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IOT-Driven Electric Vehicle Charging Infrastructure

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***Abstract*— Electric vehicles are a new and forthcoming technology in the transportation and power sector that have numerous benefits in terms of profitable and environmental. This study presents a comprehensive review and evaluation of different types of electric vehicles and its associated outfit in particular battery bowl and charging station. A comparison is made on the marketable and prototype electric vehicles in terms of electric range, battery size, bowl power and charging time. The different types of charging stations and norms used for charging electric vehicles have been outlined and the impact of electric vehicle charging on mileage distribution systems is also bandied. The methodology presented then was time- and cost-effective, as well as scalable to other associations that enjoy charging stations. Electric vehicles (EVs) are getting decreasingly popular in numerous countries of the world. EVs are proving further energy effective and environmental friendly. But the lack of charging stations restricts the wide relinquishment of EVs in the world. As EV operation grows, further public spaces are installing EV charging stations.**

***Keywords*— ATMEGA8, RFID, Proximity Sensor, ESP32, Touch Screen.**

1. INTRODUCTION

1.1 NECESSITY

Since the early 2000, India's crude oil painting significances have risen exponentially. The demand for oil painting grew by5.1 in 2016, advanced than the world's largest net importers, the US(0.7) and China(2.9), making India the world's third largest crude oil painting consumer. India ranks as the third largest carbon emitting country in the world counting for 6 of the global carbon dioxide emigrations from energy combustion. According to the WHO Global Air Pollution Database (2018), 14 out of the 20 most weakened metropolises of the world are in India4. Rising population – a sustainable mobility challenge India's current population of1.2 billion is anticipated to reach1.5 billion by 2030. India is the world's fourth largest patron of internal combustion machine (ICE) grounded motorcars. The growth in the automotive request in India has been the loftiest in the world, growing at a rate of 9.5 in 2017. An adding uptake in electric vehicles is likely to pose a challenge to the being automotive request if the country doesn't plan its transition towards newer mobility results and develop the needed manufacturing capabilities. Electric Mobility an implicit result for India.

1.2 Need

In 2017, Indian government pushed a major policy of dealing at least 6- 7 million EV's in India by 2020. They're planning to vend only EV's by 2030. But numerous experts in machine assiduity blamed this plan and said that it might be fail. Only reason they've stated, is lack of structure, and majorly lack of 'Charging stations '. Indian government is really trying to push electric vehicle in our ecosystem. But people are reticent to buy an electric vehicle. Reason people aren't buying electric vehicle is 'Range Anxiety '. Range anxiety is solicitude on the part of a person driving an electric vehicle that the battery will run out of power before the destination or a suitable charging point is reached. So what's the point in buying EV? Why would I, you'll buy an electric vehicle? Then, charging station plays vital part.

I. 1.3 Motivation

Electric vehicles are a new and forthcoming technology in the transportation and power sector that have numerous benefits in terms of profitable and environmental. Electric vehicles (EVs) are getting increasingly popular in numerous countries of the world. EVs are proving further energy effective and environmental friendly. But the lack of charging stations restricts the wide relinquishment of EVs in the world. This has motivated design each along so that it's stoner friendly system.

1.4 Objective

i. To design IoT based electric vehicle charging system. ii. To design user friendly and reliable system.

2. ANALYSIS & DESIGN APPROACH

2.1 Block Diagram:

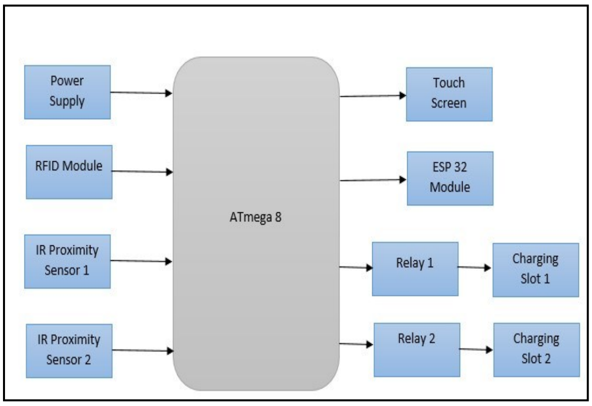

Fig 1 Block Diagram of the system

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2.2 Block Diagram Description:

- Here we used ATmega8 controller for this project.
- Power Supply which is the 1st block decided to be the dual power supply of 12v, 5v. The 5v supply is for controller and the 12v is required for the relays.
- The RFID is used for the identification of the users. RFID card will be provided by us to the users.
- The IR Proximity Sensors are used to check the availability of charging slots. If the place is available, then message will be displayed on touch screen display.
- The Esp32 module is used to send messages to the user and for collecting data and analyzing the data.
- The various messages are displayed to the user about charging status, amount, and time on Touch screen.

2.3 Flow Chart

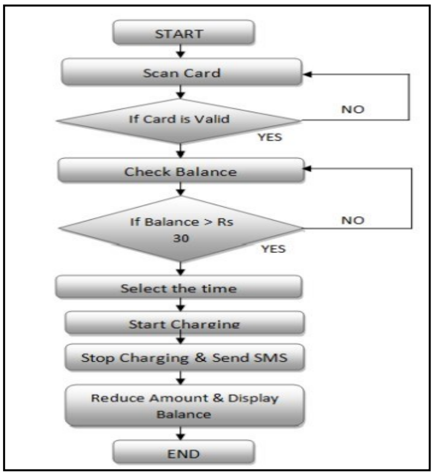

Fig2 Flow Chart

2.4 Component Used

2.4.1 ATMEGA8

It's an 8 bit CMOS technology grounded microcontroller belonging to the AVR family of microcontrollers developed in 1996. It's erected on RISC (Reduced Instruction Set Computer) armature. ATmega8 microcontroller consists of 1KB of SRAM, 8KB of flash memory, 512 bytes of EEPROM, 23 general purpose I/ O lines, 32 general purpose working registers, three flexible timekeeper/ Counters, internal and external interrupts, a periodical programmable USART. The device operates between2.7-5.5 volts. By executing important instructions in a single timepiece cycle, the device achieves throughputs approaching one MIPS per MHz, balancing power consumption and processing speed.

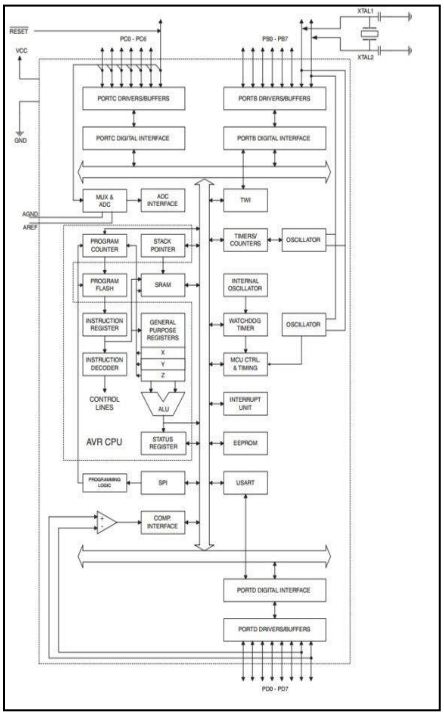

Fig 3 Block diagram of ATMEGA8

A. 2.4.2 Power Supply

Power Supply Units (PSU) don't supply systems with power- rather they convert it. Specifically, a power force converts the interspersing high voltage current (AC) into direct current (DC), and they also regulate the DC affair voltage to the fine forbearance needed for ultramodern computing factors. Then we used binary power force of 12V and 5V, in which 12V goes to relay and 5V is for regulator.

B. 2.4.3 RFID

Radio Frequency Identification is a type of communication between a transmitter (transponder or tag) and a receiver (reader). The system works fully automatically and is used for contactless communication, identification and localization of objects such as goods, medicines, vehicles or living beings.

EM-18 Features and Specifications

- Operating voltage of EM-18: +4.5V to +5.5V
- Current consumption:50mA
- Can operate on LOW power
- Operating temperature: 0ºC to +80ºC
- Operating frequency:125KHz
- Communication parameter:9600bps
- Reading distance: 10cm, depending on TAG
- Integrated Antenna

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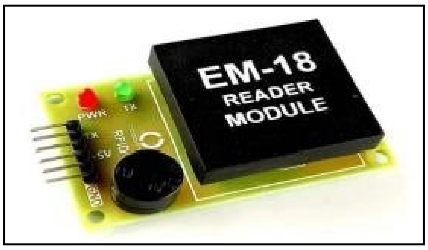

Fig 4 RFID Module

C. 2.4.4 IR Proximity Sensor

Proximity Sensors are used to detect objects and obstacles in front of the sensor. Sensor keeps transmitting infrared light and when any object comes near, it is detected by the sensor by monitoring the reflected light from the object.

Features of IR Proximity Sensor:

- IR transmitter
- Ambient light protected IR receiver
- 3 pin easy interface connectors
- Indicator LED & Power LED
- Distance 2cm to 30cm
- Can differentiate between dark and light colors.
- Active Low on object detection
- 3.3 to 5V operation

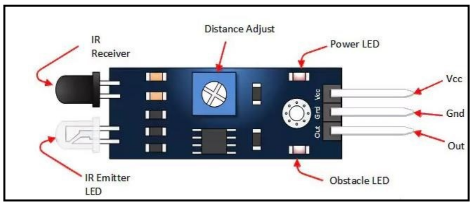

Fig 5 IR Proximity Sensor

2.4.5 ESP32

ESP32 is a single 2.4 GHz Wi-Fi-and-Bluetooth combo chip designed with the TSMC low-power 40 nm technology. It is designed to achieve the best power and RF performance, showing robustness, versatility and reliability in a wide variety of applications and power scenarios.

Features of ESP32:

- 802.11n (2.4 GHz), up to 150 Mbps Integrated TR switch, balun, LNA, power amplifier and matching network
- 4 × virtual Wi-Fi interfaces
- Compliant with Bluetooth v4.2 BR/EDR and Bluetooth LE specifications +19.5dBm output power in 802.11b mode
- Internal 8 MHz oscillator with calibration
- External 2 MHz ~ 60 MHz crystal oscillator (40 MHz only for Wi-Fi/Bluetooth Functionality)
- 34 × programmable GPIOs, 12-bit SAR ADC up to 18 channels, 2 × 8-bit DAC, 10 × touch sensors, 4 × SPI, 2 × I2S, 2 × I2C, 3 × UART.
- Ethernet MAC interface with dedicated DMA and IEEE 1588 support
- Five power modes designed for typical scenarios: Active, Modem-sleep, Light-sleep, Deep-sleep, Hibernation
- Power consumption in Deep-sleep mode is 10 µA

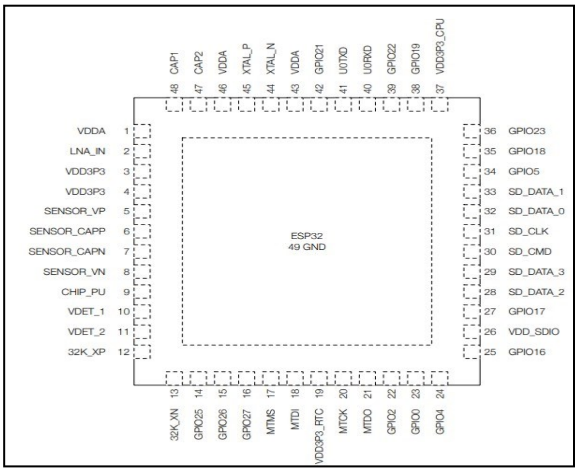

Fig 6 ESP32 Module

2.4.6 Relays

Relays are electric switches that use electromagnetism to convert small electrical stimuli into larger currents. These conversions occur when electrical inputs activate electromagnets to either form or break existing circuits.

Features of Relay:

- Max Current: 5A AC/DC (max).
- Max Voltage: 250V AC/30V DC.
- Nominal Voltage: 12V.
- Coil resistance: 270Ω. Coil Current: 44.4Ma.
- Operating Voltage: 8.6 to 21.6V.

D. 2.4.7 Touch Screen

The touch screen enables the user to interact directly with what is displayed, rather than using a mouse, touchpad, or other such devices (other than a stylus, which is optional for most modern touch screens).

Features of Touch Screen:

- 320 x 240 Resolution
- RGB 65K true to life colors
- TFT screen with integrated resistive touch panel
- 4 pin TTL serial interface
- 4M Flash memory for User Application Code and Data
- On board micro-SD card slot for firmware upgradation
- Visual Area: 57.6mm(L)×43.2mm(W)
- Adjustable Brightness: 0~180 nit, the interval of adjustment is 1% • 5V65mA power consumption
- Compatible with Raspberry Pi A+, B+, Pi 2, Pi 3, Arduino.

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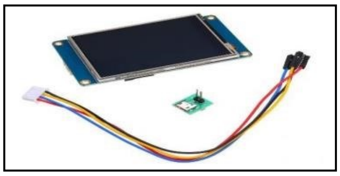

Fig 7 Touch Screen

3.HARDWARE DESIGN

3.1 CIRCUIT DESIGN

3.1.1 Power Supply

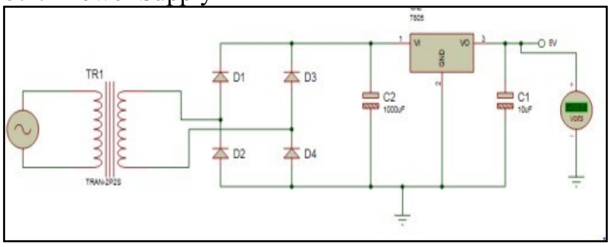

Fig 8 Power Supply Simulation

3.1.2 Main Circuit Diagram

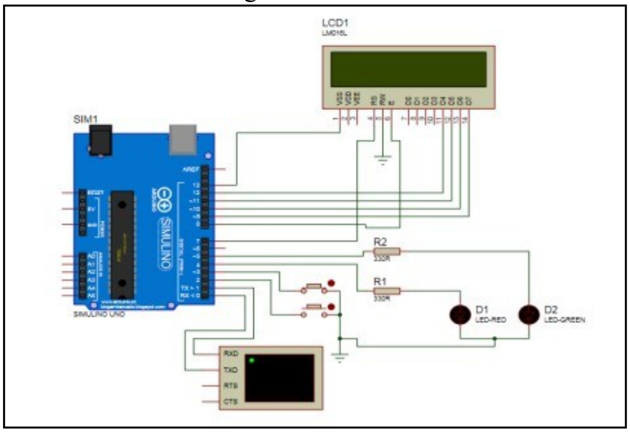

Fig 9 Circuit Diagram of system

3.2 Calculation

Power supply Calculations:

Voltage Rating:

As we require Vldc of almost 8V so by considering the voltage drop across diodes and other components. We decided to use 12V transformer.

As, $Vrms = Vm/\sqrt{2}$

$Vm = Vrms * \sqrt{2}$ ∴ $Vm = 16.97V$ As, $Vldc = 2 Vm/\pi$

∴ $Vldc = 10.80V$

By considering the diode drop of around 1.4 V we get,

∴ $Vldc = 9.54V$

This is more than sufficient for IC 7805 for generating output of +5V.

- Current Rating :

  As we require Ildc of almost 1A so we decided to use 1A transformer current rating. If we choose 1A then we get 0.9A as Ildc which is not sufficient.

  As, $Irms = Im/\sqrt{2}$

  ∴ $Im = Irms * \sqrt{2}$ ∴ $Im = 2.82A$

  As, $Ildc = 2 Im/\pi$

  ∴ $Ildc = 1.79A$

- Capacitor Calculations:

  If we assume that our step down transformer reduces the amplitude of 50 Hz sine wave from 230V to 12V. The discharge time of the capacitor in this case is $Tdischarge = 1/(2*f)$

  As, f=50Hz

∴ Tdischarge = 10 ms

Now, at the beginning of each discharge period our capacitor is charged up to the peak value i.e. Vmax = 16.97V.

In order to prevent our capacitor voltage going below Vmin= 7V in the end of the discharge period, so the capacitor value should be chosen with the equation:

$C = (Imax * Tdischarge) / (Vmax - Vmin)$ ∴ $C = (1 A * 10 ms) / (16.97-7)$

C = 1mF

E. 4. IMPLEMENTATION, TEST & PERFORMANCE

F. 4.1 FLOW CHART

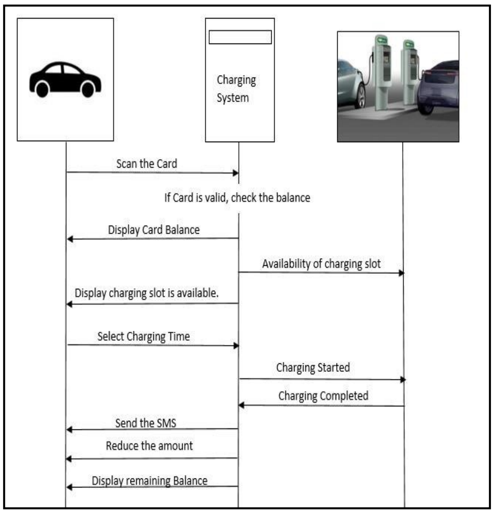

Fig 10 Flow Diagram

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Flowchart description:

1. Firstly, customer arrives at the charging station to charge the car.
2. Then he will wait for swiping the card, after swiping the card, the system will check the space for the arrived person.
3. Also check for availability of either one or two spaces.
4. If space is vacant, the message is shown on the screen that space is vacant, you can charge your vehicle.
5. Then the customer will proceed for the next process.
6. He will swipe the card.
7. After swiping, a balance checking process will be going on in the system.
8. If there is balance in the card, then the system will allow that person, but if there is no sufficient balance, the system will give the message for repeating the process till the available balance is sufficient and display the message to recharge your card.
9. After the balance is checked, the customer has to select the timing for charging his vehicle.
10. Charging will start.
11. After charging is finished, the system will display that message that you're charging is done.
12. Then the amount is reduced from the customer's account. And final balance will be displayed on screen.

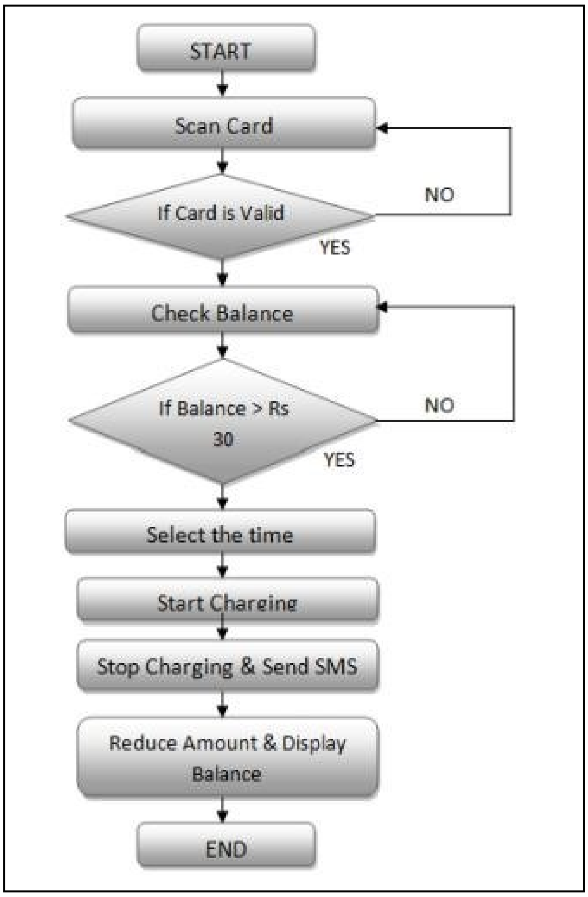

Fig 11 Flow Chart

5. CONCLUSIONS

The purpose of this project is to provide fast charging to electric vehicle. In the proposed EV charging System, introduction of mobile application will facilitate connectivity user's interaction. The Simulation tool helps on this charging process to simulate behavior an operating condition under different assumptions. The application of IoT approaches has a great potential, once we are able to store consumption and production data and the knowledge information created which can help both consumers and producers. Mobile devices and applications will help on the access to information.

G. 6. FUTURE SCOPE

In Future, we are planning to include some interesting features like solar based system and battery voltage detectors to check the status of battery. We are planning to link RFIDs with user's prepaid bank account using various payment apps like paytm, google pay. This extra features make the system more accurate, reliable and user friendly.

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