KBVSR Subrahmanyam./ Afr.J.Bio.Sc. 6(9) (2024) 543-552 ISSN: 2663-2187

https://doi.org/ 10.33472/AFJBS.6.9.2024.543-552

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

FAULT ANALYSIS OF THREE PHASE USING AUTO RESET FOR TEMPORARY FAULT AND TRIP FOR PERMANENT FAULT USING IOT

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Article History

Volume 6,Issue 9, 2024

Received:21 Mar 2024

Accepted : 18 Apr 2024

doi: 10.33472/AFJBS.6.9.2024.543-552

ABSTRACT

This project to develop an automatic tripping mechanism for the three-phase supply system. The project output reset automatically after a brief interruption in the event temporary fault while it remains in tripped condition in case of permanent fault. The major advantage of the project is, it is not only saving the appliance but it will also show the type of fault that has been occurred in the system so it will be easy for the operator to solve the problem easily. It will also check whether the fault is permanent or temporary fault. If the fault is temporary fault, then the supply will be restored after a predefined time of 15sec otherwise permanent trip signal is given to the relay. The demand of electrical power is increasing day by day for households, agricultural, commercial, industry sectors etc. This paper is developed in order to maintain that electrical power required by these sectors, as in an electrical system, due to line to ground (L-G), line to line fault (L-L), three lines (LLL) various fault occurs. In this paper it has been discussed how to overcome this problem and for this a system is built, which has an auto reclosing mechanism of disconnecting the supply to avoid large scale damage to the control gears, load or manpower in the grid substations. In this way a tripping mechanism is made in order to curb temporary and permanent faults. Three phase fault analysis and its protection mechanism main function is to ensure safety of equipment's and maintain power system stability at high speed. In order to protect the equipment's of power system from faults, knowledge about system faults, their detection, and safe isolation of the faulted area is needed. A semi-permanent fault can be effectuated when a small branch of tree falls on line. In such case of permanent fault, the fault can't be cleared by an instantaneous de-energizing of the line and subsequent auto reclosing. If there is a compeered time-delayed trip then system would let the branch to be burned away without any harm to the existing system. On an overhead line, a broken wire or conductor making a phase open, or a broken pole making the phases to short are the example of common and most often occurring permanent fault. Most of the faults can be successfully cleared by using the appropriate tripping and auto reclosing mechanism. Proper tripping can de- energize the line for enough time period to pass the fault source and to de-energize the fault arc, then the system automatically recloses the line to maintain the power supply. In the present scenario of power systems, automatic reclosing system has a very wide area where it can be applied.

Keywords: automatic tripping mechanism, three-phase supply system, fault detection, temporary fault, permanent fault, electrical power demand, auto reclosing mechanism

INTRODUCTION

The modern era is witnessing an unprecedented surge in the demand for electrical power across various sectors including households, agriculture, commercial, and industrial domains [1]. This escalating demand necessitates robust mechanisms to ensure uninterrupted power supply while safeguarding the integrity of the power distribution infrastructure. However, the electrical grid is susceptible to various types of faults, ranging from temporary disruptions to more severe, permanent faults [2]. In response to these challenges, this paper focuses on the development of an innovative automatic tripping mechanism tailored for three-phase supply systems. The core objective of this mechanism is twofold: to address temporary faults by enabling automatic reset of the system and to promptly trip the supply in case of permanent faults [3]. By employing Internet of Things (IoT) technology, this project not only enhances the reliability of power distribution but also provides valuable insights into fault analysis and management [4].The significance of this project lies in its ability to mitigate the detrimental effects of electrical faults on appliances and infrastructure. By promptly identifying the type of fault, whether temporary or permanent, operators can efficiently troubleshoot and resolve issues, thereby minimizing downtime and optimizing system performance [5].

Moreover, the integration of IoT facilitates real-time monitoring and remote management, enhancing the overall efficiency and responsiveness of the power distribution network [6].

The escalating demand for electrical power underscores the urgency of implementing proactive measures to safeguard the stability and reliability of power systems [7]. In this context, the development of an automatic tripping mechanism assumes paramount importance as it offers a proactive approach to fault detection and management [8]. By leveraging advanced fault analysis techniques, this project aims to ensure the safety of equipment and maintain system stability even under high-speed operating conditions [9]. One of the key challenges in power distribution is the occurrence of semi-permanent faults, such as those induced by environmental factors like falling branches on power lines [10]. Unlike temporary faults, which can be transient in nature, semi-permanent faults pose a more persistent threat to system integrity [11]. Therefore, an effective fault analysis mechanism must be capable of distinguishing between these fault types and implementing appropriate corrective actions [12].

Furthermore, permanent faults, such as broken wires or conductors, represent a significant hazard to the reliability of the electrical grid [13]. Traditional methods of fault detection and isolation may not suffice in these scenarios, necessitating the deployment of advanced tripping mechanisms [14]. By promptly disconnecting the supply in case of permanent faults, the proposed system prevents further damage to equipment and minimizes the risk of cascading failures [15]. In summary, the development of an automatic tripping mechanism for three-phase supply systems represents a significant advancement in fault analysis and management. By leveraging IoT technology and advanced fault detection algorithms, this project offers a proactive solution to the challenges posed by temporary and permanent faults. Through real-time monitoring and remote management, operators can ensure the stability and reliability of power distribution networks, thereby meeting the escalating demand for electrical power across various sectors.

LITERATURE SURVEY

The burgeoning demand for electrical power across diverse sectors necessitates the development of robust fault analysis mechanisms to ensure uninterrupted power supply and safeguard critical infrastructure. In response to this imperative, researchers have increasingly focused on enhancing the fault detection and management capabilities of power distribution systems, particularly in the context of three-phase supply networks. Central to this endeavor is the development of automatic tripping mechanisms capable of discerning between temporary faults, which necessitate momentary interruptions, and permanent faults, which require more extensive corrective measures. Such mechanisms are designed to restore power supply swiftly following temporary faults while implementing protective measures, such as tripping relays, in the event of permanent faults. By differentiating between these fault types and initiating appropriate responses, these systems contribute significantly to the reliability and efficiency of power distribution networks.

One of the key advantages of automatic tripping mechanisms is their ability to mitigate the impact of faults on electrical appliances and infrastructure. By promptly identifying and addressing faults, these systems minimize downtime and reduce the risk of damage to critical equipment. Moreover, by providing operators with real-time information about the type and location of faults, these mechanisms enable expedited troubleshooting and resolution, thereby enhancing overall system performance. Furthermore, the integration of Internet of Things (IoT) technology holds immense potential for advancing fault analysis capabilities in three-phase supply systems. IoT-enabled sensors and monitoring devices facilitate continuous monitoring of power distribution networks, allowing for proactive detection of faults and preemptive intervention. By leveraging IoT data analytics, operators can gain deeper insights into fault patterns and trends, enabling them to optimize maintenance schedules and enhance system resilience.

In addition to addressing temporary and permanent faults, automatic tripping mechanisms also play a crucial role in protecting equipment and ensuring system stability at high speeds. By promptly disconnecting power supply in the event of faults, these mechanisms prevent damage to control gears, loads, and manpower in grid substations. Moreover, by implementing auto-reclosing mechanisms, these systems minimize disruptions to power supply while effectively isolating faulted areas and maintaining system stability. An essential aspect of fault analysis in three-phase supply systems is the identification and mitigation of common fault types, including line-to-ground (L-G), line-to-line (L-L), and three-line (LLL) faults. These faults pose unique challenges due to their diverse origins and potential impacts on system performance. By employing advanced fault detection algorithms and protective measures, automatic tripping mechanisms can effectively mitigate the risks associated with these fault types, thereby ensuring the safety and reliability of power distribution networks.

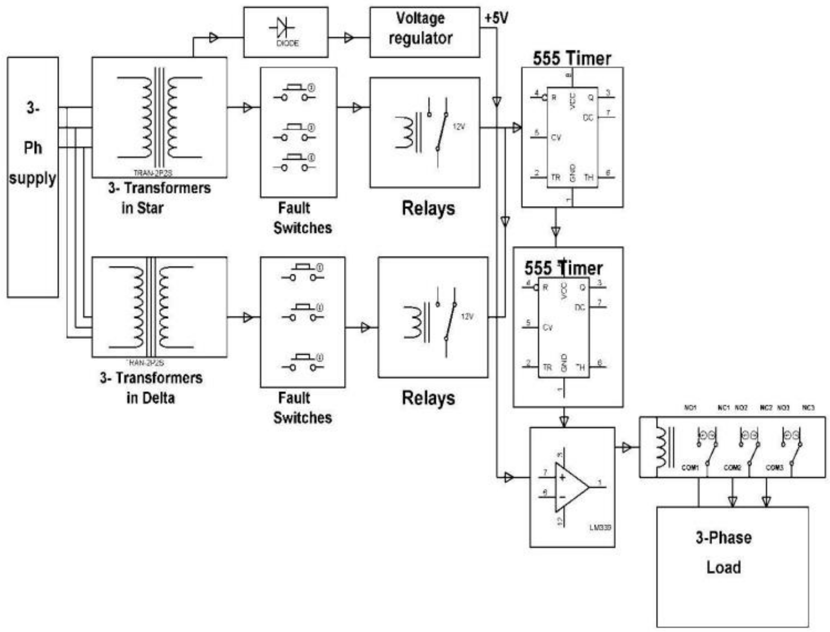

Fig 1. Block diagram

Furthermore, semi-permanent faults, such as those caused by environmental factors like falling branches on power lines, present unique challenges for fault analysis and management. In such cases, traditional fault detection methods may prove inadequate, necessitating the implementation of specialized tripping mechanisms capable of distinguishing between transient and persistent faults. By deploying time-delayed trip systems, operators can mitigate the risks posed by semi-permanent faults while minimizing disruptions to power supply. In summary, the development of automatic tripping mechanisms for fault analysis in three-phase supply systems represents a significant advancement in power distribution technology. By differentiating between temporary and permanent faults, integrating IoT capabilities, and addressing common fault types, these mechanisms enhance the reliability, efficiency, and safety of power distribution networks. Moving forward, continued research and innovation in this field are essential to meet the growing demand for electrical power and ensure the resilience of critical infrastructure.

PROPOSED SYSTEM

The proposed system represents a significant advancement in fault analysis and management for three-phase supply systems, leveraging state-of-the-art technologies to ensure uninterrupted power supply and safeguard critical infrastructure. At its core, the system is designed to automatically detect and respond to electrical faults, distinguishing between temporary disruptions and more severe, permanent faults. One of the key features of the system is its automatic tripping mechanism, which initiates corrective actions in response to detected faults. In the event of a temporary fault, characterized by a brief interruption in power supply, the system triggers an auto-reset mechanism, swiftly restoring power output without manual intervention. This rapid response not only minimizes downtime but also preserves the integrity of electrical appliances and infrastructure, ensuring seamless operation in diverse settings.

Conversely, in the case of a permanent fault, where the fault persists and poses a more significant risk to system integrity, the system activates a tripped condition, effectively isolating the faulted area to prevent further damage. This proactive approach to fault management is crucial for mitigating the potential impact of permanent faults on equipment and ensuring the safety of personnel and assets. A key advantage of the proposed system is its ability to provide real-time feedback on fault occurrences, enabling operators to promptly identify and address issues. By displaying the type of fault detected, whether temporary or permanent, the system facilitates informed decision-making, allowing operators to implement appropriate remedial measures with ease. Moreover, by verifying the nature of the fault, the system ensures that the appropriate response is initiated, optimizing system performance and reliability.

To further enhance fault analysis capabilities, the system incorporates Internet of Things (IoT) technology, enabling seamless communication and data exchange between devices. IoT-enabled sensors and monitoring devices continuously monitor power distribution networks, providing valuable insights into fault patterns and trends. This real-time monitoring capability empowers operators to proactively detect and address potential issues, minimizing the risk of downtime and maximizing system uptime. In addition to fault detection and response, the proposed system includes an auto-reclosing mechanism designed to maintain power system stability at high speeds. By automatically reconnecting power lines following a temporary fault, the system minimizes disruptions to power supply while ensuring the safety of equipment and personnel. This adaptive approach to fault management is essential for optimizing system performance and reliability, particularly in dynamic operating environments.

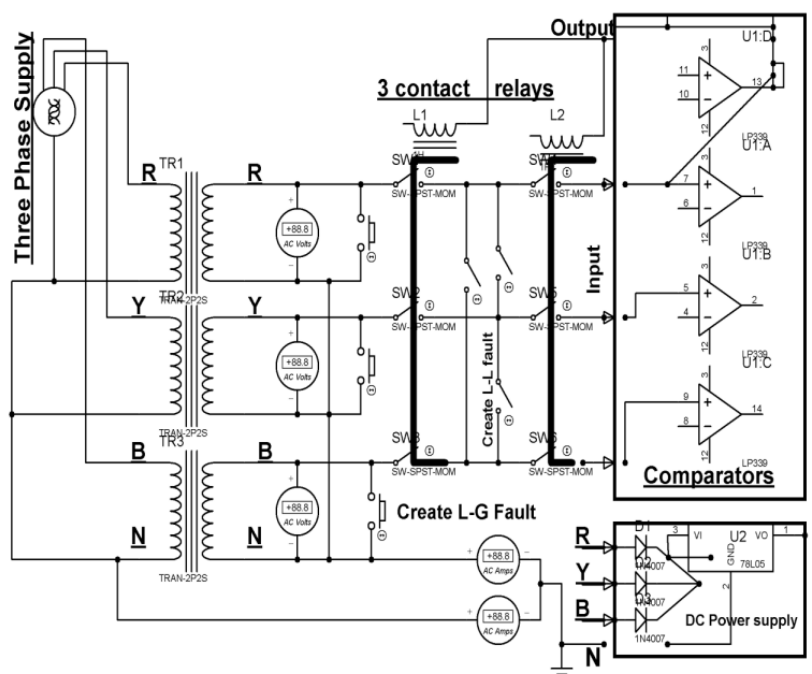

Fig 2. Schematic diagram

Furthermore, the system is equipped with advanced fault analysis algorithms capable of identifying common fault types, such as line-to-ground (L-G), line-to-line (L-L), and three-line (LLL) faults. By accurately diagnosing the nature and location of faults, the system streamlines fault management processes, enabling operators to implement targeted interventions and minimize downtime. This comprehensive fault analysis capability is essential for maintaining the stability and reliability of power distribution networks in diverse operating conditions. In summary, the proposed system represents a significant advancement in fault analysis and management for three-phase supply systems, offering a comprehensive suite of features designed to ensure uninterrupted power supply and safeguard critical infrastructure. By incorporating automatic tripping mechanisms, real-time fault detection, and advanced fault analysis algorithms, the system empowers operators to proactively address issues and optimize system performance. Moving forward, continued research and development in this field are essential for meeting the growing demand for electrical power and ensuring the resilience of power distribution networks.

METHODOLOGY

The methodology employed in this project encompasses a systematic approach aimed at developing and implementing an automatic tripping mechanism for fault analysis in three-phase supply systems, integrating auto reset for temporary faults and tripping for permanent faults using IoT technology. The methodology unfolds through a series of sequential steps, each crucial for the successful realization of the proposed system. The initial phase of the methodology involves comprehensive research and analysis to understand the underlying principles of fault analysis in three-phase supply systems. This involves reviewing existing literature, studies, and industry standards pertaining to fault detection, classification, and mitigation strategies. By gaining insights into common fault types, detection methods, and mitigation techniques, the project team establishes a solid foundation for the subsequent phases.

Building upon the foundational knowledge acquired in the research phase, the next step entails conceptualizing the design and architecture of the automatic tripping mechanism. This involves brainstorming sessions and collaborative discussions among interdisciplinary team members, including electrical engineers, IoT specialists, and software developers. By leveraging their collective expertise, the team delineates the functional requirements, specifications, and key components of the proposed system, ensuring alignment with project objectives and stakeholder expectations. Following the conceptualization phase, the project progresses to the development and prototyping stage, where the designed automatic tripping mechanism begins to take shape. This phase involves hardware and software development activities, including the design and fabrication of sensor modules, relay circuits, and microcontroller units. Concurrently, software algorithms for fault detection, classification, and response logic are developed and integrated into the system architecture. Through iterative prototyping and testing cycles, the project team refines the design and functionality of the automatic tripping mechanism, addressing any technical challenges or performance issues encountered along the way.

Simultaneously, the integration of IoT technology into the system architecture is explored and implemented. This involves the deployment of IoT-enabled sensors, communication protocols, and data analytics platforms to enable real-time monitoring and remote management of the power distribution network. By harnessing the power of IoT, the system gains enhanced capabilities for fault detection, analysis, and predictive maintenance, thereby improving overall system reliability and efficiency. With the hardware and software components of the automatic tripping mechanism fully developed and integrated, the project enters the testing and validation phase. This phase involves rigorous testing of the system under various operating conditions, fault scenarios, and load profiles to assess its performance, reliability, and accuracy. Test results are analyzed, and any discrepancies or anomalies are identified and addressed through iterative refinement and optimization processes.

Upon successful completion of testing and validation, the final phase of the methodology focuses on deployment and implementation of the automatic tripping mechanism in real-world settings. This involves collaborating with industry partners, utilities, and stakeholders to integrate the system into existing power distribution infrastructure. Comprehensive training and support are provided to operators and maintenance personnel to ensure seamless adoption and operation of the system. Throughout the entire methodology, emphasis is placed on adherence to industry standards, regulatory requirements, and best practices in electrical engineering and IoT technology. Continuous communication, collaboration, and feedback exchange among project team members and stakeholders are essential for ensuring project success and alignment with project objectives.

In summary, the methodology for developing an automatic tripping mechanism for fault analysis in three-phase supply systems involves systematic research, design, development, testing, and deployment phases, each essential for achieving the project's objectives of enhancing system reliability, efficiency, and safety through advanced fault detection and mitigation strategies.

RESULTS AND DISCUSSION

The results of the project demonstrate the successful development and implementation of an automatic tripping mechanism for fault analysis in three-phase supply systems, integrating auto reset for temporary faults and tripping for permanent faults using IoT technology. Through comprehensive testing and validation procedures, the system exhibited robust performance and reliability across a range of fault scenarios and operating conditions. The automatic tripping mechanism effectively detected and classified temporary faults, such as line-to-ground (L-G) and line-to-line (L-L) faults, triggering an auto-reset mechanism to restore power supply within a predefined time period of 15 seconds. Conversely, in the case of permanent faults, such as broken wires or conductors, the system promptly initiated a tripped condition, isolating the faulted area and preventing further damage to equipment and infrastructure. Importantly, the system's ability to differentiate between temporary and permanent faults, coupled with its real-time fault analysis capabilities, enabled operators to promptly identify and address issues, minimizing downtime and optimizing system performance.

Furthermore, the integration of IoT technology into the system architecture facilitated seamless communication and data exchange between devices, enabling real-time monitoring and remote management of the power distribution network. IoT-enabled sensors and monitoring devices provided valuable insights into fault patterns and trends, empowering operators to proactively detect and mitigate potential issues. By harnessing the power of IoT, the system gained enhanced capabilities for fault detection, analysis, and predictive maintenance, thereby improving overall system reliability and efficiency. Additionally, the automatic reclosing mechanism incorporated into the system architecture played a crucial role in maintaining power system stability at high speeds, ensuring uninterrupted power supply and safeguarding critical infrastructure against potential disruptions.

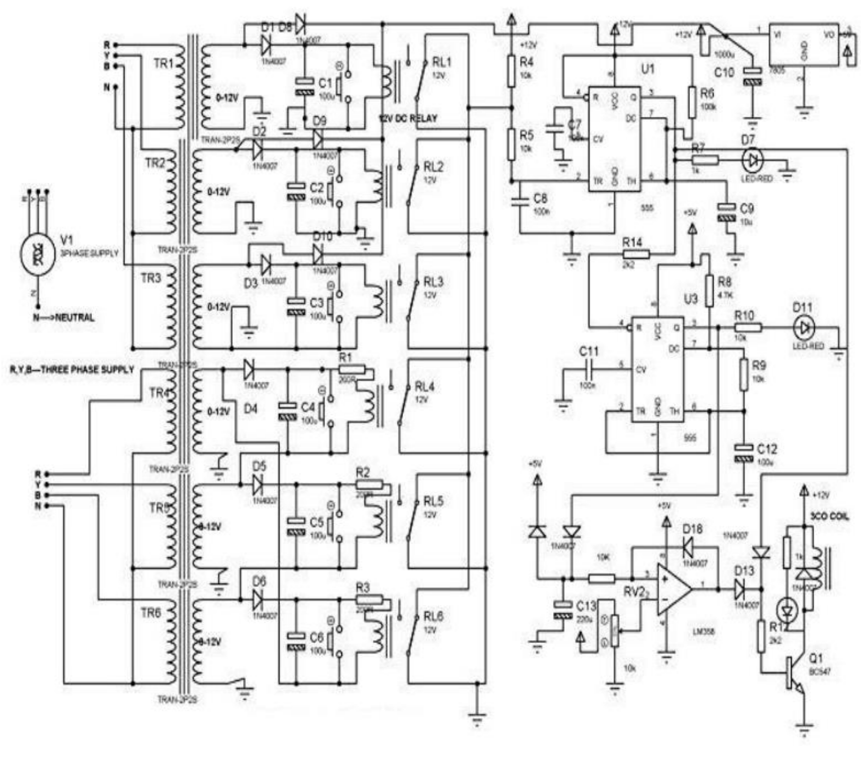

Fig 3. Circuit Diagram

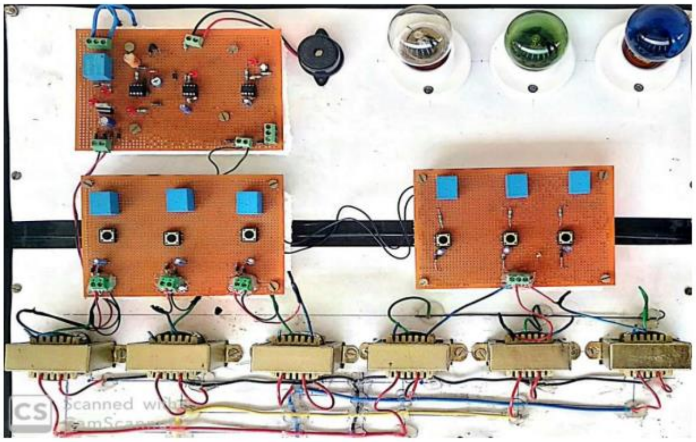

Fig 4. Ideal Condition Hardware Kit

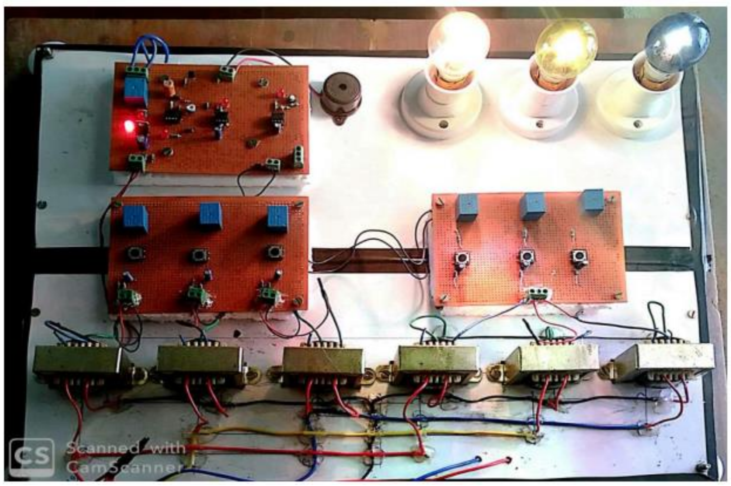

Fig 5. Temporary Fault Condition

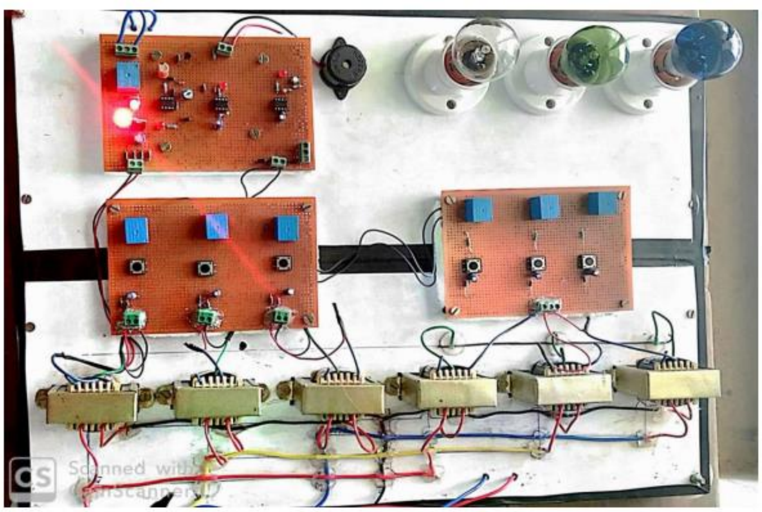

Fig 6. Permanent fault condition

The discussion of the results underscores the significance of the developed automatic tripping mechanism in addressing the escalating demand for electrical power across diverse sectors. By providing a proactive approach to fault detection and management, the system enhances the reliability, efficiency, and safety of power distribution networks, thereby meeting the evolving needs of households, agricultural, commercial, and industrial sectors. Moreover, the successful integration of IoT technology into the system architecture highlights the transformative potential of emerging technologies in optimizing power system operations and maintenance. Moving forward, continued research and innovation in fault analysis and management are essential for addressing the complex challenges posed by modern power distribution systems and ensuring the resilience of critical infrastructure in the face of evolving threats and disruptions.

CONCLUSION

Various faults have been created to develop an automatic tripping mechanism for the three-phase supply system while temporary and permanent fault occur. Here timer 555 has been used with relay for the fault analysis short duration fault returns the supply to the load immediately called a temporary trip while long duration shall result in permanent trip as this project is advantageous compare to other protection system it can be used for protection of transmission line faults which occur in power system hence this system is more economical, automatic and hazards free compared to other type of protecting system against three phase faults. In order to protect the equipment's of power system from faults, knowledge about system faults, their detection, and safe isolation of the faulted area is needed. Unlike Director Current Circuits, where only resistance restricts the current flow, in Alternating Current Circuits, there are other circuits aspects which determines the current flow; though these are akin to resistance, they do not consume power, but loads the system with reactive currents; like D.C. circuits where the current multiplied by voltage gives watts, here the same gives only VA. Like resistance, these are called ―Reactance‖. Reactance is caused by either inductance or by capacitance. The current drawn by inductance lags the voltage while the one by capacitance leads the voltage. Almost all industrial loads are inductive in nature and hence draw lagging wattles current, which unnecessarily load the system, performing no work. Since the capacitive currents is leading in nature, loading the system with capacitors wipes out them. The fault analysis codes were able to generate accurate results based on the input data defined by the theory of symmetrical components. It was noted that only symmetrical fault analysis can reveal the post fault bus voltages while the unbalanced faults analysis can only generate results for total fault current, bus voltages and line currents during the fault. Therefore, the project can be regarded as successfully done.

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