Smart EV Car Charging System By Using The Raspberry PI Pico

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Abstract: A new way to improve accessibility and convenience in EV charging infrastructure is the Wireless Electric Vehicle (EV) charging system. For electric vehicles, wireless power transfer (WPS) offers a workable way to solve range issues and lower onboard battery costs. For optimal performance, electric vehicles require quick, affordable, and dependable charging systems. Unlike traditional wired charging systems, wireless charging solutions eliminate the hassle of plugging in the gadget that needs to be charged. The suggested method transfers energy wirelessly from a transmitter coil to a receiver coil by means of electromagnetic induction. The charging procedure is managed and observed by the Raspberry Pi. A transmitter unit, a receiver unit, and a user interface make up the system. The wireless charging solution combines Raspberry Pi technology with a coin-based payment mechanism to give users a simple and alternate payment option.

Index Terms - Electric Vehicle, Wireless charging technology, Raspberry Pi technology, IOT, Sensor.

I. Introduction

Electric vehicles (EVs) are an important step toward ecofriendly transportation, as they help lower greenhouse gas emissions and reduce the need for fossil fuels. However, the mass adoption of EVs depends on the availability of convenient and accessible charging infrastructure. The well designed mobile apps offered by all EV charging infrastructure providers let you pay for the wireless charging session with net banking, credit, debit, UPI, or online wallets. A digital wallet (Amazon Pay, Paytm, etc.) linked to the EV charging app is the most preferred way of payment for the wireless charging. However, traditional payment methods, such as RFID cards or mobile apps, may not cater to all users specifically public parking lots or remote areas without internet access., leading to limitations in usage and potential revenue loss for charging station operators. In-motion charging of EVs is now possible because to recent research initiatives that have produced wireless or inductive charging options, making EVs more appealing to many drivers for daily use. The charging process is safer and more convenient while using stationary wireless charging. However, stationary charging is not much different from traditional plug-in conductive charging in terms of charging duration, frequency, vehicle operation, and charging station distribution. On the other hand, the EV's battery can be charged while it is operating thanks to dynamic and quasi dynamic wireless charging. Because of this potential, new operational and infrastructure design concerns have been brought up that were not present with traditional plug-in EVs. There is one another feature is added to do a payment of EVs car where the users can do the payment by conventional method also by using the coin insertion. These systems allow EV owners to charge their vehicles in areas where traditional charging options may be limited. By utilizing a Raspberry Pi, a flexible and cost-effective single-board computer, this system not only increases accessibility but also demonstrates the potential of IoT (Internet of Things) technology in modern infrastructure. Increasing the travel range, lowering

the size of the battery, and minimizing the length of time the battery must wait to charge are the three primary benefits of wireless charging technology. These benefits increase the benefits to the economy and environment, as well as the rates at which EVs are being adopted by transportation networks.

II.   Methodology

- **Block Diagram**

The Raspberry Pi, IR sensors, transmitter and receiver coils, an AC to DC converter, a relay, a battery, a DC motor, and an LED are all shown in this block diagram. The primary element of the project is the Raspberry Pi, which manages and keeps an eye on the parameters. An IR sensor detects the presence of the vehicle and notifies the Raspberry Pi of its presence. Relay is turned on to activate the transmitter coil based on the position of the vehicle. Through mutual coupling, the transmitter and receiver coils in the car energize each other. The energy generated powers an AC to DC converter, which is then connected to the battery. The motor runs on power from the battery. This is the whole process where wireless charging is done.
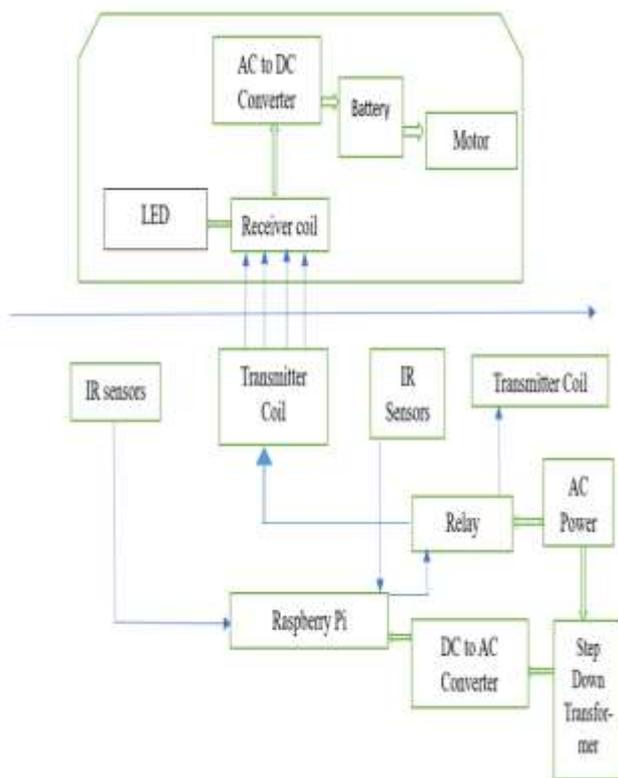

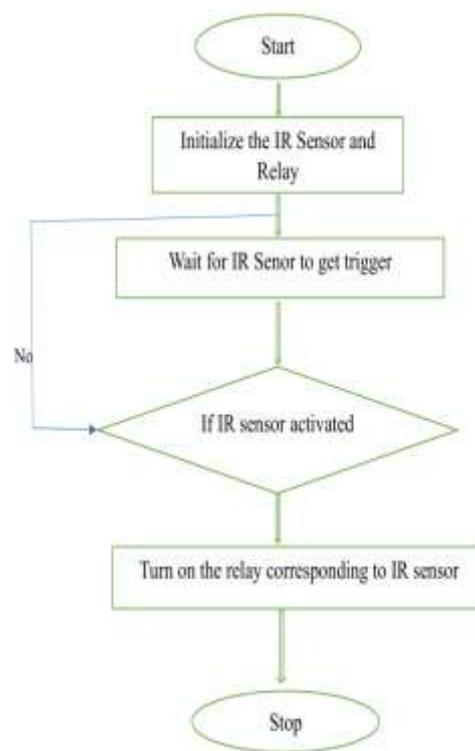**Fig 1.1** Block Diagram of Wireless EV Charging System

Fig 1.2 Flow Chart of Wireless EV Charging System

- **Block Diagram and Flow Chart of Wireless Charging System by Using Coin Insertion Payment Method.**

In this block diagram we will shows that how to work the project in a simple method. We connect different peripherals to the Raspberry pi pico. In this we connect LCD display, Relay Mod Coin project the main part is controller that is Raspberry pi pico Sensor, Led, etc. this project worked liked paid Ev Car charging system. So we use one coin sensor for counting and detecting the coin. One you inserted the coin in the coin sensor the coin sensor will detect the coin and check it is right coin or not. If coin is correct then only the controller count the coin so in this case one coin of two rupee is for 2 min of charging. So if user want to add more coin at a time it can add. So time will automatically get multiplied. So once user add all coin it needs to press a

ready switch. Then controller will count all time and start the charging by switching relay ON. And after estimated time the relay will automatically turn OFF, and all this process is display on LCD display.
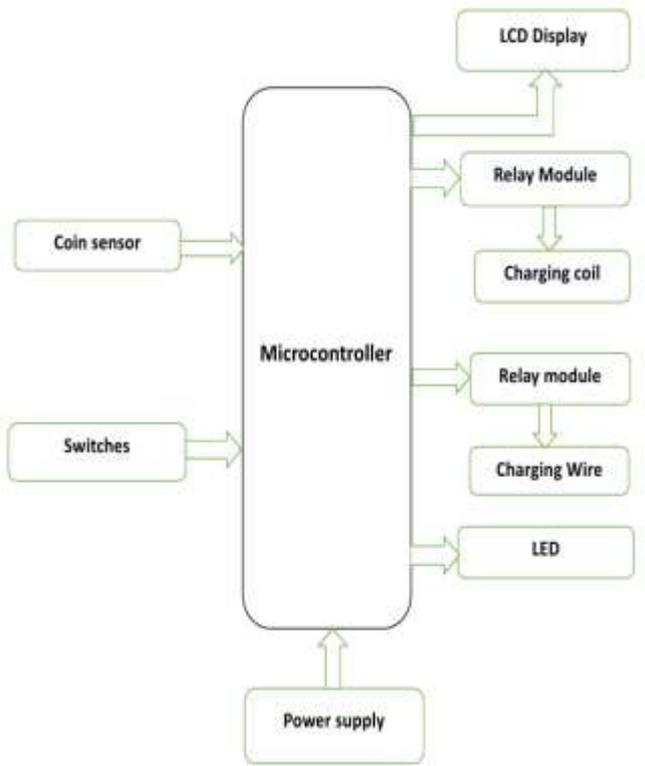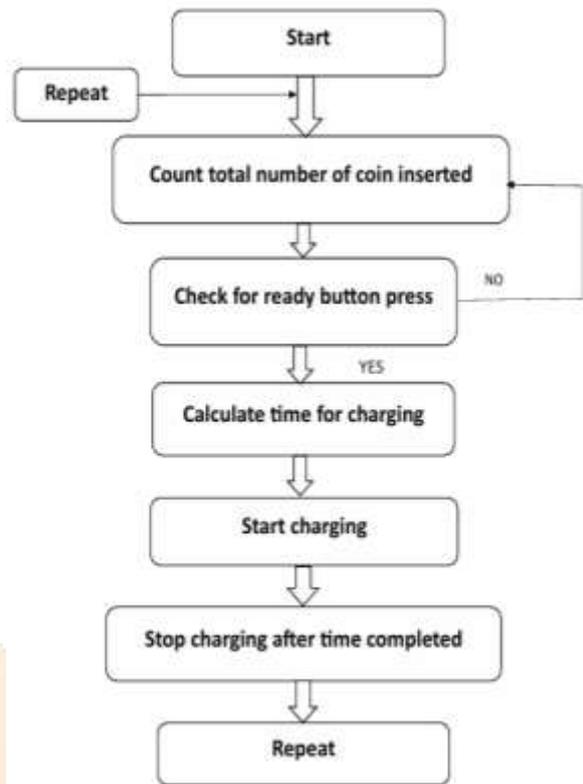

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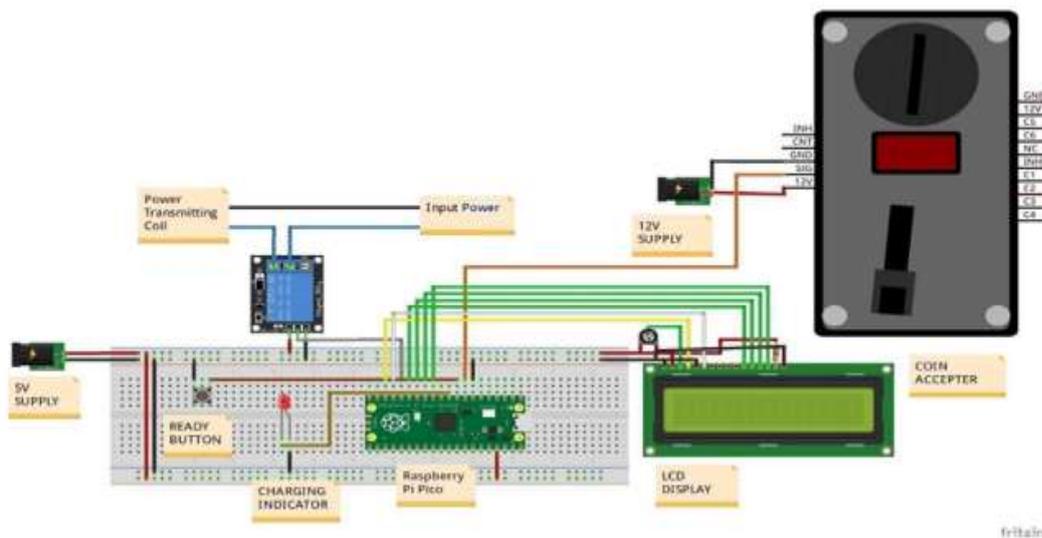Fig 2.1 Block Diagram   Fig 2.2 Flow-Chart

- **Circuit Diagram**

Fig 2.3: Circuit Diagram of model

III.   Components Used
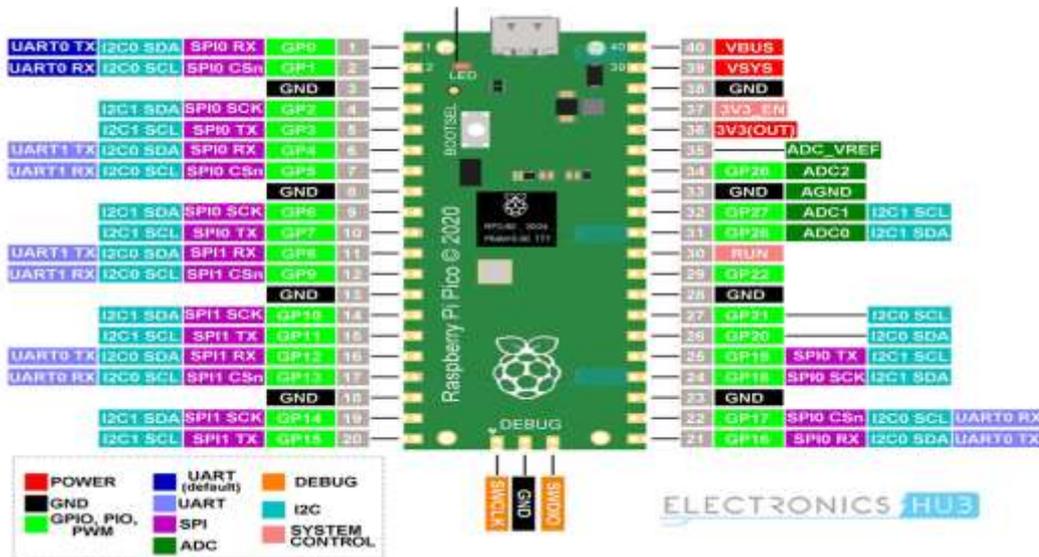
- **Raspberry pi Pico**

Figure 3.1: Raspberry pi pico configuration

The Raspberry Pi Foundation created the microcontroller board known as the Raspberry Pi Pico. Here are some of its salient characteristics and details: Microcontroller: The RP2040 microcontroller, a dual-core ARM Cortex-M0+ CPU with a maximum frequency of 133 MHz, powers it. Memory: The Pico supports external memory via QSPI and has 264KB of RAM. GPIO Pins: It includes 26 multi-function GPIO pins that can be used for UART, PWM, SPI, I2C, digital input/output, and analog input. Peripherals: It has a range of peripherals, including timers, an area-time clock, and a programmable I/O state machine. USB: The Pico can be programmed using Micro Python and contains a micro USB connector for power and data transfer. Low Cost: It is designed to be an affordable micro controller, making it accessible for hobbyists, students 21 and anyone interested in learning about electronics and programming. Open-Source: The Raspberry Pi Pico is an open-source hardware project, and its schematics and desigsnare available for users to modify and build upon. Community Support. Due to the popularity of Raspberry Pi products, including the Pico, there is a vibrant community that shares projects, tutorials, and support for those working with the Pico.

- **Diode IN4007 Diode Pin Configuration**

A diode is a component that only permits one direction of current passage. That is, the anode to cathode current should always travel in that direction. A grey bar can be used to identify the cathode terminal. The device can handle peaks of up to 30A, although its maximum current carrying capacity is 1A. For circuits intended for less than 1A, we can therefore use this. The 5uA reverse current is very little. This diode dissipates 3W of power. 1000V is its maximum repeating reverse voltage.

Fig 3.2: IN4007 Diode

- **Coin Insertion**

Fig 3.3: Coin Insertion

A core-less oblong transmitter coil and a core-less oblong reception coil placed apart on opposing sides of a coin route so that every coin's complete diameter passes between the coils make up a coin detector and counter. To determine each coin's conductance, the greatest peak voltage produced in the receiver coil upon passing through it is measured. Each coin is thus identified and counted by comparing its measured conductance with the known conductance of coins. One goal of this design is to create a coin recognition system that is less susceptible to jamming than previous systems because it does not require precise tolerances. A transmitter coil on one side of the coin and a receiver coil on the other have been used in a number of earlier coin identification devices. Regardless of the rate at which the coins travel—whether they do so steadily or sporadically, as in a fare box, for instance—the design's system accurately detects and counts each coin as it moves across the field. To regulate the position or pace of coins as they travel through, no device is needed. This significantly reduces the complexity of the coin handling device needed to feed coins through the field. The only condition is that coins cannot cross over one another in the area between coils.

- **Relay Module**

Fig 3.4: Relay

An electromagnet powers an electrical switch used in a power relay module. A separate low-power signal from a micro controller activates the magnets. The electromagnet pulls to open or close an electrical circuit when it is turned on. An iron yoke that provides a low reluctance path for magnetic flux, a moveable iron armature, a wire coil wound around a soft iron core, or solenoid, and one or more sets of contacts make up a basic relay. The moveable armature is connected to one or more sets of moving contacts and attached to the yoke. When the relay is de-energized, the armature, which is held in place by a spring, creates a gap in the magnetic circuit. In this configuration, one of the two contact sets is closed and the o ther is open. An armature is activated by a magnetic field created when an electrical current flows through a coil. A connection with the fixed contact is established or broken by the movement of the moveable contacts. The contacts that were closed open and break the connection when the relay is de-energized, and vice versa if the contacts were open. When the coil's current is cut off, the armature is forcibly brought back to its relaxed state. In most cases, a spring provides this force, although in some situations, gravity can also be employed. The majority of power relays are designed to function quickly. GEP Power Products is the market leader in high power relay module design and production for power distribution in high current applications. GEP's power relay modules, rated up to 70 amps, are engineered for smooth integration in high power distribution applications. The easy installation and accessibility are made possible by the handy inbuilt mounting brackets. GEP Power Products offers a plethora of alternatives, including terminal position assurance for wire retention, and their power distribution solutions and off-road industry knowledge are unmatched.

- **Battery**

Fig 3.5: Li-iron Cell

An apparatus that directly transforms chemical energy into electrical energy is a battery. It is made up of several voltaic cells, each of which is made up of two half-cells joined in series by a conductive electrolyte that has both anions and cations in it. Anode or negative electrode is the electrode to which anions (negatively charged ions) migrate; cathode or positive electrode is the electrode to which cations (positively charged ions) migrate. Both electrolyte and electrode are components of one half-cell.

IV. RESULT

Here in this model, we involving coin insertion as a payment method in an EVs wireless charging systems using the raspberry pi pico could be the development of the cost effective and customized wireless charging solution. With the raspberry pi pico capabilities, you could create a system that accepts coin as a payment for charging services, It monitors charging progress and provides user feedback. This model could potentially make EV charging more accessible in various locations, such as public parking lots or remote areas without internet access. The result of a wireless EV charging system activated by coin insertion payment could be a revolutionary solution for EV owners. By integrating wireless charging technology with a coin insertion mechanism, the project aims to simplify the charging process and enhance convenience for users. With this setup, drivers can simply insert a coin to initiate wireless charging without the hassle of plugging in cables. This model has the potential to make EV charging more accessible and user-friendly, promoting the adoption of electric vehicles. Here we done a case study on battery Charging calculation of EVs :- Suppose we consider an example of OLA S1 pro Scooter which has a battery capacity of 5 KWH. It requires 5 hours to fully charge (100%) by the company given charge and by the hyper charger it requires only 45 min. It has motor rated power of 5.5 kw. range of 150 Km/charge. Company given charger have capacity of 750W and the Hyper charger have the capacity of 12 KW. Company given charger can be plug into the 15A socket. To fully charge the scooter it consumes 5unit.

• Now let's calculate the charging cost

Charging Cost = (Battery Capacity In KWH) × (Electricity rate per unit) × (Charging Efficiency)

Now For Above Example

Here we consider a per unit electricity rate is 10Rs/unit. Charging efficiency is 80% (0.8). The battery capacity is 5kwh.

Charging Cost = (Battery Capacity In KWH) × (Electricity rate per unit) × (Charging Efficiency)

$$= 5 \times 10 \times 0.8$$
$$= 40 \text{ Rs.}$$

Here are some calculations about Hyper charger, In this model we use the 5 Rs coin to insert.

Battery (Charging Time)	Charging (in %)	Coin Quantity	Total Cost
6 min	12.5%	1	5
12 min	25%	2	10
23 min	50%	4	20
35 min	75%	6	30
45 min	100%	8	40

Result of the Calculation: -

1. If you put 4 coins of 5Rs, it will charge the battery up to 50% of its rated charging battery capacity. It will take approximately 23 min.
2. If you put 8 coins of 5Rs, it will charge the battery up to 100% of its rated charging battery capacity. It will take 45 min. by the hyper charger in the charging station.
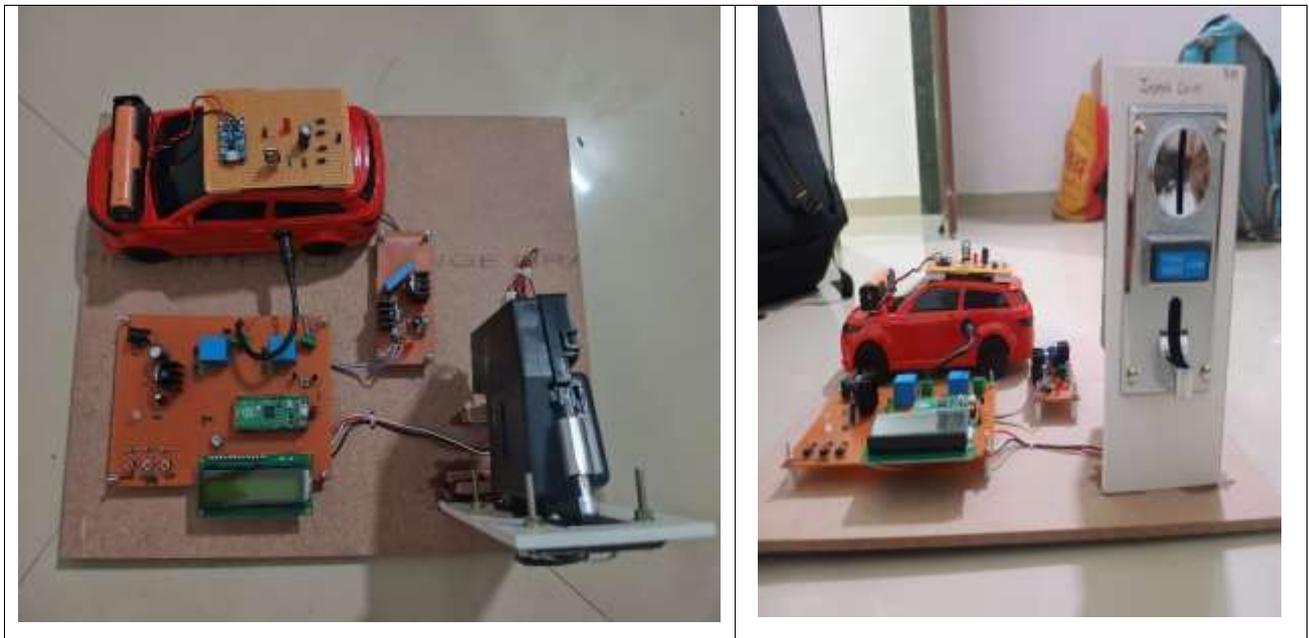
Fig 4.1: Prototype

V. CONCLUSION

In conclusion, the wireless Electric Vehicle (EV) charging system by using the Coin insertion payment method system presents a viable solution to address certain challenges and offer unique advantages within the realm of EV infrastructure and accessibility. This system provides a straightforward and familiar payment method for EV users who prefer or rely on cash transactions, thereby expanding the reach and inclusivity of EV charging services. The advantages of the coin operated EV charging system lie in its accessibility, catering to users who may lack access to digital payment methods, its convenience for those accustomed to cash transactions, and its ability to complement existing payment systems rather than replacing them entirely. This system offers flexibility, allowing users to pay for charging services using tangible currency and manage their expenses accordingly. However, while the coin insertion-based EV charging system provides numerous benefits, it's important to ac knowledge its limitations and potential challenges. This includes the need for physical maintenance, concerns about security related to handling cash, higher operational costs compared to digital payment systems, and potential limitations in scalability and technological advancement. Moreover, the success and applicability of the coin inserted payment method EV charging system depend on various factors such as geographic location, user demographics, technological infrastructure, and the evolving trends in payment methods within the EV charging industry.

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