

# IOT Based Three Phase Balancing Smart Distribution Line

**Prof. Kute U. V<sup>1</sup>, Dome Jayesh<sup>2</sup>, Shete Sai<sup>3</sup>, Rodge Rohit<sup>4</sup>, Suryawanshi Kunal<sup>5</sup>**

<sup>1</sup> Assistant Professor, Department of Electronic and Telecommunications Engineering

<sup>2,3,4,5</sup> Students, Department of Electronic and Telecommunications Engineering

Amrutvahini Sheti & Shishkan Vikas Sanstha's Amrutvahini Polytechnic, Sangamner.

<sup>2</sup>jayeshdome@gmail.com, <sup>3</sup>officialsaishete@gmail.com, <sup>4</sup>rodage.rohit15@gmail.com,

<sup>5</sup>suryawanshikunal405@gmail.com

**Abstract:** *In three phase distribution system the unbalance phenomenon occurs due to single-phase loads and unequal sharing of loads in each phase. To overcome this problem, distribution systems require equal sharing of load in each phase. This is possible by automatic three phase load balancing technique. The automatic three phase load balancing system is possible by the proposed hardware which is micro-controller and relay based hardware. This hardware is installed in the incoming of three phase lines and will accordingly switch the domestic load to the least loaded phase using fast switching relays. The single full house load is connected to the phase that is least loaded by relay switching ON/OFF. The result of the proposed hardware and simulation shows that microcontroller and relays switching is effective in reducing the unbalancing in three phase lines and also reducing the current in the neutral wire of the system. In addition, it retains voltage regulation and stability in the all three phase and display in IOT web sever.*

**Keywords:** IOT, Three Phase, Load balancing, Smart distribution Voltage, Microcontroller, Energy efficiency, Monitoring

## I. INTRODUCTION

In a three-phase power distribution system, load balancing is essential for efficient performance. Unequal load distribution can cause voltage imbalance, power loss, and damage to equipment. Traditional methods are not always accurate or fast.

This project uses IoT technology to monitor voltage and current in real time. It automatically detects imbalance and balances the load using sensors, relays, and a microcontroller. The system improves efficiency, reduces losses, and supports smart energy management.

## II. LITERATURE SURVEY

Many researchers have studied load balancing in three-phase power systems. Uneven load distribution causes voltage imbalance and power losses. Traditional manual methods are slow and less efficient. Automatic load balancing systems improve performance and reliability. Sensors and microcontrollers are widely used for monitoring. Advanced techniques like fuzzy logic and AI enhance accuracy.

IoT technology enables real-time monitoring of voltage and current. It also supports remote access and control of the system. Integration with smart grids improves energy management. Overall, IoT-based systems provide efficient and reliable solutions

## III. METHODOLOGY

The system consists of the following parts:

The transmitter section and the receiver section.

Copyright to IJAR SCT  
[www.ijarsct.co.in](http://www.ijarsct.co.in)



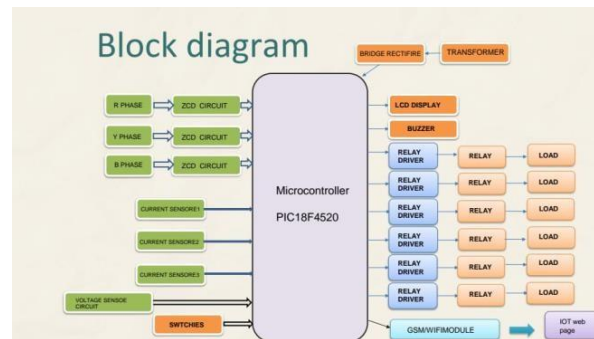
DOI: 10.48175/568



470

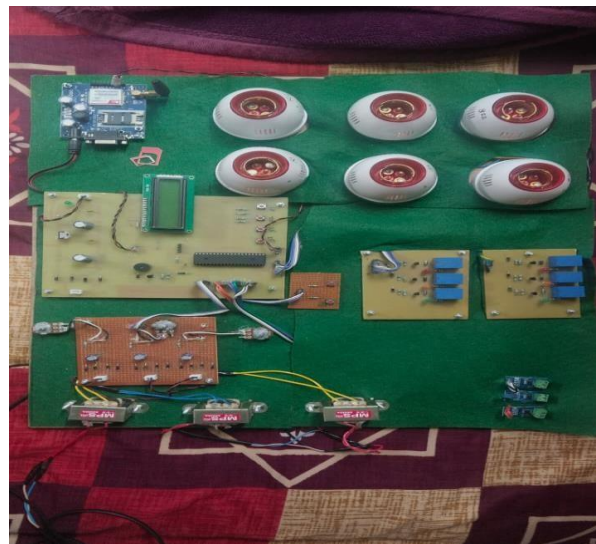
1. Data Sensing:  
Voltage and current sensors measure parameters of all three phases.
2. Data Processing:  
Microcontroller analyzes sensor data to detect phase imbalance.
3. Load Balancing:  
Relays are activated to shift load from overloaded phase to underloaded phase.
4. IoT Monitoring:  
System sends real-time data to cloud for remote monitoring and control  
The system monitors each phase and shifts load automatically when imbalance is detected.

#### IV. SYSTEM DESIGN



The system is designed to monitor and balance load in a three-phase distribution line. It includes voltage and current sensors connected to each phase. Sensors continuously measure electrical parameters. A microcontroller processes the data. It detects imbalance between the phases. Relay modules are used for load switching. Relays shift load from overloaded to underloaded phase. An IoT module enables wireless communication. Data is sent to cloud for real-time monitoring. The system ensures efficient and automatic load balancing.

#### Working Principle



The system continuously measures voltage and current in all three phases. Sensor data is sent to the microcontroller for processing.

The microcontroller compares values to detect imbalances. If one phase is overloaded, imbalance is identified. Relay modules are activated to shift the load. Load is transferred to underloaded phases automatically.

IoT system displays real-time data for monitoring and control.

### **AC Power Input**

The system begins with a three-phase AC power supply taken from the main distribution line (R, Y, B phases). This AC input is used to supply power to both the load and the control system.

The incoming AC power is first passed through a power supply unit, where it is converted into a low-voltage DC using a rectifier, filter, and voltage regulator. This regulated DC voltage is required to operate components like the microcontroller, sensors, and relay module.

At the same time, the main AC supply is connected to the load through relay switches. These relays control which phase supplies power to the load.

The sensors continuously monitor the voltage and current of each phase from the AC input. This data is sent to the microcontroller for analysis.

Proper isolation and regulation are maintained to ensure safety and protect electronic components from high voltage. Thus, the AC power input acts as the primary energy source for both load operation and system control.

### **V. RESULT**

The developed system successfully detects and balances load in a three-phase distribution line.

It continuously monitors voltage and current of each phase in real time.

When imbalance occurs, the system automatically shifts the load using relays.

This reduces power loss and improves overall efficiency. The IoT module provides real-time data monitoring and remote access.

The system shows reliable performance and quick response to imbalance conditions.

### **VI. ADVANTAGES**

- Automatic load balancing
- Reduces power losses
- Improves system efficiency
- Real-time monitoring using IoT
- Fast response to imbalance
- Low cost and easy to implement
- Increases equipment life
- Supports smart grid applications

### **VII. APPLICATIONS**

- Smart grid systems
- Industrial power distribution
- Residential areas
- Electrical substations
- Commercial buildings
- Energy management systems



## **VIII. FUTURE SCOPE**

### **1. Smart Grid Integration:**

The system can be integrated with smart grid technology to enable efficient, reliable, and automated power distribution. This will improve overall energy management.

### **2. AI-Based Load Balancing:**

Artificial Intelligence can be used to predict load demand and automatically balance phases more accurately, reducing human intervention and improving efficiency.

### **3. Mobile App Monitoring:**

A dedicated mobile application can be developed to monitor system performance in real time and control operations remotely from anywhere.

### **4. Renewable Energy Integration:**

The system can be combined with renewable energy sources like solar and wind, making it more eco-friendly and sustainable.

### **5. Advanced Automation:**

Future systems can be fully automated with minimal manual control, ensuring faster and more precise operation.

### **6. Cloud Data Analysis:**

All system data can be stored on cloud platforms, allowing advanced analysis, performance tracking, and better decision-making.

### **7. System Scalability:**

The system can be expanded for large-scale applications such as industries, smart cities, and power distribution networks.

### **8. Improved Fault Detection:**

Advanced technologies can be used to detect faults quickly and accurately, improving system safety and reliability.

## **IX. CONCLUSION**

The IoT-based three-phase balancing smart distribution system presents an advanced and practical solution for managing load imbalance in electrical power systems. In conventional distribution systems, uneven load sharing between phases leads to problems such as voltage fluctuation, increased power losses, overheating, and reduced equipment life. The proposed system effectively overcomes these challenges through automation and real-time monitoring.

By using voltage and current sensors, the system continuously collects data from all three phases. The microcontroller processes this data and detects any imbalance condition.

When an imbalance occurs, relay modules automatically redistribute the load from the overloaded phase to the underloaded phase. This ensures uniform load distribution and stable system operation.

The integration of IoT technology is a key advantage, as it enables real-time data monitoring, remote access, and better decision-making. Users can easily observe system performance and take necessary actions through cloud platforms or mobile devices. This reduces the need for manual intervention and improves response time.



Additionally, the system helps in reducing energy losses, improving efficiency, and increasing the lifespan of electrical equipment. It is cost-effective, easy to implement, and suitable for a wide range of applications including residential, industrial, and smart grid systems.

In the future, the system can be enhanced with advanced technologies such as Artificial Intelligence, cloud computing, and renewable energy integration. These improvements will further increase the system's performance, intelligence, and scalability.

Overall, the proposed system plays an important role in developing smart, efficient, and reliable power distribution networks, contributing to modern energy management solutions.

#### REFERENCES

- [1]. L. Alhmoud, Q. Nawafleh, and W. Merrji, "Three-Phase Feeder Load Balancing Based Optimized Neural Network Using Smart Meters," *Symmetry*, 2021.
- [2]. MDPI G. Bao and S. Ke, "Load Transfer Device for Solving a Three-Phase Unbalance Problem in Low-Voltage Distribution Network," *Energies*, 2019.
- [3]. OUCI M. Uthman and M. I. Balami, "Smart Three-Phase Distribution System Load Balancer Using Microcontroller," 2024.
- [4]. atbuftejoste.com.ng
- [5]. "Automatic Three-Phase Load Balancing System Using Fast Switching Relay," *IEEE*, 2018.
- [6]. "Optimization of Three-Phase Feeder Load Balancing Using Smart Meters," *IEEE*, 2021.
- [7]. A Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," *IEEE*, 2011.
- [8]. H. Farhangi, "The Path of the Smart Grid," *IEEE Power & Energy Magazine*, 2010.
- [9]. G. Srinivasan et al., "Load Balancing in IoT-Based Systems Using Optimization Techniques," 2024.

