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# Wirelessly chargeable Eco-friendly Bus with secured RFID Authentication

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**Abstract*:*** This paper aims at the possibility of charging the electric vehicles wirelessly using inductive coupling scheme. We are exploring a key enabling element that will overcome problem associated with charging of moving electric vehicles and which will successfully demonstrate the feasibility of wireless power transfer directly to vehicles cruising at highway speed, via magnetically-coupled resonating coils located in the roadbed and in the vehicles. This paper uses two sources of energy for wireless charging which are inductive coupling scheme and solar energy. Also it uses RFID technique for authentication of vehicles. This paper will contribute to overcoming a critical limitation of existing electrical vehicles, by offering range at competitive costs in development of eco-friendly bus.

**Keywords*:*** Eco-friendly, RFID, Inductive Coupling.

## I. INTRODUCTION

Electric vehicles offer superior energy efficiency while offering an enormous Potential for reducing CO2 emissions if the electricity is supplied from a renewable or nuclear source. Electricity is the most versatile and widely used form of energy. The global demand for electricity is continuously growing. However, they are presently neither range nor cost-competitive compared to conventional vehicles, due to limited options for recharging, and expensive energy storage (batteries).This paper aims at extending the wireless power transfer to the charging of moving electric vehicles.

Electromagnetic induction non-contact power transmission employs the phenomenon in which application of an electric current to one of adjacent coils induces an electromotive force in the other coil with magnetic flux as the medium. By extending the range of electric vehicles, this paper will contribute to overcoming a critical limitation of existing electrical vehicles, by offering range at competitive costs. The objective of such initiative is to investigate on the feasibility, financing and development of new plans.

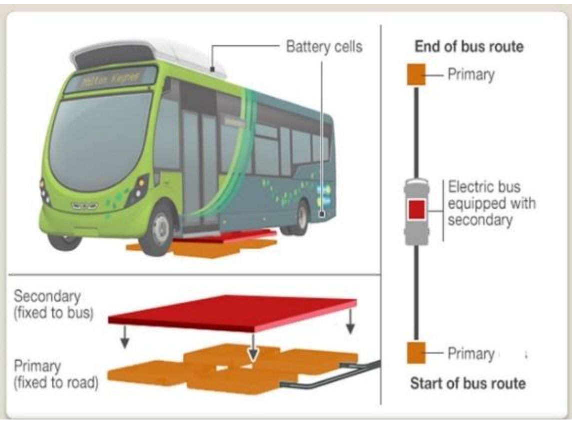


Fig. 1. Eco-friendly bus with inductive coupling principle

## II. LITERATURE SURVEY

In today's era, almost all buses operate on petrol or diesel. The major problem with this buses is air pollution which is harmful for human health. Solution for this is buses which operate without such fuels. China developed a BYD electric bus called K9 in which it operates on battery.

The K9 has following specification:
1) Electric power consumption: less than 100kWh/60mins
2) Acceleration: 0–50 km/h in 20s
3) Top speed: 96 km/h
4) Normal charge: 6h for full charge
5) Fast charge: 3h for full charge
6) Overnight charging: 60 kW Max power to fully charge the bus within 5h

In December 2013, Bangalore Metropolitan Transport Corporation, Bangalore, India has the ownership of K9 model of the BYD buses, and has plans to start operation of the bus from the second week of the month. If we compare Normal bus and BYD electric bus then we observe things like: BYD system requires more investment cost than normal bus. But BYD bus is One Time investment service. So we think like that these buses are more useful now a days. [2]

*1) Wireless Power Transmission Using Satellite Based Solar Power System*

A wireless power transmission using microwave is a system which contains satellite based solar power system (SPS), microwave generator, microwave transmitter (magnetron) and microwave receiver. The DC power received on earth is converted into AC for various useful purposes. This paper gives a comprehensive study of various components of satellite based SPS and projects this technology as a bulk source of power generation in future. [1]

2) Wireless Chargeable Eco-friendly Bus
Nowadays conventional buses which run on fuel results in release of the harmful gases such as CO2 which leads to increase in environment pollution ,global warming, this also affect the health of human being, along with these fuels which is used in buses is non-renewable source of energy and goes on decreasing day by day. In order to control the situation we are proposing a method in which instead of using a fuel in buses we are developing a electric bus. This bus is eco-friendly and uses renewable source of energy. Electric vehicles offer superior energy efficiency while offering an enormous Potential for reducing CO2 emissions if the electricity is supplied from a renewable or nuclear source. However, they are presently neither range- nor cost-competitive compared to conventional vehicles, due to limited options for recharging, and expensive energy storage (batteries). This system aims at extending the wireless power transfer to the charging of moving electric vehicles. As an optional part we are using a solar panel if in case bus get not fully charge through the circuitry. Along with this the BRT bus indication unit i.e. signalling system and verification system is also provided to verify the BRT bus and to indicate the status of the bus. [2]

*3) An Innovative Design of Wireless Power transfer by High Frequency Resonant Coupling*
The main objective of this paper is to develop a concept of transferring power without use of any wires. The concept is based on low frequency to high frequency conversion. High frequency power is transmitted between inductor through air core. By using two self-resonating coils, non-radiative power is transmitted over distances up to three times the radius of the inductor coils. [3]

*4) Design of Fast Response Smart Electric Vehicle Charging Infrastructure*
The response time of the smart electrical vehicle (EV) charging infrastructure is the key index of the system performance. The traffic between the smart EV charging station and the control center dominates the response time of the smart charging stations. To accelerate the response of the smart EV charging station, there is a need for a technology that collects the information locally and relays it to the control center periodically. To reduce the traffic between the smart EV charger and the control center, a Power Information Collector (PIC), capable of collecting all the meters' power information in the charging station, is proposed and implemented in this paper. The response time is further reduced by pushing the power information to the control center. Thus, a fast response smart EV charging infrastructure is achieved to handle the shortage of energy in the local grid. [4]

*5) Design of RFID Mesh Network for Electric Vehicle Smart Charging Infrastructure*
With an increased number of Electric Vehicles (EVs) on the roads, charging infrastructure is gaining an ever-more important role in simultaneously meeting the needs of the local distribution grid and of EV users. This paper proposes a mesh network RFID system for user identification and charging authorization as part of a smart charging infrastructure providing charge monitoring and control. The ZigBee-based mesh network RFID provides a cost-efficient solution to identify and authorize vehicles for charging and would allow EV charging to be conducted effectively while observing grid constraints and meeting the needs of EV drivers. [5]

*6) Analysis and design of noncontact charger using LC load resonant coupling for electrical vehicle system*
A wireless power transfer system for roadway powered electric vehicles (EVs) is presented. The system concept is using resonant inductive coupling of primary coils arranged in a linear array in the roadway to secondary coils in each EV. Due to the convenience of using electronic devices, contactless energy transfer (CET) systems have garnered interest in various fields of industry. In this system, a new design approach that uses antiparallel resonant loops for CET systems is presented. Forward and reverse loops forming an antiparallel resonant structure stabilize the transfer efficiency and therefore prevent it from dramatic distance-related changes, a phenomenon that can occur in CET systems with non-radiative methods (or resonant methods). This paper proposes frequency-insensitive antiparallel resonant loops and the optimal design of these loops for uniform transfer efficiency according to the distance. The proposed technique achieves frequency variation that is one-sixth that of conventional unidirectional loops, thus improving the power efficiency to a maximum of 87%. The improved performance of data transmissions for near-field communication is also verified. Effectiveness of the proposed approaches is demonstrated by using a dual-band (1.83/3.36 GHz) antenna of only 0.01λ2 in size. Power conversion efficiency (PCE) represents a major challenge for WPT, especially at low input power levels. Our results indicate that PCE is related to the distributions and the combinations of input power spectrum. Therefore, a novel multi tone powering system is developed to achieve a high output voltage. [6]

*7) Introduction and overview on wireless transfer of electric energy*
In this paper we have introduced a technology in which we can transfer the electric energy using wireless technology. Also we have a short overview on wireless transfer of electricity. Using self-resonant coils in a strongly coupled regime, the team experimentally demonstrated efficient non-radiative power transfer over distances up to 8 times the radius of the coils. They were able to transfer 60 watts with ~ 40% efficiency over distances in excess of 2 meters. Also we refer different types of antennas using which we implement this technology. [7]

## **III.** PROPOSED SYSTEM WITH WORKING PRINCIPLE

The block diagram of proposed system is divided into three parts:
1. Bus Stop Unit
2. Bus Unit
3. Depo Unit

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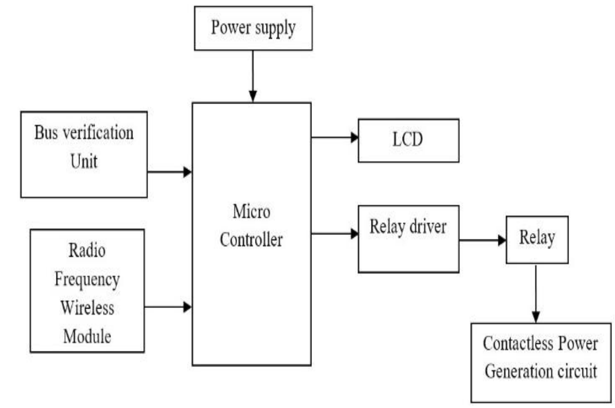

Fig.2. Bus Stop Unit

At bus stop unit, the bus verification unit identifies the bus by sending the bus info to controller. Then the controller switch ON the relay through relay driver circuit. Then the relay activates "contactless power generation circuit" through inductive coupling where the battery gets charged. The current status of the battery is displayed on LCD. RF wireless module will send the bus location updates to depo.

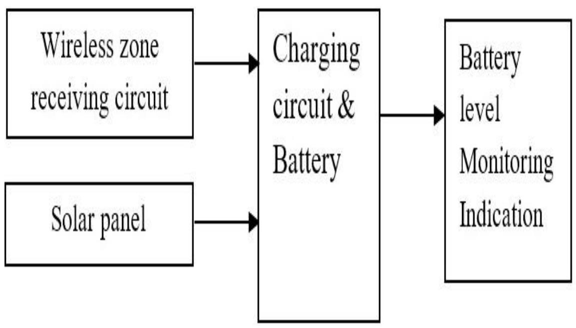

Fig. 3. Bus Unit

In bus unit, it consists of wireless zone receiving circuit and solar panel, through which charging of the battery is done.

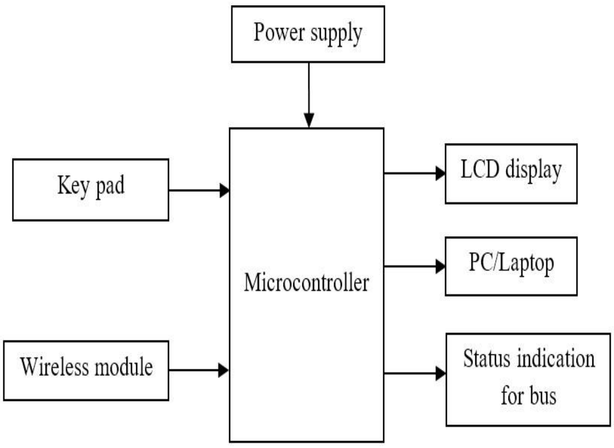

Fig. 4. Depo Unit

At first the moderator unlocks the system by entering the password. Then the RFID tag is identified by the RFID reader and it is processed by the microcontroller. Here it also shows the status of the bus.

## IV. SPECIFICATIONS OF HARDWARE

The following are the important elements in the block diagram:

*1) Microcontroller*
The signals from EM Transponder are given to the Microcontroller. Microcontroller processes all these signals and gives data to LCD display.

TABLE I: MICROCONTROLLER COMPARISON

| | AT89S52 | PIC | AVR |
|---|---|---|---|
| Flash Program Memory | 8K | 4K/8K | 2K |
| Data Memory | 256 | 192 | 128 |
| Ports | 4 | 3-5 | 4 |
| Timers | 3 | 3 | 2 |
| ADC | 8 channel | 8 channel | Not present |
| Micro-Controller | 8 bit | 8 bit | 32 bit |
| I/O Pins | 32 | 22 | 15 |

*2) EM reader*
When EM transponders come in the range of EM reader it will read the unique id number.

Features:-
- Fully-integrated, low-cost method of reading passive RFID transponder tags.
- Single-wire, 2400 baud Serial TTL interface to PC, BASIC Stamp and other processors.
- Requires single +5VDC supply.
- Bi-colour LED for visual indication of activity.

*3) EM transponder*
EM transponders are used for unique identification.

There are two types of RFID tags:
*i) Active RFID*
Identification system in which tags have their own power source (usually a battery), enabling them to broadcast an identifying signal. This extends the range of the tags and the capability for communicating advanced information such as location.

*ii) Passive RFID*
Identification system, in which the tags are not powered, relying on active signals from the location transmitters for their response. This limits the range of the tags to a few feet.

*4) LCD display*
It is used for the displaying the information.


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*5) Relay*

It is used to drive AC/DC Load & also used for auto switching purpose.

*6) Solar cell*

It is used to convert sun energy into electrical energy. Photovoltaic (PV) systems convert light energy directly into electricity. Commonly known as “solar cells.” The simplest systems power the small calculators we use every day. More complicated systems will provide a large portion of the electricity in the near future. PV represents one of the most promising means of maintaining our energy intensive standard of living while not contributing to global warming and pollution

*7) Battery*

A battery is a device that converts chemical energy directly to electrical energy. There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded, and secondary batteries (rechargeable batteries), which are designed to be recharged and used multiple times.

## V. CONCLUSION

We are trying to develop wireless charging system which is having the RFID authentication for the moving vehicle using inductive coupling principle. This will reduce the emission of harmful gases such as CO2 or SO2 that are produced by the fuel vehicles.

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