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Electric Vehicle Charging Stations in Smart Campus Parking Lot

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***Abstract*— Smart parking lots are intelligent locations that can accommodate both parking and electric vehicle charging services (EVs). The parking lot local controller (PLLC) has to communicate data with EV charging stations (EVCSs) through communication infrastructures in order to manage EV charging. Data loss and transmission lag, however, are inevitable and may seriously impair system performance. This project looks into the communication networks that underlie remote EVCS monitoring in a smart campus parking lot. Parking Area Network (PAN) and Campus Area Network are the two subnetworks that make up the communication network (CAN). PAN handles communication between EVs, charging stations, and PLLCs, while CAN permits specialised communication between PLLCs and a university-wide controller. We design communication models for the in-vehicle system and EVCSs based on the logical node idea of the IEC 61850 standard because one of the biggest barriers to EV systems is the lack of single communication architecture to integrate EVCS in the power grid. In modelling and simulations, various communication methods and configurations are taken into account, and end-to-end delay is assessed and analysed.**

Index Terms—Communication network, electric vehicle (EV), electric vehicle charging station (EVCS), smart parking lot.

I. INTRODUCTION

Electric vehicles (EVs) are receiving more attention as a technology that can help reduce carbon dioxide emissions and reliance on oil. Many nations have established ambitious goals for the deployment of EVs, supported by legislation and regulations, in order to considerably meet these aims.[1] Smart parking lots are intelligent locations that can accommodate both parking and electric vehicle charging services (EVs). A battery-powered electric vehicle is one that emits no pollution, is very affordable, and requires no maintenance. A rechargeable battery that transforms electrical energy into mechanical energy is the electrical technology used in an electric vehicle. An electrical connection makes it simple to recharge the battery of an electric car. [2], [3].

Almost every electric vehicle can be equipped with an electric power-assist system using chain drive, belt drive, hub motors, or friction drive. Over the next ten years, India will make better development with regard to electric buses, rickshaws, and two-wheelers. [4] The analysis predicts that only 40% of India's fleet of passenger vehicles will be electric by 2040. [5] Effect of Electric and Hybrid Vehicles on the Environment Effects of electric automobiles on the environment. Due to the electric engine's efficiency versus the gasoline engine, even when the electricity used to charge an electric vehicle comes from a CO2-discharge source like a coal or gas-fired power plant, [6] the net CO2 production from an electric vehicle is typically between 50 and 30 percent less than that from a comparable combustion vehicle. Nearly no air pollution are released when an electric vehicle is operating. Additionally, centralised power plants with pollution control systems are typically simpler to construct than earlier, massive amounts of cars. [7][8] Contrary to internal combustion engines, electric motors do not require oxygen, which is advantageous for submarines. Although the carbon emissions from electric and hybrid automobiles have decreased, the energy they use is occasionally produced in ways that have an impact on the environment.[9] For instance, using an electric vehicle in the US would not be totally carbon neutral because the majority of power produced worldwide comes from fossil fuels (coal and natural gas).[10]

Electric and hybrid vehicles can reduce energy consumption and pollution, and someday they may even run entirely on renewable resources.[11] However, changing one's way of life to include more walking, bicycling, and public transportation would have the least detrimental effects on the environment. While they could alternatively create pedestrian-friendly cities or an electric mass transition, the government may invest in the research and development of electric cars with the goal of lessening their environmental impact. [12]

The selection of suitable communication technologies that provide a dependable end-to-end communication network is essential for realising future smart grid applications, such as EVs. [13] By creating communication models for the in-vehicle system and EVCS based on the logical node idea of IEC 61850 standards, this work seeks to close the knowledge gap of communication network modelling and simulation of the EV system, facilitating a seamless grid integration of EVs.[14]

A parking lot on a university campus is taken into account as a case study. The types of monitoring data, traffic volume, communication needs, and potential technologies are only a few of the factors that must be taken into account while designing the communication model for the EV system. These are the primary contributions made by this work. [15]

Design, simulate, and assess the effectiveness of a communication network architecture for campus parking lots that includes EVs, charging stations, regional parking lot controllers, and a university control centre.

1) To make the integration with the power grid easier, provide a communication model for the EV system and the EV charging station based on the IEC 61850 standards' logical node idea.
2) As a case study, implement communication models for various scenarios in Chonbuk National University's parking lots in Jeonju, South Korea, using OPNET modeller.
3) Assess the end-to-end delay and data loss performance of the suggested communication models for Ethernet and WiFi, two different types of networking. The format of this essay is as follows. In Section II, the campus EV system is explained. In Section III, we suggest a two-layer architecture for the campus EV system's communication network and create a communication model based on the IEC 61850 standard for EVs and charging stations. The performance assessment of a case study involving a university campus is presented in Section IV. Section V comes to a conclusion and offers guidelines for future development.

II. BLOCK DIAGRAM

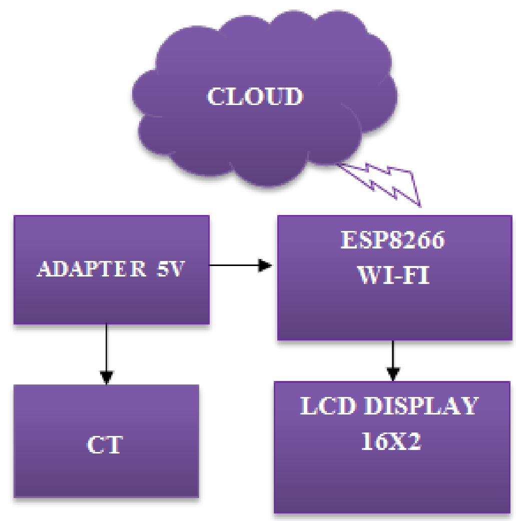
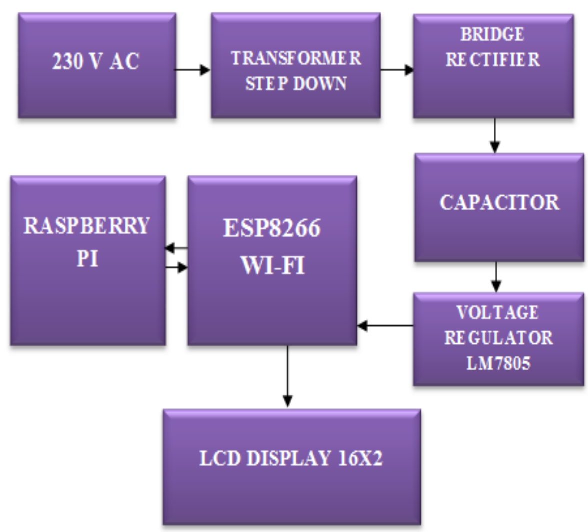


Fig.1: For parking- 1



Components required

1. Raspberry Pi: The most recent Raspberry Pi 4 Model B has the specifications listed below.

- Processor: 1.5GHz quad-core Cortex-A72 (ARM v8) 64-bit SoC from Broadcom (BCM2711).

- 8GB LPDDR4-3200 SDRAM for RAM.
- Bluetooth: BLE, Bluetooth 5.0
- Wi-Fi: IEEE 802.11ac wifi at 2.4 and 5.0 GHz
- USB ports: two USB 3.0 ports and two USB 2.0 ports
- Gigabit Ethernet for Ethernet.
- Micro-HDMI ports: two (up to 4kp60 supported)
- MicroSD Card Slot for storage
- 5.1V 3A USB Type C Power supply (Recommended)
- The GPU core is activated when the Raspberry Pi is first powered on, while the ARM core is off. The SDRAM is currently disabled.
- The first stage bootloader, which is kept in ROM on the SoC, begins to run on the GPU. The first stage bootloader reads the SD card before running the second stage bootloader (bootcode.bin) after loading it into the L2 cache.
- Loader.bin, the third stage boot loader, is read into RAM by Bootcode.bin, which also turns on SDRAM. It is then executed.
- Start.elf (Loader.bin) reads the kernel.img, config.txt, and cmdline.txt files for the GPU firmware. SoCSystem on a Chip GPU Graphics Processing Unit ARM Advanced RISC Machine SDRAM Synchronous Dynamic Random-Access Memory

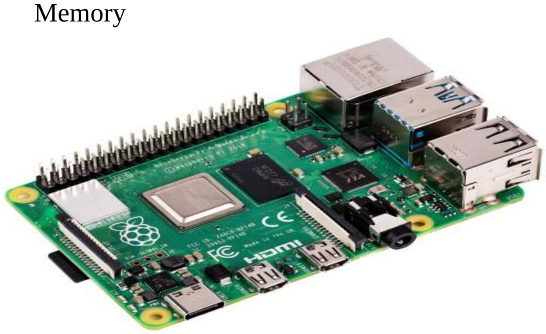


Fig.2: Raspberry Pi

2. Node MCU ESP8266

It serves as the device's brain. It offers the framework for IOT. A Wi-Fi module with esp8266 firmware is what it is. This micro-controller is connected to all the additional sensors. When they submit it their measured results, it uploads all of the data to the cloud where it is then analysed. This board's creator is the ESP8266 Open source Community. It utilises the XTOS operating system. ESP8266 is the CPU (LX106). It has a storage capacity of 4 MBytes and 128 Kbytes of internal memory.

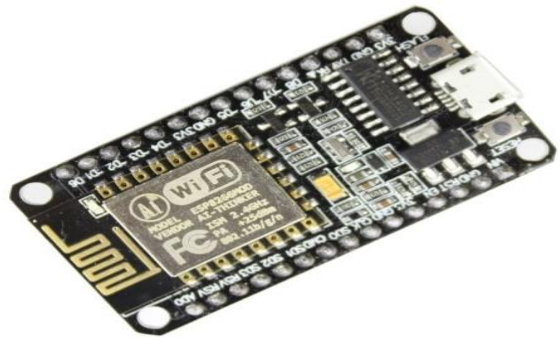


Fig.3: Node MCU

3. Liquid Crystal Display(LCD) 16x2

All electronics projects employ LCDs (Liquid Crystal Displays) to show the progress of the process. The most popular LCD module today is a 16x2 alphanumeric display. There are other additional LCD models on the market as well. A huge number of characters can be displayed on the LCD, which is inexpensive, easily programmable, and compatible with practically any microprocessor and microcontroller. Two horizontal lines make up a space on a 16x2 LCD that can display 16 characters. It includes two internal registers:

- Command Register
- Data Register

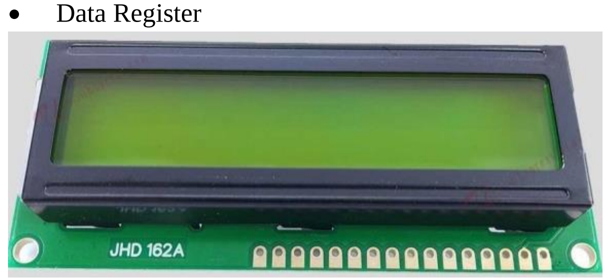


Fig.4: LCD Display

4. CT Sensor

Fig.5: CT Sensor

The secondary rating for most current transformers is typically 5 amps, and the primary and secondary currents are stated as a ratio like 100/5. Accordingly, when 100 amps are flowing in the primary conductor, there will be 5 amps flowing in the secondary winding since the primary current is 20 times bigger than the secondary current. For example, a 500/5 current transformer will generate 5 amps in the secondary for 500 amps in the primary conductor, which is a 100-fold increase.

III PROPOSED WORK

There are two main parts that are needed in order to enable energy trading in a smart parking lot a physical energy network and a virtual energy market platform. The physical energy network is required for energy transfer among electric vehicles and the parking lot operator. The proposed system is capable of saving necessary time, minimizing human errors, conserving energy, and charging cars based on real-time system information. For EV users, it is extremely helpful in terms of energy savings and reduced electricity costs. Wireless power transmission is a new field of development for EV charging. This study discusses strategies to increase wireless charging performance for high-frequency and high-power applications, as well as the efficiency of resonant inductive coupling for EV charging. The proposed electric vehicle battery monitoring system in this work is consists of a potential transformer, current sensor and Raspberry pi module. In the figure, the potential transformer, current sensor is connected to the Raspberry pi module. The system has been verified to display voltage values, Current values and coordinates simultaneously. The voltage values, current values and coordinates are updated in real time with a one minute delay. So with the help of this survey I have decided to make an electric remote monitoring electric vehicle charging station in the college campus parking lot.

IV. RESULT

Fig.6: Hardware of Charging Station-I

In our project there are two sections, first is processing unit which are process by raspberry pi and second unit is control unit which is control by esp8266. The main working of ESp8266 is to measure the current by using CT that is current transformer. The Current transformer is work on Corona losses that is weak flux generated around the alternative current carrying conductor this weak flux is link with the coil which is present in CT.

As shown in figure 7, the charging station result shown, in this table we monitor different parameter in charging station. Like voltage, current, time, power and bills we are conclude that how much time battery get charge and during a charging we observed the live voltage, current and power due to this we can understand the battery performance as well the exact charging time.

PARKING ONE

VOLTAGE	CURRENT	POWER	TIME	BILL
13.1	0.0	00	___	___

Fig.7: Charging station no vehicle charge

The purpose of an IP address is to handle the connection between devices that send and receive information across a network. The IP address uniquely identifies every device on the internet; without one, there's IP addresses are like telephone numbers, and they serve the same purpose. When you contact someone, your phone number identifies who you are, and it assures the person who answers the phone that you are who you say you are. IP addresses do the exact same thing when you're online that's why every single device that is connected to the internet has an IP address no way to contact them.

PARKING ONE

VOLTAGE	CURRENT	POWER	TIME	BILL
13.1	0.0	00	___	___

PARKING TWO

VOLTAGE	CURRENT	POWER	TIME	BILL
13.3	0.17	2.19	15	30

Fig.8: Charging Station

V. CONCLUSION

The conclusion of this project is to use natural resources at very efficient level with cloud record of charging and discharging cycle. By using this project we proof that the transportation hierarchy can be brake and cost required for the traditional transportation method is so much higher than the existing newly updated electric vehicles transportation method.

In this project we conclude that the existing solar power station or solar roof top can be easily converted in solar electrical vehicle charging stations. Conclusion With the increasing consumption of natural resources of petrol, diesel it is time to shift our way towards other resources like the Electric vehicle because it is necessary to find out a new way of transport with the help of this remote monitoring station of electric vehicle we can monitor how energy consumed, what are the charging and discharging rate, the timing of charging. The electric vehicle charging station is a modification of the existing station by using electric energy and also solar energy if solar panels are provided, that would sum up to an increase in energy production. Since it has the quality to high energy-efficient, electric vehicle running cost is cheaper and affordable to anyone. It can be contrived throughout the year.

The second most important feature is it is pollution-free, eco-friendly, and noiseless in operation. For offsetting environmental pollution using onboard Electric vehicles is the most viable solution. It can be charged with the help of an AC adapter if there is an emergency. Since it has fewer components it can be easily dismantled into small components, thus requiring less maintenance.

ADVANTAGES

- The IoT Based charging Meter can record and measure the total energy consumption in small amount of time. By recording total energy at a small interval, this allows the utility to easily calculate the bill.
- With the information in mobile, user can see immediately and adjust according to his/her need.
- By making energy usage more easily understood, the consumer can make smarter decision to save energy and money.
- The user can calculate his/her own bill according to their total energy consumption. So more accurate bill can be paid and no misunderstanding will be created between the consumer and charging station supplier.
- This system is much smaller than traditional system and also cost efficient to build.
- Charge faster and safer
- Monitor your electricity consumption
- Optimize charging time
- Electric vehicles are energy efficient.
- Better performance.
- Low maintenance due to an efficient energy motor.
- Environmental friendly as they do not emit pollutants.
- No fuel is required so you save money gas.

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