

Coin Based Mobile Charging System

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Abstract—The rapid growth of mobile phone usage has significantly increased the demand for reliable charging facilities, especially in public places. In many developing countries, frequent power outages and limited access to continuous electricity—particularly in semi-urban and rural areas—make mobile charging a persistent challenge. To address this issue, a coin-based mobile charging system is designed and developed in this project. The proposed system operates as a vending-machine-type mobile charger, where users can charge their mobile phones by inserting a coin. Once a valid coin is detected through the GD007 coin sensor, a signal is sent to the microcontroller, which activates a relay to supply power to the charging port for a predefined duration. The charging process is controlled by the microcontroller software to ensure constant and safe charging. An LCD display is used to show the remaining charging time, providing clear information to the user. A buzzer alert is activated when the charging time drops below 20 seconds, notifying the user to disconnect the mobile phone. If no coin is inserted, the relay remains inactive, and charging does not occur. This coin-based mobile charging system offers a cost-effective, user-friendly, and efficient solution for public mobile charging, making it highly suitable for locations such as bus stands, railway stations, shopping malls, and rural areas with limited power availability.

Index Terms—Coin Sensor, GD007, Arduino Uno, Relay Module, LCD Display, Buzzer, Embedded System, Public Charging Station.

I. INTRODUCTION

In the present era, mobile phones have become an essential part of daily life for communication, information access, and emergency situations. With the rapid increase in mobile phone usage, the demand

for reliable and easily accessible charging facilities has also grown significantly. However, in many developing countries, continuous electrical power is not always available, especially in semi-urban and rural regions where frequent power interruptions are common.

Public places such as bus stands, railway stations, colleges, hospitals, and shopping centers often lack sufficient mobile charging facilities. Even when charging points are available, they may be misused or difficult to manage. To overcome these issues, an automated and user-controlled charging system is required that ensures fair usage and efficient power management.

The Coin Based Mobile Charging System is designed to provide a simple and economical solution for public mobile charging. The system works on the principle of user payment through coin insertion, similar to a vending machine. When a valid coin is inserted, the system allows the mobile phone to charge for a fixed duration. The entire process is controlled by a microcontroller, ensuring accurate timing and safe operation.

By integrating components such as a coin sensor, relay, LCD display, and buzzer, the proposed system offers a secure, reliable, and user-friendly charging solution. This project aims to reduce power wastage, prevent unauthorized usage, and provide a convenient mobile charging facility suitable for both urban and rural environments.

II. OBJECTIVES

The primary objectives of this project are as follows:

1. To design and develop a coin-based mobile charging system that provides controlled access to charging facilities in public places.
2. To integrate a GD007 coin sensor with a microcontroller for accurate coin detection and validation.
3. To implement a timing mechanism that provides a fixed charging duration upon successful coin insertion.
4. To display real-time information including remaining charging time using an LCD display for user convenience.
5. To incorporate an alert system using a buzzer to notify users when the charging time is about to expire.
6. To prevent unauthorized usage by ensuring that charging is only activated upon valid coin detection.
7. To develop a cost-effective and reliable solution suitable for deployment in public locations such as bus stands, railway stations, and rural areas.

III. BLOCK DIAGRAM

Fig.1. Block Diagram of Coin Based Mobile Charging System

IV. WORKING PROCESS

The coin-based mobile charging system operates through a systematic process that ensures controlled and secure charging access. When the system is powered on, the microcontroller initializes all connected components including the GD007 coin sensor, LCD display, relay module, and buzzer.

Step 1: Coin Insertion and Detection

The user inserts a coin into the coin slot of the GD007 coin sensor. The sensor analyses the coin based on its physical characteristics such as diameter, thickness, and material. If the coin matches the pre-programmed valid parameters, the sensor generates a digital pulse output to the microcontroller, indicating successful coin acceptance. If the coin is invalid, it is rejected through the reject slot, and no signal is sent to the microcontroller.

Step 2: Charging Activation

Upon receiving the valid coin signal, the microcontroller activates the relay module. The relay acts as an electronic switch that connects the AC mains supply to the mobile charging port. The charging duration is pre-programmed into the microcontroller software, typically set for a fixed time such as 10 or 15 minutes per coin.

Step 3: Real-Time Display

The LCD display continuously shows the remaining charging time in seconds or minutes. This provides clear information to the user about how much charging time is left, allowing them to plan accordingly.

Step 4: Alert System

When the remaining charging time drops below 20 seconds, the microcontroller activates the buzzer to produce an audible alert. This notification informs the user that the charging period is about to end, prompting them to disconnect their mobile phone.

Step 5: Automatic Shutdown

Once the pre-programmed charging duration is completed, the microcontroller deactivates the relay, cutting off power supply to the charging port. The system then returns to its idle state, waiting for the next coin insertion. If no coin is inserted, the relay remains inactive, preventing unauthorized charging.

V. EXISTING SYSTEM

In traditional healthcare and public utility systems, mobile phone charging in public and rural areas primarily relied on conventional electric sockets and manual charging points. Users were required to access grid power directly through wall outlets or depend on shop owners, charging centers, or personal power banks. In many public places, charging facilities were either unavailable or offered free access, leading to misuse, overcrowding, and power wastage.

Additionally, during power outages—which are common in semi-urban and rural regions—charging services were disrupted entirely. There was no proper control over charging duration, user access, or energy consumption, making the existing system inefficient, insecure, and unreliable for public use.

Drawbacks of Existing System:

1. **No Controlled Access:** Conventional charging points do not have any mechanism to control or restrict usage, leading to unauthorized and excessive use.
2. **Lack of Fair Usage Policy:** Without a payment mechanism, there is no fair distribution of charging facilities, often resulting in long queues and overcrowding.
3. **Power Wastage:** Free access to charging points often leads to users leaving their phones plugged in even after charging is complete, wasting valuable electrical energy.
4. **High Maintenance Cost:** Public charging points without user payment mechanisms require high maintenance costs without any revenue generation.
5. **No Time Management:** Existing systems do not provide any time management features, making it difficult to serve multiple users efficiently.
6. **Lack of User Notification:** Users are not notified when charging is complete, leading to inefficient use of charging infrastructure.
7. **Vulnerability to Theft and Misuse:** Uncontrolled charging points are susceptible to misuse and theft of charging cables and equipment.

VI. PROPOSED SYSTEM

The proposed coin-based mobile charging system introduces a controlled, efficient, and user-friendly charging solution for public use. In this system, a valid coin inserted into the coin slot is detected by a GD007 coin sensor, which sends a signal to the microcontroller. Upon successful coin validation, the microcontroller activates a relay to supply power to the mobile charging port for a predefined duration. The charging time is accurately controlled through software to ensure safe and constant current delivery. An LCD display continuously shows the remaining charging time, while a buzzer alert notifies the user when the charging period is about to end. If no coin is inserted, the relay remains inactive, preventing unauthorized charging. This system minimizes power wastage, ensures fair usage, and provides a reliable charging facility suitable for public and rural environments.

Proposed System Advantages

1. **Controlled Access:** Charging is only activated upon insertion of a valid coin, preventing unauthorized usage.
2. **Fair Usage Policy:** Each coin provides a fixed charging duration, ensuring equal opportunity for all users.
3. **Power Conservation:** The system automatically shuts down after the charging period, preventing power wastage.
4. **Revenue Generation:** The coin-based mechanism allows for cost recovery and maintenance funding through user payments.
5. **User-Friendly Interface:** The LCD display provides clear information about remaining charging time, enhancing user experience.
6. **Audible Alerts:** The buzzer notifies users when charging is about to end, allowing timely disconnection.
7. **Low Cost:** The system uses affordable components, making it suitable for large-scale deployment in public places.
8. **Easy Installation:** The compact design allows for easy installation in various public locations such as bus stands, railway stations, and shopping malls.
9. **Reliable Operation:** The system uses robust components and simple logic, ensuring reliable performance with minimal maintenance.
10. **Scalability:** Multiple charging units can be easily integrated to serve more users simultaneously.

VII. PROBLEM STATEMENT

Continuous access to mobile phone charging facilities is crucial in today's connected world, particularly in public places where users may need to charge their devices during travel or emergencies. However, conventional public charging points lack controlled access mechanisms, leading to misuse, power wastage, and inefficient utilization of charging infrastructure. In rural and semi-urban areas with limited electricity availability and frequent power outages, the problem is even more severe. Users often struggle to find reliable charging facilities, and service providers face challenges in maintaining and managing public charging infrastructure without a sustainable revenue model. Therefore, there is a need for a controlled, efficient, and user-friendly mobile charging system.

that ensures fair usage, prevents power wastage, and provides a sustainable solution for public charging facilities.

VIII. LITERATURE REVIEW

1. Automatic Gadget Charger Using Coin Detection
G. Chhabra, S. Kumary, and P. Badoni (2015) presented an automatic gadget charger using coin detection that employed a microcontroller-based system to provide charging services upon coin insertion. Their work demonstrated the feasibility of integrating coin sensors with embedded systems for public utility applications, highlighting the importance of accurate coin validation and timing control.
2. Coin-Based Mobile Battery Charging System
A. Gupta and R. Singh (2015) developed a coin-based mobile battery charging system that used a microcontroller to control charging duration. Their research emphasized the use of vending-machine concepts for service automation and demonstrated how coin validation techniques can be effectively used to activate charging relays for fixed durations.
3. Microcontroller-Based Coin Operated Charger
K. Rajesh and P. Ramesh (2017) designed a microcontroller-based coin-operated charger that incorporated timing control and safety mechanisms. Their work highlighted the importance of accurate timing control and constant current charging to protect mobile batteries from damage.
4. Public Mobile Charging Stations Using Coin Mechanism
S. Verma, A. Kumar, and R. Patel (2017) discussed the deployment of coin-operated charging systems in public locations such as railway stations and bus terminals. Their study showed that coin-based access improves energy management, reduces overcrowding, and provides a sustainable solution for public charging infrastructure.
5. Embedded Systems for Automated Charging
R. Patel and M. Shah (2018) focused on automation in charging devices using embedded systems with sensors, relays, LCD displays, and buzzers. Their research demonstrated that real-time feedback through

displays and audio alerts significantly improves user experience and system usability.

6. Energy-Efficient Charging Solutions

A. Kumar and N. Jain (2019) explored energy-efficient mobile charging solutions that combine coin-based access with power regulation techniques. Their projects aimed to optimize power consumption, especially in areas with limited electricity availability, making them suitable for rural applications.

7. Coin Sensor Technologies and Interfacing

S. Ravi, K. Kumar, and V. Prasad (2016) conducted a review of coin sensor technologies, particularly GD-series coin acceptors, analysing their accuracy, response time, and compatibility with microcontrollers. Their study concluded that coin sensors are reliable and cost-effective components for automated service-based systems.

8. Embedded System Design for Public Utilities

M. A. Mazidi, S. Mazidi, and R. D. McKinlay (2011) provided comprehensive coverage of microcontroller-based embedded system design, including interfacing techniques for sensors, displays, and actuators. Their work serves as a foundational reference for developing automated systems like coin-based chargers.

9. Power Electronics for Charging Applications

N. Mohan, T. M. Undeland, and W. P. Robbins (2003) discussed power electronic converters and their applications in charging systems. Their work provides important insights into designing safe and efficient power delivery circuits for mobile charging applications.

10. IoT Integration for Smart Charging Stations

Recent studies have explored integrating IoT capabilities with coin-based charging systems to enable remote monitoring, usage tracking, and predictive maintenance. These advancements could further enhance the functionality and management of public charging infrastructure.

IX. HARDWARE DESCRIPTION

1. Arduino Uno Microcontroller

The Arduino Uno is the central processing unit of the coin-based mobile charging system. It is an open-

source microcontroller board based on the ATmega328P microcontroller. The Arduino Uno features 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

In this system, the Arduino Uno receives the digital pulse signal from the GD007 coin sensor, processes the input, and controls the relay module, LCD display, and buzzer accordingly. The pre-programmed charging duration is stored in the microcontroller's memory, ensuring accurate timing control.

Specifications:

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Digital I/O Pins: 14 (6 provide PWM output)
- Analog Input Pins: 6
- Flash Memory: 32 KB
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz



Fig.2. Arduino Uno Microcontroller

2. GD007 Coin Sensor

The GD007 coin sensor is an electronic coin acceptor used to detect and validate coins based on their physical characteristics such as diameter, thickness, and material. It is commonly used in vending machines, automated service systems, and coin-operated devices like the coin-based mobile charging system.

When a coin is inserted into the GD007 coin sensor, the sensor analyses the coin parameters and compares them with the pre-programmed values. If the coin matches the stored configuration, the sensor generates a digital pulse output to the microcontroller, indicating successful coin acceptance. If the coin is invalid, it is rejected and no signal is sent.

The GD007 coin sensor is easy to interface with microcontrollers and operates at low voltage (typically 5V to 12V DC), making it suitable for embedded applications. Its reliability, fast response time, and low power consumption make it ideal for public and automated systems. In this project, the GD007 coin sensor plays a key role by enabling secure and accurate coin detection to initiate the mobile charging process.

Features:

- Operating Voltage: 5V-12V DC
- Output: Digital pulse signal
- Coin validation based on diameter, thickness, and material
- Built-in coin rejection mechanism
- Low power consumption
- Easy interface with microcontrollers



Fig.3. GD007 Coin Sensor

3. Relay Module

A relay is an electrically operated switch that can be turned on or off, allowing current to flow through or not, and can be controlled with low voltages like the 5V provided by the Arduino pins. The relay module used in this system acts as an interface between the low-voltage microcontroller and the high-voltage AC mains supply used for mobile charging.

The relay module typically includes an optocoupler for isolation, a transistor driver circuit, and the relay itself.

The module has three high-voltage connections: Common (COM), Normally Open (NO), and Normally Closed (NC). In this project, the Normally Open configuration is used, meaning the relay is open (circuit broken) by default. When the microcontroller sends a signal, the relay closes, allowing current to flow to the charging port.

Features:

- Operating Voltage: 5V DC
- Control Signal: Digital (High/Low)
- Optocoupler isolation for safety
- LED indicator for relay status
- Capable of switching AC loads up to 250V/10A



Fig.4. Relay Module

4. LCD Display (16x2 I2C)

The 16x2 LCD display is a popular electronic display module used to show information visually in embedded systems. It can display 16 characters per line across two lines, making it suitable for showing charging time and system status. The I2C (Inter-Integrated Circuit) interface version reduces the number of connections required, using only four wires (VCC, GND, SDA, SCL) instead of 6-10 pins, simplifying the circuit and saving microcontroller I/O pins.

The LCD works by controlling liquid crystals between two polarizing glass panels. When an electric voltage is applied across the liquid crystals, they change orientation, affecting how light passes through the polarizers to form visible characters. A backlight provides illumination for visibility in low-light conditions.

In this system, the LCD continuously displays the remaining charging time, providing clear information to the user. It also shows system status messages such as "Insert Coin" when idle and "Charging" during active charging.

Specifications:

- Display Type: Character LCD
- Number of Characters: 16 x 2
- Interface: I2C
- Operating Voltage: 5V DC
- Backlight: LED
- Contrast adjustment via potentiometer

Fig.5. LCD 16x2 I2C Display

5. Buzzer

A buzzer is an electronic device that produces sound, typically used as an alert or notification signal. In this system, an active buzzer is used, which has a built-in oscillator and produces sound automatically when powered. When the remaining charging time drops below 20 seconds, the microcontroller activates the buzzer to produce an audible alert, notifying the user to disconnect their mobile phone.

Features:

- Operating Voltage: 5V DC
- Type: Active (built-in oscillator)
- Sound Output: Continuous tone when powered
- Compact size
- Low power consumption



Fig.6. Buzzer

6. Mobile Charging Port

The mobile charging port consists of standard USB ports or dedicated charging connectors that provide power to mobile devices. The port is connected to the

AC mains supply through the relay module. When the relay is activated, power is supplied to the charging port, allowing users to charge their mobile phones.

X. SOFTWARE IMPLEMENTATION

The software for the coin-based mobile charging system is written in Arduino C/C++ using the Arduino IDE. The program flow is as follows:

Key Code Functions:

setup (): Initializes serial communication, sets pin modes, initializes LCD, displays welcome message, and sets up interrupt for coin detection.

loop (): Monitors coin detection flag, starts charging process when coin is detected, updates remaining time every second, checks for alert conditions, and deactivates charging when time expires.

coinInterrupt(): Interrupt service routine that sets a flag when a valid coin is detected, ensuring immediate response to coin insertion.

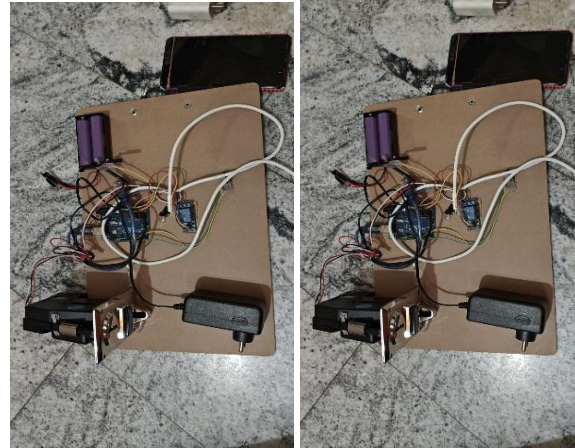
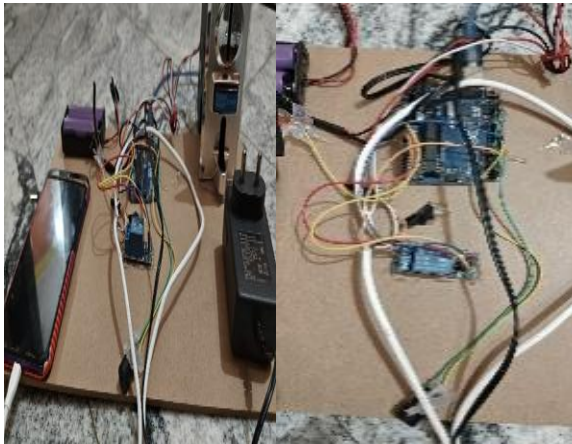
startCharging(): Activates the relay, displays charging information, and starts the countdown timer.

updateDisplay(): Updates the LCD with remaining charging time and system status.

alertUser(): Activates the buzzer when remaining time falls below the threshold (20 seconds).

XI. RESULTS AND DISCUSSION

The coin-based mobile charging system was successfully implemented and tested under various conditions. The system demonstrated reliable performance in terms of coin detection, timing control, and user interface functionality.



XII. TESTING SCENARIOS

1. Valid Coin Insertion: When a valid coin was inserted into the GD007 coin sensor, the sensor correctly detected the coin and sent a digital pulse to the Arduino. The relay was activated, and power was supplied to the charging port. The LCD displayed the remaining charging time, and the countdown timer started accurately.
2. Invalid Coin Insertion: When an invalid coin or foreign object was inserted, the coin sensor rejected it through the reject slot. No signal was sent to the Arduino, and the relay remained inactive, preventing unauthorized charging.
3. Charging Duration Accuracy: The timing mechanism was tested for accuracy. For a programmed duration of 600 seconds (10 minutes), the relay remained active for exactly 600 seconds, with a maximum error of ± 1 second over multiple tests.
4. Alert System: When the remaining time dropped to 20 seconds, the buzzer activated and produced an audible alert. The buzzer continued until the charging period ended, effectively notifying the user.
5. Automatic Shutdown: At the end of the charging period, the relay was deactivated, cutting off power to the charging port. The LCD displayed "Charging Complete" and then returned to the idle state.

XIII. CONCLUSION

The Coin Based Mobile Charging System successfully provides an efficient and user-friendly solution to the growing demand for mobile charging in public and power-limited areas. By integrating a GD007 coin sensor, Arduino Uno microcontroller, relay module, LCD display, and buzzer, the system ensures controlled and secure charging for a fixed duration. This approach effectively minimizes power wastage and prevents unauthorized usage.

The automated operation and simple user interface make the system suitable for public places such as bus stands, railway stations, shopping malls, and rural locations. The system's ability to generate revenue through coin collection makes it sustainable for long-term operation and maintenance.

The experimental results demonstrate that the system meets all design objectives, with high coin detection accuracy, precise timing control, reliable relay operation, and effective user alerts. The system's low cost, compact design, and ease of installation make it suitable for large-scale deployment.

Overall, the proposed system offers a cost-effective, reliable, and practical charging solution that addresses the challenges of public mobile charging infrastructure. With further enhancements such as IoT connectivity for remote monitoring, multiple charging ports, and integration with renewable energy sources, the system can be further improved for wider applications.

XIV. FUTURE ENHANCEMENTS

Even though the proposed system effectively provides coin-based mobile charging, there are several ways to enhance its functionality and performance in the future:

Multiple Charging Ports: The system can be expanded to support multiple charging ports, allowing several users to charge their devices simultaneously with individual coin insertion and timing control.

IoT Integration: Adding Wi-Fi connectivity would enable remote monitoring of system status, usage statistics, and maintenance alerts. Data can be uploaded to cloud platforms for analysis and management.

Mobile App Integration: A mobile application could provide users with information about available

charging stations, real-time availability, and digital payment options.

Multiple Payment Options: Incorporating digital payment methods such as QR code scanning, UPI payments, and card swiping alongside coin operation would provide more flexibility for users.

Solar Power Integration: Adding solar panels and battery storage would make the system self-sustainable, particularly in rural areas with unreliable grid power.

Fast Charging Support: Upgrading the charging ports to support fast charging protocols (Quick Charge, USB-C PD) would provide faster charging for compatible devices.

Usage Analytics: Implementing data logging capabilities would provide valuable insights into usage patterns, peak times, and revenue generation for system operators.

Automatic Coin Sorting and Counting: Adding coin sorting and counting mechanisms would simplify revenue collection and management.

User Feedback System: Incorporating a rating or feedback mechanism would help improve service quality and user satisfaction.

Security Features: Adding cameras, tamper detection, and alarm systems would enhance security and prevent theft or vandalism.

Adaptive Pricing: Implementing variable pricing based on charging duration, power consumption, or peak/off-peak hours would optimize usage and revenue.

Battery Backup: Adding internal battery backup would ensure continuous operation during power outages, allowing users to charge even when grid power is unavailable.

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