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EV Charging Station Using Solar Power

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Abstract: The main requirement for the adoption and implementation of electric vehicles (EV) is the availability of charging facilities in public locations. In order to create an enabling EVSE ecosystem and hasten the adoption of EVs, this paper addresses several challenges relating to electric vehicle supply equipment (EVSE) or charging stations linked to legislation, standards, interoperability, and business models.

Electric vehicle (EV) supply equipment (EVSE) or charging equipment are necessary for vehicle owners to adopt EVs. With varying degrees of success, several nations utilised various strategies and economic models to build the EVSE ecosystem. As India prepares to launch an EV revolution, a few crucial EVSE-related questions continue to plague the industry's players: What criteria apply to EVSE in India? whose will berun and keep up an EVSE? Utilities? Utility franchisees, perhaps? or outside parties like business owners, parking lot managers, and fleet operators? What will the electricity cost be for charging an EV? Will there be only energy charges or will there be capacity charges as well (minimum monthly fee per kW of capacity)? Who will cover the expense of the electric grid upgrade (higher capacity distribution transformers and new cables when necessary): the owner of the EVSE or the utility's usual grid improvement capex? Where will the public EVSEs be installed, and will the land be given away for free, at a discount, or at market value? This paper seeks to summarise the extensive work that has previously been done by numerous parties on the aforementioned topics and environment that will facilitate the rapid implementation of EVs.

I. INTRODUCTION

Variety of EVSEs The two main types of EVSE or charging equipment are AC and DC charging equipment. Direct current (DC), which a DC charger can provide straight to the EV battery, is what the EV battery requires. Alternately, a DC supply can be provided to the EV battery by converting the AC power from the AC charger using an on-board AC-DC converter. A built-in AC-DC converter is required for AC charging, which will increase the cost and weight of the EV. To allow for charging from any AC source, practically all EVs incorporate a modest size AC-DC converter. When using an AC charger, The DC output from the on-board AC-DC converter determines how quickly batteries charge.

An EV with a 10 kWh battery and an onboard AC-DC converter with a 1 kW DC output, for instance, could take 10 hours to fully charge the battery with a single phase 220V AC, 15 Amps supply (AC output: 3.3 kW).

Depending on the battery chemistry and battery management system (BMS) in the EV, high power output AC chargers are available that can quickly charge the batteries.

High power output DC Fast Chargers (DCFC) can supply DC power to the battery and can charge the EV battery significantly more quickly. An EV with a 25 kWh battery can be charged by a 50 kW DCFC in 30 minutes (Theoretically) minutes. Since the AC-DC conversion occurs in the EVSE rather than the car, DCFCs are more cost-effective.

The BMS in the EV assumes management of the charging process once it is linked to the EVSE, and a handshake is established between the EV and EVSE.

A. Charging Rate

Not all batteries can be quickly recharged. The term "C-rate" refers to the charging rate in battery slang. A complete charge at a 1C rate takes an hour, a 2C charge takes thirty minutes, and a 10C charge takes six minutes. Additionally, C/2 denotes a two-hour charge time.

The table below lists the maximum rate at which various battery types can be charged: The battery chemistry and its thermal characteristics are closely correlated with the BMS. Based on the input voltage, current, ambient temperature, and the amount of remaining charge in the battery, BMS calculates the charging rate.

Battery Chemistry	Maximum C Rate	Max Temperature (Degree C)	Life (Maximum Cycles)	Power Density (Wh/kg for cell)	Average Module Price (US$/kWh in 2018)*
Lithium Ion Iron-Phosphate (LFP)	Up to 2C	40	1500-3000	100-130 Wh/kg	270
Lithium Ion- Nickel Manganese Cobalt (NMC)	C/2	40	1000-2000	230-250 Wh/kg (for NMC 811)	250
Lithium Ion- Nickel Manganese Cobalt (NMC)	3C	40	3000-4000	200 Wh/kg (for NMC 811)	400
Lithium Nickel Cobalt Aluminium (NCA)	2C	40	1000-1500	250-270 Wh/kg	230
Lithium ion Titanate Oxide (LTO)	6C	60	7500-10000	50-80 Wh/kg	700

1) Electricity Tariff for EVSE

For the first time in the nation, the Delhi Electricity Regulatory Commission (DERC) announced a distinct EV charging tariff in 2017 with its tariff order that is significantly less expensive than the commercial tariff: Rs 5/kWh for charging from HT supply and Rs 5.5/kWh for charging from LT supply. There are no minimum monthly fees for capacity either. This was purposefully kept lower to encourage the spread of EVs and the development of the EVSE ecosystem. While DERC kept the 2017–18 tariff for 2018–19, the State Electricity Regulatory Commissions of Karnataka and Maharashtra set distinct EV tariffs in 2018. In the upcoming years, we anticipate different, variable EV pricing across the nation, based on time of usage (TOU).

2) Grid Upgrade Cost for EVSE

Distribution transformers (DT) and overhead/underground wires are typically overburdened in most of India. One specific DT may fire if many EVs are connected to the low voltage wires from it. Since friends and neighbors might influence a person's decision to buy an EV, initial EV trials in almost all regions have seen the formation of pockets of EV concentration where grid equipment required to be upgraded According to an ISGF research conducted in Kolkata in 2016–17, the existing DTs may not be able to handle DC Fast Chargers for 8 months of the year (apart from November to February, when air conditioners are rarely utilized). The cost of power will be so exorbitant that e-mobility will not take off if the EVSE institution is charged for the grid upgrade, which will cost millions of dollars. Instead, ISGF has been arguing with regulators and policy makers that grid upgrades for EVSE should be included in the annual capex of the DISCOMs because the benefits of e-mobility (such as decreased air and noise pollution, fatigue-free travel in air-conditioned electric buses, etc.) are available to the entire population in a city.

3) Land for EVSE

The EVSE itself takes up minimal room and can even be placed on a wall. However, parking space is needed for the EVs that will be linked to the EVSE for a number of minutes or hours. In cities, the cost of the same type of land might be high. The EVSE company will not be profitable even if local governments or property owners (such as malls, hospitals, campuses, train stations, bus stops, airports, and office buildings) charge a little rent for the same. According to ISGF, at least 10% of parking spaces may be set aside for EVSEs without charging a lease rent.

B. Objective

Designing a system with both mechanical and electrical components is the goal of this project. In light of this, the team made the decision to create a "Wireless Charging Station for Electric Vehicles”. Electric powered vehicles require charging stations, and for people to drive long distances there needs to be a network of such stations situated strategically. Charging an electric vehicle's battery with a charger and wire is inconvenient, dangerous, and expensive.

1) Additionally, battery recharge typically takes three hours, which is significantly longer than a petrol reloads.
2) The floor's charging cords could present a tripping danger. In frigid climates, leakage from old, fractured cable might put the owner in even more dangerous situations.
3) The efficiency of the wireless power delivery can be lowered due to the extremely changeable relative spacing and lateral distance between the primary and secondary coils.

4) Range anxiety, or the worry that a car won't have the range to get where it's going and will leave its occupants stranded, is one of the issues with electric vehicles.

II. LITERATURE SURVEY

The wireless power transfer method is utilised in this paper to power a 5 V battery that might be used to power phones. Solar energy that was gathered at the wireless power transfer's transmission side is used to recharge the battery. The report also includes a hardware model of the system. The prototype includes inductive power transfer and is equipped with the efficiency of power transmission made possible by the system's solar power. This project makes use of inductive power transmission and one of the main sources intended to be the solar system.

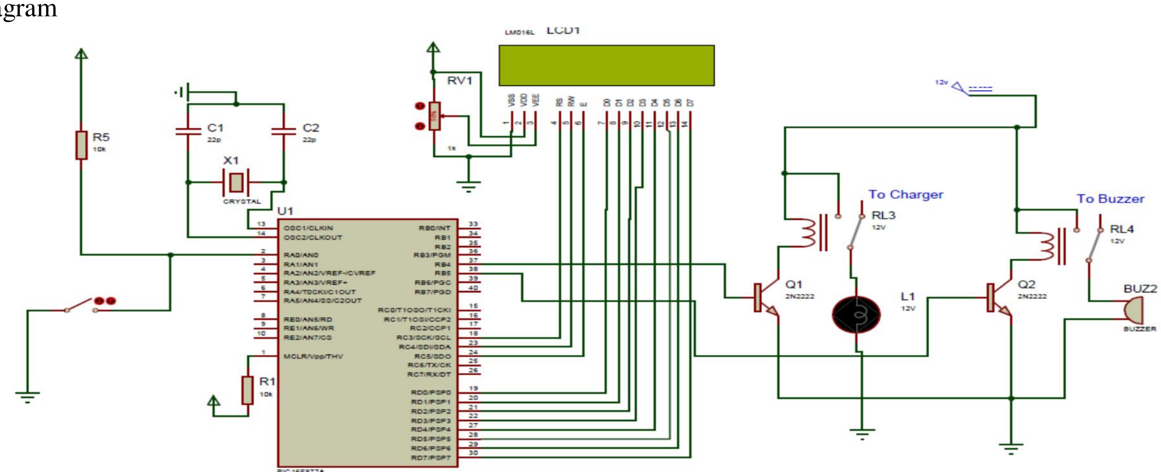
The main goal of energy management was to handle the disrupted generation of power from renewable sources, to extend the lifecycle of storage devices by prioritising caution on overcharging, and to make the system reliable in the absence of utility grid. This paper provides implications of controller for energy management for grid-connected solar system.

A. *Technical Specification*

1) Power supply: 5 v
2) Microcontroller: PIC 16f877A
3) RFID Card
4) RFID card reader Module: E18
5) Display: LCD
6) COMPILER: MPLAB 8
7) Programming Language: Embedded C

B. *Methodology*

Circuit Diagram



C. *Design To Step Down Transformer*

Before the design of the transformer begins, the following data must be available to the designer.

1) Power generated
2) a working voltage.
3) Frequency Spectrum
4) Effectiveness and Control

The size of the core is one of the first factors to be taken into account while choosing the core and winding configuration. The area or size of the core is typically determined using the formula below.

$$Ai=\sqrt{\left(\frac{p1}{0.87}\right)}$$

Where,

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Ai = Area of cross section in sq. cm.

P1 = Primary voltage

In Transformer P1 = P2

For our project we required +5V regulated output. So transformer secondary rating is 12V, 500 mA. So secondary power wattage is,

$P2 = 12 \text{ X } 500 \text{ X } 10^{-3}$ w

= 6w.

, Ai = (6/0.87) = 2.62

Generally 10% of area should be added to core accommodate all turns for low Iron losses and compact size.

So, Ai = 2.88.

Turns per volt Turns per volt of transformer are given by relation

$$\text{Turns/volt} = \frac{10{,}000}{4.44 f\, B\, Ai}$$

Here;

F is the frequency in Hz

B is flux density in Wb/m2

A is net area of cross section.

For project for 50Hz the turns per volt for 0.91 wb/m2,

Turns per volt = 50/Ai

= 50/ 2.88

= 17

Thus, for primary winding = 220 X 17 = 3800.

For secondary winding = 12 X 17 = 204

D. Rectifier Design

R. M. S. Secondary voltage at secondary of transformer is 12V. So, maximum voltage Vm across Secondary is

= RMS voltage *1.41

= 12* 1.41

=16.97

D.C. output voltage at rectifier o/p is

Vdc = 2Vm/3.14

= 2*16.97/3.14

= 10.80 v

PIV = 2 Vm

= 2 X 16.97

= 34V

Design of filter capacitor

Formula for calculating filter capacitor is,

$$C = \frac{1}{4.3\, r\, f\, RL}$$

r = ripple present at o/p of rectifier.

(Which is maximum 0.1 for full wave rectifier ?)

f = Frequency of mains A.C.

R = I/p impedance of voltage regulator IC.

$$C = \frac{1}{4\,3\; 0.1*50*28} = 1000F$$

IC 7805 (Voltage regulator IC):-

Specifications: -

- Available o/p DC. voltage = + 5V
- Line regulation = 0.03
- Load regulation = 0.5
- Vin maximum = 35 V
- Ripple Rejection = 66-180(db)

III. CONCLUSION

This study presents an RFID-based charging permission system that makes it simple for users to enable charging at smart charging stations. The system moves SMERC research one step closer to developing a secure, energy-efficient, affordable, and user-friendly smart charging technology that meets EV drivers' needs for convenience while enhancing the stability and reliability of the local grid.

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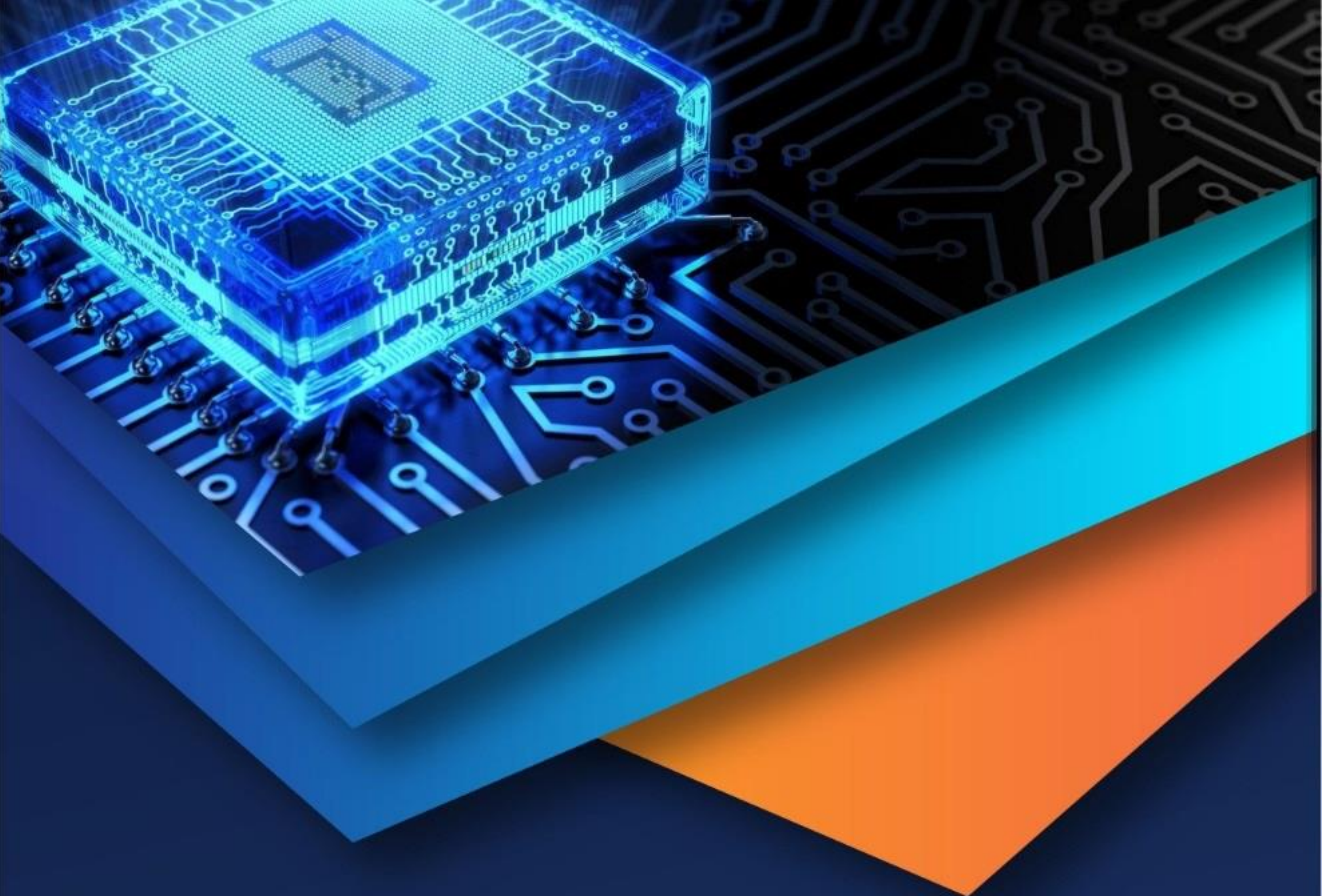

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