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Mobile Charging Station based on Coin Insertion System

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Abstract - *Mobile phones are marvelous device from past few years for communication as well as for usage in day-to-day life. Hence, keeping mobile phones charged has become a more significant task. In this project, we designed a prototype for mobile battery charging on coin insertion. A coin-based mobile charging system provides an alternate solution to all mobile users for charging their mobile phones during travelling or emergency where they may not have access to conventional power banks. This system can be used by shop owners, the general public and can be implemented in public places like railway stations and bus stand to provide mobile charging facilities. This system can also be implemented in commercial complexes, colleges, and offices. The prototype is based on the Arduino MEGA microcontroller, which controls the entire system. This coin based charging system will supply needed charge to the mobile phone and available on-demand in public places. The project also focuses on various applications of this system and how it can be integrated to add more features, sustainability, and reliability to solve people's problems related to charging their phones when needed. The system's future scope also revolves around implementing this system in rural areas where constant power failures are experienced using renewable energy sources.*

Key Words: **Coin Insertion Module, Mobile Charging, Charging on Coin Insertion, Arduino MEGA Microcontroller, Public Charging.**

1. INTRODUCTION

Now a day's smart phones become an ineluctable part of human's life. The power supply is an integral part of all electronic systems. Most of the works are done through mobile phones daily, so charging is the essential requirement to operate them. Therefore, the idea is to develop a system that will provide charging on coin insertion. The important thing is that the said system will be available at public places at any time. The user has to insert the coin into the coin acceptor and plug the suitable adapter into the mobile phone. The amount of charging will be pre-defined values, as mentioned in the microcontroller. This system is easy to install and useful for everyone using a Smartphone.

The project is based on developing a coin insertion-based mobile charging system that provides an effective solution to everyone's low battery issues while travelling or during day- to-day activities. Most people use a Smartphone, which consumes tremendous battery power.

Within a few hours of usage, the mobile battery gets drained, and the users either have to switch off their net packs or use their mobile in power saving modes. At this time, users use readily available power banks, but power banks' availability is not a surety in each case. What if the mobile is switched off during the case of an emergency and there is an extremely urgent need to call someone or to check any email or respond to someone during travelling. Often, the battery becomes low in the middle of a conversation, particularly at inconvenient times when access to a standard charger is not possible. Also, at certain places such as colleges during exam time and in many commercial complexes, people are asked to keep their mobile phones outside before entering the premises. This time can be an excellent utilization for charging their phones using the coin insert mobile charger, which would provide efficient charging at reasonable rates. An Arduino microcontroller is programmed for all the controlling applications. Once the coin is inserted, the coin acceptor detects for authenticity of coin. For every unit of price, the power will be available only for a limited period. Then Arduino calculates the time based on the number of coins inserted. This is how a charging system will work. The system can be installed in places like malls, cafeterias, hospitals, railway stations, restaurants, colleges, airports, and many more.

The project was ideated considering the various issues, particularly college students faced throughout their day. Based on a survey done, many students did not have any safe source for charging their phones in case of an emergency. Hence the idea of implementing this system was formed. This project has been implemented by USA by a company called "Chargetech", wherein it is used at a public places like malls and restaurants. This system can be used to generate revenue by displaying advertisements on the cabinet.

1.1. LITERATURE REVIEW

In 2017, Dhara G. Rangani, Nikunj V. Tahilramani [1] presented mobile charging using a coin in which their main focus was coin detection, for which they have used a cantilever type sensor for coin detection. The cantilever-type sensor detects the weight of the 5-rupee coin and gives a digital signal to ADC. They were using this controller to check whether the coin is original or duplicate. They have also used solar power for charging the mobile batteries and used greed power when solar power is not available.

In May 2017, Mr. C V Raja Reddy, Uzoigwe Daniel, Rupesh Rai, Balaji R [2] proposed coin based mobile charging with solar tracking in which their main focus was solar tracking for which they have used LDR's so according to the sunlight intensity, LDR resistance will be varied. When the sun intensity is high, then LDR offers less resistance, the voltage across each LDR is given to the ADC, then the controller checks in accordance with the algorithm designed and rotate the motor in the specified direction.

In 2015, Nupur Khera [3] had presented a solution to improve the control in charging and discharging of the battery. The solar charge controller will prevent the battery from overcharging; thus, it will increase battery life. The solar charge controller will also prevent the reverse flow of current from the batteries to the night's solar panels.

In 2013, S. B. Sridevi [4] had provided a solution to solar tracking. As the sun rises in the east and sets in the west, if the system cannot change the sun's direction, it will not consume maximum sunlight; this makes the system inefficient to overcome the problem solar tracking system has been developed.

The small amount of charge can be used in the initial phase to reduce the long charging time without pushing the batteries' reliability limits. This DPCS technique effectively decreases longer charging time hence provides an efficient alternative battery charging system. In this method, after applying a constant current for a short amount of time (e.g., a few seconds), the system rests for a few tens of a millisecond to let ions and chemicals settle and stabilize. This technique can be utilized in future mobile, wireless charging and power transfer systems. [5]

This paper focuses on the acoustic method, in which coin recognition is based on the detection of the coin's natural frequencies. The frequencies of these vibrations depend on the object's properties like mass, shape and material type, and remain the same as long as these properties do not change, thus being used as acoustic fingerprints. Also, this method permits the recognition of fake or deteriorated coins because they have different properties. The principle applied in this paper can be used for the recognition of numerical sequences produced by others. [6]

The type of coin and the size will be displayed at the LCD to ensure correct coin insertion. Any other coin, if inserted in the slot, will be returned to the refund box. A sensor attached to the coin insertion slot accepts the coin into the battery charging unit and starts charging the mobile battery for a specific period controlled by the microcontroller's software. The sensor is an I.R. sensor. The resistance of the sensor decreases when I.R. (infrared) light falls on it. Coin is whether accepted or rejected is based on the diameter of the coin. When the routine completes, it indicates the complete charge message through the LCD. [7]

2. PROPOSED SYSTEM

We have proposed an efficient, cost-effective and reliable system to charge mobile phones in public places. The heart of this system is the coin insertion machine, and the brains are the microcontroller. We have used the ATmega328P microcontroller and Sun Robotics Coin insertion module (programmable for six-coin types). The coin insertion module for the proposed system is programmed to take INR 5 and INR 10 coin. The system will not accept any other coin.

2.1. BLOCK DIAGRAM

There are six blocks in the block diagram of the proposed system: Power Supply, Coin Insertion Module, Microcontroller, Keypad, Liquid Crystal Display and Mobile Charging Adapter. We have bought these modules separately and designed the required prototype out of them. The various functions of each block in the complete system is explained in the latter part. In a nutshell, the system will charge the users Smartphone when he/she enters the desired number of coins in the machine.

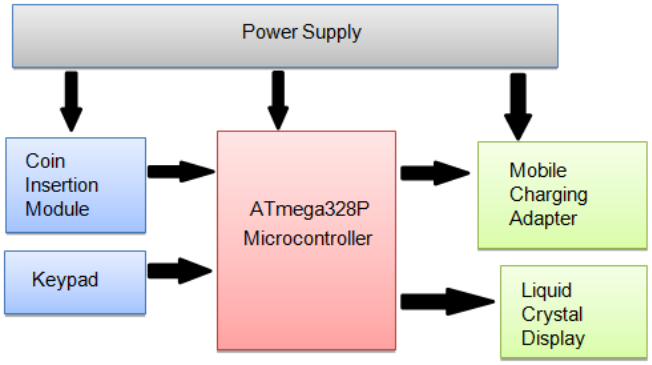

Fig – 1: Block Diagram of Proposed System.

2.2. HARDWARE

The inputs to the system are provided via the keypad matrix and the coin insertion module. Outputs are observed on the LCD and the mobile charging adapter. The microcontroller does the processing, and the power supply unit makes sure that each one performs perfectly by providing them with sufficient current and voltage.

Microcontroller

The system uses the Arduino Mega Microcontroller. It is our system's brain. The mega consistently checks if any coin is inputted into the system by reading the coin insertion module's coin pin. After detecting the coins inputted by the user, it calculates the amount required for charging and then turns on the mobile charging unit via a relay module for the exact time for which the user inserted the coins.

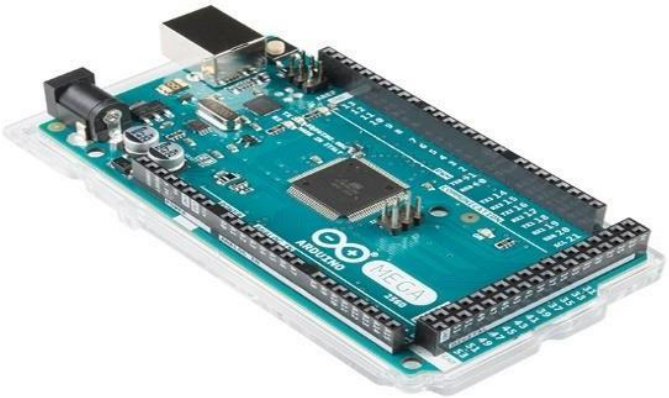

Fig – 2: Arduino MEGA 328P Microcontroller.

Coin Insertion Module

The coin Insertion module is the heart of the proposed system. The user interacts with this machine to input the desired number of coins. It is a multi-coin acceptor that can accept up to 6 kinds of different coins simultaneously. This type of coin selector is widely used in the Vending machine, Arcade Game, Message chair, and other self–management systems. To identify coins it is based on material Weight and Size. We have programmed it to take only two coins; INR 5 and INR 10 are acceptable. If the user inputs any other coin or wants to input a fake coin, it will be returned to him/her. It works on 12V DC and requires 65mA for optimal working.

Fig – 3: Coin Insertion Module.

Keypad

The keypad is used for simplifying the process of using the system. The user simply has to press 1, 2, and 3 numbers on the keypad for giving the command to the microcontroller. On pressing 1, the system will allow the user to insert coins. Now when the user is finished with inputting coins into the system, he/she can press "2" from the keypad to start charging.

Liquid crystal display (LCD)

The LCD interacts with the user visually. It displays a welcome message and guides the user on how to operate the system properly. The system uses a 16x2 liquid crystal display for interacting with the user.

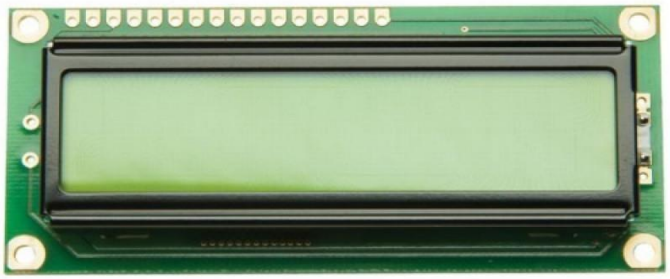

Fig – 4: Liquid Crystal Module.

Mobile Charging Adapter

This unit is the most important one. It charges the users Smartphone. It draws power from the mainline (230V AC) and converts it to 5V DC. It has an inbuilt transformer, rectifier and filter. A relay is used to switch ON the charging when coins are inserted and switches OFF when the allotted time for charging has passed.

Fig – 5: Mobile Charging Adapter.

The purpose of using an adapter with cable is that the user may not always have a data cable with himself, and so we have included it in our machine. We have inculcated a type C charger pin considering it is the most common one nowadays. Different types of pins can also be provided in different machines on user demand.

Relay Module

The Relay Module is used to control the charging of the user's smartphone when connected to the system. Hence, it is necessary to include it in hardware requirements. The relay is controlled and powered by the microcontroller.

Fig – 6: Relay Module.

Power supply

Now the system needs the power to work. It is provided by the power supply to other modules as shown in Fig: 7. We need to provide power to the microcontroller, coin insertion module and mobile charging unit. This power is received from the mainline (230V AC) and converted to a regulated 12V DC supply via AC to DC converter. The power to relay and LCD module is provided by the microcontroller itself when connected.

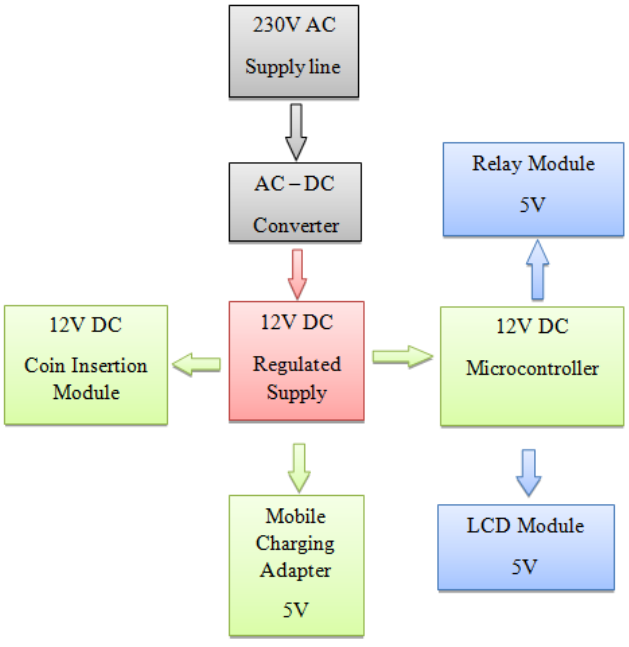

Fig – 7: Block Diagram of Power Supply.

2.3. SOFTWARE

The proposed system is a Real-Time system and is a combination of hardware and software. In the previous section, all the required hardware and its functioning are described. In this section, the Software used to write the source code of the system is explained. The system uses Arduino Mega Microcontroller, and hence Arduino IDE is used to write the source code.

Arduino IDE Software

This open-source Arduino Software (IDE) makes easier to write code and upload it to the board in this case we have used Arduino Mega Microcontroller. This software can also be used with any Arduino board.

2.4. FLOWCHART

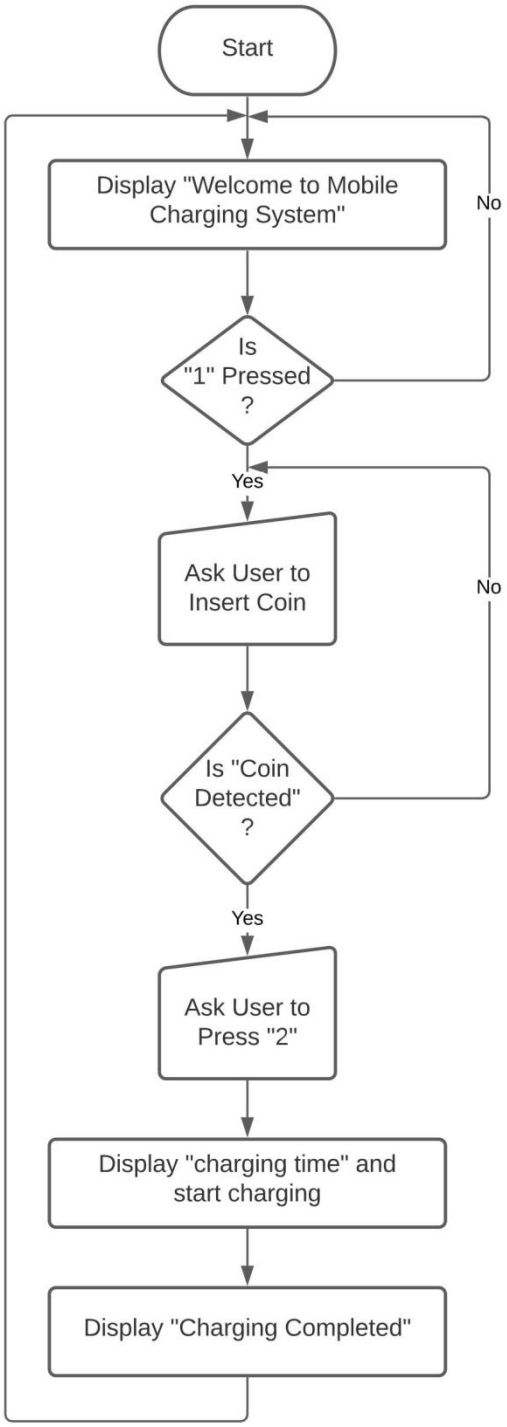

Fig – 8: Flowchart of Proposed System.

2.5. WORKING

A welcome message is being displayed to the user on startup, "Welcome to CS Press '1' to Enter." The user now has to press one, and the system will show the message "Insert Coin(s)" the user now has the option to insert as many coins as he wants but is only allowed to insert an INR 5 or 10-rupee coin. Any other coin the user inserts will not be accepted by the system and is returned to the user. When the user has just pressed one, the LCD will display the Insert Coin(s) message and will also display "Balance= 0." It will keep updating itself as the user keeps on inserting the coins into the system. For example, If the users enter a 5-rupee coin, the balance will update from 0 to 5, and if he then enters a 10-rupee coin, the balance will update from 5 to 15. After inserting the desired amount, the user now has to press two (2) on the keypad to start charging. The charging time is related to the amount of money entered into the system. For 5 rupees, the user will be allotted a 5-minute time slot to charge their device, and for 10 rupees, 10 minutes will be allotted.

After the charging time has elapsed, the controller needs to be reset manually in this prototype. If the system is not reset manually, the following user has to press one and then keep on inserting the desired amount for charging but will not see the welcome message. The complete system is assembled in a cardboard box as of this prototype but will have a metal casing for the final product, which comes under this project's future scope.

Images of different stages are attached below

Fig – 9: Implemented Mobile Charging Station.

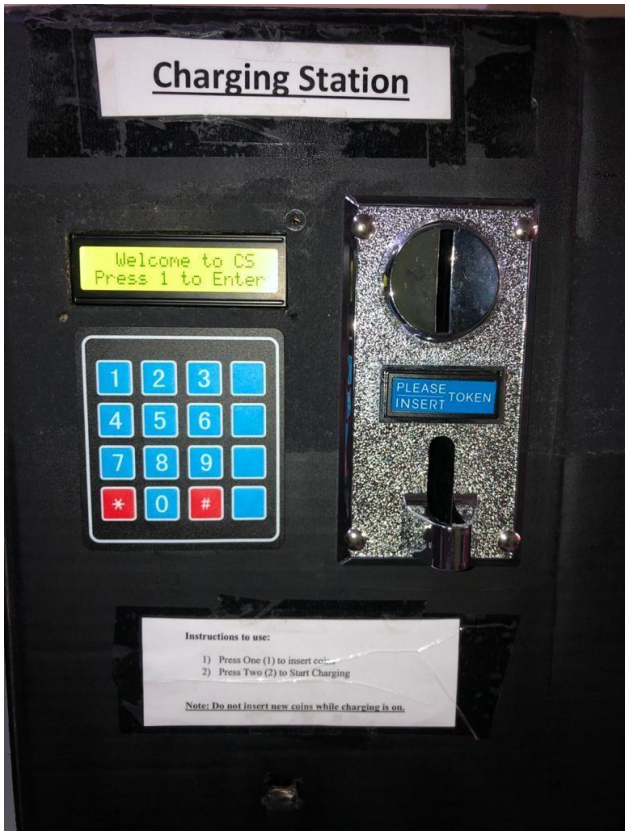

Fig – 10: Displaying Welcome Message.

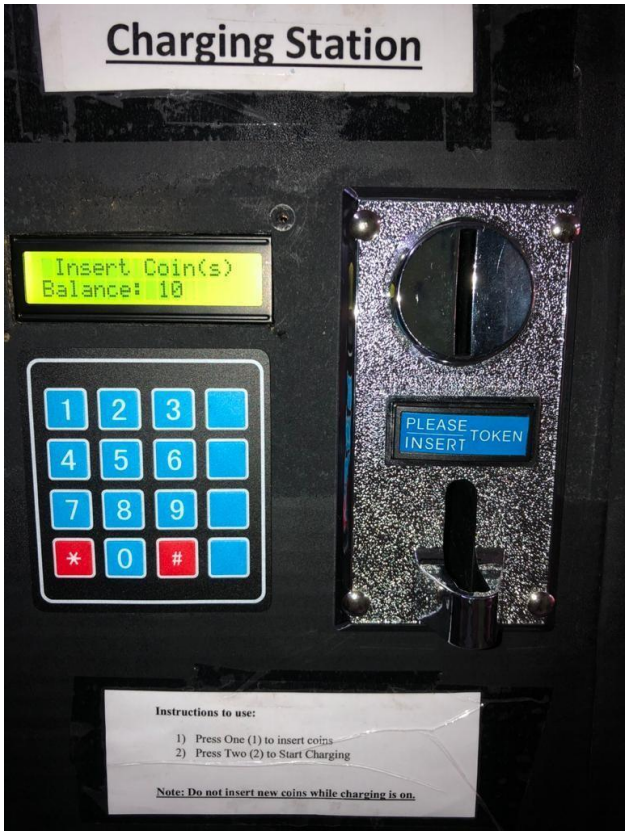

Fig – 11: Displaying Balance.

Fig – 12: Displaying "Charging Started and Time Left".

3. RESULT

The proposed system is designed and developed using Coral Raw and is programmed in Arduino IDE. It comprises Arduino Mega Microcontroller, 16x2 Liquid Crystal Display, I2C Module, 4x4 Keypad Matrix, DC 5V Single Channel Relay, DC 12V Adapter, and Coin Insertion Module. The complete hardware is assembled in a cardboard box for this project to look like a presentable prototype. Firstly welcome message is displayed by using microcontroller and displayed in liquid crystal display. Then, based on user input as this input is insertion of coin viz. INR 5 and INR 10 rupee coin. This coin is detected by coin insertion module and it keep updating microcontroller. After, Coin is accepted microcontroller sends HIGH signal to Relay module and Relay changes it state from NO to NC and connect the mobile charging adapter to Mainline. This is how Mobile phone starts Charging for allotted time slots.

4. CONCLUSION

A method of charging mobile batteries of particular manufacture has been designed and developed whenever required. This project is beneficial in today's life. Nowadays, communication is vital, so every person has a smartphone, but they do not carry a charger with them every time. When they are going for extended travel, they might forget to carry a phone charger. This project is used to help the people by building a coin-based charger. Also, nowadays, this kind of project is beneficial because of the extensive internet and smartphones usage. Conventional grid power is used for mobile charging; hence the project is low cost. In the literature survey, we have cited that many other peoples have provided an approach to this project, but they are powering their system with solar power, which makes the complete system less compatible, more maintenance is needed, power issue during night, more costly overall and not feasible over a long run. Our system uses the main supply, which can be produced from a renewable power plant, instead of using the solar panel and making it complicated and less productive over a long-term period.

In this project, a coin insertion based mobile charging system is designed and developed, which can be installed at public places such as airports, railway stations, wherein users need to charge their phones as well as at places such as colleges and educational institutions wherein users can charge their mobile phones. Interfacing various components like the coin insertion machine, LCD, 4x4 matrix keypad, relay with the Arduino microcontroller, and programming each of the components to function seamlessly forms this project's heart. This project can also be implemented at public places to display advertisements to generate revenue. Upon inserting the coins, the user will be allotted a specific time to charge its device, which depends on the number of rupees entered into the system. The prototype developed in this project is capable of charging one device at a time.

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