CHAPTER 1

INTRODUCTION

1.1 Introduction

In the modern era of digital communication and remote work, a stable internet connection has become a fundamental necessity. Whether it's for attending online meetings, classes, streaming content, or accessing cloud-based applications, consistent connectivity is crucial. However, in many regions, especially semi-urban and rural areas, power outages and voltage fluctuations are still common issues that disrupt internet services. This not only causes inconvenience but also affects productivity and communication. To tackle this problem, this project presents a cost-effective Uninterruptible Power Supply (UPS) system for Wi-Fi routers. The primary objective is to provide an affordable and reliable backup power source that ensures uninterrupted internet connectivity during power failures. Unlike commercial UPS systems, which are often expensive and oversized for small devices like routers, this UPS is specifically designed to be compact, efficient, and economical.

Fig:1.1 Wi-Fi Router

1.2 Necessity

In recent years, the demand for uninterrupted internet connectivity has grown rapidly due to the increasing reliance on digital platforms for communication, education, entertainment, and professional work. However, frequent power outages and voltage fluctuations remain a persistent issue in many parts of the world, particularly in developing regions. These disruptions often result in internet disconnection, affecting productivity, communication, and access to critical services. Most commercial Uninterruptible Power Supply (UPS) systems are designed for larger appliances and are costly, bulky, and not optimized for small network devices like Wi-Fi routers. For many users, investing in a high-capacity UPS just to power a router is neither practical nor economical. This creates a clear gap in the market for a dedicated, low-cost UPS solution tailored specifically for routers and similar low-power devices.

1.3 Aim and Objectives

The primary aim of this project is to design and develop a cost-effective and compact Uninterruptible Power Supply (UPS) system tailored specifically for Wi-Fi routers. With the growing need for uninterrupted internet access, especially in work-from-home, online education, and smart home environments, this project focuses on providing a reliable solution to maintain connectivity during power outages or fluctuations.

The key objectives include creating a low-cost UPS that ensures seamless transition from mains power to battery backup, preventing any disruption in internet service. The system is designed to incorporate essential safety features such as overvoltage, undervoltage, and short-circuit protection, along with cell balancing for maintaining battery health. Emphasis is placed on using readily available and affordable components, allowing easy construction and maintenance. The UPS is intended to be compact, energy-efficient, and capable of supporting typical routers during short to medium-duration power cuts.

1.4 Problem Statement

In today's digital age, a stable internet connection is essential for work, education, and communication. However, frequent power outages and voltage fluctuations in many regions cause unexpected disconnection of Wi-Fi routers, disrupting online activities and affecting productivity. Commercial UPS systems available in the market are often expensive, bulky, and not optimized for low-power devices like routers, making them an impractical solution for many users.

There is a need for a dedicated, affordable, and compact UPS system specifically designed to power Wi-Fi routers during power failures. The solution must be cost-effective, energy-efficient, easy to build and maintain, while also offering essential protection features to ensure device safety and reliable performance.

1.5 Organization

Chapter 1: In the chapter 1 there is a introduction part of the system. Necessity, Aim, Objectives, Problem Statements, etc.

Chapter 2: In the chapter 2 the literature survey has been mentioned from all previous papers.

Chapter 3: The chapter 3 shows the design of the system with the help of block diagram. Block diagram of system is completely explained in this chapter.

Chapter 4: In this chapter whole detailed component list along with the circuit diagram is mentioned. All the major components are mentioned in detailed. Also implementation in LTspice have been shown.

Chapter 5: In this chapter system analysis is done with performance, accuracy, limitations and constraints.

Chapter 6: The conclusion, application, advantages, future scope are mentioned in this chapter.

CHAPTER 2

LITERATURE SURVEY

2.1 Study of Research Paper

1. Design of a Smart Low-Cost Mini Ups for PC's

International Journal of Engineering and Computer Science ISSN: 2319-7242 Volume 5, Issue 5 May 2016

In this Journal the working principle of the smart embedded PC uninterruptible power supply unit is visually explained. The inverter block, which is the central block in the design, does the inversion of a 12V DC to a 220V AC. This block provides the backup power supply unit for the load in the case of power outage. The DC supply block is needed in order to charge the battery since the rechargeable batteries are not charged by AC voltages. Though not schematically shown, this block also powers various circuit components which would be extensively discussed in later sub-sections of this section. The switching circuit block does the automatic switching from AC mains to inverted DC power. The Arduino block comprises a single Arduino chip used for both interfacing with a conventional personal computer (software control) and for other circuit components control (hardware control)

2. Research paper on Uninterrupted Power Supply (UPS) by using Solar

International Research Journal of Modernization in Engineering Technology and Science, Volume:05/Issue:05/May-2023

Here we proposed a solar powered uninterrupted power supply project that uses the solar energy to charge the 12v battery and after that this DC battery is used to power the AC load by using an inverter. Solar panel constantly charge the 12v DC battery. Two main components of our system are outdoor solar panel to be made up of solar cells which converts solar energy into electrical energy and an inverter circuit that will convert this energy in alternating current used for the home appliances.

Solar bowl circuit that's used to charge Lead Acid battery using the solar energy power. The circuit crops solar energy to charge a12 volt4.5 Ah rechargeable battery for colorful operations. The bowl has voltage and current regulation and over voltage cut-off installations. The circuit uses a 12- volt solar panel and a variable voltage controller IC LM 317. The solar panel consists of solar cells each rated at1.2 volts. 12- volt DC is available from the panel to charge the battery. Charging current passes through D1 to the voltage controller IC LM 317. By conforming its Acclimate leg, affair voltage and current can be regulated.

3. Design and Implementation of a Cost-Effective Quasi Line-Interactive UPS With Novel Topology

Article in IEEE Transactions on Power Electronics · August 2003

This paper presents an improved single-phase passive-standby uninterruptible power supply (UPS) for low-cost applications. The proposed system includes an input rectifier/charger and a switching inverter. It is basically an off-line UPS structure, but has nearly the performance of a line-interactive UPS. It can continuously regulate the sustained voltage swells and sags by injecting a voltage in series with the source voltage in the normal mode, and can be switched smoothly to back-up mode when the utility voltage goes outside the specified range, or fails. The regulation range is also larger than conventional off-line and line-interactive UPSs. Additionally, the proposed system has no low frequency transformer, which would involve a heavy and bulky structure.

4. Innovative UPS System for Reliable Power Supply in Residential and Industrial Applications

International Research Journal of Engineering and Technology (IRJET) Volume: 11 Issue: 11 | Nov 2024

The uninterruptible power supply (UPS) system is engineered to guarantee an uninterrupted power supply to a load, even during a mains AC failure. The process encompassed the selection and integration of essential components, including a 230V AC mains input, a transformer, a rectifier, a battery, a relay, and an inverter, each contributing significantly to the operation of the UPS. The circuit was engineered to facilitate an uninterrupted transition between AC mains and battery backup with negligible delay. The uninterruptible power supply (UPS) functions in two primary modes: AC Supply Mode (Normal Mode) and Battery Backup Mode. The direct current energy from the rectifier is accumulated in the battery for subsequent utilization. This stored energy is essential for the UPS to supply power during a mains outage. The battery functions as a power reservoir utilized during Battery Backup Mode. The relay functions as a switching device that observes the status of the mains electricity. In standard operation, the relay guarantees the uninterrupted routing of AC power to the load while simultaneously charging the battery. The UPS continuously analyzes the incoming AC supply. Upon detection of a problem, such as a blackout or a substantial voltage decrease, the relay promptly transitions the power source from the AC mains to the internal battery. The inverter functions by converting stored DC power from the battery, which is insufficient for directly powering most AC-operated equipment. Consequently, the UPS employs an inverter to transform the stored DC power from the battery into AC power. The AC output is thereafter delivered to the load, guaranteeing that connected devices receive uninterrupted power. The shift from AC power to battery power is engineered to be seamless, facilitated by the relay's rapid switching mechanism. It guarantees that the load is perpetually energized, without any discernible interruptions or delays. The UPS will maintain AC power to the load as long as the battery is adequately charged. The duration of operation in Battery Backup Mode is contingent upon the battery's capacity and the power requirements of the attached devices. The load will cease to function after the battery is exhausted, unless the AC supply is reestablished.

5. Solar Powered UPS Systems

International Journal of Innovative Research in Science, Engineering and Technology .Vol. 7, Issue 5, May 2018

In this solar based UPS project, we have used solar energy for charging 12V DC battery. Our solar panel will constantly charge battery with the help of solar charge controller . And once we switch on the circuit the battery charge will inverted into AC with help of inverting circuit and stepped the voltage from 12V DC to 230V AC . This system can successfully use as UPS as an emergency power cut and have a capacity to standalone without any external electricity. Here N Channel MOSFET Q1 is in forward biased condition in order to stop flow of current to the battery from solar panel. When sun rises and solar panel voltage reaches 10 V then this 10 V make Zener diode start conducting and thus turn on .The MOSFET Q2 which ultimately turn on the relay U1.This is known as low voltage protection. When panel voltage reaches 15 V then Zener diode reaches its conduction state and transistor Q4 reaches its saturated state and negative (-) voltage flows through it and thus turn off the MOSFET Q2.This is known as over voltage protection. If the battery is not fully charged then most of the current flow through the battery but when battery charging is full then less current flow through it, which turn off the MOSFET Q3 which ultimately turn off the 2nd relay U2.This is known as over charge protection.

Table: - 2.1 Summary of the Literature Survey

Paper Title	Methodology	Advantages	Disadvantages
Low-Cost Mini UPS for PC’s (2016)	Software (Using Arduino for all features of UPS)	High Accuracy, High Sensitivity	Costly, Arduino Malfunction.
Uninterruptable power supply by using Solar (2023)	Solar Panel (for battery charging and direct supply)	No Electricity Required for charging of battery	Bulky System, Maintenance required, and Costly.
Cost-Effective Quasi Line-Interactive UPS (2011)	Rectifier and Switching inverter	High Power Density, Smaller size	Costly, Maintenance required.

CHAPTER 3

SYSTEM BLOCK DIAGRAM

3.1 Block Diagram

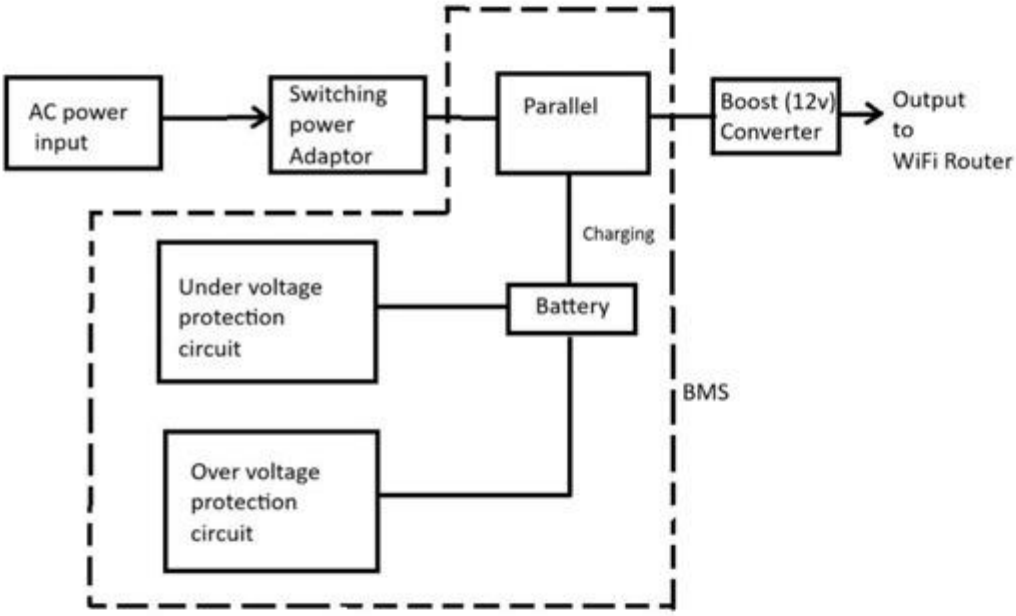


Fig:3.1 Block Diagram

3.1.1 AC Power Input

The AC Power Input is the primary source of electrical energy for the system. In most residential or office environments, this input comes from a standard wall socket that supplies alternating current at 230V and 50Hz (in India) or 120V and 60Hz (in some other countries). Since most electronic devices, including batteries and Wi-Fi routers, require direct current (DC) for operation, this AC supply needs to be converted. The system starts functioning the moment AC power is supplied. It is the most reliable and high-power source compared to a battery, which has a limited energy capacity. As long as AC power is available, the Wi-Fi router and the battery (if charging is required) are powered using this input. During a blackout or power failure, the system automatically switches to the battery, ensuring uninterrupted operation.

3.1.2 Switching Power Adaptor

The Switching Power Adaptor is a type of Switched-Mode Power Supply (SMPS) that converts the high-voltage AC power into a lower DC voltage. Unlike linear power supplies, which dissipate excess voltage as heat, SMPS units are highly efficient as they use high-frequency switching techniques and minimize energy loss. This makes the adaptor compact, lightweight, and energy efficient — ideal for embedded or battery-backed systems. It provides a stable DC voltage (such as 5V or 9V, depending on system design) to power the Wi-Fi router directly and simultaneously charge the battery. The adaptor is the backbone of the charging process, and its output is routed through protection circuits and parallel connections to ensure the system runs smoothly without damaging the battery or router components. If the adaptor fails or AC input is lost, the system seamlessly switches to the battery without interruption.

3.1.3 Battery Management System

The Battery Management System is an intelligent subsystem that monitors and controls the battery's charging and discharging cycles. It ensures that the battery operates within its safe voltage, current, and temperature limits. Without a BMS, batteries are prone to overcharging, over-discharging, and thermal runaway — all of which can lead to battery degradation or safety hazards. A typical BMS includes protection mechanisms, balancing circuits (in multi-cell batteries), and monitoring systems. In this block diagram, the BMS includes the undervoltage protection circuit, overvoltage protection circuit, and the battery itself. It plays a critical role in extending battery life, ensuring user safety, and guaranteeing uninterrupted operation of the load (Wi-Fi router). When AC power is not available, the BMS allows the battery to discharge safely while supplying power to the load via the boost converter.

3.1.4 Parallel Connection Block

This block connects the output of the power adaptor and the battery in parallel, allowing both sources to contribute power to the output as needed. The parallel configuration ensures that the battery remains charged during AC availability and kicks in instantly when AC power is lost — eliminating the need for manual switching or external controllers.

3.1.5 Under Voltage Protection

This protection circuit continuously monitors the battery voltage. If the voltage drops below a predetermined safe limit (usually around 3.0V per cell for Li-ion batteries), the circuit disconnects the battery from the load. This prevents deep discharge, which can cause permanent damage to the battery's internal chemistry, leading to a shorter life span and potential failure to recharge. Without this circuit, the battery might continue discharging until it reaches dangerously low levels.

3.1.6 Over Voltage Protection

This circuit ensures that the battery does not receive a voltage higher than its maximum rated value during charging. Overcharging a battery, especially lithium-based ones, can lead to thermal runaway, swelling, or even fire. The over voltage protection circuit constantly monitors the charging voltage and cuts off the charging current once the maximum threshold is reached.

3.1.7 Output to Wi-Fi Router

This is the final stage of the system where the regulated 12V DC power is supplied to the Wi-Fi router. The router expects a clean, stable 12V power input to operate reliably. Any fluctuations or interruptions in power can lead to connectivity issues or hardware failure. Hence, the output here must be protected and regulated, which is ensured by the entire upstream system. This output can come either from the power adaptor (during normal AC operation) or from the battery via the boost converter (during backup mode). The design ensures that the router experiences no downtime, even during sudden power outages. This makes the system ideal for remote working, online education, or IoT systems where continuous internet connectivity is essential.

CHAPTER 4

SYSTEM IMPLEMENTATION DETAILS

4.1 Circuit Diagram

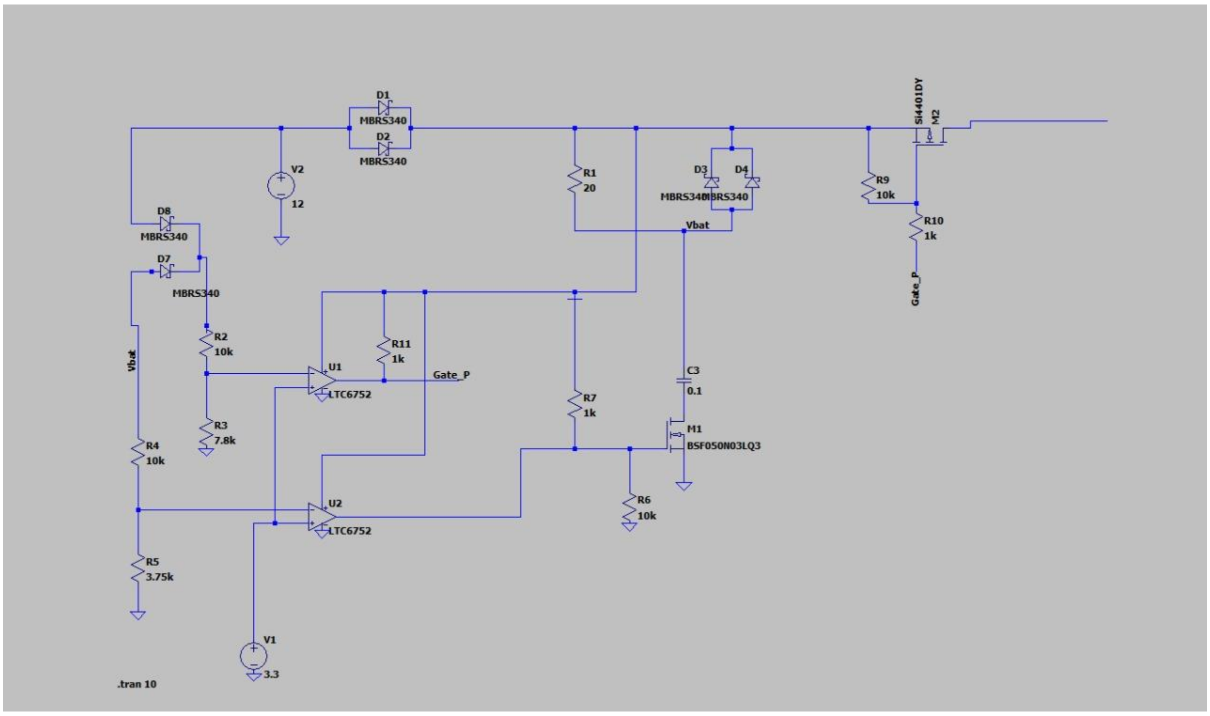
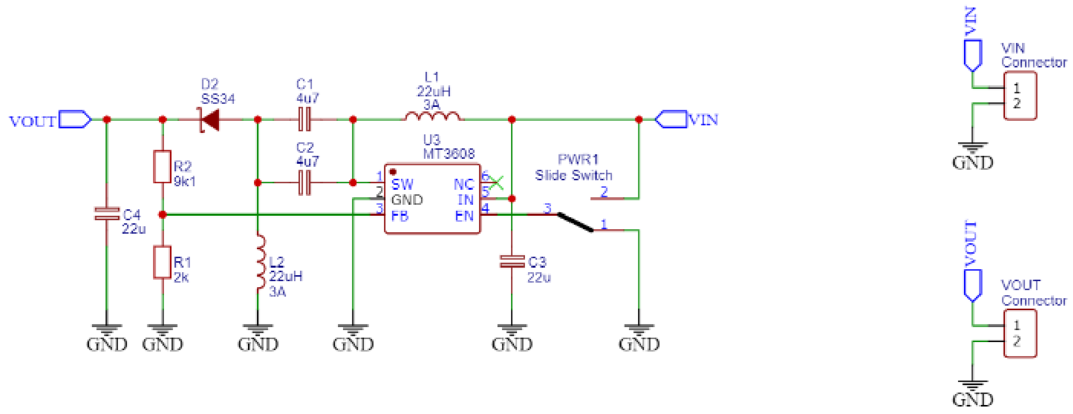


Fig:4.1 Circuit Diagram

4.1.1 MT3608 (DC-DC Boost Module)

MT3608 DC-DC Boost 2A Module | MT3608 is a constant frequency, current-mode step-up converter intended for small, low-power applications. Internal soft-start results in a small inrush current and extends battery life. The MT3608 features automatic shifting to pulse frequency modulation mode at light loads. The MT3608 includes under-voltage lockout, current limiting, and thermal overload protection to prevent damage in the event of an output overload.

Voltage Adjustment – The module has a single-turn potentiometer for adjustment of the output voltage. Turning the pot CW decreases the output voltage while turning it to CCW increases the output voltage. The upper limit of the adjustment range will depend on the input voltage and the load. With a 9V input for instance, at 1A, the upper voltage limit will be approximately 20V.



$$VOUT = 0.6 * \frac{R1 + R2}{R1}$$

Fig:4.1.1.1 Block Diagram of MT3608

Features:

- 2V to 24V input voltage with output boost 5V to 28V adjustable
- Maximum output current: 2A
- Input voltage: 2V ~ 24V
- Maximum output voltage: > 5V - 28V
- Efficiency: > 93%
- Input voltage should not exceed the maximum input voltage
- Peak current output current should not more than 2A
- Output voltage should always be higher than Input voltage
- PCB Size: 36 mm * 17 mm * 14 mm

Fig:4.1.1.2 MT3608

4.1.2 Li-ion Battery

Lithium-ion is the most popular rechargeable battery chemistry used today. Lithium-ion batteries power the devices we use every day, like our mobile phones and electric vehicles. Lithium-ion batteries consist of single or multiple lithium-ion cells, along with a protective circuit board.

Features:

- Cell Type: Lithium-ion (ICR – Lithium Cobalt Oxide chemistry)
- Nominal Voltage: 3.7 V
- Full Charge Voltage: 4.2 V
- Cutoff Voltage: ~2.75 V (may vary slightly by manufacturer)
- Typical Capacity: 2000 mAh to 2600 mAh (varies with brand)
- Max Continuous Discharge Current: 2A to 5A (depends on manufacturer)
- Charging Current (Standard): 0.5C to 1C (e.g., ~1A for 2000 mAh cell)
- Charging Time: Around 3–4 hours with standard charger
- Cycle Life: 300–500 charge cycles (approximate)

Fig:4.1.2.1 Li-ion Battery

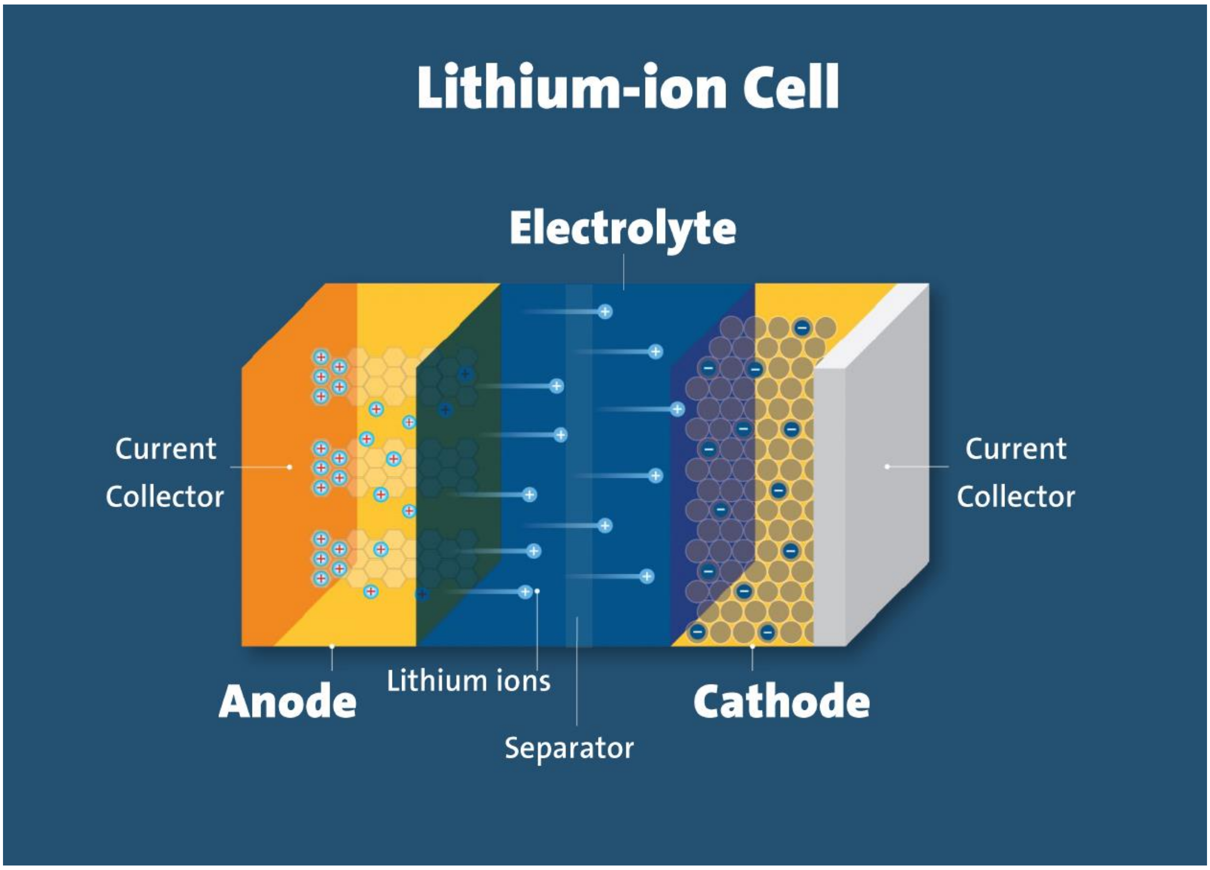


Fig:4.1.2.2 Li-ion cell

4.1.3 IC LM339

LM339 is a widely used voltage comparator integrated circuit. It is part of the LMx39x series and is designed to deliver reliable performance in a variety of applications. This device contains four independent voltage comparators, all capable of operating from a single power supply. The option to use it with two power supplies adds flexibility, as long as the voltage difference between the two supplies is within 2 to 36 volts.

The LM339 is valued for its ability to handle tasks requiring precision voltage comparison. Its design ensures it works seamlessly in systems with low power requirements. Whether you are working on small-scale circuits or complex industrial designs, this IC provides a dependable way to compare voltage levels efficiently.

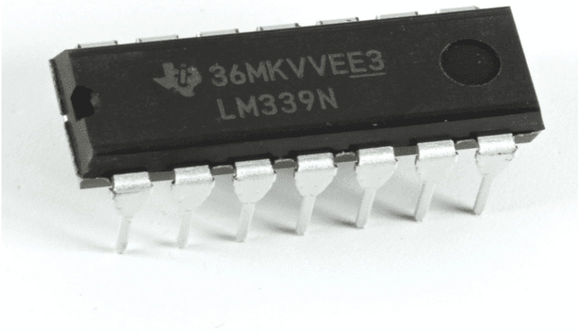


Fig:4.1.3.1 IC LM339

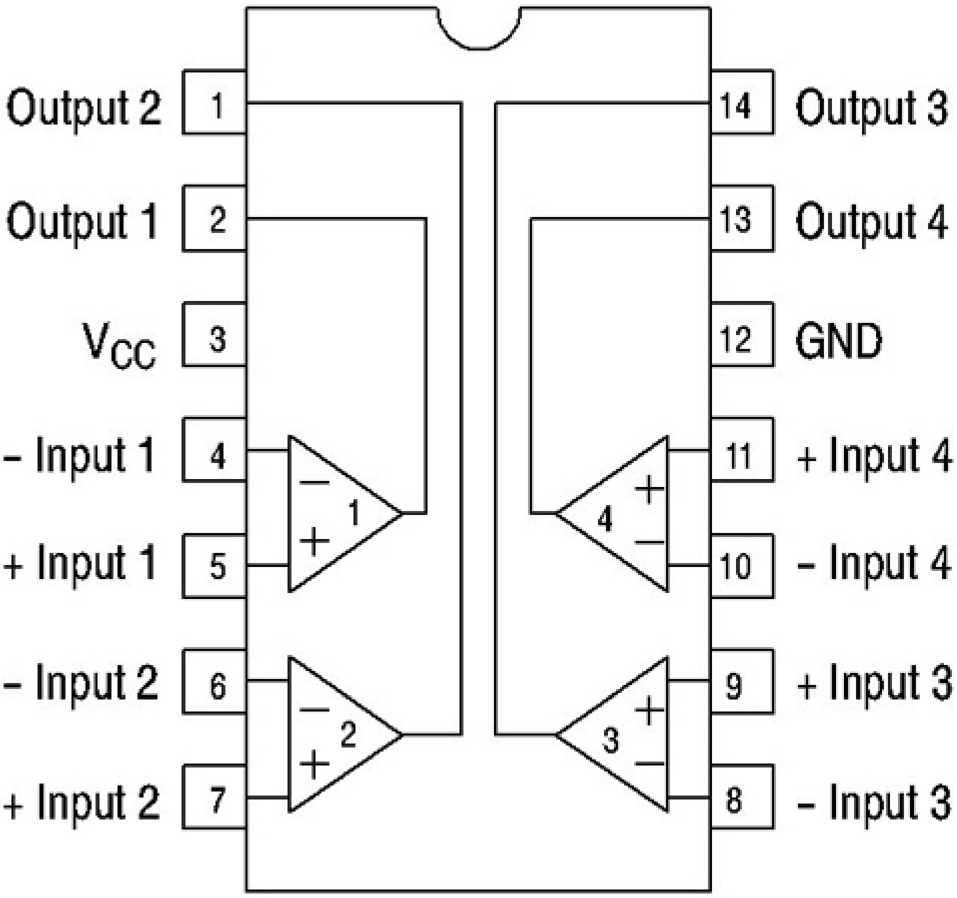


Fig:4.1.3.2 Pinout of LM339

Features:

- **Independent Voltage Comparators**

The LM339 includes four independent voltage comparators. Each comparator works on its own, allowing you to use them in separate circuits or applications simultaneously without interference.

- **Low Noise Design**

The design reduces noise interference between the comparators. This helps maintain the accuracy of the outputs, even when all comparators are in use.

- **Wide Supply Range**

You can operate the IC with a single power supply ranging from 3 V to 36 V. If you prefer dual supplies, it supports up to ±18 V, giving you flexibility for different setups.

- **Low Power Consumption**

The IC has a low input bias current of 25 nA and offset current of ±5.0 nA, which makes it energy-efficient. This feature is especially helpful in battery-powered devices.

- **Common Mode Voltage Range**

The input voltage range extends down to ground, letting the IC work even when the inputs are near zero volts. This makes it more versatile for different types of circuits.

- **TTL and CMOS Compatibility**

The LM339 is designed to work seamlessly with both TTL and CMOS logic circuits. This compatibility ensures that it integrates well into a variety of systems.

- **Reliable Output**

The IC provides a low output saturation voltage of 130 mV at 4 mA, which ensures stable and consistent performance. This is helpful in maintaining output quality under varying conditions.

- **Robust Build**

The IC includes ESD clamps on the inputs. These clamps protect it from static discharge without affecting how it functions. Additionally, the IC is RoHS compliant, ensuring it meets environmental safety standards.

4.1.4 Resistors

A resistor is a passive two-terminal electronic component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

Resistors are passive components with a specific electric resistance. The work of a resistor is based on Ohm's law, i.e., voltage (V) = current (I) × resistance (R). Resistors have four main roles: current control, voltage division, current detection, and biasing.

Fig:4.1.4 Resistor

Resistors Used:

- 2.2k
- 6.8k
- 10k

4.1.5 Diode

A diode is a semiconductor device that allows current to flow primarily in one direction, acting like a one-way valve for electricity. This unidirectional current flow is based on the interaction of p-type and n-type semiconductor materials, forming a p-n junction. When a voltage is applied across the junction, the flow of charge carriers (electrons and holes) is determined by the polarity of the voltage, enabling the diode to conduct in the forward direction and block current in the reverse direction.

Electrical, Fundamentals. A diode is a semiconductor device, typically made of silicon, that essentially acts as a one-way switch for current. It allows current to flow easily in one direction but severely restricts current from flowing in the opposite direction.

A diode is an electronic component that allows current to flow in one direction only. Similarly, data diode technology lets information flow safely in only one direction, from secure areas to less secure systems, without permitting reverse access.

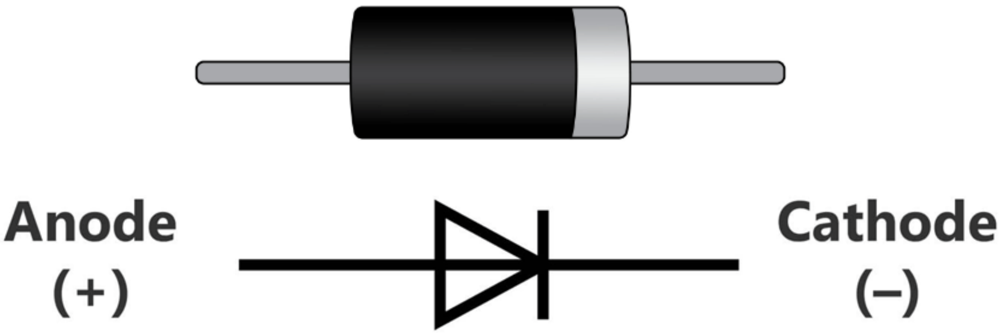


Fig:4.1.5 Diode

Diode used:

❖ 1N5408

4.1.6 Zero PCB

A zero PCB (printed circuit board) refers to a type of board used in electronics that does not have any printed or pre-defined circuits on it. It’s essentially a bare board, also known as a general-purpose PCB, perfboard, or breadboard.These boards are perforated with tiny holes, each of which is electrically isolated from the others. They are useful for prototyping as you can build a circuit on them by inserting components into the holes and then connecting them with wire, instead of having a pre-defined path for the current to follow.

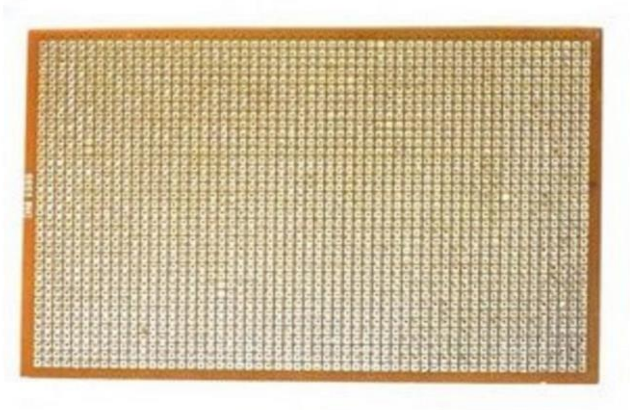


Fig:4.1.6 Zero PCB

4.1.7 Zener Diode

Zener diode is a type of diode designed to exploit the Zener effect to affect electric current to flow against the normal direction from anode to cathode, when the voltage across its terminals exceeds a certain characteristic threshold, the Zener voltage.

Zener diodes are manufactured with a variety of Zener voltages, including variable devices. Some types have an abrupt, heavily doped p–n junction with a low Zener voltage, in which case the reverse conduction occurs due to electron quantum tunnelling in the short distance between p and n regions. Diodes with a higher Zener voltage have more lightly doped junctions, causing their mode of operation to involve avalanche breakdown. Both breakdown types are present in Zener diodes with the Zener effect predominating at lower voltages and avalanche breakdown at higher voltages.

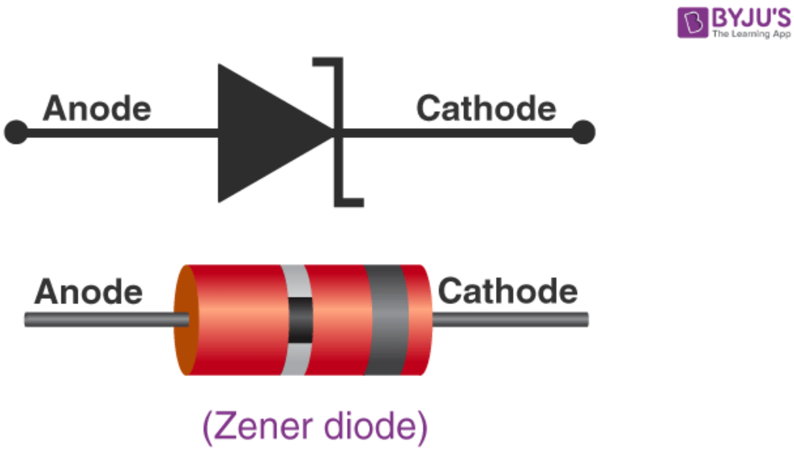


Fig:4.1.7 Zener Diode

Zener diode Used:

- Zener 3.3V
- Zener 4.3V

4.1.8 Other Components

- **Plastic casing**

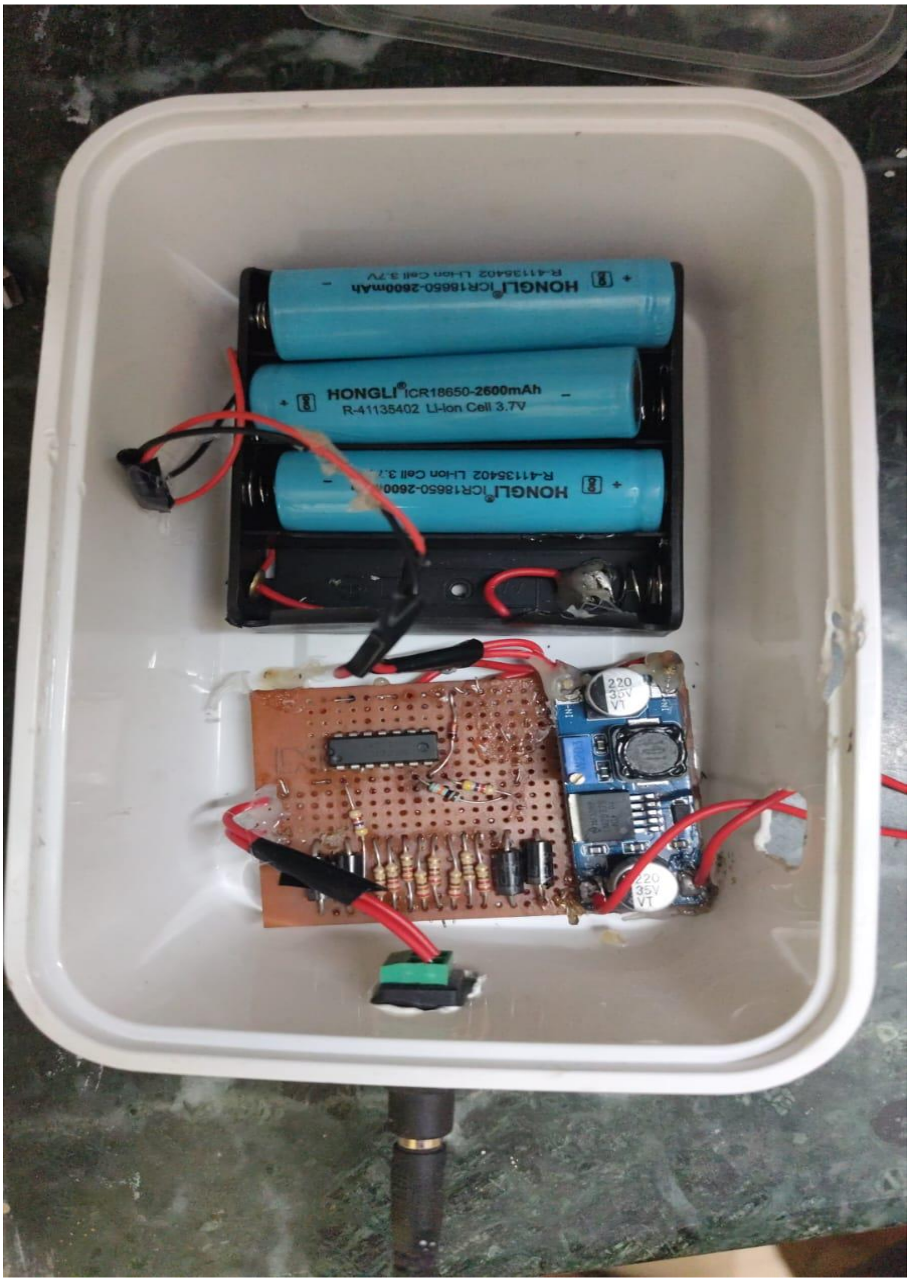


Fig:4.1.8.1 Plastic casing

- **Battery Case**

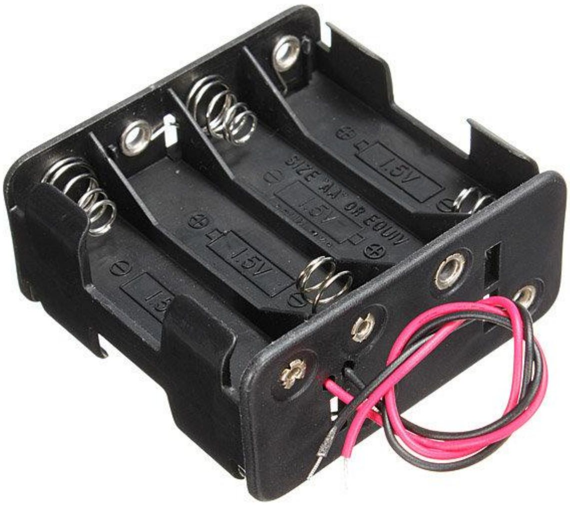


Fig:4.1.8.2 Battery casing

- **Connecting Wires**

Fig:4.1.8.3 Connecting Wires

- **Mosfet**

Fig:4.1.8.4 SL3409 P-Channel Mosfet

4.2 Implementation

Implementing a design actually on hardware. Here we first design layout of our circuit on paper. After the design the circuit we did the simulation on software.

1. Power Input Section

- **Input Source:** The circuit receives a 12V DC input from an AC to DC adapter.
- **Protection Diodes (IN5408):** These protect against reverse polarity and ensure current flows only in the correct direction.

2. Battery Charging and Protection Section

- **Battery Bank:** A series of batteries are used (labeled Vbat+ and Vbat-), likely 3.7V Li-ion cells arranged to reach the required voltage.
- **Current Limiting Resistors (2.0Ω):** Limit charging current to the batteries, preventing overcurrent during charge.
- **Charging Path Diodes (IN5408):** Ensure unidirectional current flow to prevent backflow from the battery.

3. Overvoltage Protection (Left LM393 Section)

- **Comparator IC (LM393):** Used to compare the battery voltage with a reference voltage (3.3V zener diode).
- **Function:** If the battery voltage exceeds a preset level, the comparator output drives the gate of a MOSFET (via a 47k resistor) to disconnect or control charging, thereby preventing overvoltage charging.
- **Zener Diode (3.3V):** Provides reference voltage for comparison.

4. Undervoltage Protection (Right LM393 Section)

- **Second LM393 Comparator:** Monitors if battery voltage drops too low.
- **Function:** Disconnects output load via MOSFET if voltage drops below safe discharge level, protecting the battery from deep discharge.
- **Reference Voltage:** Again set by a 3.3V zener.

Switching Section (MOSFET Control)

- **MOSFET (likely N-channel):** Controls battery output to the boost converter based on the logic signals from the comparators.
- **Gate Resistors (47k):** Control the turn-on behavior of the MOSFET.

5. Boost Converter

- **Boost Converter Module:** Steps up battery voltage (e.g., 7.4V or 11.1V) to a stable 12V output for the router.
- **Ensures Stable Output:** Even when battery voltage fluctuates, the router continues to receive a constant 12V.

6. Output to Router

- **Output Connection:** The final boosted and regulated 12V output is supplied to the WiFi router for uninterrupted operation during power failures.

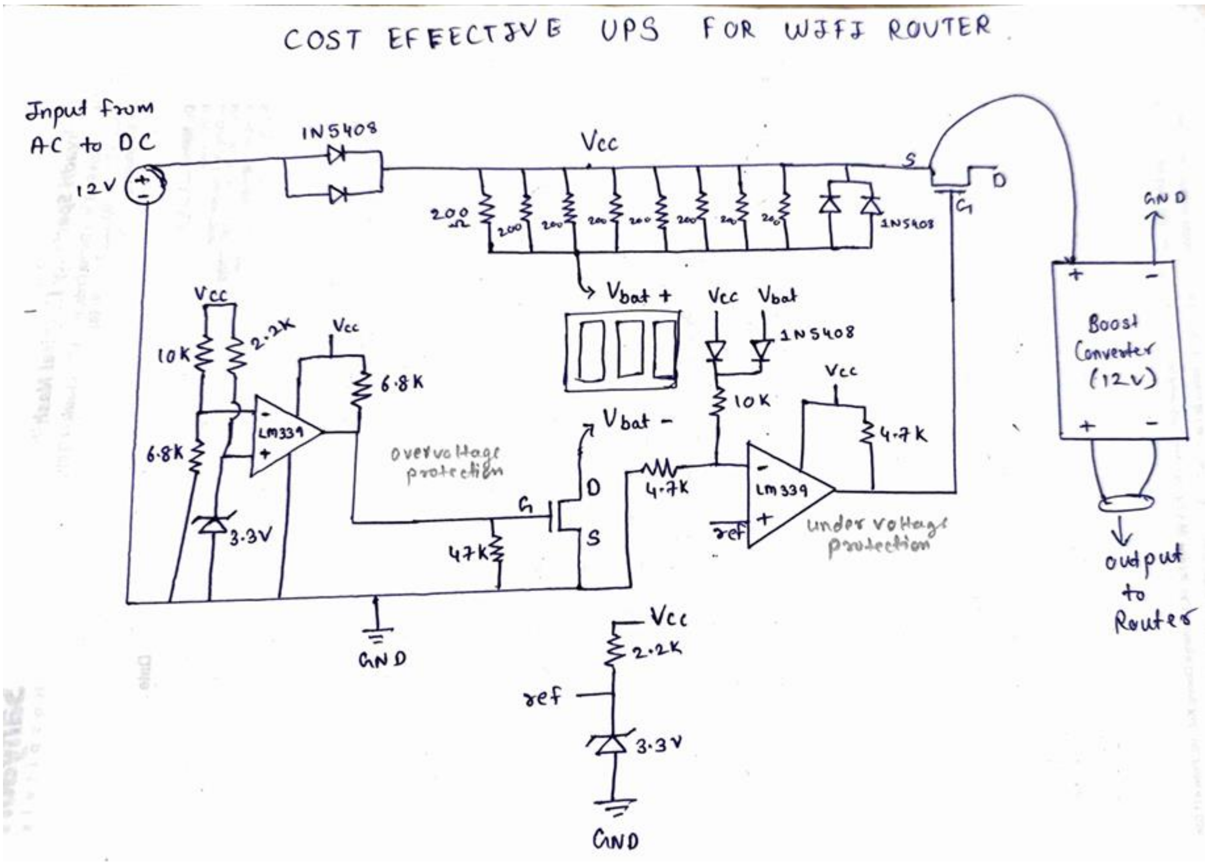


Fig: 4.2.1 Circuit Design (Self Designed)

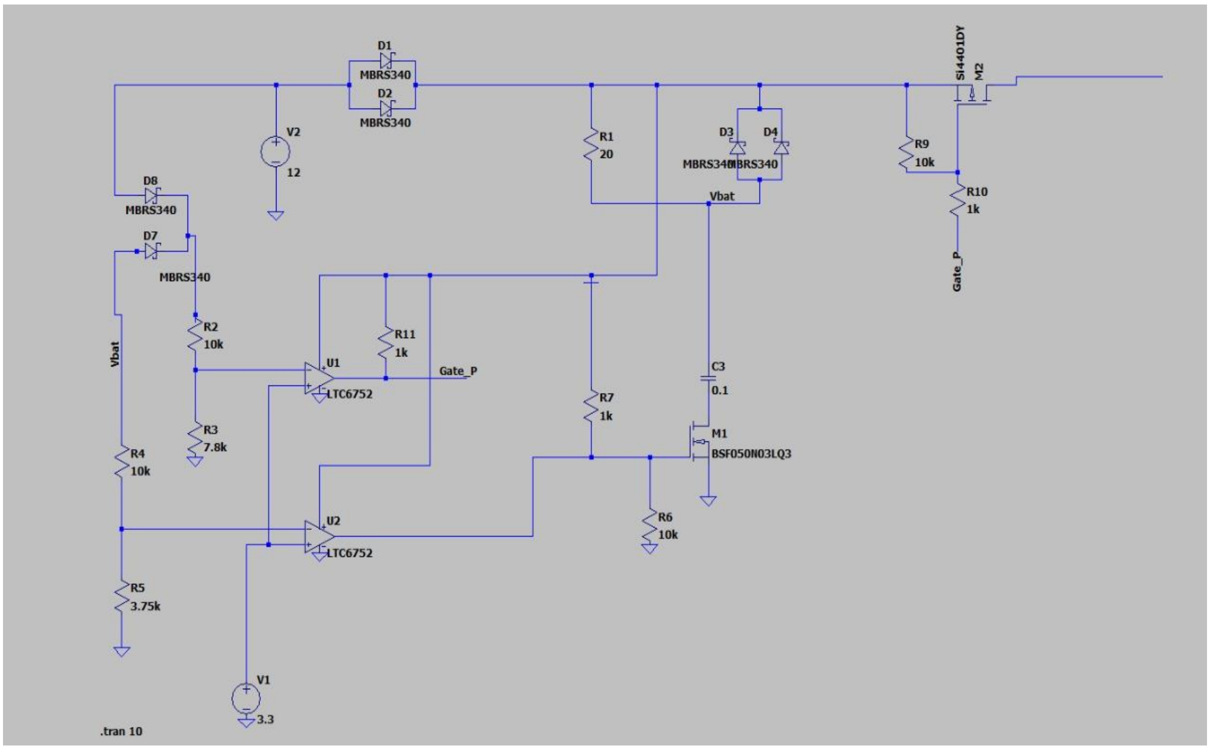


Fig:4.2.2 Implementation in LTspice

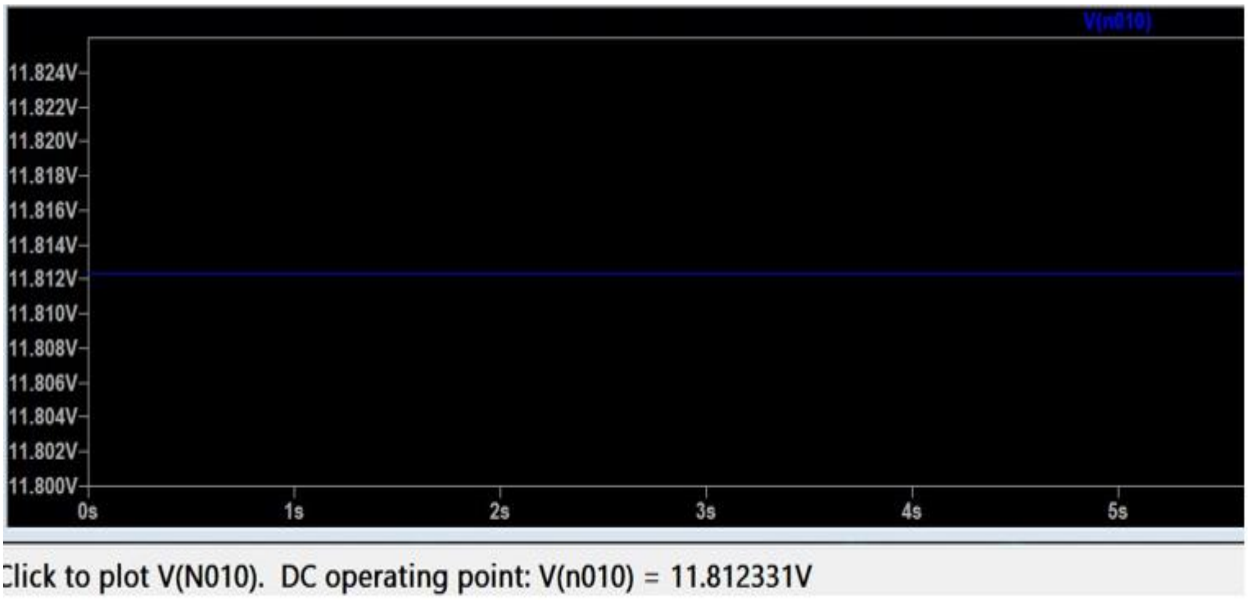


Fig:4.2.3 During Charging of the Battery

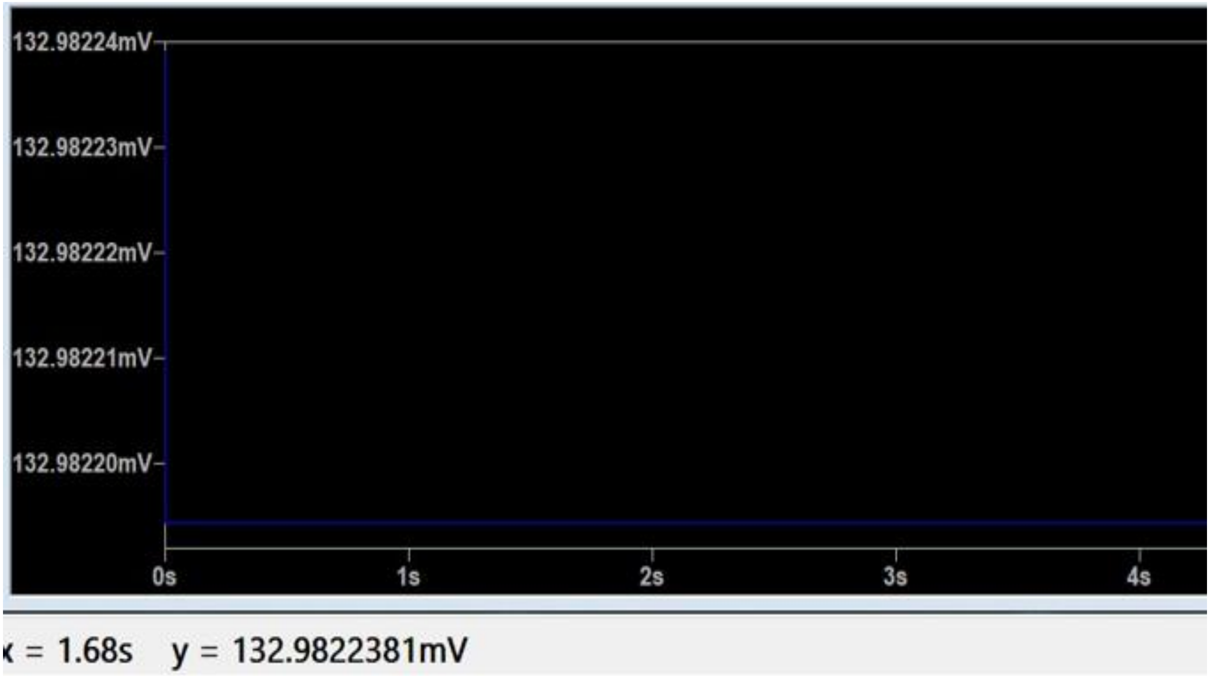


Fig:4.2.4 After Overvoltage

CHAPTER 5

DISCUSSION AND ANALYSIS OF RESULTS

5.1 Performance and Accuracy:

The performance of the cost-effective UPS for Wi-Fi routers largely depends on the quality of its battery, circuit design, and how well it's matched to the router's power needs. In real-world use, it can reliably keep a router running during short to moderate power outages, usually lasting between 1 to 2 hours depending on usage. While it may not match high-end models in terms of advanced features or longer backup time, it still delivers consistent performance for basic needs. In terms of accuracy, the power output is generally stable and well-regulated, ensuring the router operates without interruptions or voltage drops. For its price range, it offers a solid balance between reliability and cost, making it a dependable solution for everyday internet backup.

5.2 Final Implementation

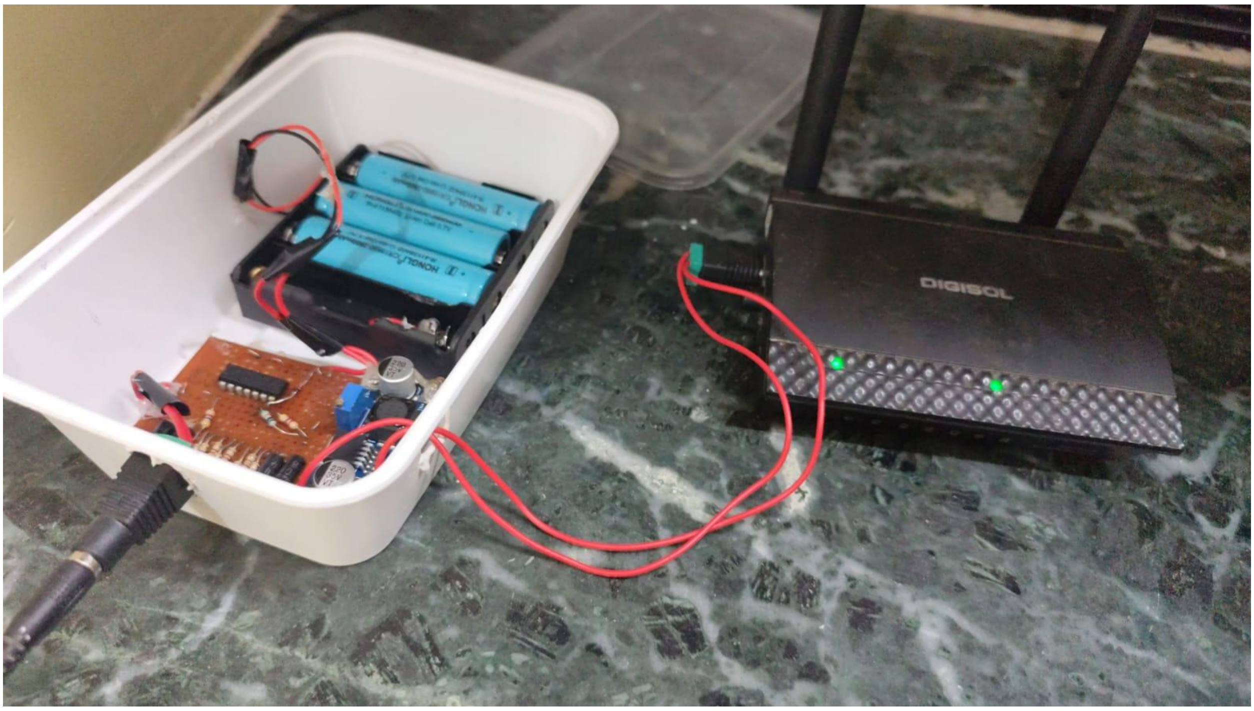


Fig: 5.2 Final Implementation

5.3 Hardware result

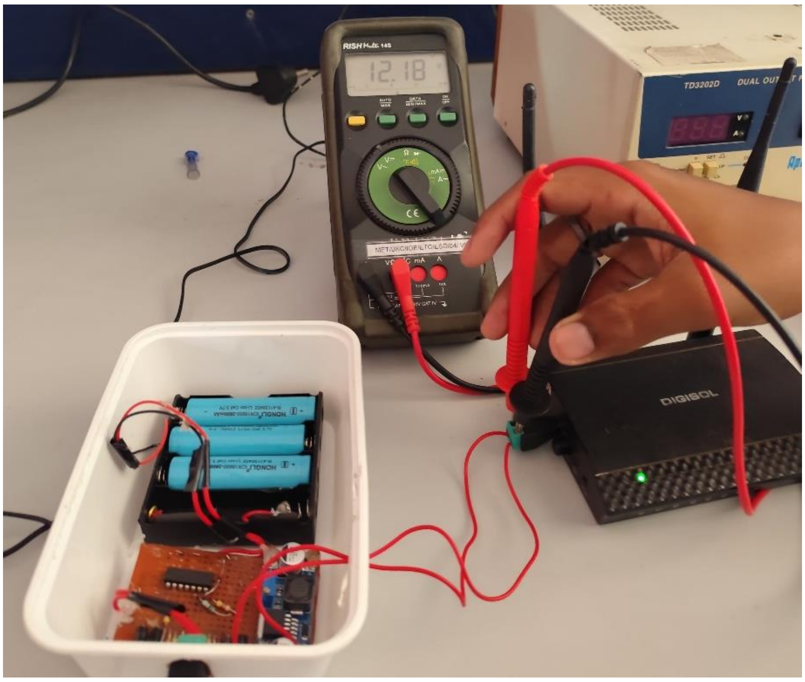


Fig: 5.3.1 Supply to router while charging

The UPS correctly accepts 12V DC input and charges the battery without overheating or voltage drops. Also getting the correct power supply(12V) to the Wi-Fi router and the Wi-Fi is working on the power supply. Due to Overvoltage protection, the battery Voltage does not go beyond 12V.

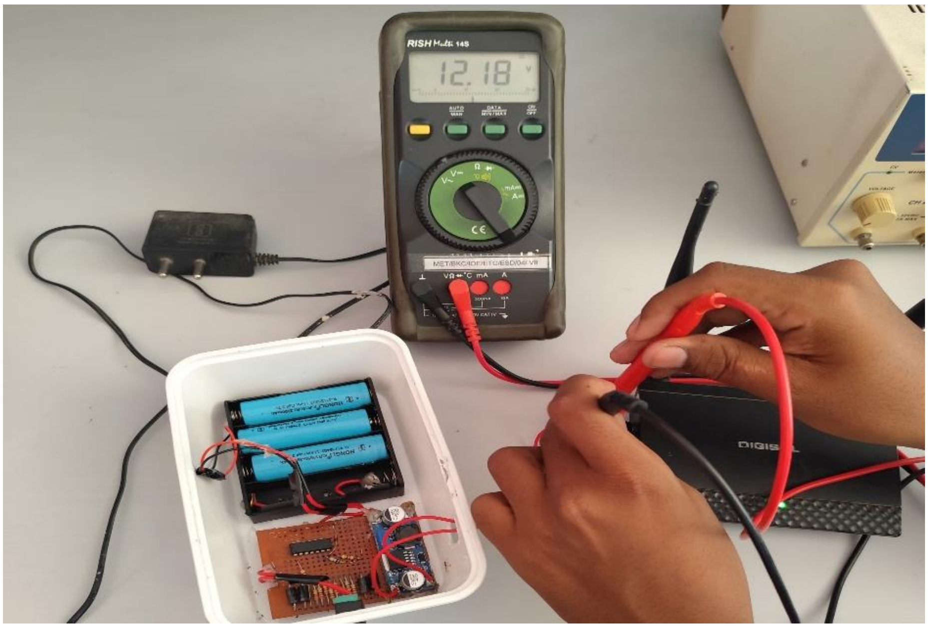


Fig: 5.3.2 Supply to router while power cut

When the main 12V input is cut off, the circuit automatically switches to battery power without restarting the router. Here the battery is Fully Charged and now it starts to drain.

The table records the **drain duration** of the UPS system across **five different rounds of testing** under similar load conditions (Wi-Fi router connected). Each round represents a full cycle where the UPS runs purely on battery backup after the main power supply is disconnected.

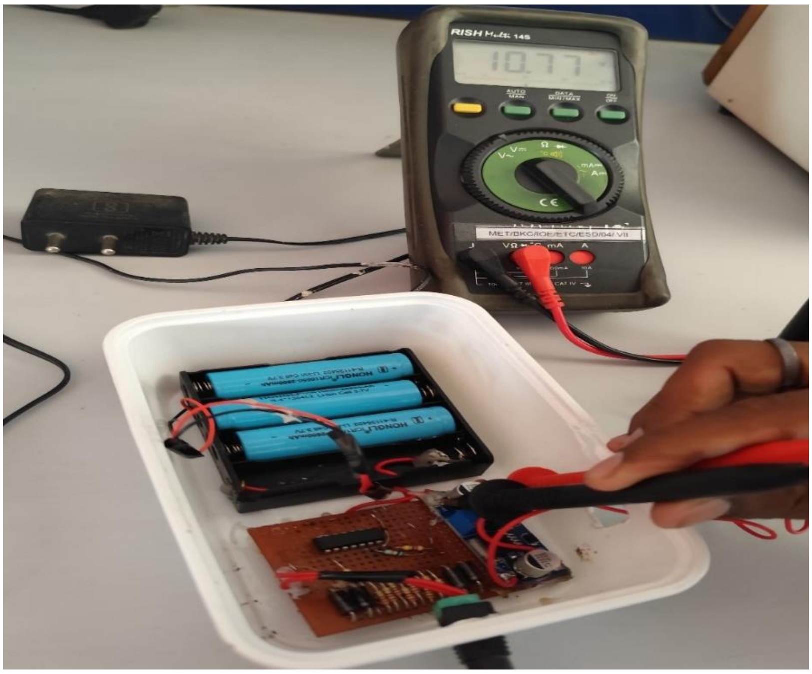


Fig: 5.3.3 Battery Drain after 15 minutes

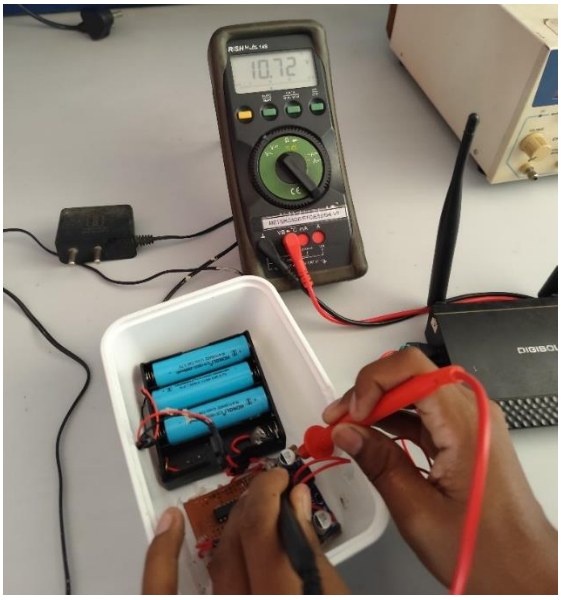


Fig: 5.3.4 Battery Drain after 20 minutes

Small differences in time are normal and could be due to minor fluctuations in router power consumption, battery temperature, or internal resistance changes during each cycle.

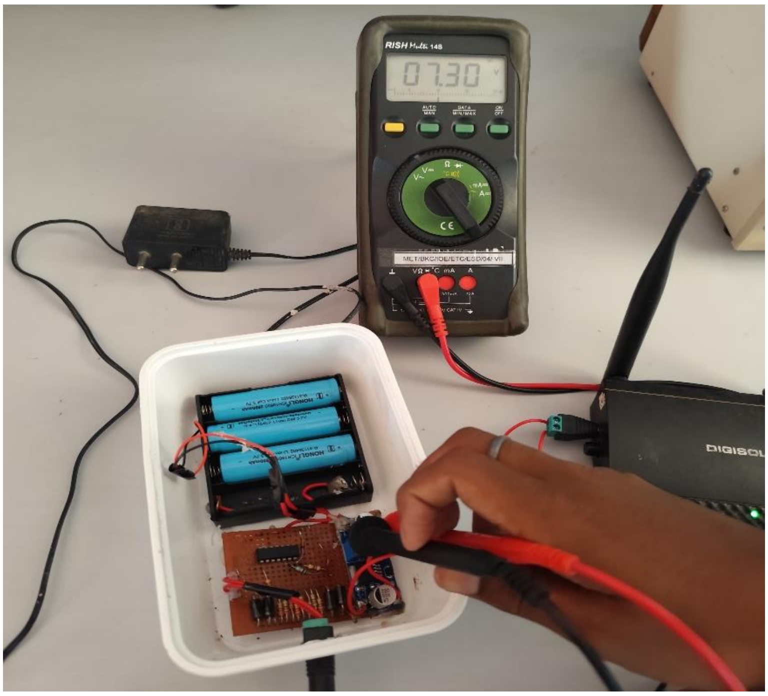


Fig: 5.3.5 Battery Drain after 50 minutes

5.4 Observation

Table:- 5.4 Drain Duration Table

Rounds	Drain Duration
Round 1	1 hour, 2 min
Round 2	1 hour, 8 min
Round 3	1 hour, 9 min
Round 4	1 hour, 4 min
Round 5	1 hour, 5 min

CHAPTER 6

CONCLUSION

6.1 Conclusion

In today's world, where staying connected is more important than ever, a budget-friendly UPS for WIFI routers can be a real lifesaver. Whether it's for working from home, attending online classes, or just keeping smart devices running smoothly during power cuts, it plays a valuable role. Of course, it does have some limitations—like shorter backup time and limited device support—but for the price, it gets the job done. And with tech always evolving, we can expect these small devices to become even smarter and more reliable in the near future.

6.2 Applications and Constraints:

- Supports remote work and online classes – limited backup duration.
- Powers smart home/IoT devices – handles only low-wattage loads.
- Useful for small businesses – may face router compatibility issues.
- Ideal for rural areas – battery life may degrade over time.
- Helps in emergency services – lacks advanced thermal management.

6.3 Advantages

- The systems automatically switch to the backup battery. So, the power can supply even after the ac power is gone.
- Preventing the disconnection over internet access.
- It automatically switches from ac power input to backup power without any manual intervention, ensure a smooth user experience.
- This unit is affordable than traditional UPS units, reducing the power loss from conversions.
- This battery acts as the buffer against voltage fluctuations, preventing to router form potential damage.
- This system used the rechargeable battery so it's reducing the electronic waste and power consumption.

6.4 Approximate Cost of Project

Table:- 6.4 Component Price

Sr.no	Components	Price
1.	MT3608 (DC-DC Boost Module)	52
2.	Li-ion Battery	90
3.	LM339 Comparator	12
4.	Resistors	12
5.	Diode	24
6.	Zenor Diode	6
7.	PCB	28
9.	Plastic casing	39
10.	Battery Case	21
	TOTAL	284

6.5 Future Scope

The future scope of a cost-effective UPS for WIFI routers is highly promising, driven by the increasing global reliance on uninterrupted internet connectivity. With the rise of remote work, online education, smart homes, and IoT devices, maintaining a stable internet connection has become essential. In many regions, frequent power outages disrupt connectivity, making a compact and affordable UPS an attractive solution. Future developments may include integration with smart home ecosystems, allowing real-time monitoring and control via mobile apps. Features such as battery health prediction, fast charging, and power optimization can further enhance user experience and reliability. Additionally, incorporating renewable energy options like solar charging could make the solution even more sustainable. As the digital world continues to expand, the demand for such reliable and intelligent backup solutions is expected to grow significantly.

REFERENCES

[1] Naohiko Shiokawa and Others: "Technologies Supporting Reliability of Power System Products" SANYO DENKI Technical Report No.3.

[2] B. H. Kwon, J. H. Cho, and T. W. Kim, "Improved single-phase line interactive UPS," IEEE Trans. Ind. Electron., vol. 48, pp. 804–811, Aug. 2001.

[3] International Journal Of Engineering And Computer Science ISSN: 2319 7242 Volume 5 Issue 5 May 2016, Page No. 16740-16745

[4] International Research Journal of Modernization in Engineering Technology and Science(Peer-Reviewed, Open Access, Fully Refereed International Journal)

[5] A review paper on Solar powered UPS. Dr. V.G. Neve*1, Kaushal Talkokulwar*2, Dinesh Shevatakar*3, Vaishnavi Meshram*4, Manoj Jamkar*5, Nikita Kottewar*6, Shivam Neware*7, Avan Pawar*8, presented at international research journal of modernization in Engineering Technology and science. Volume:05/Issue:03/March-2023 Impact Factor- 7.868.

[6] Innovative UPS System for Reliable Power Supply in Residential and Industrial Applications . International Research Journal of Engineering and Technology (IRJET)

[7] International Journal of Innovative Research in Science, Engineering and Technology (A High Impact Factor, Monthly, Peer Reviewed Journal) Visit: www.ijirset.com Vol. 7, Issue 5, May 2018