BPC INSTITUTE OF TECHNOLOGY
KRISHNAGAR, NADIA

DEPARTMENT OF ELECTRICAL ENGINEERING

- Major Project Report -

Project Name: -

Variable Battery Charger using LM317 IC

Submitted By –

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Semester: - 5th
Year: - 3rd
Session: - 2024-2025

Under Supervision of

Mr. Anupam Paul

Lecturer in DEE, B.P.C.I.T

~Certificate of Recommendation ~

This is to certify that the project titled ***"Variable Battery Charger using LM317 IC"*** has been carried out by Amatya Das, Ankan Das, Rinita Samaddar, Snehasish Khan, Subhayu Pal, Sufal Biswas, Rana Halder under the supervision of ***Mr. Anupam Paul***, in partial fulfillment of the requirements for the Diploma In Electrical Engineering, at ***Bipradas Pal Chowdhury Institute of Technology,*** during the academic year **2024 – 2025** under **WBSCTE**

This project represents the culmination of dedicated research and practical application, showcasing the students' proficiency in designing, implementing, and calibrating a Battery Charger circuit integrated with an LM317 IC for accurate Voltage Regulation.

The work presented in this project is original, innovative, and adheres to high academic standards. It demonstrates the students' ability to apply theoretical concepts to practical challenges in the field of electronics and instrumentation.

I recommend this project for academic recognition and further exploration in the field of Charging technology.

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Mr. Anupam Paul

Lecturer in DEE, B.P.C.I.T

Dated: -

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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Dated: -

~ACKNOWLEDGEMENT~

We would like to express our gratitude and thank to all those who contributed to successfully complete our Major Project, "***Variable Battery Charger using LM317 IC***". First and foremost, we extend our sincere thanks to our Teacher, **Mr. Anupam Paul,** for his invaluable guidance, encouragement, and continuous support throughout the project. His expertise, insights, and constructive feedback that's helped us to understand the theoretical and practical aspects of Variable Battery Charger using LM317 IC Circuitry.

We are also grateful to our institution, **"Bipradas Pal Chowdhury Institute of Technology"** for providing us with the necessary resources, facilities which are needed to carried out this project.

Thanking You,

Yours Sincerely,

Students Signatures –

1. Rana Halder – EE_3 – 16 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

2. Ankan Das – EE_3 – 17 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

3. Rinita Samaddar – EE_3 – 19 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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5. Snehasish Khan – EE_3 – 24 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

6. Subhayu Pal – EE_3 – 25 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

7. Sufal Biswas – EE_3 – 26 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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1.Introduction:-

The use of batteries as a source of energy is ubiquitous in modern society. From powering our portable devices to propelling our cars, batteries have become an essential part of our daily lives. However, batteries are not infinite sources of energy and require recharging to maintain their functionality. This is where battery chargers come into play, providing a means to recharge batteries efficiently and safely. Among the various types of battery chargers available, the variable battery charger is a popular and versatile option, capable of charging and maintaining the batteries of a wide range of devices, from car and boats to power tools and portable electronics. In this project, we will explore the functionality of variable battery chargers, their advantages, limitations, and applications, and analyse the results of a series of tests performed on a selected variable battery charger to assess its performance and effectiveness.

2.Objectives:-

- To design and construct a variable battery charger that demonstrates fundamental principles of electronics and circuit design, providing safe and efficient charging for standard 12-volt batteries.
- This project aims to explore practical skills in fabrication, component selection, and troubleshooting while ensuring functionality, reliability, and adherence to safety standards.

3.Brief Theory:-

A 12V battery charger is designed to provide a controlled flow of electric current to a 12-volt battery in order to recharge it. The process of charging a battery involves reversing the chemical reactions that occur during discharging, which involves converting the chemical energy stored in the battery into electrical energy that can be used to power devices. The charging process essentially involves passing an electric current through the battery in the opposite direction to the discharging current.

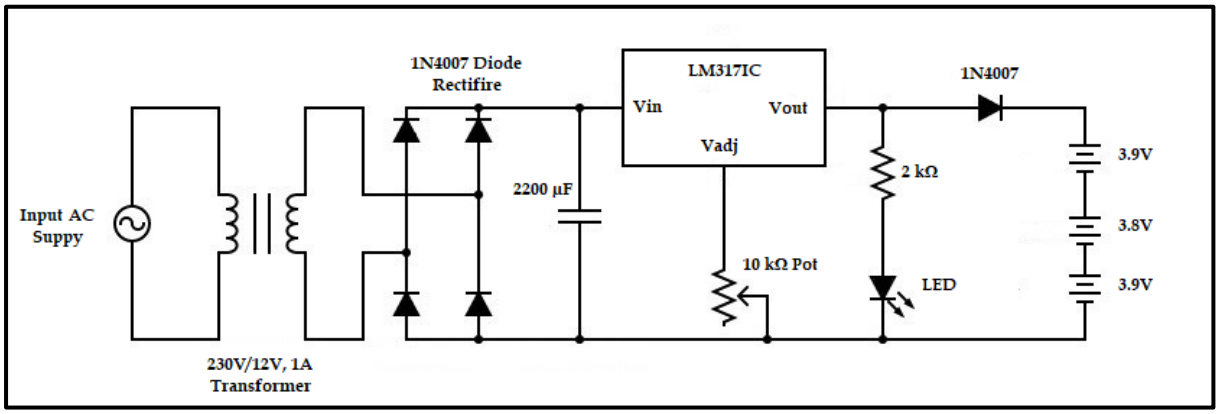
12V battery chargers typically use a three-stage charging process that includes bulk, absorption, and float charging. During the bulk charging stage, the charger supplies a high current to the battery until its voltage reaches a certain threshold, which typically ranges from 14.2V to 14.8V. Once the battery reaches this threshold, the charger switches to the absorption charging stage, where it maintains a constant voltage while gradually reducing the charging current. This stage is designed to top up the battery and ensure that all the cells are fully charged. Finally, during the float charging stage, the charger supplies a low, maintenance-level current to the battery to keep it charged and prevent self-discharge.

One key feature of 12V battery chargers is their ability to detect when a battery is fully charged and automatically shut off or switch to a maintenance mode to prevent overcharging, which can damage the battery. This is typically achieved using voltage and current sensing circuits that monitor the battery's state of charge and adjust the charging current and voltage accordingly.

Overall, the ability of 12V battery chargers to efficiently and safely recharge12-volt batteries has made them a popular and essential tool for a wide range of applications, from automotive to industrial and consumer electronics.

4.Circuit Diagram and Working Principle:-

- ***Circuit Diagram-***



- ***Working Principle-*** The above battery charger Circuit Which we practically made, it consists with a 12-0-12 transformer a diode bridge rectifier with a filter circuit and the we used LM317 IC which help to regulate the voltage and in adj pin of IC a 10K POT is used for varying the voltage and then we use a LED with a resistor which indicate than the Circuit is ON and a diode for reverse charging protection. In below We discussed how the Circuit work.

  The circuit is designed to charge three 3.9V batteries connected in series (totalling 11.7V) using a 12-0-12V, 1A transformer, a bridge rectifier, an LM317 voltage regulator, and supporting components. The 230V AC mains is first stepped down to 12V AC by the transformer. This reduced AC voltage is then passed through a bridge rectifier made up of four 1N4007 diodes, which converts the AC signal into a pulsating DC. To eliminate the ripples and provide a smooth DC voltage, a 2200µF, 35V electrolytic capacitor is used as a filter. The filtered DC output is then fed to the LM317 voltage regulator IC.

  The LM317 is an adjustable voltage regulator that allows fine control of the output voltage using an external 10kΩ potentiometer. This ensures the voltage is properly regulated to match the charging requirement of the batteries. A red LED, connected in series with a 2kΩ resistor, acts as a power indicator to show that the circuit is active. For safety, a diode is placed at the output of the circuit to prevent reverse current from the batteries back into the charger, which could damage the circuit components.

  The regulated and stabilized output voltage is then applied to the series-connected batteries. The LM317 ensures that the charging voltage and current are controlled, protecting the batteries from overcharging. This setup provides a simple, reliable, and efficient solution for charging 12V batteries while incorporating voltage adjustment and reverse polarity protection.

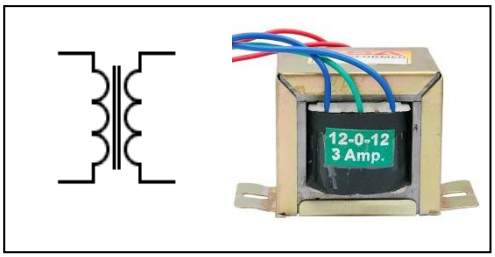
5.Components Required & Their Function and Apparatus Table:-

- ***List of Components Required –***

Sl. No.	Name of Item	Specification	Quantity
1.	Transformer	12-0-12,5amp	1 no.
2.	Diode	1N4007	5 no.
3.	Capacitor	35V, 2200 microF	1 no.
4.	LM 317 IC		1 no.
5.	Resister	100ohm, 1kohm	2 no.
6.	POT	10K	1 no.
7.	LED	3.5v, RED	1 no.
8.	Battery	12volt, Lead Acid	1 no.
9.	Veroboard	Veroboard(3*4 Inch)	1 no.
10.	Breadboard	MB102 830 Pins High Quality White Colour Breadboard	1 no.
11.	Connecting Wire	0.5 sq.mm, 1.5A Tinned Copper Wire	As Per Required

- ***Function of Components –***

1. Transformer -

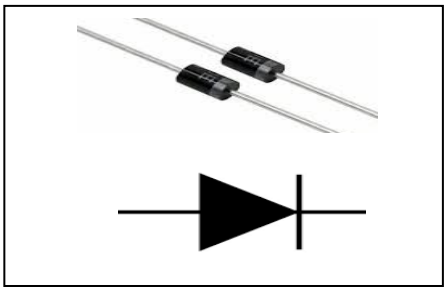


Transformer

A transformer is an electrical device that transfers energy between two or more circuits through electromagnetic induction. A step down transformer is one whose secondary voltage is less than its primary voltage. It is designed to reduce the voltage from the primary winding to the secondary winding. This kind of transformer "steps down" the voltage applied to it. As a step-down unit, the transformer converts high-voltage, low-current power into low-voltage, high-current power. Transformers are most commonly used for increasing low AC voltages at high current (a step-up transformer) or decreasing high AC voltages at low current (a step-down transformer) in electric power applications, and for coupling the stages of signal-processing circuits.

2.Diode-

In electronics, a diode is a two-terminal electronic component with asymmetric conductance; it has low (ideally zero) resistance to current in one direction, and high (ideally infinite) resistance in the other. Semiconductor diodes were the first semiconductor electronic devices. Today, most diodes are made of silicon, but other semiconductors such as selenium or germanium are sometimes used.

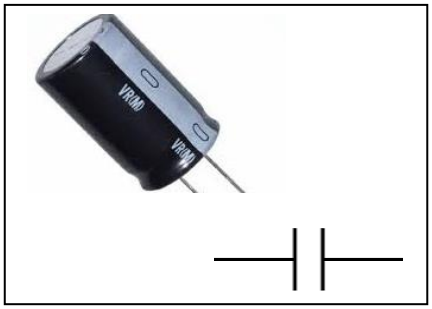


Diode

3.Capacitor-

capacitor is an electrical component that stores and releases electricity into a circuit. It frequently sends alternating current rather than direct current due to this it is a very important part of every electrical equipment.

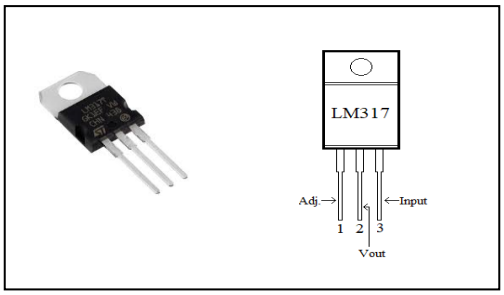
A major function of the capacitor has the capacity to store electrical energy when it is connected to its charging circuit. Additionally, when it is taken out of its charging circuit, it will release the stored energy, making it possible to utilize it as a temporary battery



Capacitor

4.LM 317 IC-

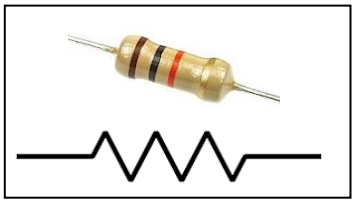
It is a type of positive-linear-voltage regulators used for voltage regulation, which is invented by Robert C. Dobkin and Robert J. Widlar while they worked at the National Semiconductor in 1970. It is a three-terminal-adjustable-voltage regulator and is easy to use because to set the output voltage it requires only two external resistors in the LM317 voltage regulator circuit. It is majorly used for local and on-card regulation. If we connect a fixed resistor between the output and adjustment of the LM317 regulator, then the LM317 circuit can be used as a precision current regulator



LM 317 IC

5.Resister-

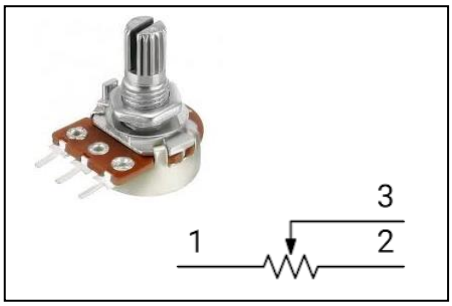
A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits. In electronic circuits resistors are used to limit current flow, to adjust signal levels.



Resister

6.POT-

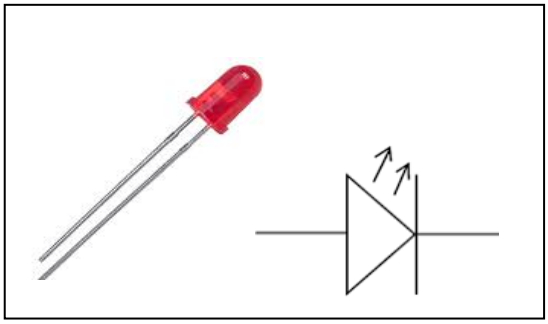
A preset resistor is a smaller PCB mounted version of a potentiometer. These are useful where adjustment or configuration of a circuit needs to be made but such adjustment only occurs during building a circuit, not during normal use. An appropriate value for the PICAXE system is 10k (do not use 100kdevices).



Potentiometer

7.LED-

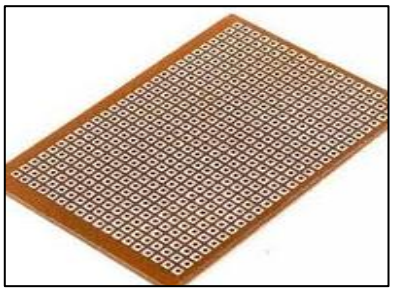
A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.



Light Emitting Diode

8.Veroboard-

A Vero board is a thin, pre-drilled board with parallel copper strips on one side, and a rectangular grid of holes on the other. The copper strips allow for easy soldering of electronic components.



Veroboard

9.Breadboard-

A breadboard is a tool used to build and test electronic circuits, breadboards are used to quickly create temporary electronic circuits or prototypes. They are also used for experiments with circuit design. Breadboards are rectangular plastic boards with many tiny holes that allow user to insert electronic components or wires. The holes are connected by spring clips underneath the board, allowing user to easily connect components or wires. Breadboards are reusable because it don't require soldering iron to connect electronic components.

Breadboard

10.Connecting Wire-

The wires are used to connect the circuit elements together. Connecting wires are one of the most important components in an electrical circuit because these are the components through which electricity flows from one electrical component to another. The gauge of wire depends upon the current rating of the circuit elements and the insulation of the wire depends upon the voltage level. The wire may be stranded or single cored.

Connecting Wire

- ***Apparatus Table –***

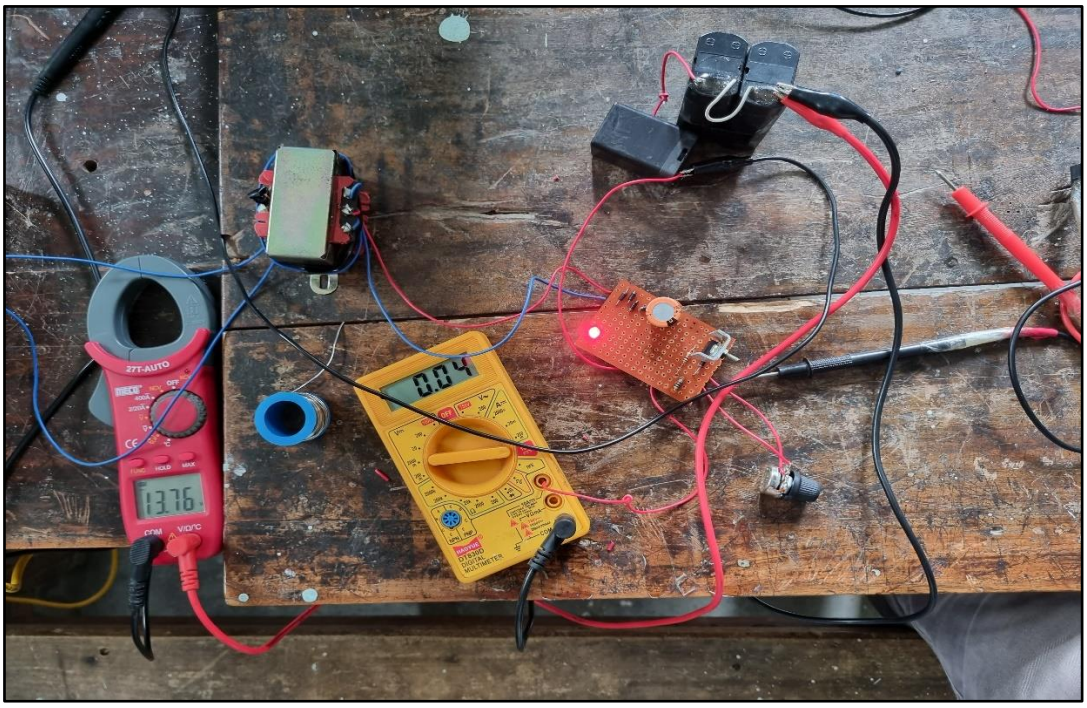
Sl. No.	Name of Item	Specification	Quantity
1.	Multi-meter	Meco 27-Auto Digital Clamp meter, DT830D Digital Multi meter	2 no.
2.	Soldering Iron	60 Watt, 240volt	1 no.
3.	Soldering Wire	18 SWG (50g)	As per req.
4.	Soldering Flux	-/-	As per req.
5.	Electrical Tool Box	-/-	1 no.

6.Price Chart –

Sl. No.	Name of Item	Price in Rupees	Quantity	Cost in Rupees
1.	Transformer	220₹	1 no.	220₹
2.	Diode	1.5₹	5 no.	8₹
3.	Capacitor	30₹	1 no.	30₹
4.	LM 317 IC	18₹	1 no.	18₹
5.	Resister	1₹	2 no.	2₹
6.	POT	15₹	1 no.	15₹
7.	Red LED	2₹	1 no.	2₹
8.	Battery	250₹	1 no.	250₹
9.	Veroboard	10₹	1 no.	10₹
10.	Breadboard	90₹	1 no.	90₹
11.	Connecting Wire	10 per meter	3 Meter	30₹
Total Cost of Circuit Components			675 ₹	

7. Practical Connection and Output Waveform/Table :-

- ***Practical Connection-***



- ***Table-***

- **Discharging-**

  Voltage Before Discharge- 12.4 volt

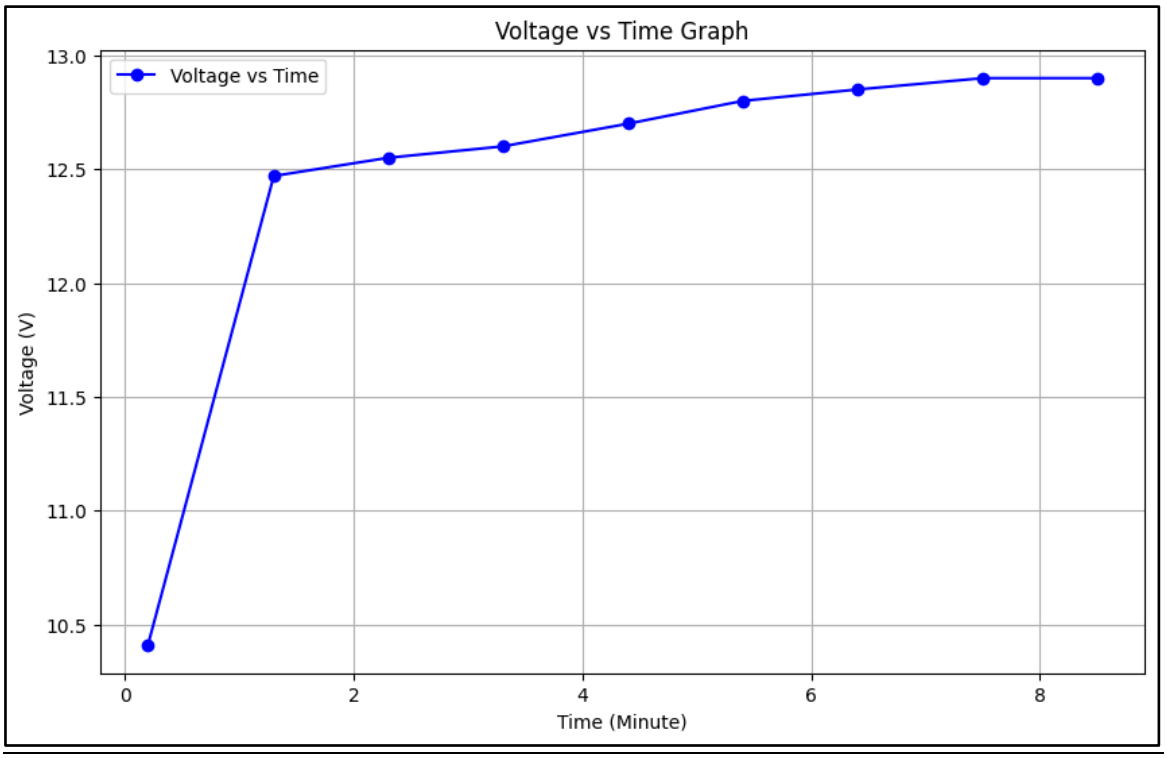
  Discharging Load- 12 volt DC Motor

- **Charging-**

  Initial Voltage- 8.24 volt (After Discharge)

Sl. No.	Time	Voltage	Current
1.	20 Sec.	10.41V	110mA
2.	1.30 Min.	12.47V	70mA
3.	2.30 Min.	12.55V	70mA
4.	3.30 Min.	12.6V	70mA
5.	4.40 Min.	12.7V	60mA
6.	5.40 Min.	12.8V	60mA
7.	6.40 Min.	12.85V	60mA
8.	7.50 Min.	12.90V	50mA
9.	8.50 Min.	12.90V	40mA

➢ ***Graph-***



The graph illustrates the Charging Characteristics of the given batteries, whare time plotted on the x-axis (in Min) and voltage on the y-axis (in volts). The data points represent the measured voltage at various time intervals. The graph shows a gradual increase in voltage over time, reflecting a charging or stabilization process. Initially, the voltage rises more noticeably and the batteries drawn high current, but as time progresses, it approaches a saturation point, and drawn less current ,indicating a slower rate of charging. This trend demonstrates the behaviour of voltage over time, highlighting Charging characteristics of batteries.

8. Advantages and Disadvantages :-

- ***Advantages-***

1. Fabricating a 12-volt battery charger is generally low-cost compared to buying commercial chargers, making it an affordable option for students and hobbyists.

2. A custom-designed charger can be made compact and portable, ideal for easy transportation and use in various settings.

3. It allows for tailored charging parameters, reducing the risk of overcharging, undercharging, or overheating, which extends battery life.

4. Building the charger offers hands-on experience, enhancing understanding of electronics, power management, and circuit design.

5. By customizing components and settings, energy efficiency can be optimized, minimizing power loss during the charging process.

- ***Disadvantages-***

1. A simple 12-volt charger may not be suitable for larger batteries or rapid charging applications, limiting its usability.

2. If not properly designed, there's a risk of overheating, short circuits, or other hazards, which can potentially damage the battery or pose safety risks.

3. Homemade chargers may lack the durability and reliability of professionally manufactured ones, particularly if components or build quality are suboptimal.

4. Unlike commercial chargers, it may lack features like automatic shutoff, voltage monitoring, or LED indicators.

5. Due to wear and tear or component degradation, maintenance may be required over time to ensure the charger continues to operate effectively.

9. Application and future scope :-

- ***Application-***

1. Charging the battery in a car or other vehicle. If the battery is dead or low on power, a 12V battery charger can be used to bring it back to life.
2. Charging the battery in a boat or other watercraft. Boats often have multiple batteries, and a 12V charger can be used to keep the mall charged and ready to go.
3. Charging the battery in an RV or camper. Like boats, many RVs have multiple batteries that need to be kept charged in order to power appliances and other devices.
4. Charging the battery in a lawnmower or other outdoor equipment. Lawnmowers, weed eaters, and other outdoor equipment oftenrunon12V batteries that need to be charged regularly.
5. Charging the battery in a motorcycle or scooter. Smaller vehicles like motorcycles and scooters can be charged using a 12V battery charger.
6. Charging the battery in an ATV or other off-road vehicle. Off-road vehicles like ATVs and dirt bikes often have 12V batteries that can be charged using a charger.
7. Charging the battery in a portable generator. Some portable generators are powered by 12V batteries that can be charged using a charger.
8. Charging and maintaining the battery in a backup power system. With a variable 12V charger, you can adjust the charging voltage to the specific needs of your backup power system's battery, which can help prolongates lifespan and keep it performing at its.

- ***Future Scope-***

1. The charger could be upgraded to work with solar panels or other renewable energy sources, enabling sustainable and off-grid battery charging, especially useful for remote areas.

2. Adding smart features like Bluetooth connectivity, mobile app control, and Internet of Things (IoT) capabilities can allow users to monitor charging status, battery health, and set charging schedules remotely.

3. Future improvements could include advanced safety features, such as thermal sensors, automatic cut-off on overcharging, and short-circuit protection, which would make the charger safer and more efficient.

4. The charger could be upgraded to support charging for batteries of different voltages, making it more versatile and suitable for a wider range of devices and applications.

5. With advancements in fast charging technology, future versions of this charger could incorporate components and designs that allow faster charging speeds without compromising battery health.

6. Incorporating a battery diagnostic feature could help users evaluate the health of the battery before charging, providing useful data and extending the overall life of the battery.

7. Future iterations could focus on using eco-friendly materials and recyclable components, making the charger not only cost-effective but also environmentally sustainable.

10. Conclusion :-

Based on the findings presented in this project report, it can be concluded that the12V battery charger is an essential tool for maintaining the performance and longevity of batteries. Through a series of tests and measurements, it was demonstrated that the charger was able to effectively charge and maintaina12V battery, ensuring that it remained at a consistent voltage and was able to deliver reliable power when needed.

It was also found that the charging process was influenced by a variety of factors, including the temperature of the battery and the charging rate selected. These factors must be taken into consideration when using a12Vbattery charger to ensure that the battery is charged safely and efficiently. Overall, the results of this project report highlight the importance of using a high-quality, reliable 12V battery charger for maintaining the performance and lifespan of batteries. By following proper charging procedures and monitoring the charging process, users can ensure that their batteries are always ready to deliver reliable power when needed.

11. References :-

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