



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 6, June 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Enhancing Smartphone Battery Life: An Arduino-Based Charging Controller

M.Nirmala¹, R. Jeevansanjay², Pradeepkumar S³

Assistant Professor, Department of Computer Applications, Hindusthan College of Engineering and Technology,
Coimbatore, Tamil Nadu, India^{1,3}

II MCA Student, Department of Computer Applications, Hindusthan College of Engineering and Technology,
Coimbatore, Tamil Nadu, India²

ABSTRACT: This paper presents a novel solution to address common challenges associated with smartphone charging, particularly the detrimental effects of overcharging on battery lifespan. The system comprises essential components including an Arduino board, LCD display, rotary encoder, relay module, 10kΩ potentiometer, breadboard, and a power supply switch board. The functionality of the system revolves around user-controlled charging durations facilitated by the rotary encoder. Once set, the LCD display provides real-time feedback on the remaining charging time. Upon completion of the specified duration, the system autonomously disconnects the charging power, effectively mitigating the risk of overcharging.

KEY WORDS: Smartphone, Battery Life, Arduino, Charging Controller, Overcharging

I. INTRODUCTION

The term "Internet of Things" (IoT) describes a system in which everyday objects are able to gather and share data over an online network thanks to sensors, software, and connection. The Internet of Things (IoT) can complement the "Enhancing Smartphone Battery Life: An Arduino-Based Charging Controller" project by making the charging controller system more practical and user-friendly.

With the use of Internet of Things (IoT) technology, users can keep tabs on their phone's charging progress from afar, accessing real-time data and making adjustments via a web interface or mobile app. Users can make informed decisions to prolong battery life and boost device efficiency with the help of this data, which can reveal charging habits, battery performance, and optimization options. Internet of Things (IoT) sensors and algorithms for predictive analytics can foresee when batteries might fail and trigger preventative maintenance. Charging controllers that are Internet of Things (IoT) capable can work in tandem with preexisting smart home systems to optimize energy consumption and coordinate charging schedules according to the availability of renewable energy sources. By maximizing efficiency, decreasing waste, and encouraging environmentally friendly charging habits, they can help achieve sustainability and energy efficiency targets. Charging controllers can improve the charging experience and prolong the longevity of smartphone batteries by utilizing Internet of Things (IoT) technology. These controllers will become smarter, more connected, and responsive to user needs and environmental circumstances.

II. LITERATURE SURVEY

The significance of charging has grown due to the rising use of smartphones. It takes a few hours to charge a phone using an electrical outlet. But at some point in their lives, the vast majority of people have overcharged their phones by accident.

A big issue with using a smartphone or other electronic gadgets is the weight of the charging experience on users [1]. To that end, this finding served as the research's foundation. Navjeet Kumar [2] developed a smart charger for the Internet of Things devices platform using the ESP8266, which is one of several studies pertaining to smart chargers.

The smart charger developed in this study makes use of an Arduino-based module. Designed to give a low-cost and straightforward means for professionals, students, or hobbyists to build devices that interact with their surroundings using sensors and actuators, the Arduino was debuted in 2005 [3].

People can simplify their charging systems with the help of an Arduino-based smartphone charging controller. For instance, as an example of the influence that people allow their phones to charge over time, it's common for individuals to be lazy and not control their charging systems [4]. Because overcharging poses the danger of the battery phone exploding, this behavior can shorten the battery life and potentially harm the owner. An Arduino-based smartphone charging controller can help preserve the planet by cutting down on power consumption. Also, consumers will be able to use this research to better predict how long it will take to charge their phones, which would reduce the likelihood of mishaps caused by overcharging.

The results of this study will be useful for those who either don't have the time or energy to manually operate their charging system or who are too busy to charge their battery [5]. A smart charger, once developed, will allow the user to operate the charger with a simple rotary encoder, greatly simplifying the process. Those who tend to overcharge their phones can also benefit financially from this study's findings on the topic. The purpose of developing an Arduino-based smartphone charging controller was to make it easier for users to estimate the time it will take for their device to fully charge and to stop batteries from going boom. Thus, this study can shorten the battery's lifespan while simultaneously reducing power consumption and associated costs.

III. SYSTEM MODEL AND ASSUMPTIONS

- Arduino UNO
- 16×2 LCD Display
- Rotary Encoder
- 5V Relay Module
- 10KΩ POT
- Connecting Wires
- Breadboard
- Charging Adapter
- Single Socket Power Outlet Box

ARDUINO UNO

The open-source microcontroller developed by Arduino, the Arduino Uno, is based on the Microchip ATmega328P. Connecting it to other circuits and expansion boards is made possible by sets of digital and analogue input/output (I/O) pins on the board. One of Arduino's open-source microcontroller boards, the Arduino Uno, is based on the Microchip ATmega328P microprocessor. The board includes digital and analogue sets of input/output (I/O) pins that can be used to connect to other circuits and expansion boards.

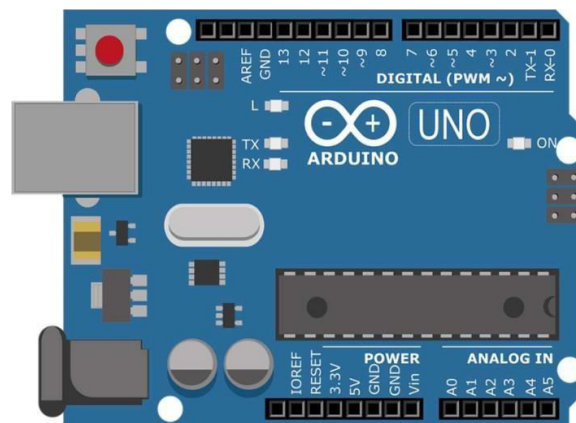


Figure 3.1 Adruino UNO

LCD DISPLAY



Figure 3.2 LCD display

Features of 16x2 LCD module

- 4.7V to 5.3V operating voltage; 1mA current consumption in the absence of a backlight; and an alphanumeric LCD display module that can show both digits and letters
 - Is made up of two rows, may print sixteen characters.
- Every character is constructed using a 5x8 pixel box.
- Able to operate in both 4- and 8-bit modes
 - Additionally, it can show any custom-generated characters.

ROTARY ENCODER



Figure 3.3 Rotary Encoder

One kind of position sensor that is used to ascertain the angular location of a rotating shaft is a rotary encoder. Depending on the rotational movement, it produces an analog or digital electrical signal.

To prevent any encoding issues, it is preferable to include an appropriate "debouncer" with the configuration when connecting an RT to Arduino. This is required because, similar to a mechanical switch, there are two metal contacts inside the rotary encoder that are not precisely touching one another. This might cause missing steps or even reverse steps when moving forward. While there is a software solution as well, I personally like the hardware approach that employs an RC filter.

5V RELAY MODULE

1. 5 V DC is the trigger voltage (voltage across the coil).
2. Nominal current (trigger current): 70 Ma
3. Maximum current of AC load: 10A at 250/125V AC
4. DC load current maximum: 10A at 30/28V DC
5. Time spent operating: 10 ms Time of release: 5 ms
6. Maximum switching speed (mechanically): 300 operations per minute

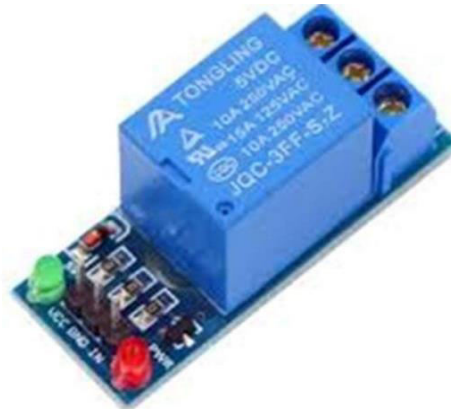


Figure 3.4 Relay Module

10KOHM POT



Figure 3.5 10 kohm pot

- Type: Rotary, also known as Radio POT.
- Multiple resistance levels are offered, such as d 1 M.
- 200Vdc as the maximum input voltage; • 0.3W as the power rating; • Rotational life of 2000K cycles

BREAD BOARD

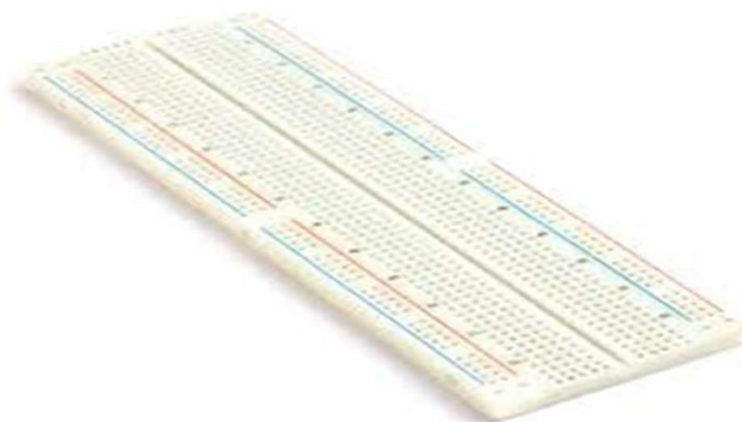


Figure 3.6 Bread Board

Breadboards are rectangular plastic boards that have millions of small holes punched into them. This light-emitting diode (LED), resistor, battery, and switch prototype is an example of an early version of an electronic circuit that makes use of these holes to facilitate the placement of electrical components. In most cases, soldering is not necessary when

using a breadboard to construct and test electronic circuits. Power can be neatly transferred from one component to another on the breadboard thanks to a few coupled components. Whether you're a beginner or an expert, you may use them to test out different circuit ideas and, in some cases, build working devices on the breadboard.

CHARGING ADAPTER



Figure 3.7 Charging Adapter

An adapter is a device that changes the characteristics of one system or device to another that would not otherwise work together. Some simply change a connector's physical form, while others alter power or signal characteristics. An AC-to-DC power supply converts electricity from 120 or 230 volts AC, which is the standard household mains voltage, to a low voltage DC that can be used to power consumer electronics. AC adaptors, often known as power bricks, wall warts, chargers, or other similar terms, are small, detachable power supply for consumer devices.

Single Socket power outlet box:



Figure 3.8 Switch Box

A building's thermoplastic-sheathed cable (TPS) wiring system or electrical conduit may include a small junction box made of plastic or metal. When intended for surface installation, it is primarily found in ceilings, beneath flooring, or hidden behind an access panel—especially in residential or business structures. A suitable kind (like the one in the gallery) can be cast into concrete so that just the cover is visible, or it can be buried in wall plaster (though complete concealment is no longer permitted by current rules and standards).

Block Diagram

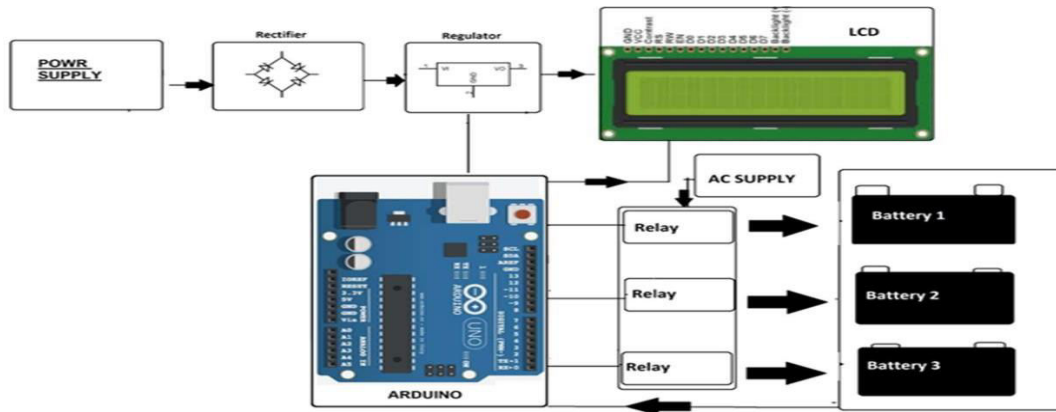


Figure 3.9 Block Diagram of Charging Controller

The Figure 3.9 depicts the block diagram of the Arduino-based smartphone charging controller includes key components such as the power input, Arduino microcontroller, voltage and current sensors, safety and protection circuits, and user interface (LCD/LED display). The microcontroller monitors and controls the charging process, ensuring optimal and safe charging while providing real-time feedback to the user.

Circuit Diagram

The Figure 3.10 depicts the circuit diagram for the Arduino-based smartphone charging controller consists of an input power source connected to voltage and current sensors, which feed data to the Arduino microcontroller.

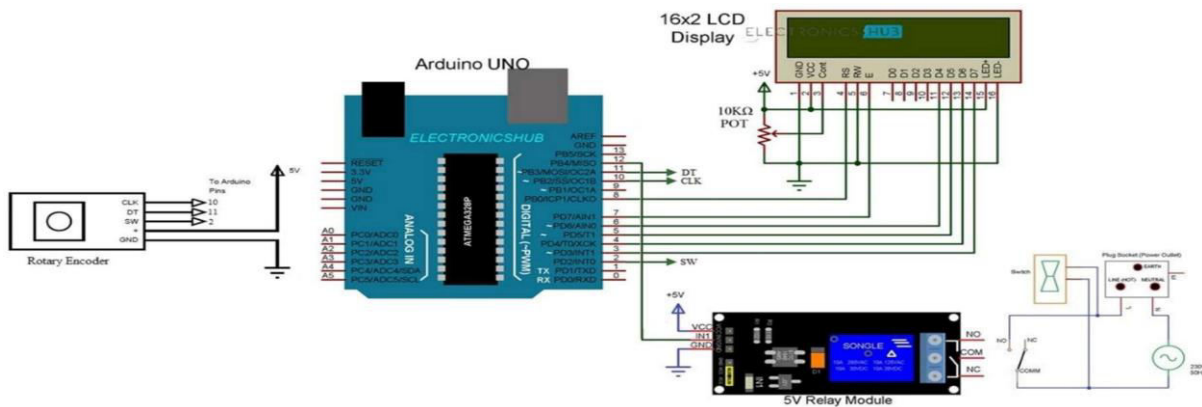


Figure 3.10 Circuit Diagram of Charging Controller

IV. WORKING PRINCIPLE

Assembling Parts

The brains of the operation is the core microcontroller, the Arduino Uno. The remaining charging time is shown on the 16x2 LCD display. The user can adjust the charging duration using the rotary encoder.

Connecting Circuits

Hook up the LCD to the Arduino by connecting its digital pins to the Arduino's RS, E, D4, D5, D6, and D7 outputs. To link a rotary encoder to an Arduino, just link the digital pins of the two devices. Linking the Relay Module to the Arduino: Join the input pin of the relay module to a digital pin on the Arduino. To charge the phone, plug in the power adapter and link the relay to the device.

Arduino Code

To begin, go into the Arduino code and initialize the components. This includes the LCD display, rotary encoder, and relay module. Charging time can be adjusted in hours, minutes, or seconds using the rotary encoder, which is part of the user interface.

Display

The LCD will show the countdown timer and the specified charging duration. Create a countdown timer that starts at the specified time and keeps going down until the end. Manage the relay module to activate or deactivate the charging power in response to the countdown timer.

Steps for Execution Activate

After powering up the system, you'll see "Set Charging Time" on the LCD. To configure the charging duration, turn the rotary encoder to choose between hours, minutes, and seconds. To change the time from hours to minutes to seconds, press the encoder button.

Once you've confirmed the duration, you can start charging. When the relay module turns on, the charging adaptor gets juice. You can see how much time is left to charge it on the LCD screen. As soon as the countdown begins, the time will refresh on the LCD. When the timer approaches zero, the charging adapter's power is automatically turned off by deactivating the relay module.

V. EXPERIMENTED RESULTS AND DISCUSSIONS

This table provides a clear overview of the key evaluation parameters, measurement methods, and criteria for assessing the performance and effectiveness of the Arduino-based smartphone charging controller.

Table 5.1 Parameter Evaluation for Charging Controller

Evaluation Parameter	Measurement	Criteria
The timer's accuracy	Compare the set duration with the actual elapsed time.	There should be minimal deviation, ideally within a few seconds.
Reliability of Power Disconnection	The ability of the test system to disconnect power at the end of the charging duration	The power consistently cuts off at the exact end of the countdown.
User Interface Usability	Assess the ease of setting the duration with the rotary encoder, as well as the clarity of the LCD display.	The interface is intuitive, the instructions are clear, and the controls are responsive.
Handling power interruptions	The test system has the ability to save and restore remaining time during power outages.	The system ensures accurate saving of remaining time to EEPROM and correct resumption after restoration.
Impact on Battery Health	Monitor battery health over time.	There is a reduction in the frequency of overcharging and an improvement in the lifespan of the battery.
Energy Efficiency	Compared to traditional methods, evaluate power consumption during operation.	A significant increase in power consumption does not promote energy-saving practices.
Component Durability	It is important to assess the longevity and performance of components over extended use.	Components remain functional and accurate over long periods without frequent replacements.
Scalability and Compatibility	We are testing the system with different smartphone models and charging adapters.	Seamless operation with a wide range of devices, not limited to specific models
Safety Features	Evaluate safety mechanisms like overcurrent protection and thermal management.	It prevents overheating and handles unexpected power surges without damage.
User Satisfaction	Gather user feedback on overall satisfaction.	High levels of user satisfaction and positive feedback

The Table 5.2 summarizes the test case scenarios for the Arduino-based smartphone charging controller

Table 5.2 Test Scenarios for Arduino Smart Phone Charging Controller

Test Scenario	Description	Outcome
Setting Different Charging Durations	Various charging durations (e.g., 1 hour, 2 hours, 30 minutes) were set using the rotary encoder.	The LCD display correctly showed the remaining time and counted down accurately.
Automatic Power Disconnection	Upon reaching the end of the set duration, the relay module successfully disconnected the power, stopping the charging process.	This confirmed the system's ability to prevent overcharging.
Power Interruption Handling	The system was tested by simulating power interruptions. The remaining time was stored in the Arduino's EEPROM.	Upon power restoration, the system prompted the user to either resume the countdown from where it left off or set a new duration.
User Interface and Interaction	The rotary encoder was used to set charging times, and the interface was found to be intuitive and responsive.	The LCD display provided clear and accurate real-time feedback on the charging status.

The Figure 5.1 depicts the wiring connections between various components of the Arduino-based smartphone charging controller. It shows how the wires are connected to ensure proper functionality and communication between the Arduino board, LCD display, rotary encoder, relay module, and other components.

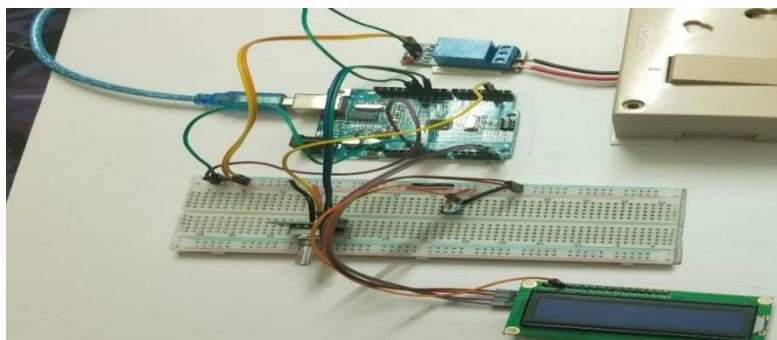


Figure 5.1 Components in Connection State

The Figure 5.2 demonstrates the process of setting the charging duration using the rotary encoder. It likely shows a user adjusting the encoder to select the desired amount of time for charging their smartphone. This step is crucial for customizing the charging duration according to the user's preference or battery requirements.

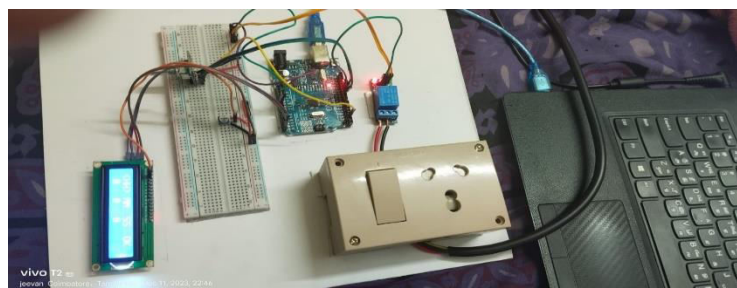


Figure 5.2 Setting the Timing into the Rotary Encoder

The Figure 5.3 showcases the charging process in action, with the smartphone connected to the charging adapter. It may display the output on the LCD screen, indicating the remaining charging time or other relevant information. This step confirms that the system is operational and effectively managing the charging process.

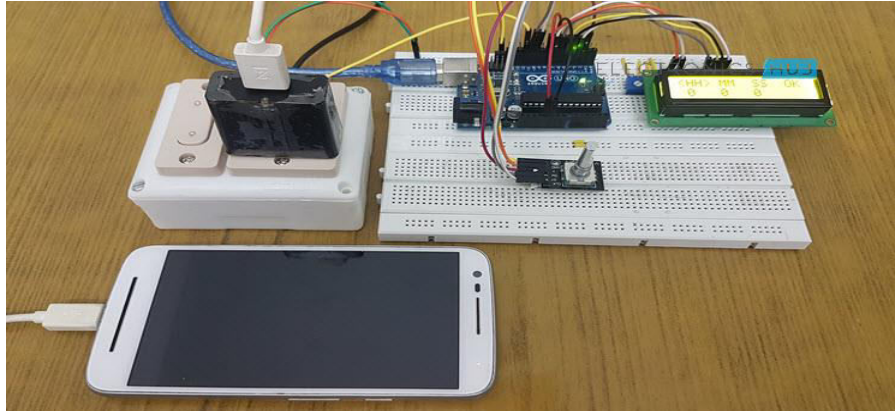


Figure 5.3 Charging the Phone Displaying the Output

VI. CONCLUSION

In summary, the Arduino-based smartphone charging controller is a useful way to deal with typical problems related to smartphone charging procedures. The technology, which aims to prolong battery life by avoiding overcharging and trickle charging, has proven to have several advantages, such as affordability, customization possibilities, and ease of use. Although there are certain drawbacks to the system, like compatibility issues and user dependence, they can be resolved with ongoing development and enhancement. There is a great deal of room for development going forward, including both technological and user-focused improvement

VII. FUTURE ENHANCEMENT

Future improvements to the Arduino-based smartphone charging controller might involve machine learning algorithms for predictive maintenance and customized charging profiles, as well as integration with IoT and smart home systems for voice control and remote monitoring. It is possible to include improved safety features like more environmental sensors and sophisticated fail-safe procedures. Efficiency and sustainability can be increased by integrating wireless charging capabilities and making adjustments for renewable energy sources like solar panels. Creating a mobile application for comprehensive analysis and user management will also improve the user experience in general.

REFERENCES

1. Humavox, "Smart Parking and EV Charging," 2016. [Online]. Available: <http://www.humavox.com/blog/wireless-charging-iot/>. [Accessed: January 20, 2019].
2. N. Kumar and K. M. S. Anusuya, "IoT Based Smart Charger: An ESP8266 Based Automatic Charger," in Proceedings of the International Conference on Big Data and Internet of Thing, London, United Kingdom, 2017, pp. 153-157.
3. L. Louis, "Working Principle of Arduino and Using It as a Tool for Study and Research,"
4. International Journal of Control, Automation, Communication and System (IJACCS), vol. 1, no. 2, 2016.
5. C. Crawford, "People too lazy to control their charging," 2017. [Online]. Available.
6. Yang, X.; He, X.; Jinyu Zhao, Y.Z.; Zhang, S.; Xie, P. COVID-CT-dataset: Arduino smart
7. charger. arXiv 2020, arXiv:2003.13865.
8. Garain, A.; Basu, A.; Giampaolo, F.; Velasquez, J.D.; Bluetooth via Arduino charger.
9. Chattopadhyay, S.; Dey, A.; Singh, P.; Geem, Z.; Sarkar, R. Arduino smart cable with
10. Bluetooth , A deep learning 2021, 11, 315.
11. Sen, S.; Saha, S.; Chatterjee, S.; Mirjalili, S.; Sarkar, R. A bi-stage feature selection
12. approach for COVID-19 prediction using chest CT images. Appl. Intell. 2021, 1–16.
13. Karbhari, Y.; Basu, A.; Geem, Z.W.; Han, G.T.; Sarkar, R. A Deep Learning Based Approach on Bluetooth charging using Arduino 2021, 11, 895.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details