Calibrating Best Route Based on Battery Percentage and Availability of Charging Station

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Abstract: ***The electric vehicle market is increasing rapidly. Smart cars and AI integrated cars are under development for automatic driving. Embedded software is necessary for an electric vehicle to function properly. Almost all cars have inbuilt software navigation purposes. The user's main concern about electric vehicles is the driving range. Electric cars having an inbuilt navigation system that indicates appropriate charging points suitable for the user. The planning route is essential to reach the destination before the battery dies. The software can provide a solution here by analyzing and optimizing the data which is stored in the cloud. Battery swapping can also be done by booking batteries at charge stations before the time of travel. This solution will promote users to drive electric vehicles for even long travels.***

Keywords: Electric vehicle, Battery, Zero Input Response, Open-Circuit Voltage, Zero state response, Charge station, MQ Telemetry Transport.

I. INTRODUCTION

The digital world is developing at an extreme pace where simultaneously there is an urgent need for transition in the transport sector around the world. The gasoline should be replaced by a renewable source to maintain the equilibrium of the Earth. Although electric vehicles are way behind gasoline-powered vehicles in terms of power density, it is still the priority to take the place of gasoline vehicles since there are no suitable alternative resources available until now. Some automobile giants have already taken the leap to manufacture electric vehicles while testing and analysis are carried out by many companies including startups. Many technologies and trends are arising to promote electric vehicle growth. Finding solutions for limitations should be dealt with foremost importance because apart from electric vehicle's advantages its limitations are considered as the big deal today. There is heavy competition among several companies providing solutions through different platforms to be conspicuous to be successful. Software applications are developed mainly for the purpose to benefit the end-user.

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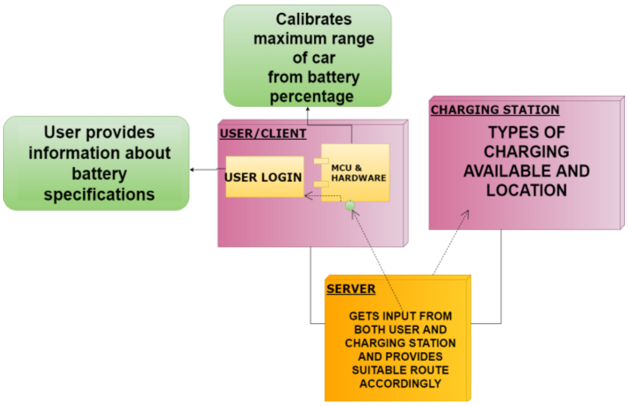
Artificial Intelligence concept is growing day by day following IoT, which revolutionized Industry 4.0 by segregating large budgets to achieve high potential in all fields Unlike gasoline, EV,s have different charging systems in charging stations in distinct locations.
The limitation arises due to information gaps. Electric vehicles generally run on motors powered by batteries. Electric vehicles (EV)have three common types of charging batteries namely, Conductive charging, Inductive charging, and Battery swap technology. These charging types are further divided into AC and DC. These AC and DC charging types have a variety of connector types. Every electric vehicle has one of these charging types. Charging stations supporting all categories of charging is impossible. Hence, EV users face difficulties in finding the appropriate charging station for their vehicles. Electric vehicles are mainly not preferred by many people due to this limitation. To overcome this, we are planning to build an application that connects charging stations and EV users through MCU.

II. LITERATURE REVIEW

Charging the Future: Challenges and Opportunities for Electric Vehicle Adoption: The authors have analyzed the different challenges that we have to overcome to adapt to EVs. Installation of charging infrastructure which is accessible, easy to use and relatively inexpensive leads to success of EV commercially. Even if it is cheaper and its performance is better, without an accessible infrastructure that can re-charge an EV in a short period of time, people will not be willing to buy EVs. Charging equipment, termed as “Electric Vehicle Supply Equipment” (EVSE) comes in two basic varieties. The first variety has “Level 1” and “Level 2” chargers, which is operated using alternate current (AC), and can draw electricity directly from the local distribution system. All BEVs(Battery Electric Vehicle) and PHEVs(Plug-in Hybrid Electric Vehicle) carry a limited capacity on-board inverter, to convert AC power to DC, which is required to charge the battery. The second variety consists of a “Level 3” charger and above, uses DC charging, which charges the battery directly(bypassing the need for an inverter) and therefore delivers much more power. Chargers in public or commercial locations known as commercial chargers, typically consist of Level 2 charger and above. Direct current fast charging(DCFC) consists of Level 3 charging with a power delivery of 50 kW, Level 4 corresponding to 150kW, and Level 5(ultra-fast DCFC) corresponding to 350kW.

III. PREDICTED MODULE



This figure portrays the connection between distinct modules. This depicted module illustrates the framework of the methodology. Although currently many automated technologies on smart charging are proven theoretically, this module provides a promising methodology for the future. The module fundamentally consists of three stakeholders: customer, Electric Mobility Service Provider(EMSP), Charging Point Operator(CPO). The customer part consists of a microcontroller controlled by an application. The application is capable of sending and accessing information from the cloud data. This cloud data is the database handled by Electric Mobility Service Provider. The Charging Point Operator provides the data on charging infrastructure and the authentication to charge. The application is created in a way such that it automatically matches the user's needs and plans the route to the destination.

IV. MODULAR IMPLEMENTATION

This idea focuses on getting the state of charge of the car battery and suggesting the suitable and nearest charging stations according to the battery specification and charging type. The battery voltage and the state of charge are calculated from the existing hardware system. The application's server is uploaded with the input from the user and also from the charging stations regarding the type of charging available in their station. The user has to login by giving the car battery's specification and other information required as shown in the GUI (Graphical User Interface) column. The car battery's SoC is determined by the external hardware system and transmits the result to the app via an IoT platform. This app works based on MQTT (MQ Telemetry Transport) is a messaging protocol that provides resource-constrained network clients with a simple way to distribute telemetry information. This application provides a map indicating respective charging stations. The user, having installed our device, which calculates the battery percentage and range, sends the data to the application which will calibrate the route to the destination via charging stations. Booking charging slots and battery swapping will also be available through this application.

V. USER INTERFACE

Upon opening the app, the user is led to a welcome page (Fig1), where the user is asked to choose between 2 options - client and charging station. Upon clicking the client option the user is asked to either login or sign up.it is the same case with the charging station. The signup page of both the options will ask the user to provide particular details for the creation of an account via which they can log in anytime. After logging in as a client, the user will be able to access details such as car battery percentage, range along with a map that gives the location of the nearest appropriate charging station. The charging station login lets you create an account, delete an account, to create an account the details must be filled accordingly.

Fig 1

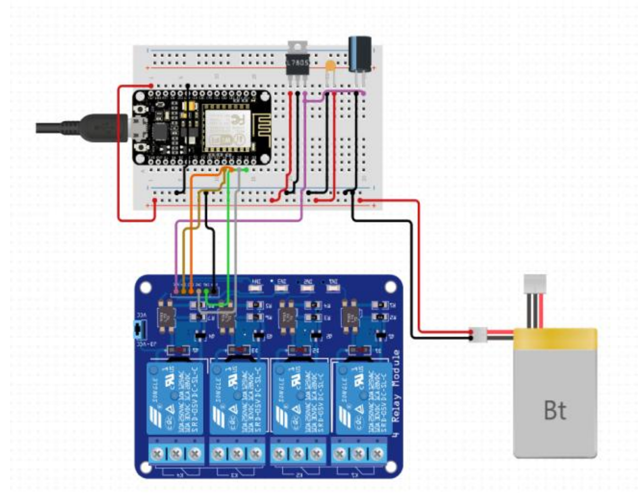
Fig 2

Fig 3

VI. IOT HARDWARE

The IoT hardware consists of
1)node MCU
2)Relay
3)Voltage controller
4)Battery
NODEMCU ESP8266 is a low-cost wifi-enabled microchip possessing microcontroller capabilities. Having 12 analogue pins and 1 digital pin it is very powerful, cheap and small. Relay module is a remote switching device with which devices can be powered on or off over the internet. A voltage controller converts a fixed voltage, fixed frequency AC in order to obtain variable voltage in the output device. Battery is the power source. The connection is depicted clearly in the image below.

The battery is connected to the microcontroller via voltage controller, capacitor and relay.



VII. MATHEMATICAL FORMULAE

(a) The State of Charge of a system is calculated by coulomb counting method. Here the battery current is integrated over the time period. The formula is given below

$$SOC = SOC(t_0) + \frac{1}{C_{rated}} \int_{t_0}^{t_0+\tau} (I_b - I_{loss})\, dt$$

This SoC is a universal formula for voltage calculation. In our case, it's used to calculate the voltage of the car battery. The terminal voltage is the key to calculate OCV (Open Circuit Voltage) and thereby SoC is calculated. This calculation follows certain assumptions that the SoC is constant within a time window of certain width and the battery is assumed to be almost a linear system.

(b) In each time window, the terminal voltage can be given as follows

$$v(t) = v_{zi}(t) + v_{zs}(t)$$
$$v(t) = v_{zi}(t) + h(t) + i(t)$$

where $v_{zi}(t)$ is the output of the system when the input signal is set to zero (ZIR-Zero Input Response) corresponding to the terminal voltage without discharge current $v_{zs}(t)$ is the zero-state response corresponding to terminal voltage with discharge current, *i(t)* as input and the voltage source is shorted and $h(t)$ is the impulse response of the linear system modelling of the battery. When the self-discharge effect is neglected then the output of the system at zero input signal is actually the open-circuit voltage.

VIII. CONCLUSION

The main objective of the project is to provide a platform for customers and charging stations through networking, thereby reducing the intricate process in finding respective charging points while travelling with low cost. The proposed model shall be improvised for better working. It could be improved by adding features like live traffic monitor, weather report etc. It encourages sustainability by promoting electric vehicle growth.

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