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# Design of Charging Station for Electrical Vehical Study in Amravati

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**ABSTRACT:** As the global automotive industry transitions towards sustainable mobility solutions, the adoption of electric vehicles (EVs) has gained significant momentum. Accommodating this shift necessitates the establishment of robust charging infrastructure to support the growing fleet of EVs. This study focuses on the design of a charging station tailored to the specific needs and characteristics of Amravati city, situated in the state of Maharashtra, India. The research examines various factors including geographical location, demographic patterns, traffic density, and urban infrastructure to determine the optimal placement and configuration of charging stations. Utilizing methodologies such as GIS mapping, demand forecasting, and stakeholder consultations, the study aims to propose an efficient and scalable charging infrastructure network. Additionally, considerations for sustainability, accessibility, and integration with existing urban amenities are incorporated into the design framework. The findings of this research are intended to provide valuable insights for policymakers, urban planners, and industry stakeholders seeking to promote the widespread adoption of electric vehicles in Amravati city and beyond.

**KEYWORDS:** electric vehicle, EV charging station, solar energy system, e mobility, RFID, Arduino

## I. INTRODUCTION

In response to the imperative for sustainable urban transportation solutions amid rapid urbanization, Amravati City, like many urban centers globally, is poised to tackle emissions reduction and energy efficiency challenges by embracing electric vehicles (EVs). A pivotal aspect of this endeavor is the design and implementation of an Electric Vehicle Charging Station (EVCS) infrastructure tailored specifically for the city. This comprehensive study delves into various parameters such as geographical considerations, urban infrastructure assessment, energy demand analysis, technology integration, sustainability, resilience, user experience, and accessibility. By meticulously analyzing these factors, the aim is to formulate an optimal blueprint for an EVCS that not only caters to existing needs but also anticipates future requirements. Through strategic placement leveraging Amravati City's unique topography and climate, alongside the integration of renewable energy sources like solar power, the charging stations aim to ensure accessibility and convenience for EV users, while also addressing potential areas of congestion and grid stability. Integration of advanced technologies such as smart charging systems and vehicle-to-grid (V2G) capabilities enhances efficiency and flexibility, contributing to demand-side management. Moreover, sustainability efforts encompass leveraging renewable energy sources, optimizing energy efficiency, and ensuring resilience against natural disasters and grid disruptions. Prioritizing user experience through user-friendly interfaces and amenities fosters widespread adoption of EVs, thus catalyzing the transition towards sustainable and efficient urban mobility. This study not only serves the local community but also provides a blueprint for cities worldwide seeking to embrace the electric mobility revolution and advance clean transportation infrastructure.



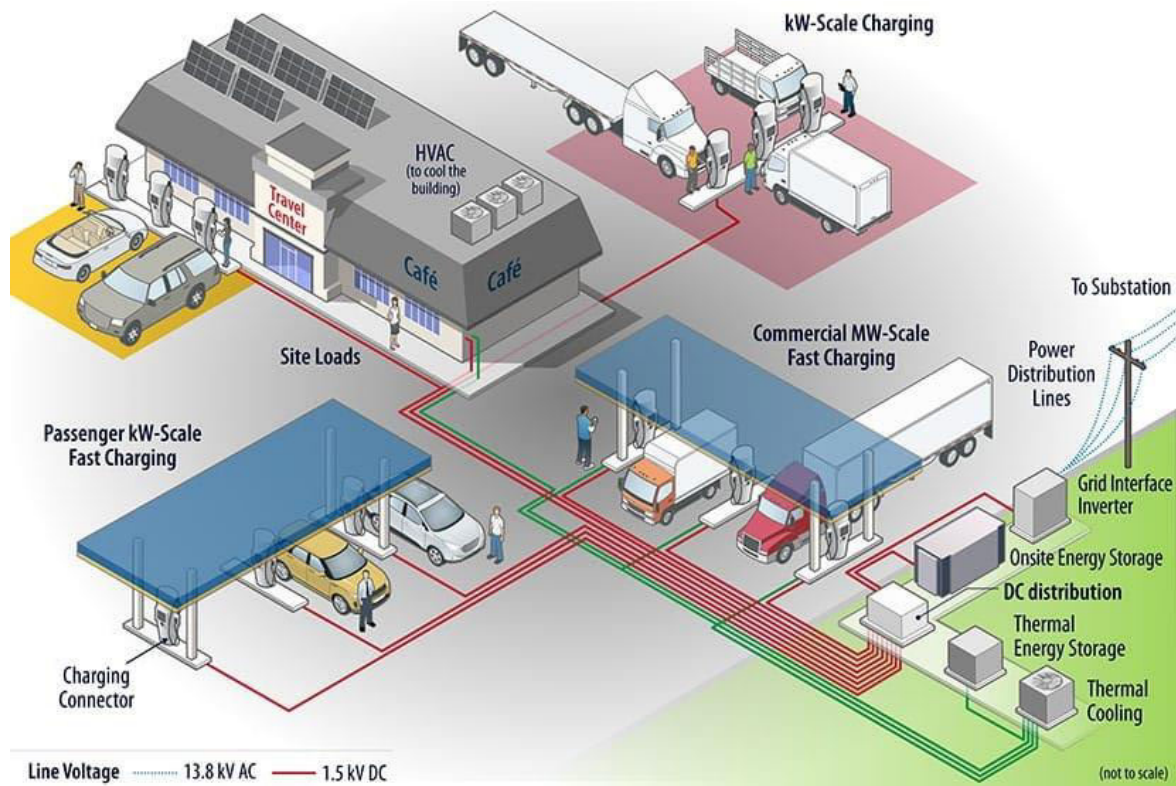


Fig 1:-Infrastructure of EVs Charging Stations.

## II. LITERATURE REVIEW

1].Brief History Contrary to common belief, electric cars were invented before gasoline combustion ones, as early as the 1830s by Robert Davidson. However, they were not very practical since, at the time, batteries could not be recharged yet. In 1859, rechargeable batteries came along, which made the idea of EVs more viable. Over the following couple of years, EVs were starting to make appearances across the United States from different manufacturers. Moreover, in New York, electric taxis were becoming more and more common. In the early years of the 20th century, EVs were at an all-time high, with advancements in the electric field and wider access to electricity, it became increasingly easier to charge EVs which made them very popular. However, around the same years, advancements in gasoline-powered vehicles were also being made, adding to their advantages and attraction compared to their counterparts .[1]

2]2002EEVs in the Moroccan Context: Challenges and Current Status Since this project will be taking place in AUI, it is important to study the Moroccan context to consider all factors that come into play. In Morocco, EVs aren't very popular or common among citizens, compared to gasoline powered vehicles. However, there is still an EV market in the kingdom, despite its relatively smaller scale. In the year 2019, a study has shown that there were 2717 hybrid electric vehicles around Morocco. This same study forecasts an exponential growth of this number by 2030, to account for over 425,704 electric vehicles [2]. However, EVs still face numerous challenges due to some of their inconvenience compared to gasoline powered cars. The first one being the charging time; Insofar as it takes longer (around) to charge an EV's battery as opposed to a couple of minutes to fuel an internal combustion engine. Secondly, the price of EVs is heftier than that of a conventional car, which is why many people tend to opt for the latter. Moreover, another concern for buyers was the range of EVs, as they feared that they wouldn't travel far. However, as of recent years, EVs' range matches, if not surpasses that of a regular engine car. In addition, in many countries including Morocco, the grid may not be able to power a large number of EVs since an increase in EVs will lead to an increase in energy demand that the country's supply may not be able to meet. Lastly, but definitely not least, a crucial aspect to the use of EVs is the

charger. Unfortunately, charging infrastructure is very rare in Morocco which discourages possible buyers from switching to electric mobility.

3] A. Y. S. Lam, Y.-W. Leung and X. Chu have designed to enhance environmental sustainability, many countries will electrify their transportation systems in their future smart city plans, so the number of electric vehicles (EVs) running in a city will grow significantly. There are many ways to recharge EVs' batteries and charging stations will be considered as the main source of energy. The locations of charging stations are critical; they should not only be pervasive enough such that an EV anywhere can easily access a charging station within its driving range, but also widely spread so that EVs can cruise around the whole city upon being recharged. Based on these new perspectives, we formulate the EV charging station placement problem (EVCSP). [3]

4] 4) S Alshar. P. Macedo. F. Mohamed and V. Disfani have designed EV charging infrastructure that hinders the development of the EV market. To compensate for these shortcomings, Charging Stations could play a prominent role to accelerate EV penetration by providing charging services with no restrictions on the location and time of the charging process. [4]

### III. PROPOSED SYSTEM

#### Level 1:-

Electric vehicles are charged via an AC power supply at a normal (Level1) or semi fast charging rate: Voltage: 120V 1-Phase AC

Amps: 12-16 Amps. Charging Loads: 1.4 to 1.9 KW. Charging Time: 3-5 Miles of range per hour

Price per Mile: 2c-6c mile

Electric vehicles are charged via an AC power supply at semi fast (Level2) charging rate: Voltage: 208V or 240V 1-Phase AC

Amps: 12-80 Amps (Typ 32 Amps)

Charging Loads: 2.5 to 19.2KW (Type 7KW)

Charging Time: 10-20 Miles of range per hour

Price per Mile: -2c-6c mile.

#### Level 2:-

Electric vehicles are charged via an AC power supply at semi fast (Level2) charging rate: Voltage: 208V or 240V 1-Phase AC.

Amps: 12-80 Amps (Typ 32 Amps).

Charging Loads: 2.5 to 19.2KW (Type 7KW).

Charging Time: 10-20 Miles of range per hour.

Price per Mile: 2c-6c.

#### Level 3:-

Electric vehicles are charged via an DC power supply at a fast (Level3) charging rate:

Voltage: 208V or 480V 3-Phase AC Amps

<125 Amps (Typ 60 Amps).

Charging Loads: <90KW (Type 50KW).

Charging Time: 80% Charge in 20-32 minutes.

Price per Mile: 12c-25c per mile.

### IV. RESULT ANALYSIS

#### 1] System Configuration:

The proposed electric vehicle charging station (EVCS) integrates both solar energy and biogas fuel to reduce reliance on the national power grid.

Components include a photovoltaic solar module (15 kW), biogas generators (10 kW), a converter (15 kW), 27 lead-acid batteries (100 Ah each), and EV charging equipment.

The system aims to optimize renewable energy utilization.

#### 2]Economic and Environmental Analysis:

Levelized Cost of Energy (LCOE): The estimated LCOE for the system is \$0.1902/kWh.

Net Present Cost (NPC): The system's NPC is \$68,202.

Operating and Maintenance Cost: The annual operating and maintenance cost is \$2,820.

CO<sub>2</sub> Emission Reduction: The proposed system has the potential to reduce CO<sub>2</sub> emissions by approximately 44.16% per year compared to conventional EVCS.

Cost Savings: Charging an EV using this system can save approximately \$13–\$17 per month.

#### 3]Software Tool Used:

The study employed the HOMER Pro software tool for economic and technical analysis.

In summary, this innovative EVCS design demonstrates the feasibility of combining renewable energy sources to power electric vehicles, contributing to sustainability and environmental benefits.

### V. COMPLIANCE WITH ETHICAL STANDARDS

The authors declare that current research work was conducted in accordance with ethical standards and policies. We have strictly followed the ethical standards and policies governing research involving human or various technical domains. Any human or technical context involved / inherited in the research were treated ethically, and informed consent was obtained from all participants (or authors). Due Credit is provided to the legitimate authors of the source by citing them in the manuscript and also they are mentioned in the reference list.

### VI. COMPETING INTERESTS

The authors declare that they have no competing interests that could influence the interpretation of the research findings or the presentation of the manuscript. Any potential conflicts of interest, financial or otherwise, related to the publication of this research have been disclosed transparently.

### VII. CONCLUSION

The main aim behind this capstone project was to design a charging station for small EVs for on-campus use. This report includes on the state-of-the-art review of electric vehicles and EV charging. It also focuses on the system design and theoretical calculations. Namely, for the Solar energy input and the requirements of our chosen EV, the analysis and design of a DC-DC converter with 28 isolation and a DC-AC Inverter. Furthermore, on the control aspect, it includes both a PWM Control and an Access control using Arduino and RFID. It also contains a 3D design of our final product and a small scale implementation to concretely apply the design and theory. However, it is undeniable that there is still work to be done and further research to be made. The largest challenge or limitation that we faced during this project was the unavailability of some important equipment. In the future, this project can be developed further at a larger scale with the availability of all necessary parts. That being said, this capstone project was an amazing and fun experience overall, it allowed me to put to practice a large array of concepts that I have learnt throughout my degree, as well as to discover some new ones and apply them in a concrete way.

### REFERENCES

- [1] ChargeHub, "Electric Vehicle Charging Guide | ChargeHub," Chargehub.com, 2019. <https://chargehub.com/en/electric-car-charging-guide.html>.



- [2] “Charging stations in Morocco,” Electromaps. [https://www.electromaps.com/en/charging\\_stations/morocco](https://www.electromaps.com/en/charging_stations/morocco) (accessed Mar. 03, 2022).
- [3] M. A. Syed, T. L. Tek, B. C. S. Seet, and S. Ayadi, “Review of Electric Vehicle Technologies, Charging Methods, Standards and Optimization Techniques.” Aug. 09, 2021, Accessed: Mar. 03, 2022. [Online].
- [4] A. serein, “IMPACT ASSESSMENT OF ELECTRIC CAR CHARGING ON LV GRIDS,” Budapest University of Technology and Economics Faculty of Electrical Engineering and Informatics Department of Electrical Power Engineering, 2019.
- [5] Cayetano, F. (2022, April 14). RFID Access Control: What is it & how does work? ButterflyMX. Retrieved April 18, 2022, from <https://butterflymx.com/blog/rfid-access-control/>





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