution. The main drawback of this vehicle is, since it utilizes battery power source and if the battery is drained, it is very difficult to charge the battery in the middle of the road and moreover we find very few charging points located far away from each other. Sometimes due to the heavy rains, if a vehicle happened to pass through the water over the road, the battery will be shorted because, water is a conductor and the battery will be discharged immediately. In such cases, it is essential to borrow the electric energy from other vehicles. Presently this is not possible because any EV doesn't carry the conducting cables to transfer electric energy from one battery to another battery.

To prove the concept practically, we need to construct 2 small electric vehicles for demo purpose. These are the basic versions and to prove the basic concept, simple motorized low speed 4 wheeler moving chassis are designed. The control circuit built with 89C52 will be arranged over the chassis along with other devices like rechargeable batteries, power transmitting circuit, power receiving circuit, inductive coils, etc. In this regard here in this project work, one set of similar to each other prototype modules of electric cars will be constructed and the power is transmitted from one vehicle to other vehicle. The front running vehicle battery will be charged through wireless power source acquired from rear running vehicle. Using a technology called inductive charging electricity can be transferred through an air gap from one magnetic coil in the charger to a second magnetic coil fitted in the other car. All we have to do is, the following vehicle must be very close to the power seeking vehicle, means both vehicles' coils must be parallel to each other. To maintain the close running and to avoid collision with each other, the following vehicle contains too close running protection circuit such that it can avoid too close running by stopping the following vehicle momentarily.

II. FUNCTIONAL DESCRIPTION

A. POWER TRANSMITTING COIL

The main function of this system is to provide electric energy to the power receiving coil without using any connecting cables. The concept of non-radiative method is adapted here by which electromagnetic field will be created at high frequency which in turn energy will be transferred from one coil to another coil without any conducting wires. The power transmitting coil as well as power receiving coil both must be arranged parallel to each other at certain distance.

B. POWER RECEIVING COIL

The LC circuit implemented at primary side (from where the power is transmitted), the same circuit must be adopted at secondary side. The secondary coil must be exactly similar to the primary coil and there should not be any difference in the wire gauge, no. of turns and coil size. Similarly capacitor value must be the same as primary capacitor and here high quality capacitors are preferred for proper resonance coupling. If the secondary coil is synchronized perfectly with the primary coil, distance can be increased affectively

C. MICRO-CONTROLLER

Micro-controller unit or embedded system is constructed with ATMEL 89C51/52 Micro-controller chip. The ATMEL AT89C51 is a low power, higher performance CMOS 8-bit microcomputer with 4K bytes of flash programmable and erasable read only memory (PEROM). Its high-density non-volatile memory compatible with standard MCS-51 instruction set makes it a powerful controller that provides highly flexible and cost effective solution to control applications.

D. DC Motor

DC motors are widely used, inexpensive, small and powerful for their size. They are most easy to control. One DC motor requires only two singals for its operation. DC motors take direct current voltages as input and convert it into rotation movement. DC motors usually have two wires and can be powered directly from battery or DC power supply. DC motor can also be powered through driver circuit that can regulate the speed and direction of the motor.

E. BATTERY

The system designed here utilizes high power battery of 12v – 7.5Ah to energize the power transmitter circuit and to transmit the energy through power transmitting coil. This circuit is used to charge the other vehicle battery without using any conducting cables. As long as the power transmitter is in energized condition and as long as the week battery vehicle is in accessible range, the week battery will be charged continuously. Wireless battery charging-uses an inductive or magnetic field between two objects which are typically coils to transfer the energy from one to another.

III. BLOCK DIAGRAM AND CIRCUIT LAYOUT

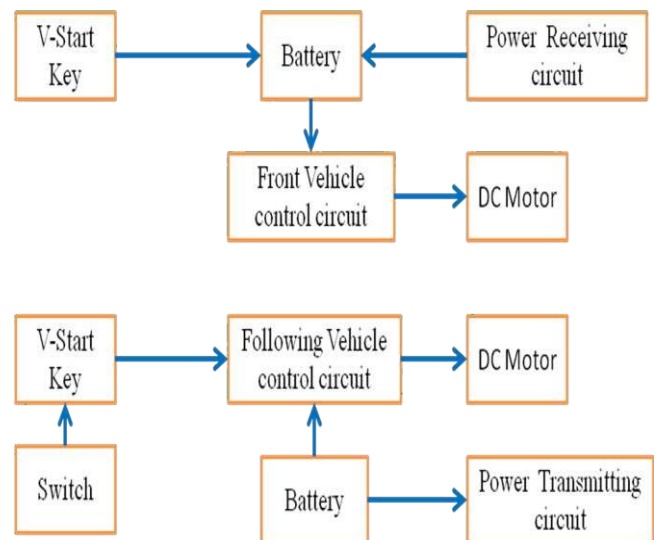


Fig. 1. Block Diagram

A. FRONT VEHICLE SYSTEM

V-Start Key: Initiates the power flow when turned on.
Battery: Supplies power to the front vehicle's systems.
Front Vehicle Control Circuit: Receives power from the battery and controls the front vehicle's DC motor based on programmed instructions or user input.
DC Motor: Drives the front vehicle.
Power Receiving Circuit: Connected to the same battery, this circuit is responsible for receiving transmitted signals or power from the following vehicle.

B. FOLLOWING VEHICLE SYSTEM

Switch and V-Start Key: The switch activates the V-Start Key, which powers the following vehicle's systems.
Battery: Supplies power to both the control and transmitting circuits.
Following Vehicle Control Circuit: Receives signals and processes them to control its DC motor to follow the front vehicle accurately.
DC Motor: Drives the following vehicle.
Power Transmitting Circuit: Sends signals or power to the front vehicle, allowing coordination between the two.

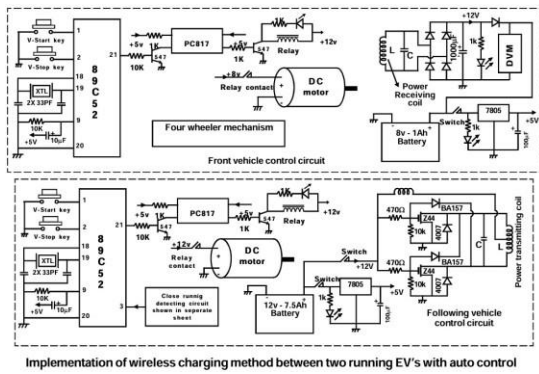


Fig. 2. Circuit Layout

The control and power flow system for a two-vehicle system comprising a front vehicle and a following vehicle. The main goal is to enable coordinated movement, where the following vehicle can mimic or respond to the motion of the front vehicle, likely in an autonomous or semi- autonomous convoy system.

IV. CLOSE DETECTION

The next important circuit used in the project work is to detect the close running between two vehicles, for this purpose IR sensors are used and are interfaced with IC567. This sensing circuit can be installed at front side of rear following vehicle. Initially the process begins with IR (infrared) sensors, here 1 set of IR sensors are used for detecting the front moving vehicle. This circuit is constructed with IR signal transmitting (Tx) LED and IR signal detecting LED. The IR signal or IR energy radiated from the IR Tx LED will be transmitted in uni direction up to certain distance in the air.

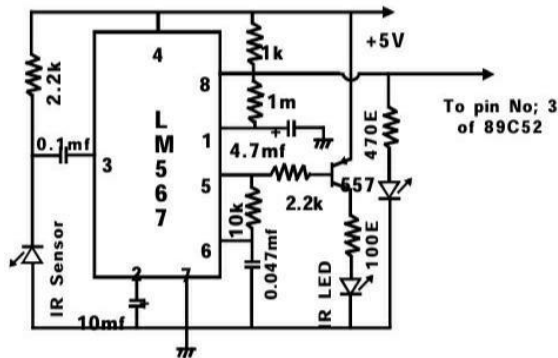


Fig. 3. Close Detection Circuit

A. LM567 DECODER

The LM567 IC is a general-purpose tone decoder IC designed to provide a saturated transistor switch to ground when an input signal is present within the pass band. The circuit consists of two-phase detectors i.e., Q and I detector that are driven by a voltage-controlled oscillator, which determines the centre frequency of the decoder.

External components are used to independently set centre frequency, bandwidth and output delay.

B. IR SENSOR

The IR is having the characteristics of a laser i.e., it almost travels in a straight line with minimum expansion and like laser light it is also a monochromatic light. Another important feature of IR is that while the transmission is being done the IR transmitter and the IR receiver (detector) both should be in line of sight.

V. RESULT AND DISCUSSION

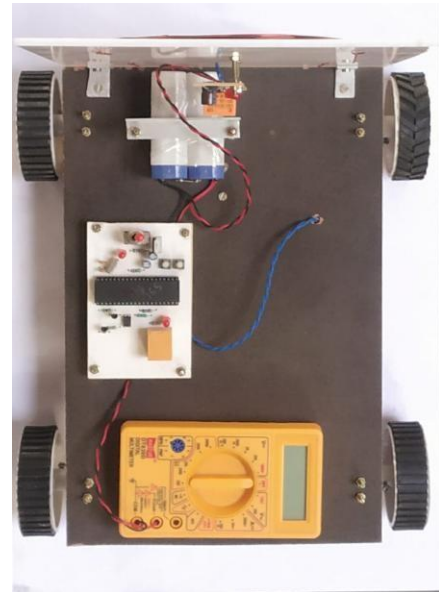


Fig. 4. Front Vehicle

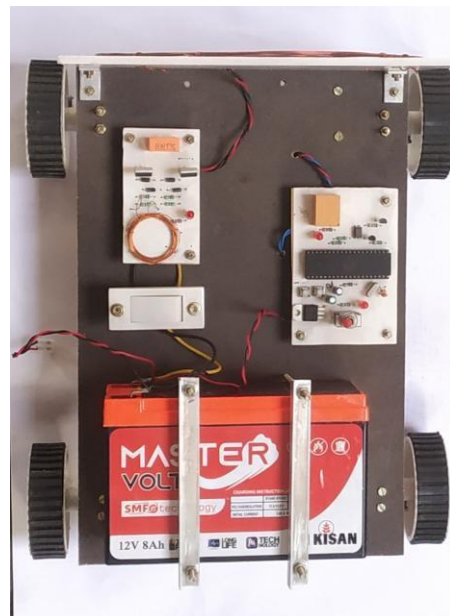


FIG. 5. Following Vehicle

This system shows a bidirectional interaction between a front and following vehicle. The front vehicle manages its movement while sharing data through a power receiving circuit. The following vehicle receives control commands or power, processes them via its control circuit, and drives accordingly. This setup can be used for automated following systems in applications such as automated convoys, material transport in warehouses, or connected vehicle platooning.

VI. CONCLUSION

These days wireless power transmission is became major subject for discussion, this technology is used for many applications and therefore to a thought is given that why can we transfer the electric energy from one vehicle battery to another vehicle battery during mobility. The concept is new and hence this project work is taken up, designed developed and a prototype module is fabricated and results are found to be satisfactory. The subject of wireless energy is focused in this project work, in this regard function of Electro-magnetic field, Resonant inductive coupling, LC network, Synchronization between two Inductive coils, etc. are studied properly, i.e. before starting the project work. Most of the information gathered from various websites.

Wireless power transmission is an important subject creates lot of enthusiasm while constructing the project work. The field of wireless transmission of electrical energy between two magnetically coupled coils requires lot of experiments to obtain better results. In our trial runs we have winded many types of magnetic coils, we tried with different Gauge wires, we tried with different turn's ratio, we tried with different sized coils, etc. Finally we have concluded and focused on one set of coils winded with 21 SWG wire with a ring size of 5", both primary and secondary coils are having six turns each. With these coils we found that the range increased slightly when compared with other coils. Finally the distance between the two coils is defined as 70mm, at this distance we found that though the power receiving coil receiving energy it is not sufficient to drive the motor that is used in moving mechanism and hence distance is reduced to less than 20mm and accordingly coils are arranged.

VII. REFERENCES

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