

REAL TIME IOT SMART GRID SOLUTION FOR AUTOMATIC PHASE SELECTION AND FAULT MONITORING

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Abstract:

Electric power distribution systems often face problems such as phase failures, voltage fluctuations, and electrical faults. These issues can lead to power interruptions and equipment damage. This paper proposes a Real-Time IoT Smart Grid Solution for Automatic Phase Selection and Fault Monitoring. The system continuously monitors the three-phase supply (R, Y, B) using voltage and current sensors. A microcontroller processes the sensor data and automatically selects the healthy phase using a relay module when a fault occurs. Additionally, an IoT module transmits real-time data to a cloud server, allowing remote monitoring of faults and power conditions. The proposed system improves reliability, reduces power interruption time, and enables efficient monitoring of the power distribution network.

Introduction:

Electric power distribution is a crucial part of modern infrastructure. Many homes and industries depend on three-phase power supply for reliable electricity.

However, power systems face several problems such as:

- Phase failure
- Voltage imbalance
- Short circuits
- Overload conditions

Traditional power distribution systems require manual monitoring and switching, which may cause delays in restoring power.

With the development of Internet of Things (IoT) technology, smart monitoring and automation can be introduced into power systems. IoT allows devices to

communicate with each other and send data over the internet for real-time monitoring.

This paper presents a smart grid system that can:

- Automatically detect faulty phases
- Switch to a healthy phase
- Monitor system conditions remotely using IoT
- This improves power reliability, safety, and efficiency.

Literature Review:

Several researchers have proposed smart grid systems for improving power distribution reliability. Previous systems mainly focused on automatic phase selection using relay circuits. However, these systems lacked real-time monitoring and remote fault detection capabilities. Recent research introduced IoT-based power monitoring systems where sensors collect electrical data and send it to cloud platforms.

However, many existing systems still have limitations such as:

- Lack of automatic switching
- Limited fault detection capability
- No real-time remote monitoring
- Therefore, integrating automatic phase selection with IoT-based fault monitoring can significantly improve the performance of power distribution systems.

Existing System:

- In traditional electrical systems:
- Phase selection is done manually.
- Fault detection requires physical inspection.
- No real-time monitoring system is available.

- Working of Existing System
- Three-phase supply is provided to the load.
- If one phase fails, power supply stops.
- Technicians must manually switch to another phase.

Limitations

- Power interruption time is high.
- No automatic fault detection.
- Manual monitoring required.
- Increased maintenance cost.

Proposed System:

The proposed system introduces a Real-Time IoT-based Smart Grid system for automatic phase selection and fault monitoring.

The system includes:

- Voltage Sensors
- Current Sensors
- Microcontroller (Arduino / ESP8266)
- Relay Module
- IoT Communication Module
- Cloud Server

Features of Proposed System

- ✓ Automatic phase selection
- ✓ Real-time fault detection
- ✓ IoT-based remote monitoring

- Reduced power interruption
- Improved system reliability

When a fault occurs in one phase, the system automatically switches to the next available healthy phase.

At the same time, the IoT module sends data to the cloud platform, allowing users to monitor the system through a mobile or web application.

System Architecture:

Block Diagram Explanation

- Three-phase power supply (R, Y, B) is connected to the sensing system.

- Components in the architecture include:
- Voltage Sensor
- Measures voltage level of each phase.
- Current Sensor
- Measures current flowing through the load.
- Microcontroller
- Processes sensor data and decides which phase is healthy.
- Relay Module
- Automatically switches the load to the available phase.
- IoT Module (ESP8266 / WiFi)
- Sends electrical data to cloud server.
- Cloud Server
- Stores data and displays system status.
- User Interface
- Allows users to monitor faults and voltage levels remotely.

Hardware Components

1. Voltage sensor

- Relay switches load between:
- R Phase
- Y Phase
- B Phase. Voltage Sensor
- Used to measure voltage levels in each phase.
- Example:
- ZMPT101B Voltage Sensor

2. Current Sensor

- Measures current drawn by the load.
- Example:
- ACS712 Current Sensor

3. Microcontroller

- Acts as the control unit of the system.
- Example:

- Arduino UNO
- ESP8266
- Functions:
- Reads sensor data
- Detects faults

5. IoT Module

- Used for internet communication.
- Example:
- ESP8266
- NodeMCU

7. Software Designs

The system software includes:

- Embedded programming
- IoT cloud communication
- Monitoring interface
- Programming Language
- Embedded C
- Arduino IDE
- IoT Platform
- Possible platforms include:
- ThingSpeak
- Blynk
- Firebase
- AWS IoT
- System Operation Steps
- Sensors measure voltage and current.
- Microcontroller analyzes the data.
- If voltage drop or fault occurs:
- Faulty phase is detected.
- Relay automatically switches to healthy phase.
- Data is sent to cloud server.
- User receives real-time system status.

8. Fault Detection Method

- The system detects faults based on:
- Voltage drop
- Overcurrent
- Phase failure
- Example:
- If
- Voltage < threshold value
- Then
- Fault detected.
- The microcontroller immediately switches to the next healthy phase.
- This ensures continuous power supply to the load.

9. Advantages of Proposed System

- Automatic phase selection
- Real-time monitoring
- Fast fault detection
- Reduced downtime
- Remote access through IoT
- Improved power reliability
- Lower maintenance cost

10. Applications

The proposed system can be used in:

- Residential power supply
- Industrial power systems
- Smart cities
- Power distribution networks
- Rural electrification systems

11. Future Scope

Future improvements can include:

- Artificial Intelligence based fault prediction
- Integration with renewable energy systems
- Smart load balancing

- Mobile application for power monitoring
- Integration with smart meters

12. Conclusion

This paper presents a Real-Time IoT Smart Grid Solution for Automatic Phase Selection and Fault Monitoring. The system improves reliability of power distribution by automatically detecting faulty phases and switching to a healthy phase. The integration of IoT technology allows remote monitoring of electrical parameters and system faults. This solution can significantly reduce power interruption time and improve efficiency in power management systems.

- Mobile application for power monitoring
- Integration with smart meters

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