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IoT-Based Electric Vehicle Charging Station

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Abstract –*The objective of this paper is to provide better socioeconomic and healthy environmental conditions. The IoT-based electric vehicle charging station system is designed for this system. This prebuilt software and hardware system of charging stations is a rising revolution in these electric vehicle industries that helps to a huge increase in electric vehicles. Here dissertation is considering three different cases to test the system in different conditions. QR code is used to check the different parameters like available balance, selection of port for charging purpose, and selection of time to charge the vehicle. The whole system is based on IoT technology.*

Key Words: **IOT, Electric Vehicle, Raspberry Pi, Arduino Uno Board, QR code, Android App, Communication Cable.**

1. INTRODUCTION

Day by day, the Electronics and IT industry develops the systems as per the requirement of people and the environment. So as an engineer, we always think about the need of society and try to complete requirements, so in point of view of these requirements here is one system which is IoT based electric vehicle system. Also, this system helps to prevent the environment from different factors like a decrease in fuel, and less pollution.

Nowadays Electrical vehicle is making a very handy topic and is also a becoming important part of this smart world. This is one lack point of electric vehicle is that range is modest. So, vehicle require eternal recharging. The point of building this system is just not EV but it's also beneficial in point of increased population. Now as per information we have we have knowledge that there is limited stock of fuel on earth and now it's important that we have to find alternative solution for this problem, so there is another option is electricity.

For charging electric vehicles, there are multiple options like,

A. Charging at a charging station

B. Solar charging.

Many EV manufacturers like Tata EVs, other EVs are providing the charging station network for their customers. However, there are thousands of EV manufacturing startup companies (small scale as well as large scale) who cannot provide charging stations to their customers because of the complex software and hardware architecture behind the charging station.

The aim in this project is to provide EV manufacturers a prebuilt software and hardware architecture of intelligent charging stations which incorporates free charging to its customers for the first year of ownership as well as a hassle-free charging and payment experience after one year of ownership which will eventually motivate customers to buy an EV and will contribute in saving the environment.

To attract more customers there is a certain plan implemented by the manufacturers. One important strategy is to make available free charging at charging stations for a certain period from the vehicle purchase date.

This project helps EV startups by giving them a ready-made hardware and software architecture of charging stations, reducing their R&D time and money as well as reducing the time to market.

2. RELATED WORK\LITERATURE REVIEW

Now a day's IoT is one of the strongest technology in overall world and this is becoming most used technology in recent applications. There is cloud-integrated smart parking system is build using this IoT which helps EV or any users to find the parking lot and its beneficial for EV users specially cause its charring time. This system also have an mobile application which gives information of this parking slots i.e. availability of slots and charging stations. And at the same time using this application user can book this parking. For controlling this systems there are different types of controllers like ardunio, Raspberry Pi which will work as a mediator between server and sensor . This mobile application is a platform to connect user with system. While building this application there are different languages are used like Java, XML, UI designing the overall data of users is saved in server which will check users information. That system gives the real time data about parking slot and near changing station.

3. PROPOSED METHODOLOGY

User A has bought an EV from company X recently. (Free charging is applicable)

User B has bought an EV from company Y. (No free charging at company X's charging station)

User C bought an EV from company X 2 years ago. (Free charging period is over)

Company X has multiple charging stations. Company X offers free-of-cost charging for its customers at its charging stations.

Company Y has no charging station network. Company X allows paid charging to EVs of company Y.

The work will be done basically in three steps:

Case1: User A will go to the charging station to charge his/her EV.

A user scans the QR code printed on the charging station from the app of company X.

The app will send a trigger to the server and send a unique ID of the vehicle owned by user A. The server will check the date of purchase of user A's EV, and then check the balance in his wallet which we can see on the android app after that, the server will send a trigger to the charging station based on the QR scanned by the user. After that there is one unique ID is sent by the server to the changing station this ID is nothing but user A's EV ID. After authentication, a particular charging station will ping the user to connect the charging connector and data communication connector of the EV to the charging station. After connecting both the connectors the charging station will ask the EV for its unique ID.

The EV will then send its unique ID to that charging station which is selected by the user. Now the charging station will cross-check this unique ID which is sent by the server and the unique ID sent by the particular user here is nothing but user A's ID and if they are matched the charging will start immediately. The user can stop the charging at any point of time.

Case2: User C will go to the charging station to charge his/her EV.

User C scans the QR code printed on the charging station from the app of company X.

The app will send a trigger to the server and send a unique ID of the vehicle owned by user C. The server will check the date of purchase of user C's EV, the balance in his wallet and after that the server will send a trigger to the charging station based on the QR scanned by the user. In this case the free charging period is over for user C, hence the server will check the balance in user C's virtual wallet. If user C has insufficient wallet balance, he will not be able to charge his EV at that charging station. User C needs to recharge the wallet in order to proceed further and charge his EV.

If user C has sufficient balance in his app wallet, the server will send the unique ID of user C's EV to the charging station.

After authentication, now charging station will prompt that user to connect the charging connector and data communication connector of the EV to the charging station. After connecting both the connectors the charging station will ask the EV for its unique ID.

The EV will then send its unique ID to the charging station, now the same process happens the charging station cross-checks the unique ID sent by the server and user, and if they match charging starts at that point in time, and if the user wants he/she can stop charging at any time.

Case3: User B will go to the charging station to charge his/her EV.

User B scans the QR code printed on the charging station from the app of company X.

The developed EV charging application will send a trigger to the server and send a unique ID to user B's owner. The server will check the balance in his wallet and after that, the server will send a trigger to the charging station based on the QR scanned by the user.

In this case, user B owns an EV from Company Y, hence the server will check the balance in user B's virtual wallet. If user B has an insufficient wallet balance, he will not be able to charge his EV at that charging station. User B needs to recharge the wallet in order to proceed further and charge his EV.

If user B has sufficient balance in his app wallet, the server will send the unique ID of user B's EV to the charging station.

After authentication, the charging station will prompt that user to connect the charging connector and data communication connector of the EV to the charging station. After connecting both the connectors the charging station will ask the EV for its unique ID.

The EV will then send its unique ID to the charging station, now the same process happens the charging station cross-checks the unique ID sent by the server and user, and if they match charging starts at that point in time, and if the user wants he/she can stop charging at any time.

3.1 BLOCK DIAGRAM

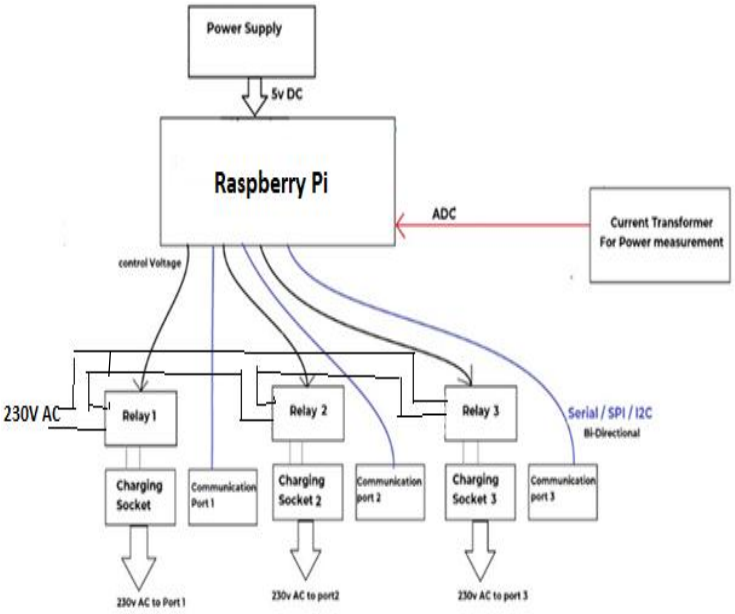

Fig 1: Block Diagram

In this proposed work, EV owners have to scan a QR code placed above the respective port, which helps the user select the charging port, also it will check the remaining balance in their wallet (bank account) and with respect to that it will suggest EV charging timeout. For that purpose EV users required an android application that is built using different languages like Java, and XML. After that using the communication cable it will be easy to understand whether the EV user and charging station are of the same company or different EV users are there, so this will helps to understand whether we have to give free charging or not as per their EV buying date. When this process is done charging starts.

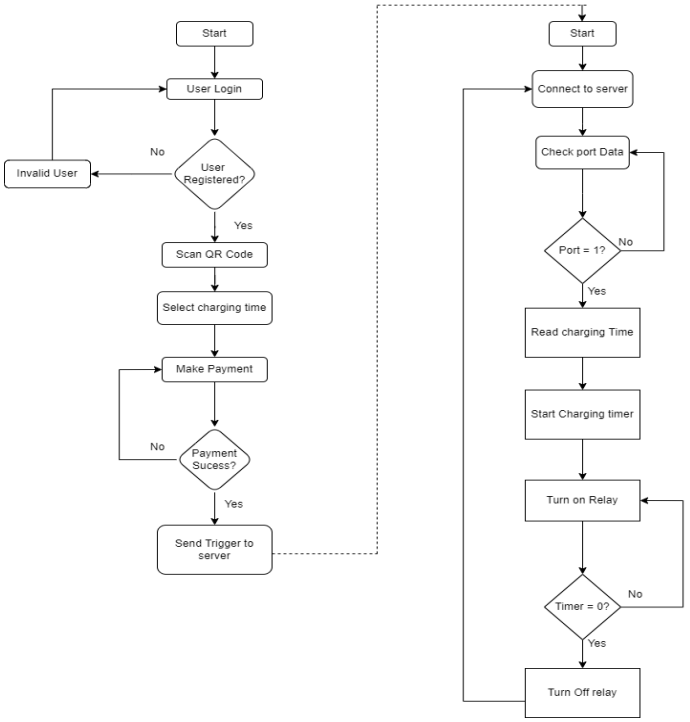

Fig2: Flow chart

4. SIGNIFICANCE AND SCOPE:

- In the future, there will be the option of directly battery swapping.
- Possibility of direct charging to the electric vehicle through home supply.
- In the future Instead of charging points, EVs can be charged with a solar system.
- Using the technology of magnetic field wireless charging system can be developed.

5. RESULT

Fig 5.1:- QR code

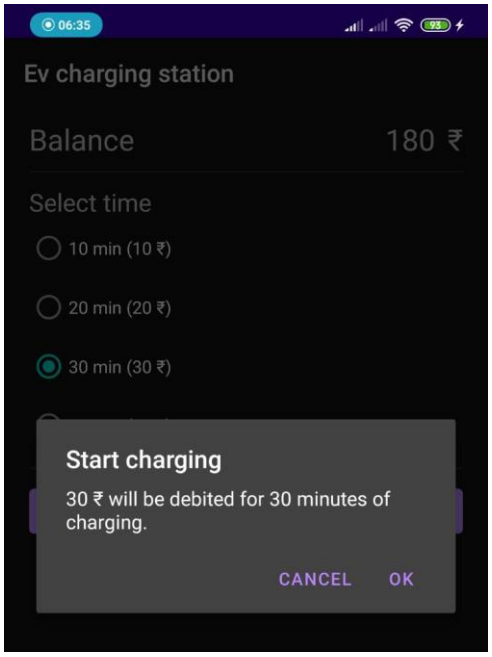

Fig 5.2:- EV application Snapshot

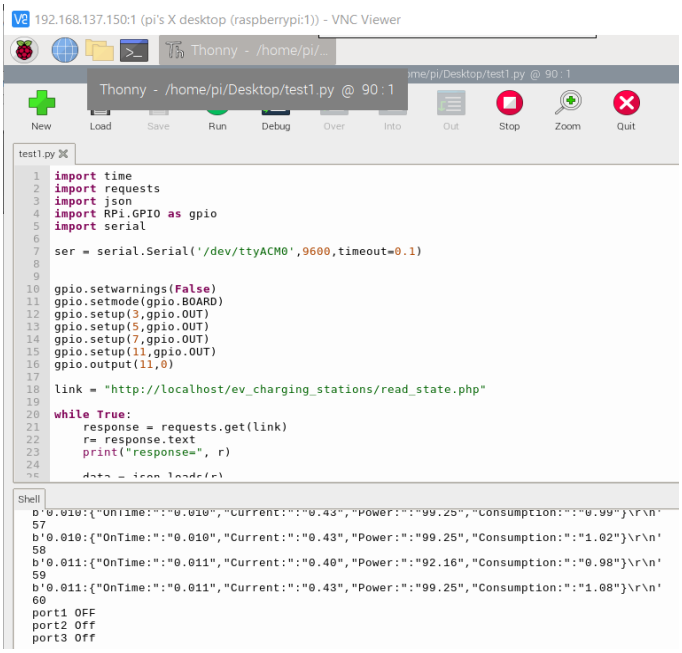

Fig 5.3:- Current Consumption

The system output is shown in the above figures,

Fig 5.1 shows the QR code for port1 there are different QR codes are there for port 2 and port3. By scanning these QR codes with the help of an EV application charging commands can be started.

Fig 5.2 shows the process after scanning QR and completing the process of payment and charging for EV is started for the selected time slot as per payment.

Fig 5.3 shows the overall result of the designed system i.e for how much time charging is on, power calculation means we can calculate how much load (Battery) we connected for charging and consumption is calculated with the formula,

Consumption = On Time * Power.

6. CONCLUSIONS

The main motive behind this system is to develop an automatic charging station with an android application for electric vehicle users. It mainly concentrates to control the charging station with the internet and make payment method easy for user. With Android app, user can select charging time and make payment easily. The system is built to work without any assistance of workers to charge the vehicle and receive payment as like the petrol pumps. The charging station give charging to EV's and the users subscription is checked through communication cable. The main purpose behind the development of this android application is to make this whole charging process easy. In upcoming years bidding process can be used for allocation for EV users.

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