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DESIGN AND IMPLEMENTATION OF SOLAR BASED SMART MOBILE CHARGING SYSTEM

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ABSTRACT

In the current trends of society, cell phones have emerged as the smost demand communication source. The necessity to provide charging service to the public is very much required in day today life, the reason that most of the people moving out from the place they stay are likely to leave their charger maybe at their residing place or in lodges and so on. The paper here presents a system based on coin insertion for cell phone charging and is designed using solar tracking. This can be of use in rendering service to exurban regions that often lacks in grid power. The proposed system enables charging the battery by harnessing the energy from the sun which can be used anytime without the need of any electricity. The user has to insert a coin in the insertion slot of the coin sensor and just connect the cell phone to the input port which initiates the battery charging. This ensures the required charge to switch on the mobile from off state but not to the fullest charged state. This is quite helpful that at least minimum charging has been done of cell phone battery so that some important calls or any emergency calls can be made use of with the mobile. The greatest advantage is that it is one- time funding since the coin sensor will receive back the coin. The system design is based on Node MCU which performs the countdown timings for duration of 1 minute and LCD display is used to show the leftover time.

KEYWORDS: Mobile Charging, Solar Based, Solar Panel & Coin Sensors

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Original Article

1. INTRODUCTION

Movements from one place to another with cell phones have emerged as a very essential mode of communication across the whole global area world. The cell phone plays a key role in connecting people no matter in which country they stay. It is a casual tendency among certain people who fail to remember where they left mobile charger maybe like at home or in their work place. This leads to the thinking of the other way to find charging. One way is the proposed coin based cell phone charging system which helps charging the cell phones that can be placed in public places where a coin is made use of similar to STD booth.

These days, frequent charging of phone is essential as maximum usage of it takes place. Different forms of battery chargers are available in the market like simple, solar chargers timer based, battery charger-analyzers which are universal, pulse, fast, inductive, intelligent, USB and motion powered chargers. The aforesaid chargers are application oriented that differ from application to application like battery charger for vehicles, cell phone charger, battery chargers used for electric vehicle and charge stations. The usage of energy sources of various kinds are utmost spread widely across the global area in the world. The sun is also a very good natural source of divergent energies of which the light energy is valued to be highly incredible.

The electrical energy is obtained from light energy conversion using Solar panel. By orienting the panel in line with the sun, efficiency can be maximized. This paper proposes designing a system for tracking the sunlight which provides a genuine and modest method of positioning the panel of solar towards the sun. In these modern times, there have been lots of emerging progresses rapidly in technologies that are being developed for charging the cell phones. In most of the cases, energy from the sun is used for charging the cell phones. Sun's energy converts light energy into direct current and hence this can be used for charging the mobile phones. The chosen solar panel is of fixed size 635x550x38mm, 37WP.The maximum amperes made use of are 2.0 amps to charge the mobile phones. The sensor for tracking sunlight is mounted. The result of this device is used to compare outputs of all for equalization. If they are all equal, then the structure of the collector is almost vertical to the sun. This indicates that the error in tracking is minimized. According to the renewable energy, sunlight is the main source of one of the renewable energy sources and called as solar energy. This energy generation is sufficiently very high because the solar panel will be positioned vertically to the rays of the sun. In addition, an IoT is also used so that the mobile phone can be charged successfully. In this framework, it keeps track of the light energy as well as power of the battery when the coin is inserted into the slot of coin box. The moment the coin gets detected, it sends signals to the Raspberry pi by which the relay gets triggered and the LCD displays the countdown time. The Thing Speak which acts as an open source of Internet of Things can collaborate with the outside world for tracking the location, data storing and retrieving and so on. The voltage obtained from a relay is fed as input to the cell phones.

2. EXISTING SYSTEMS

The challenges of the implementation of mobile charging systems are of great importance. There are many similar proposed systems which are not implemented anywhere in the India. Mobile charging systems based on inserting a coin was reviewed. G.Priyanka et al[1] have proposed the work on Coin Based Mobile Charger this system. On coin insertion, the slot that accepts it detects for the validation of the coin. For every per capita, the availability of the power is solely for a restricted period. The time is calculated using arduino in response to the insertion of number of coins count. As the panel size of the solar is being fixed 635x550x38mm, 37WP is made use of for charging the mobile phones with the greatest value being 2.0 amps. The system is centered on the Atmega 328.

The authors R.J.Sapkal et al[2], have proposed the work which use Coin Detection and Solar Panel for Automatic Gadget Charger. The mobile battery charger begins to charge in response to a mobile being connected to it the moment it detects coin insertion in the slot of the coin insertion being the initial stage. The size and coin type is sensed and displayed on the LCD .This indicates the user if the coin inserted is of the desired type and size. If the right choice of the coin is not satisfied then the coin will be sent back to the refund box. The coin of the right choice is accepted into the battery charging unit. This readily starts charging the mobile battery for an allotted time which in turn is under the control of the microcontroller software used. The microcontroller board is Arduino328 that is based on the ATmega328. Aditya Kamat et al [3], have proposed the work on the system involves a digital locker based system consisting of charging slots the users have to select the duration of charging their phone. They need to use the coin insertion system for paying the charges as well. Then the user needs to create a password for the locker which will provide security to the slot. The user can keep his mobile in charging slot to charge and the slot will get locked so that no one other than the user can open it. An Arduino UNO a microcontroller board based on the ATmega328P. Is programmed for all the controlling applications including the password protection and locking system.

Authors Aparna D. Pawar et al[4] have proposed the work on coin based solar mobile charger. Once any coin is inserted in to the slot, it is compared with a reference image coin already stored as data for comparison. Image processing plays a key role for comparing the inserted coin with the image of the coin saved. MATLAB software is made use of for comparing task to be performed. On detection of the correct inserted coin, a message is displayed as "plug the mobile phone". The charging takes place depending on the coin rate. The charging done is approximately 10% for a 1 Re coin inserted. Similarly, for 2Rs, 5Rs, 10 Rs coins and so on, the phone gets charged as per the software specified time. In this proposed system, ARM Microcontroller version 7 TDMI is used as it incorporates high storage capacity. The microcontroller receives power from the battery and makes use of solar energy. Stepper motor is made use of to control the mechanical movement of solar panel. Intensity of LDR present in its architecture system will be changed in accordance with the movement of the sun. The more the sunlight intensity, less is the LDR intensity. The motor rotates with the less LDR intensity indicating that the maximum energy of sunlight is achieved.

The authors S.B. Sridevi et al [5] have proposed the work on mobile charging using coin insertion as well as solar tracking system. This system uses coin for charging the mobile phone. This system also have solar tracking depending on the intensity of the LDR(Light dependent resistor) the solar will track the sunlight. The main design work proposed in this paper is automatic control of the solar panel by positioning it in such a way that it is oriented towards the sun. This is achieved by the mechanical movement control of the solar panel. It is a fact that sun rises in the east and sets in the west. The normal systems when positioned towards the east cannot be oriented towards the direction of the sun on set. This has a disadvantage for the panel of not receiving the required light energy. To overcome this lag, the work was designed using ATMEL 89c51 which is a 40-pin microcontroller to countdown the duration period of 3 minutes. LCD was used to display the actual time leftover. The output of the relay is latched and completing the timing in progress of the timing period. In this paper, Coin based mobile charging system is designed by tracking the solar energy. In fact, the normal solar panel is positioned only in one direction and there is shortage of light energy because of this reason for its proper operation. Hence this paper presents a controller for the solar panel with its power optimization is done to overcome the shortage of sunrays. LDR readings helps in rotating the panel. This leads to the fullest utilization of sunlight to work. By using the LDR, power optimization is also done.

In this paper, the work proposed is to upgrade a very good microcontroller based solar charger. The work carried out makes use of a coin insertion to charge mobile phone. This acting as mobile battery charger provides a distinctive service to the rural areas where there is a lack of grid power for either partially or for the whole day and an origin acting as a source of revenue to the site providers. In any business premises, the mobile battery coin based charging system may be rapidly and easily installed in the available out space.

Several times it may be noticed that the charging goes low where battery sets off while communicating in the halfway of one's conversation especially at awkward times while access to a standard charger is also highly impossible. To overcome this difficulty, a coin-based mobile battery chargers are designed as a solution which maybe satisfactory. The user has to insert a specific coin and then plug the mobile phone into the available adapters. It is observed that the phone will be provided with a micro-pulse for charging. This does not bring a mobile from 'dead' to fully charged state.

3. PROPOSED SYSTEM

The system network comprises of a number of units as shown in figure 1. NodeMCU is used which contains its own Wi-Fi model which can be used to upload and download data from the internet. Here its application is used to control and monitor

the system through cloud. Solar tracking system is implemented to solar panel to maximize the radiation of the Sun to fall the solar panel per unit area per unit time. The tracking system of light energy is developed based on node microcontroller. A minimum number of components is used in this system with the aurdino based circuit. Stepper motors are made use of that enables accurate tracking of the sun. Exploring the available intelligence in the available data table thereafter, it has been manifested that the light energy tracking systems are capable of accumulating maximum energy than a fixed panel system can gather. This leads to high efficiency throughput obtained through this tracker, and so it can be observed that the developed solar energy tracking system is a realistic process of increasing the energy of light that is obtained from the sun. Thus this method proves to be an efficient tracking system for gathering solar energy. The block diagram of the proposed system consists of three human machine interface devices which are LCD, fingerprint sensor and keypad. It also consists of stepper motor(s), DC motor, ARM microcontroller, voltage regulator, GSM module, Relay and a submersible mini-pump.

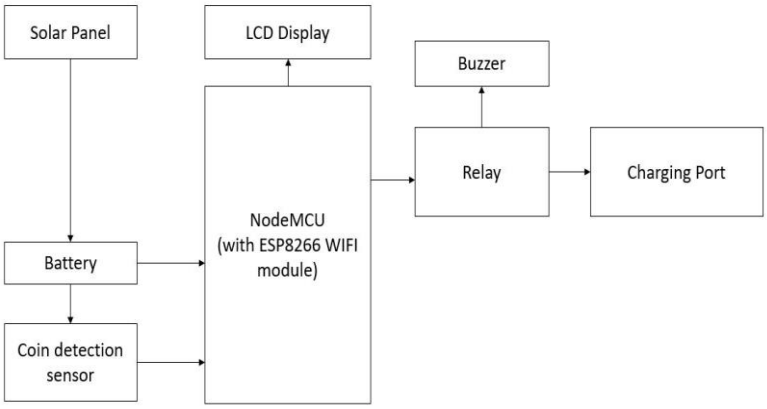

Figure 1: Block Diagram of the Coin Based Mobile Charging System.

The slot of coin insertion is the input stage wherein a coin is inserted. Followed by this, mobile is connected to the mobile battery charger and charging begins. The coin is accepted based on its size and the type. This data will then be exhibited on the LCD panel for the knowledge of user, and so could be helpful for verifying correct coin insertion. If the coin is of a different size and type, then it will be returned back to the refund box. A mechanical slot is fixed along with electrical triggering in coin insertion slot. If the inserted coin is of the desired requirements it transmits a pulse to the control unit permitting the start of charging the mobile battery connected to the device. Then the coin insertion slot accepts the coin into the battery charging unit and start charging the mobile battery for a particular period of time as directed by the software of the microcontroller.

The Controller section acts according to the input signal from the sensor circuit. The diameter of the coin accepted range is approximately 18mm to 29mm. And the thickness of coin accepted ranges from 1.2mm to 3.0mm. Coins outside this range will not be accepted. This further leads to provoking microcontroller accompanying with the LCD interface, displaying the chosen mobile option. And if a specific mobile is chosen for charging then the similar process is activated followed by charging the mobile for a particular period. On completion of the task, the message “Charge complete” is displayed on the LCD panel. Likewise at the same time, more than four different mobiles can be charged with the same procedure. The LCD displays all the information to the customer as and when required. On connecting battery of the mobile a message is displayed as “Insert Coin”. When charging begins then the message “Charging” gets displayed on LCD . Finally on completion of charging another message “Charge completed” gets displayed. If it has to be charged

repeatedly, then the coin is supposed to be inserted when the completed message gets displayed. The output has 10 terminals for connecting different types of mobile batteries and for charging mobile batteries of different make 7 of them are connected internally.

The noteworthy aspect of the cell phone battery charger of universal nature is that it draws power from the solar energy during the day time for charging the internal battery of the controller. In case if any power is required additionally, then the power used is the grid power. For supplying 230v, 50Hz, a micro inverter based solar has been designed. This is helpful as both the powers namely grid and the solar are being connected parallelly along with a switch so that it can to switch over from one another as per the requirement. The system flow is as shown in figure 2 below. In the input stage of the insertion slot, on inserting a coin, the mobile phone battery charger begins charging with mobile connected to it.

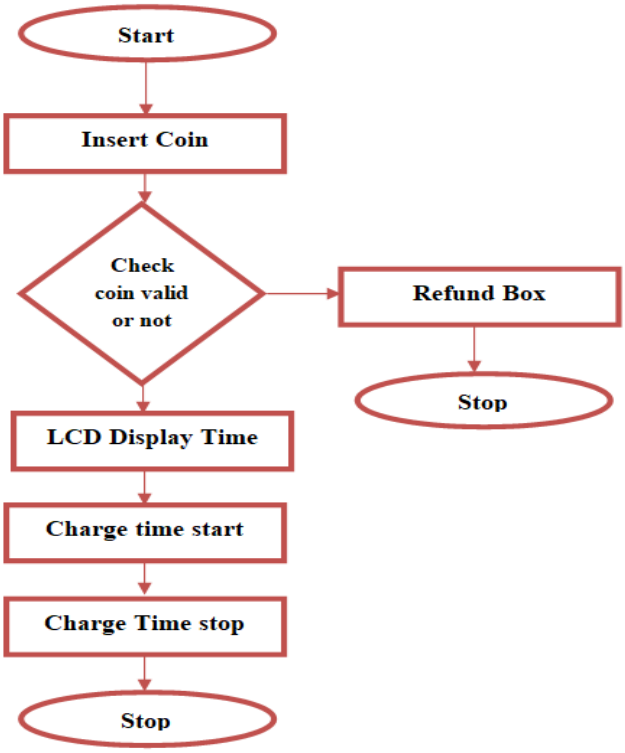

Figure 2: System Flow Chart.

The valid coin to be inserted will be displayed at the LCD panel for the user convenience. This helps the user to insert the correct type and size of the coin into the coin insertion module used which is authenticated for 5 different types of coins to be accepted. If the coin is inserted turns out to be valid, the contiguity sensor recognizes the coin then coin detection system gives out a signal in pulse form to the control unit permitting it to begin charging of the cell phone battery by turning on the relay which acts as switch. The required voltage and current for charging mobile is supplied by a regulator. The panel of the solar is used to harness the light energy. Meanwhile four Light Dependent Resistor's and stepper motor is used to trace the Sunlight to obtain the desired increased efficiency. Circuit Design and PCB layout: In this phase, simulation tools are used for designing the basic circuit which in turn helps to check the overall working of the circuit to be used in the development of smart coin mobile charging system. Many parts were collected with the aid of the simulator tool. Circuit testing was performed on the simulator to ensure proper working. PCB Layout was built granting to the circuit designed, leading to the integration of the hardware components to be set up accordingly. Assembling: In this

phase of system progress, the elements together are assembled as per the designed circuit and Printed Circuit Board layout comparatively shown in the early phases. Testing was performed following the component assembling. Figure 1 shows the block diagram of overall system indicating the functional parts that checks every single correlated components working with one another. Parallel testing was performed for the hardware set up. In Software phase incorporates two intermediate steps as follows: a) Microcontroller programming: The first step in this microcontroller programming involved generating an .asm file of the code assembly which was coded related to the operation and performance of controller. This is followed by burning microcontroller with the accumulated files of this code developed. The second step involved developing a C program that was designed to interact with .asm file code. The interaction of the whole operation is being performed by calling the functions of .asm file through the C program. b) Usage of MATLAB for performing image processing techniques: This involved value of coin detection by picture processing techniques that helped in tracing the size and type. The related techniques were masking, extracting the features, usage of Hough Transformation, matching the related patterns and so on. In correlation with the beginning hardware setup, the detection of value of coins is performed by a range of threshold value matching technique. Coin value calculation: Followed by the development of above mention codes, integration with the hardware setup was performed. Task debugging and compilation of the code developed using microcontroller is performed. On confirmation of error free code, the files compiled are passed on to the controller for its operation. On detection of some coin inside, it allows the coin - holder to move in-front of the camera and the image of the coin is captured. The value of the real time captured image is sent to the MATLAB for calculation. Finally, the power is turned ON by sending an instruction to the controller for a specific defined time duration.

4. IMPLEMENTATION RESULTS

The proposed system was tested and the results obtained are as shown in the following figure 3. The LCD displays the data and time set for the mobile charging system before coin is inserted.

Figure 3: Initial Message on LCD Display.

If the time elapses then the LCD displays the alert message as shown in the figure 4.

Figure 4: LCD Displaying the 'TIME OUT' Message.

Monitoring the output from IoT is presented in the figure below. ThingSpeak used displays the data stating the name of the person, channel ID and status of the access.

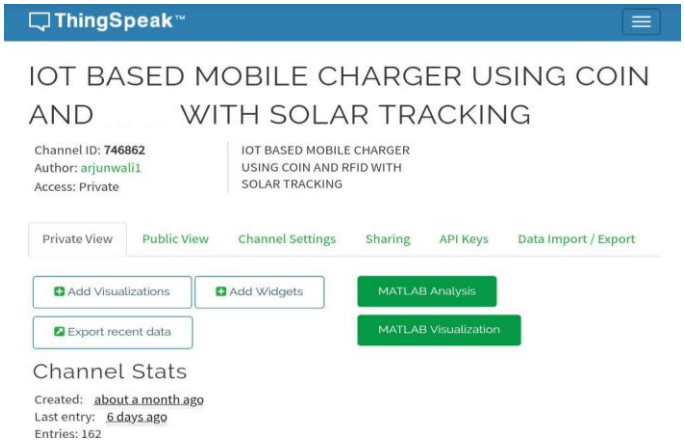

Figure 5: Data Displayed with Name, ID and Access Status.

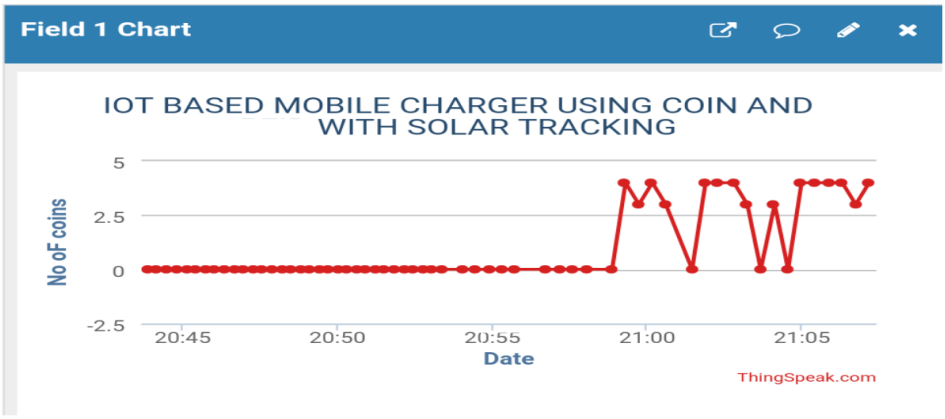

Figure 6: Field Chart of Coins Versus Date.

The graph represents the field chart displaying coins and the date.

The status of the signals is also being monitored and displayed. The two following field chart figures display the current and voltage signal status with respect to time.

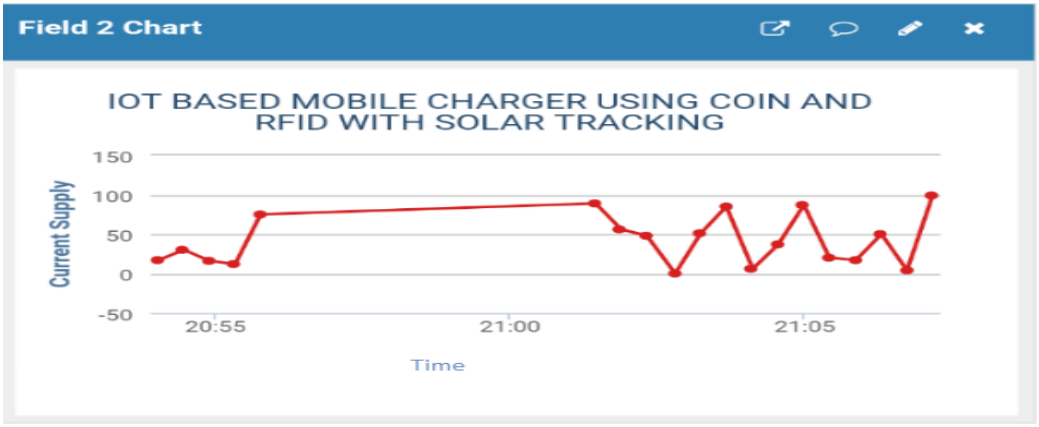

Figure 7: Field Chart of Current Versus Time.

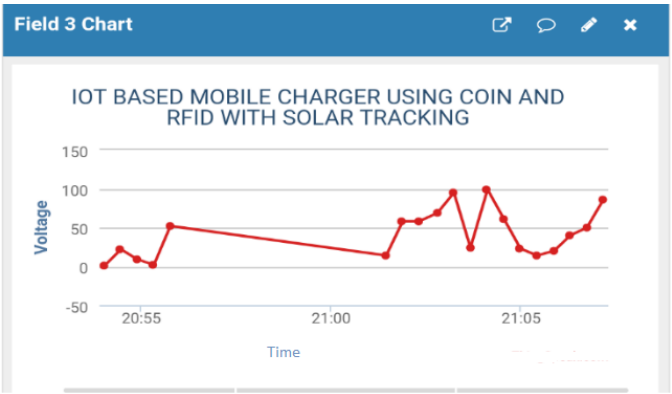

Figure 8: Field Chart of Voltage Versus Time.

5. FUTURE WORK

The modeled sensor is developed for a specific type of coin. In future, the scope can be extended by enhancing the system with such fabrication that can accept varied types of coins, so that it may be very useful and can be implemented in many public areas. By using digital image processing in coin module, different types of coin can be detected. Project has a scope too for extension as charging of electric vehicle.

6. CONCLUSIONS

In the proposed system, the developed sunlight energy tracking system is based on NodeMCU. The NodeMCU employed circuit is used in the working system with a lowest number of components. To target accurate tracking of the sun the use of enabling stepper motors is performed. After examining the data obtained, conclusion can be drawn stating that the presented solar tracking system is a feasible method of maximizing the energy of light received from the sun.

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