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Smart Charger: Advancements, Challenges, and Future Directions

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ABSTRACT: Smart chargers are devices that are designed to optimize the charging process for electronic devices such as smartphones, laptops, and electric vehicles. They have become increasingly popular in recent years due to their ability to improve battery life, reduce charging time, and enhance the overall user experience. This paper provides a comprehensive review of the advancements, challenges, and future directions of smart chargers. We first discuss the advancements in smart charger technology, including the use of artificial intelligence and machine learning algorithms to optimize charging, and the development of wireless charging technology. We then examine the challenges associated with smart chargers, such as compatibility issues, safety concerns, and the environmental impact of manufacturing and disposing of these devices. Finally, we explore the future directions of smart chargers, including the potential for integration with other smart devices, the use of renewable energy sources, and the development of more sustainable manufacturing processes.

KEYWORDS: smart plug, application

I. INTRODUCTION

Smart chargers are devices that have revolutionized the way we charge our electronic devices. They offer a range of benefits, including improved battery life, reduced charging time, and enhanced user experience. With the increasing popularity of smart devices, the demand for smart chargers has also grown. This paper provides a comprehensive review of the advancements, challenges, and future directions of smart chargers.

II. RELATED WORK

In the present era, automation has become a significant factor in human life as we live in the 21st century.Smart Plug automation allows us to control charging of household appliances like Mobile Charger, Trimmers, Laptop Chargers, etc. It also provides Secure Android Application Interface. Smart Plug Automation not only refers to reducing human efforts but also energy efficiency and time saving. The main objective of Smart Plug Automation is to control charging of electronic appliances by using android application. Many times, people forget to unplug devices kept for charging. The system alerts the user when the charging reaches the custom set Percentage. This project is used to develop a system which uses mobile technology that keeps control of 3-pin smart plug which executes with respect to signal sent by mobile. Currently, many systems are being automated to adapt to the demands of the contemporary era. Automated System has fewer manual operations, so that the flexibility, reliabilities, are high and accurate. Hence every field prefers automated control systems. Automated systems are exhibiting superior performance, particularly in the field of electronics.The main feature of this system is to protect the electronic devices from overheating and protect all the electronic devices from short-circuit

III. PROPOSED ALGORITHM

We develop the system this system very help full to control the charging of appliances using mobile. We use the controller ESP, relay driver, relay, LED. ESP is the central part of our project. We will make the application for controlling the devices using mobile. There are mainly two parts in our projects:

1) Android Application

2) Embedded System

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In the mobile Android app, we have two options, either you can the user can set custom timer or user can manualy turn the device on or off. When the device reaches custom timer, Signals are sent by the Android Application(mobile) to the ESP controller. Then ESP controller sends signal to the power relay to cut off the power supply, and the charging of the device turns off.

IV. METHODOLOGY

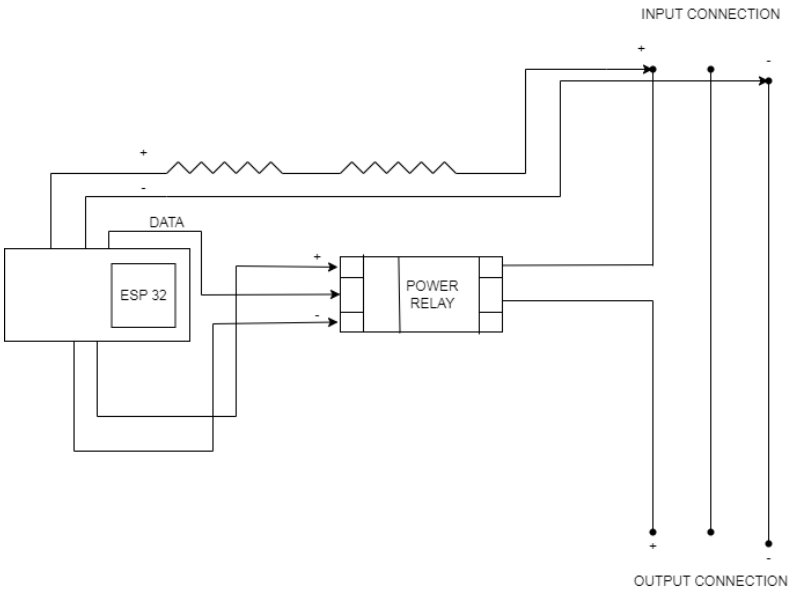

Figure 3.1Circuit Diagram

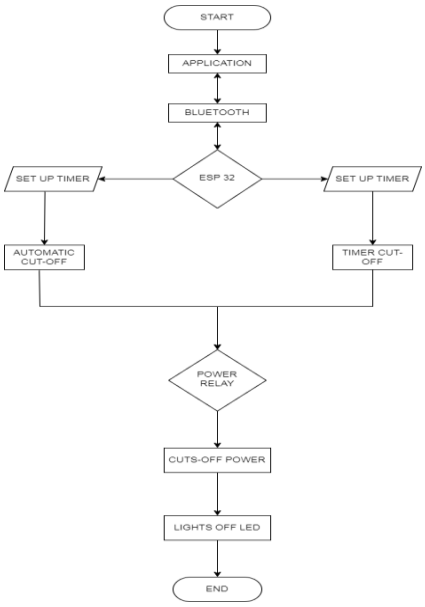

Figure 3.2Flowchart

In our system, we have used ESP 32 kit as the controller for our project. ESP 32 uses Bluetooth signals to send and recieve signals. Second component in project is Power Relay Module. It is a type of circuit which acts as an MCB, mainly used to control power flow from input plug to the device that you want to charge. By using Power Relay, device also supports fast charging i.e. if your power brick is of 120 W, the output to the device will be of 120 W only. There will be no less power usage or more power usage. Third component is Jumping wires. These are mainly used to complete the connections between the ESP 32 and the Power Relay. Also, there are two LED's one is Green and one is Red. These are used to show indications to the user, whether the device is charging or the charging has been stopped. Green will turn on when the timer for charging device has been set and Red light will turn on when the timer is completed.

V. TECHNICAL

ESP 32 KIT

The ESP32 Kit is a range of inexpensive microcontrollers that incorporate Wi-Fi and dual-mode Bluetooth, making them highly energy-efficient. These chips come equipped with a TensilicaXtensa LX6 microprocessor that is either dual-core or single-core, a single-core RISC-V microprocessor, or an Xtensa LX7 dual-core microprocessor.Espressif Systems, a Chinese company based in Shanghai, developed and designed the ESP32, which is fabricated using TSMC's 40 nm process. The ESP32 is the successor to the ESP8266 microcontroller, and multiple variants have been introduced and announced since its initial release. These microcontrollers belong to the ESP32 family and share the same SDK while also being largely code-compatible, despite having varying CPUs and capabilities.

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POWER RELAY MODULE

The Power Relay Module plays a crucial role in bridging low-powered digital electronics and high-powered devices. Its primary function is to enable digital circuits and microcontrollers to control the switching on and off of high-powered devices. This electronic component, also known as a power relay module, is commonly utilized in home automation projects, where low voltage microcontrollers like Arduino are used to control lighting circuits and motors.
The Relay Module is a simple component that works as a switch, consisting of two internal metal contacts that do not come into contact with each other. An internal switch in the relay connects these contacts to complete an electrical circuit for current flow. Unlike manual light switches, Relay Modules function using electric pulses to turn their internal switches on and off. To activate the Relay Module, an electric potential difference is supplied to one end of the circuit, which energizes an electromagnetic coil, attracting the metal contacts and enabling the flow of electric current on the opposite end of the relay.
To power the intended application, a digital signal is sent from an Arduino Uno or Raspberry Pi to the relay, enabling it to switch on and off the power to the connected device. Overall, Relay Modules are indispensable components in modern electronics and are essential in numerous applications.

JUMPER CABLES

A jump wire, also called a DuPont wire, jumper wire, or jumper, is an electric cable consisting of one or more wires with connectors or pins on each end. Its purpose is to connect the components of a prototype or test circuit or other equipment and components without soldering. By inserting their end connectors into the slots provided on a breadboard, a circuit board's header connector, or a piece of test equipment, individual jump wires can be fitted internally or with other devices.

ANDROID STUDIO

An Android App is a type of software that is specifically designed to run on an Android device or emulator. The term "Android App" can also refer to an APK file, which is essentially a Zip archive containing the app's code, resources, and meta information. Android apps can be developed using languages such as Kotlin, Java, and C++, and they run within a Virtual Machine. The official development environment for Android is Android Studio, which is where developers can write their code using Java and utilize Java core libraries. Once the code is written, it is compiled to Dalvikexecutables in order to run on the Dalvik virtual machine - a virtual machine designed specifically for mobile devices. To get started with Android app development, developers can download the Android software development kit (SDK) from the Android website, which includes tools, sample code, and relevant documents. For beginners who want to experiment with Android programming, there is the App Inventor, an online application that allows users to create an Android app by piecing together components like a puzzle. The primary integrated development environment (IDE) for Android development is the Android Studio, which is built on the IntelliJ IDEA software developed by JetBrains. It is easily accessible for installation on various operating systems, including Windows, macOS, and Linux, and has taken the place of the Eclipse Android Development Tools (E-ADT) as the chief IDE for native Android application development.Android Studio was announced at the Google I/O conference in May 2013 and entered beta stage in June 2014. It was released as the first stable build in December 2014, and in 2015, Google dropped support for Eclipse ADT, making Android Studio the only officially supported IDE for Android development. On May 7, 2019, Google announced Kotlin as their preferred language for Android app development, replacing Java.

C LANGUAGE

The C programming language, developed in the 1970s by Dennis Ritchie, is a versatile language widely utilized in computer programming. Its features are designed to align with the capabilities of targeted CPUs. C has made significant contributions in operating systems, protocol stacks, and device drivers. Though its use in application software has declined over time. C is popularly used in both large supercomputers and small microcontrollers, as well as embedded systems. Originally developed at Bell Labs by Ritchie as a successor to the programming language B, C was created to construct utilities on Unix and re-implement the operating system kernel. In the 1980s, C gained popularity and has since become one of the most commonly utilized programming languages. Nowadays, compilers for C can be found for almost all modern computer systems. architectures and operating systems. ANSI has standardized C since 1989, and it has also been standardized by the International Organization for Standardization (ISO). C language is frequently used for programming the ESP 32 to capture and broadcast signals.

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VI. RESULT

1. UI SCREENSHOTS

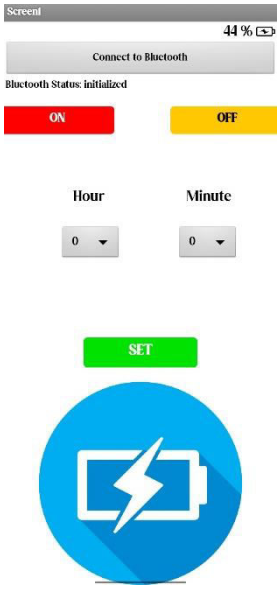

Figure 5.1.1 Home Page

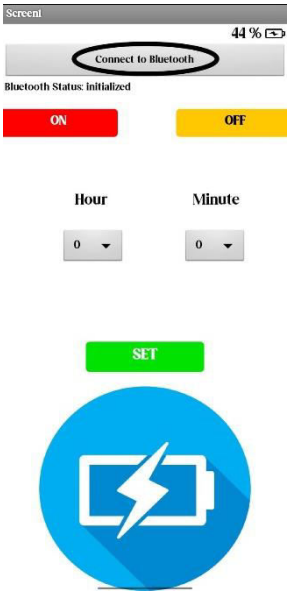

Figure 5.1.2 Connection of bluetooth

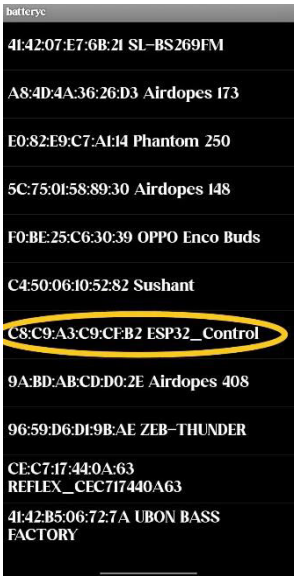

Figure 5.1.3 Connecting to ESP

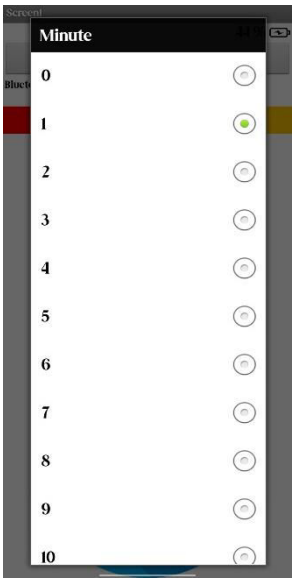

Figure 5.1.4 Set-up minute timer

2. DEVICE SCREENSHOTS

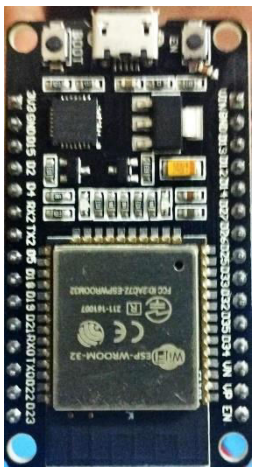

Figure 5.2.1 ESP 32

Figure 5.2.2 Power Relay Module

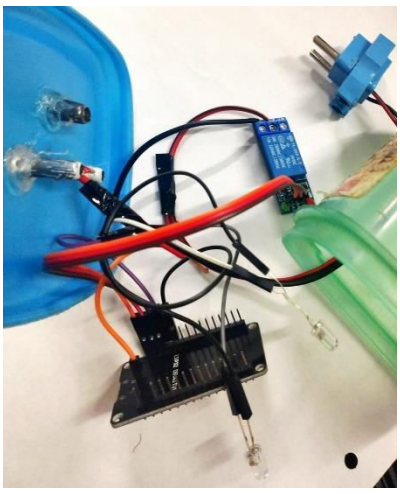

Figure 5.2.3 Built Device and Circuit

VII. CONCLUSION

Smart plugs are a convenient and easy way to control and monitor electronic devices remotely using a smartphone or voice assistant. They can help users save energy and reduce their electricity bills by scheduling devices to turn off when not in use or setting them to turn on only when needed. Smart plugs can also enhance home security by turning on and

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off lights while the occupants are away, making it appear that someone is still at home.While smart plugs have many benefits, it's important to note that they also come with some potential drawbacks. For example, smart plugs may not work with all types of devices or may require a separate hub for compatibility. Additionally, users must be mindful of the security risks associated with using smart devices, as they may be vulnerable to hacking and other cyber threats. Overall, smart plugs can be a useful addition to a smart home ecosystem, offering convenience, energy savings, and enhanced security features. However, users should carefully consider the potential benefits and drawbacks before incorporating them into their homes.This system consists of an ESP Controller board, Power Relay Module, a phone. Moreover, it can be inferred that the project goals have been achieved effectively, which are listed below:

1. Constructed a wireless Smart Plug automation system controlled by Bluetooth basedphone.
2. Designed and implemented cost effective Wireless Smart Plug system which isefficient.
3. Designed a user friendly and a safe system to control Smart Plug efficiently.
4.Supports multiple types of devices. Eg. Laptops, TV's, Razors.
5.Supports Fast Charging.

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