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Smart Charging for Electric Vehicle using Pantograph

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ABSTRACT: The remarkable development of worldwide urban communities along with expanded population and an elevated concern in regards to environmental change and energy independence have expanded interest in electric vehicles (EVs) as one intends to address these difficulties. With numerous advantages, electric vehicle technology has experienced various difficulties like battery charging, expanding electric charges, and accessibility of charging stations, and battery life assessment. The smart charging system for EVs is proposed in this paper. Vehicle detection at the charging station is detected employing an ultrasonic sensor. The charging system after sensing the vehicle battery voltage is described in the later section. The proposed system provides a highly efficient, cheaper, and environment-friendly solution for charging EVs.

KEYWORDS: Pantograph, Electric vehicle, charging.

I. INTRODUCTION

Electric Vehicles (EVs) have acquired the user's consideration because of their smart, economical, and eco-friendly services [1]. Because of the exceptional marvel of consistent development in city populaces, it is currently essential that metropolitan territories give sustainable solutions. [2]. The transportation business alone is one of the significant supporters of this ecological instability, representing about a quarter of greenhouse gases emission around the world [3]. After a very long time wherein the customary internal combustion engine (ICE) has been the prevailing automotive solution, indications of a shift toward completely electric alternatives are getting obvious and there is motivation to accept that for the time being, there will be a time of development and an ascent of the EV industry[4]. Decreasing the emission of harmful substances (both CO₂ and NO_x) is one of the key reasons, yet different additional factors like economic benefits, more noteworthy energy autonomy, and a shift towards a less oil-concentrated vehicle area play a role in the overall development of EVs sector [5]. Customer interest, industry innovation advancements, as well as government initiatives and guidelines are the three primary forces that drive the reception of EV technology [6]. As these forces acquire strength, the EV portion of the overall industry will extend. By 2030, EVs are expected to represent up to 60% of new vehicle deals. If shoppers buy EVs at the normal rates throughout the following five to ten years, an absence of charging stations could turn into a hurdle to EV adoption [7]. A developing EV charging station foundation appears to be inescapable to accomplish the future difficulties of versatility. The vehicle and battery industries have gained significant technological growth with different solutions to overcome significant obstacles for mass-market sales, such as an upgraded charging framework organization. [8]. In any case, the deployment of EVs is still at a beginning phase and there is a long way to go. [9]. The establishment and business exploitation at the necessary scale of a public charging framework, or a public charging station (CS) organization, is a critical component to work with mass EV adoption since it improves accessibility and availability, diminishes range anxiety, and empowers the utilization of EVs for significant distance travel. [10]. It addresses an expense that is excessively high for governments and public organizations to bear alone. Therefore, making a public charging station plan of action is a difficult issue that requires further exploration. With consideration of all aspects, there is a need to develop smart charging stations worldwide to enhance the applicability of EVs.

II. LITERATURE REVIEW AND OBJECTIVE

[1] Dharmakeerthi, C.H., Mithulananthan, N., Saha, T.K.: Impact of electric vehicle fast charging on power system voltage stability. *Int. J. Electr. Power Energy Syst.* 57, 241249(2014). <https://doi.org/10.1016/j.ijepes.2013.12.000> Many researchers have worked upon the development of EV charging technology. Dharmakeerthi et al. developed a static load model for EV dc fast chargers and the impact of EV load on the power system voltage stability is analyzed

[2].Amini, M.H., Kargarian, A., Karabasoglu, O.: ARIMA-based decoupledtime series forecasting of electric vehicle charging demand for stochastic power system operation. Electr. Power Syst. Res. 140, 378–390 (2016). <https://doi.org/10.1016/j.epsr.2016.06.003> Amini et al. proposed the ARIMA-based EV charging demand forecasting method using optimal values for the autoregressive and integration order parameters.The impact of an EV charging station on the power grid was systematically analyzed by Deb et al.

[3].Sachan, S., Adnan, N.: Stochastic charging of electric vehicles in smart power distribution grids. Sustain. Cities Soc. 40, 91–100 (2018). <https://doi.org/10.1016/j.scs.2018.03.03>. Sachan et al. assessed the impact of EV charging on the distribution grid and developed stochastic charging of EVs in smart power distribution grids

[4]. Mozafar, M.R., Moradi, M.H., Amini, M.H.: A simultaneous approach for optimal allocation of renewable energy sources and electric vehicle charging stations in smart grids based on improved GA-PSO algorithm. Sustain. Cities Soc. 32, 627–637 (2017).<https://doi.org/10.1016/j.scs.2017.05.007>Mozafar et al. implemented a Genetic Algorithm-Particle Swarm Optimization-based novel technique for optimal allocation of renewable energy sources and EV charging stations in smart grids.A new fuzzy-logic control-based technique for

2.1.OBJECTIVE

At present a HEV is able to operate nearly twice as efficiently as traditionalinternal combustion vehicles.

The ultimate goal of the smart charging for electric vehicle using pantograph system is to provide the equivalent power, range, cost and safety of a electric vehicle.

To overcome the losses of inductivecharging.

III. MATERIALS AND METHODS

Figure 1.0 Vehicle Unit

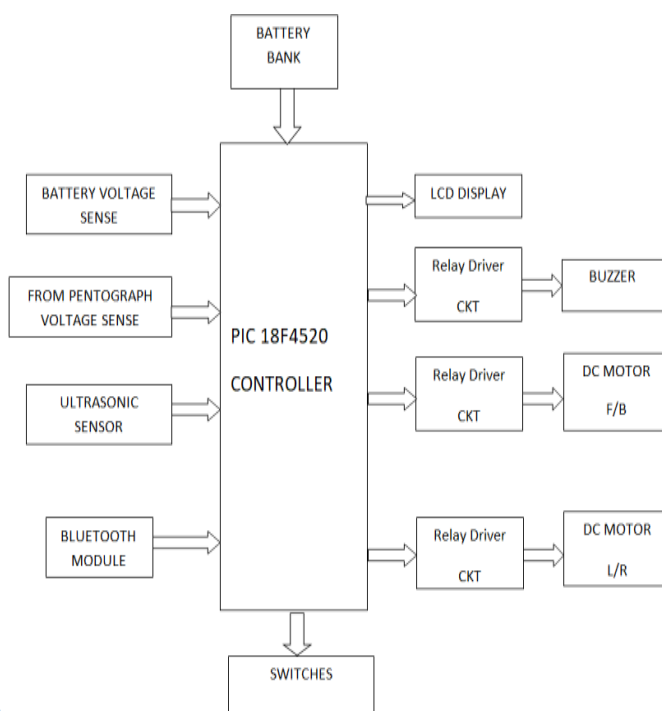
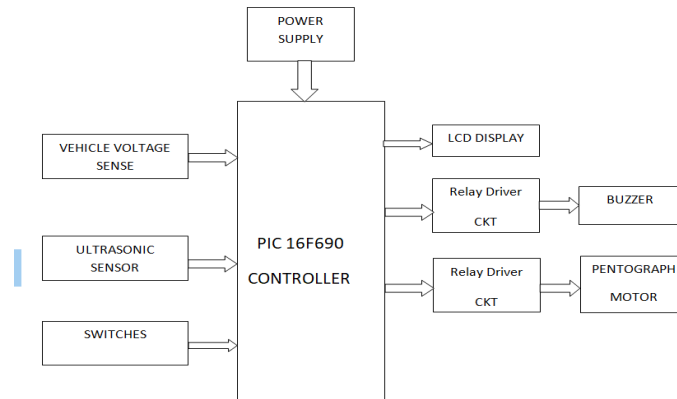


Figure2.0 Charging Unit

3.1.1. POWER SUPPLY 5V/1A: -The first is its poor regulation i.e. the output voltage is for from constant as the load varies. The second is that the D.C output voltage varies with the A.C input directly in many locations the line voltage for nominal value 230 v may vary as wide a range as 150 v to 270 v and yet it is necessary that the D.C voltage remains essentially constant.

3.1.2. Ultrasonic sensor:-Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit

3.1.3. 16*2 LCD DISPLAY: A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data

3.1.4. Relay: A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal

3.1.5. BUZZER 5V DC / 20mA PCB TYPE

sealed: yes

operating power: 3-6V DC / 25mA

extremely compact, ultrathin construction

no electrical noise

low current consumption yet high sound pressure level

3.1.6. Bluetooth Module HC-05

It is used for applications like wireless headset, game controllers, wireless keyboard or wireless mouse etc. It has range up to <100m depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is a IEEE 802.15.1 standard protocol. It uses FHSS radio technology to send data over air. This module can be used in a master or slave configuration. It uses serial communication to communicate with devices.

3.1.7. Buzzer

Operating power: 3.6v DC / 25mA

No electrical noise

Low current Consumption yet high sound pressure level

3.1.8. Pantograph

Pantograph is a word derived from Greek language which means every write. It is a structure with mechanical linkage therefore it works by forming parallelogram. The modern pantograph principle is derived from a linked

3.1.9. Working

The LCD display is used to display battery charging and voltage level. In the charging station unit, a power supply block is used to power the PIC microcontroller. A relay driver circuit is used to move the Pantograph. The presence of the vehicle on the charging location is detected using the ultrasonic sensor. A pantograph is a device that collects electric current from overhead for electric trains or trucks. This system could be

a solution that allows the electronic buses to charge quickly at stops. Almost in all pantograph-based project pantograph is placed at the top, but in this proposed design pantograph is placed at the bottom/ ground level and a motor is being used to pop up and pop down the pantograph. IR sensors are provided for safety purposes. This type of charging has less power loss and high efficiency. The system works as per the flow shown in figure 3. The vehicle as depicted in figure 2 consists of a Bluetooth module for communication purposes and two motors for motion purposes. The vehicle battery is charged when the voltage drops below the threshold level

Figure3.0 Flowchart of Charging Unit

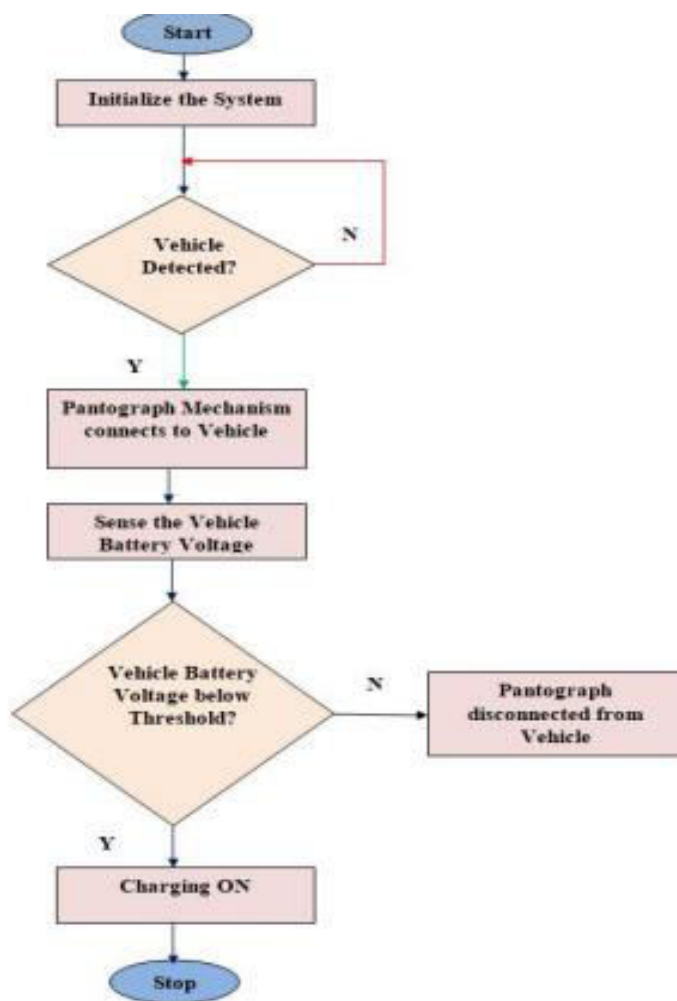


Figure4.0 Vehicle unit

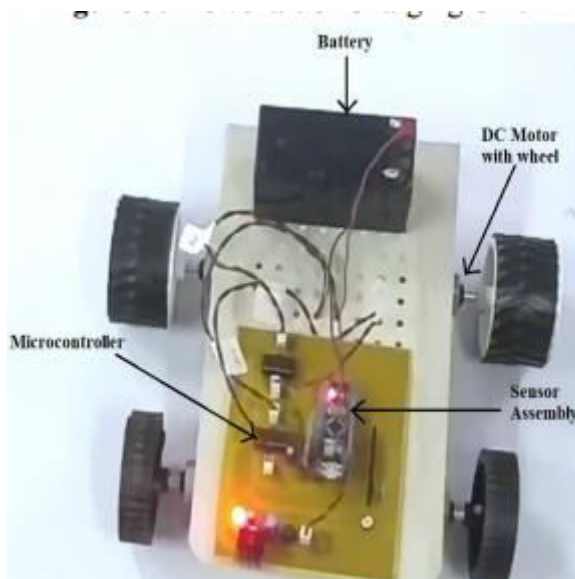
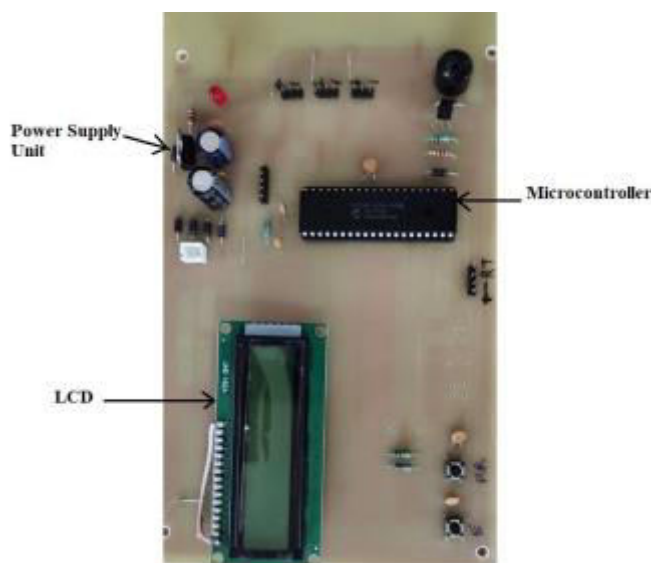


Figure5.0 Charging Unit



IV. RESULTS AND DISCUSSION

The vehicle prototype was developed as shown in figure 4. The system was tested at different voltage levels of battery. The vehicle battery was charged successfully when the battery voltage was noted below threshold level. The voltage level was displayed on LCD available at charging unit as shown

V. CONCLUSIONS

With the advancement of EV technology, charging infrastructure, and grid integration facilities, EV popularity is expected to increase significantly in the next decade. In this context, the proposed system increases the charging efficiency using Pantograph technology. The system with improved facility also works better from environmental perspective because the system avoids the emission of harmful gases. The automation in the system also facilitates more accurate technology and with less manpower requirement. Thus the proposed system is the economical and environment-friendly solution for charging EV

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