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Design and Development of Automated Electrical Circuit Fault Protector with Alarm System

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Abstract
In response to the critical need for fire and accident prevention in homes and establishments, this research presents an automated electrical circuit fault protector with an alarm system. The device automatically interrupts current flow upon detecting short circuits and overloads, safeguarding against potential hazards. Objectives include assessing sensitivity to faults, evaluating wireless remote-control performance, examining sound clarity, and ensuring voltage stability post-fault events. Equipped with a resettable system, the device allows manual or remote control. Using a developmental research method, data collection employed researcher-made observation and evaluation sheets. Thirty expert evaluators assessed the device. Micro testing revealed that the device was sensitive to faults and automatically triggered the alarm. With an overload rating of 1,500-3,000 watts, the device shuts off power automatically after the overload occurs and back to normal with a stable voltage once the problem was fixed, though this device was primarily designed only for micro-testing this device was customizable to user needs. Its alarm system boasts an audible range of up to 20 meters the same is through with remote control operation. Overall, the device effectively detects faults, incorporates an audible alarm, and supports remote operation, serving as a crucial safety measure against electrical mishaps and very acceptable in terms of design, composition, safety, and operating performance.

Keyword: Automated electrical circuit fault protector, alarm system, electrical safety, fault detection, short circuit, overload, wireless remote control, alarm signal clarity, voltage stability, design, and development.

INTRODUCTION

In today's world, where electrical appliances and systems are ubiquitous in both residential and commercial settings, ensuring their safe and reliable operation is paramount (Abdelmoumene and Bentarzi, 2020). Electrical faults, such as short circuits and overloads (Alcantara, et al. 2015; Akpeh and Madueme, 2017; Alvarez, 2019; Ara et al, 2020, Blanke, et al., 2016; Bo-Rong et al., 2017), pose significant risks ranging from property damage to potential threats to human life (IIEE, 2017). In response to these challenges, the design and development of an automated electrical circuit fault protector with an alarm system emerged as critical innovations aimed at enhancing electrical safety and performance. Electrical faults, such as short circuits and overloads, pose significant threats to property, infrastructure, and human safety. Traditional circuit protection mechanisms (Jovcic et al, 2018; Kishore, 2014, Lee et al., 2022, Liu et al., 2019, Lyashkov et al., 2018, Madueme et al., 2021, , while effective to some extent, often rely on manual intervention and may not provide timely responses to rapidly evolving fault scenarios. By incorporating advanced sensing technologies and alarm systems, an automated electrical circuit fault protector with an alarm system offers a proactive approach to electrical safety. The system can detect and respond to faults swiftly, minimizing the potential for damage and mitigating safety hazards. Moreover, the integration of a wireless remote control (Chen, 2021; Delgado et al., 2013; Huang et al., 2017; Jiangun et al., 2020), Mbumwe, 2017; Sharifu et al., 2014; Woodford, 2016) enhances user convenience and accessibility, allowing for remote operation and monitoring of the system from a distance.

According to the current state of the art in this field, traditional circuit breakers are still widely used today for power-system protection Eaton created the Arc Fault Detection Device (AFDD) in 2016 to provide enhanced protection against electric arcs (Madueme et al., 2021), leakage current (Murty, 2017), overcurrent (Lu et al., 2021), short circuits (Sheng, 2019; Institute of Integrated Electrical Engineers of the Philippines, 2017) and overvoltage the circuit breakers were usually installed as the protection (Yuan et al., 2022; Hodgson et al., 2022). An electrical circuit breaker (White, 2015; Xiao et al., 2023; Gorjian and Shukla, 2020; Lin et al., 2022) is a switching device that can be used to control and protect an electrical power system both manually and automatically. The new developed design and development of Automated Electrical Circuit Fault Protector with Alarm System is an automatically operated electrical device designed to protect an electrical circuit from damage caused by short circuit (Jijjun et al., 2017; Khan et al., 2022). Stutz's invention was the forerunner of the modern thermal-magnetic breaker commonly used in household load centers to this day (Alharbi and Habiballah, 2020). Electrical problem represent about 25% of the issue on power circuit breakers (White, 2022). Despite this point, however, electricity is inherently quite volatile, and so it *must* be precisely contained and planned for, and potential risks must be mitigated (Kabeyi and Olanrewaju, 2022) the most popular and common of which is a circuit breaker (Paynter, 2021). This is often colloquially called a "breaker trip" or "tripping a breaker" and it commonly happens when appliances or equipment acts up or too many high-power draw tools are placed (plugged into) a single circuit (Mitra and Chowdhury, 2017).

Fuses and breakers serve the same purpose overall, though breakers in many cases have overtaken fuses (Liu et al., 2019). In some cases disconnects are also fitted with a fuse (fusible disconnects) to provide further protection, though these also require the fuse be changed out in the event of an electrical issue (Shah et al., 2020).Medium voltage DC or MVDC system architectures are being considered in distribution systems of electric ships as well as electric vehicles (Tessarolo et al., 2013).

Existing and proposed techniques for interrupting DC fault current utilize electromechanical interrupters, solid-state switches, and combinations of both technologies (Gharehpetian et al., 2021). On the other hand, solid-state circuit breakers (SSCBs) make use of power electronic switches for interrupting the current without arcing (Mohammadi et al, 2020).

Even though this type of circuit breaker allows for very high interruption speeds, existing protection methods implemented on protection relays typically do not utilize this attractive feature (Sharifabadi and Norrga, 2015).

An electrical fault detector system an invention of Haun et al. (2015) detects electrical faults in an electrical distribution system by monitoring one or more conductors and producing an input signal representing one or more electrical signal conditions in the circuit to be monitored. Various mathematical models of power electronic devices and circuits are used of simulation purposes (Gwatidzo and Akindeji, 2023).

Due to the assumptions taken in the AVM approach, these models are applicable only for rectifiers with high filter inductance in case of large signal studies (He et al., 2020). The Fault Current Interruption Using

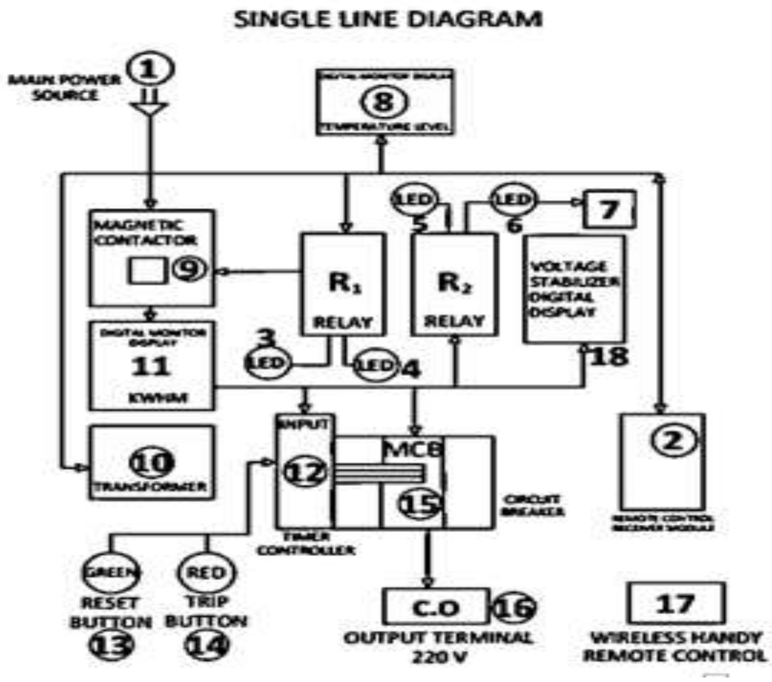
AC Circuit Breakers was the impulse current from the capacitor can be mitigated by adding a series inductor in the fault current path. (Cao et al., 2023). The Zhang et al. (2021) automatic fault alarming system for power grid dispatching invention belongs to the technical field of the grid, in particular to a fault alarm dispatching automation system. The study of Heirung and Mesbah (2019) reliably diagnosing faults and malfunctions has become increasingly challenging in modern technical systems because of their growing complexity as well as increasingly stringent requirements on safety, availability, and high-performance operation. Various fault detection techniques were explored, ranging from traditional methods like overcurrent protection to advanced techniques such as arc fault detection. These techniques leverage sensors, algorithms, and signal processing to detect and respond to different types of electrical faults promptly.

METHODOLOGY

This study used a cross sectional developmental method of research. Developmental research is defined as the systematic study of designing, developing, and evaluating products, processes, and products that must meet criteria of internal consistency and effectiveness (Budwig and Alexander, 2021). This cross-sectional developmental designing was used to examine the behavior of the device in different types of simulated troubles in electrical system as well as its behavior dealing with electrical troubles and wireless system operation. The design product was subjected to rigorous trials, testing, calibration, observation, and evaluation to meet the desired outcome. The internal and external working condition of the automated electrical circuit fault protector with alarm system has been manipulated/simulated such as short circuit and overload and based on scientific experimentation so that the observer can identify the variables been tested. The alarm system has been installed in order to inform the users of untoward incidents in their electrical system. The performances in terms of the design, construction, operating performance and safety of the product were based on an evaluation sheet used with the direct observation of the evaluators of the product. This device was anchored from the circuit breaker to protect the circuit from the short circuit. This device can be used as a portable circuit protector for any use such as installation and troubleshooting, to automatically isolate the circuit from the fault.

Before the device was made the researcher gather detailed requirements for the fault protector and alarm system, including detection sensitivity, wireless remote control range, sound clarity, voltage stability, and safety standards compliance and the performance metrics was defined for each objective to ensure clear evaluation criteria. Then the conceptual design for the fault protector and alarm system was designed based on the identified requirements and objectives and the overall architecture, component selection, and integration of fault detection, alarm generation, and wireless remote control functionalities was designed. Then after that the suitable components such as sensors, microcontrollers, wireless transceivers, alarm devices, and voltage regulators was selected based on performance, compatibility, and cost considerations. Then the selected components into a cohesive system design was integrated, ensuring compatibility and interoperability.

Furthermore, the prototype of the automated electrical circuit fault protector with the alarm system was built based on the conceptual design and the fault detection algorithm, alarm logic, wireless remote-control functionality, and voltage stabilization mechanism in the prototype was implemented then initial testing was conducted to verify the functionality and performance of individual components and subsystems.



Legend:

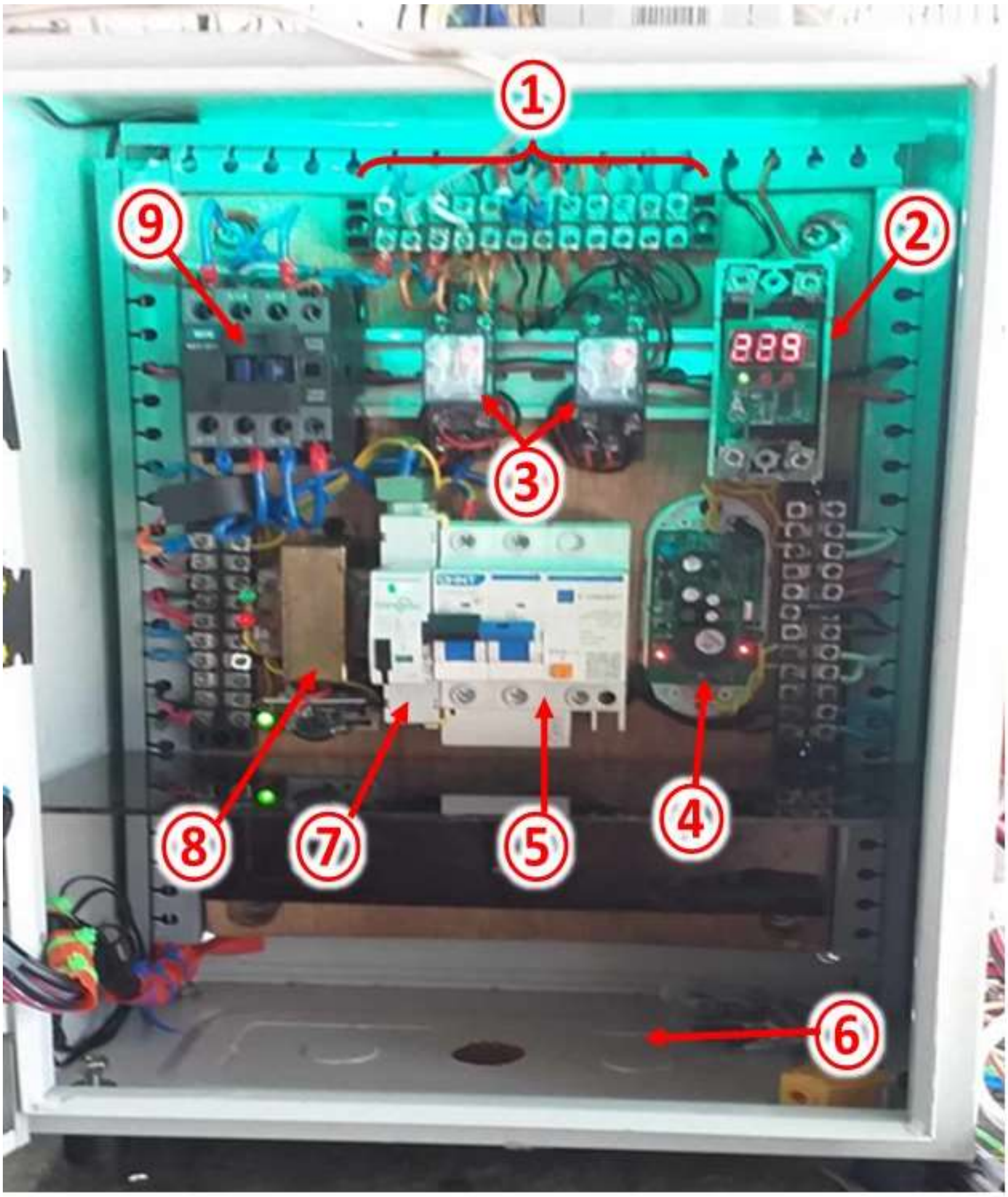
1. Main Power Source
2. Remote Control Receiver Module
3. Red LED standby power source indicator
4. Green LED general system power indicator
5. Yellow LED power output indicator
6. Red LED fault power indicator
7. Fault alarm system indicator
8. Digital monitor display temperature level
9. Magnetic contactor
10. Step-down power transformer
11. Digital monitor display kilowatt hour meter
12. Automatic transfer switching timer controller
13. Green reset push button switch
14. Red trip push button switch
15. Miniature circuit breaker
16. Convenience outlet output terminal
17. Wireless handy remote control
18. Voltage stabilizer digital monitor
19. R1 and R2 electromechanical Relay

Figure 1. Block diagram of the developed automated electrical circuit fault protector with alarm system.

Legend:

1. Fault power indicator
2. Power output indicator (220VAC)
3. General system power indicator
4. Standby power source 220VAC indicator
5. Digital monitor kWH meter
6. Door lock
7. Digital temperature display monitor
8. Fault alarm system
9. Digital fault push button
10. Digital reset push button

Figure 2. The front panel and manual controls of the developed automated electrical circuit fault protector with alarm system.



Legend:

11. Terminal block
12. Digital voltmeter monitor
13. Relay (220VAC)
14. Remote control module
15. Circuit breaker
16. Tools compartment
17. Automatic on/off circuit controller
18. Power step-down transformer 220VAC to 12VDC
19. Magnetic controller (30A)

Figure 3. Internal parts and layout of the developed automated electrical circuit fault protector with alarm system.

The prototype has been tested with the use of experimental setups to evaluate the sensitivity of the fault protector to short circuits and overloads and experiments under controlled conditions to simulate various fault scenarios and measure the system's response and alarm activation. The data was collected using researcher-made observation sheets on the sensitivity of the wireless remote control at different distances and assess sound clarity at varying distances from the alarm device. The experimental data was analyzed to determine the sensitivity of the fault protector to short circuits and overloads. This includes the wireless remote control's performance in terms of signal strength and reliability at different distances, sound clarity of the alarm system at varying distances and analyze any degradation in performance and the stability of the voltage output after a short circuit event and compare it to predefined criteria.
To further verify the acceptability of the device in terms of design, construction, operating performance, and safety the researcher conducts an evaluation to 30 experts such as electrical and mechanical engineers, electrical and electronics professors and instructors, industry professionals, and target consumers to gather feedback and overall satisfaction with the device using 5-Point Likert Scale. The performance of the automated electrical circuit fault protector with the alarm system against predefined acceptance criteria was validated to ensure it comply with relevant safety standards and regulations governing electrical devices and installations.

RESULTS AND DISCUSSIONS

Sensitivity of the Automated Electrical Circuit Fault Protector with Alarm System in terms of Short Circuit

Table 1 disclosed that the automated electrical circuit fault protector with alarm system was sensitive in terms of simulated scenario using wire plugged into the outlet as man-made trouble, and the device automatically responded to the fault circuit and the alarm this means that this device feature a good sensitivity that can detect short circuits at their earliest stages, often before they escalate into more serious issues. Early detection was crucial for preventing damage to the electrical components and minimizing downtime. The system was able to precisely identify the location and nature of the short circuit within the electrical circuitry. This allows for targeted isolation of the faulty section and quicker restoration of normal operation. While it was important for the system to be sensitive to actual short circuits, it also had a low false alarm rate. False alarms can lead to unnecessary disruptions and decrease the trustworthiness of the system. The sensitivity of the system was adjustable and adaptable to different operating conditions and environments. It can maintain high sensitivity without being overly susceptible to interference or noise. The fault protector's sensitivity was seamlessly integrated with the alarm system. When a short circuit was detected, the alarm was triggered promptly to alert operators or users, allowing them to take appropriate action. This means that the device was reliable to detect short circuits under various circumstances, providing an added layer of safety and protection to the electrical system.

Table 1. Sensitivity of the Automated Electrical Circuit Fault Protector with Alarm System in terms of Short Circuit.

Short circuit	**Fault**	**Sensitivity of the automated device in terms of short circuit**											
		Trials										**Mean**	**Remarks**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
Simulated scenario using wire plugged into the outlet as man-made trouble.	Short	1	1	1	1	1	1	1	1	1	1	1	sensitive

Legend:

1 - Sensitive *-if the automated electrical circuit fault protector with alarm system device alarm and detect the short circuit and over load.*

0-not sensitive *-if the automated electrical circuit fault with alarm system device will not respond nor alarm*

Sensitivity of the Automated Electrical Circuit Fault Protector with Alarm System when Overload Occurred

Table displayed the sensitivity of the automated electrical circuit fault protector with alarm system when overload occurred. The device responded when an overload occurred at 2,000 watts or higher. However, it did not respond when different electrical devices within wattage ratings of 100 watts to 1,200 watts were plugged into the device. However, when electrical appliances with wattage of 2,000 watts and higher were plugged, the device responded and became “Sensitive” in detecting overloading. The device includes adjustable settings and parameters that allow users to set the threshold for overloading based on their specific requirements.

This involves adjusting voltage levels, current limits, or other parameters relevant to the detection and management of overloads. It has also had external controls or interfaces that enable users to adjust its settings or configuration to accommodate different wattage levels. This includes physical controls, digital interfaces, and communication protocols for remote configuration. It also allows for easy expansion or upgrading to support higher wattage levels in the future. This ensures that the device can grow with the changing needs of the user or application.

Table 2. Sensitivity of the Automated Electrical Circuit Fault Protector with Alarm System when Overload Occurred

	LOAD	Wattage	Trials			Mean	Remarks
			1	2	3		
Over current protection	Electric motor	1865W (2.5Hp)	1	1	1	1	Sensitive
	Portable Welding machine	2000W	1	1	1	1	Sensitive

Legend:

1 – Sensitive *-if the automated electrical circuit fault protector with alarm system, alarm and detect the over load circuit.*

0-not Sensitive *-if the automated electrical circuit fault protector with alarm system has not response nor alarm.*

Sensitivity of the Automated Electrical Circuit Fault Protector with Alarm System Terms of wireless Remote Control with Four Varying Distances

Table 3 showed the sensitivity to the wireless remote control with four varying distances in meters the design and development of automated electrical circuit fault protector with alarm system is sensitive up to 20 meters distance. The device can effectively receive signals from the remote-control device even when operating at the farthest distance specified. This ensures that users can trigger the fault protector and alarm system from anywhere within the designated range. The sensitivity of the system remains consistent across all specified distances. Regardless of whether the user was close to or far away from the electrical circuit, it was able to rely on the remote control to activate the protector and alarm system without issues. A sensitive system able to filter out interference from other wireless devices or environmental factors that disrupted signal transmission. This ensures that the remote control remains effective and reliable even in challenging conditions. Ideally, the sensitivity of the system was adjustable to accommodate different environmental conditions and user preferences. This allows users to fine-tune the sensitivity based on factors such as signal strength, distance, and potential sources of interference. While maintaining sensitivity, the system was able to optimize battery life in both the remote-control device and the receiver unit. This ensures long-term usability without frequent battery replacements or recharging. The remote control's sensitivity was seamlessly integrated with the fault protector and alarm system. Upon receiving a signal from the remote control, the system promptly activates the necessary protocols to protect the electrical circuit and alert users of any faults.

Table 3. Sensitivity of the Automated Electrical Circuit Fault Protector with Alarm System Terms of wireless Remote Control with Four Varying Distances

Remote control with four varying distances	Trials (in meters)										MEAN	Remarks
	1	2	3	4	5	6	7	8	9	10		

5 meters	1	1	1	1	1	1	1	1	1	1	1	Sensitive
10 meters	1	1	1	1	1	1	1	1	1	1	1	Sensitive
15 meters	1	1	1	1	1	1	1	1	1	1	1	Sensitive
20 meters	1	1	1	1	1	1	1	1	1	1	1	Sensitive

Legend:

1- Sensitive *-if the automated electrical circuit fault protector with alarm system can be respond in four (4) varying distances*

0-Not Sensitive *-if the automated electrical circuit fault protector with alarm system cannot be respond in four varying distances*

Operating Performance of the Automated Electrical Circuit Fault Protector with Alarm System in Terms of Sound Clarity In Four Varying Distances

Table 4 revealed the operating performance, the sound clarity of the alarm of the design and development of automated electrical circuit fault protector with alarm system was audible from 5 to 20-meter distances. The alarm system produces clear and distinguishable sounds that effectively alert users to potential faults or issues within the electrical circuit. This includes ensuring that the alarm tones were audible and recognizable, even in noisy environments. Regardless of the distance from the alarm system, the sound clarity remains consistent. Users were able to clearly hear and understand the alarm signals whether they were near or far from the system. The system offers volume adjustment capabilities to accommodate different distances and environments. Users were able to increase or decrease the volume of the alarm to suit their preferences and needs. Consideration was given to the directionality of the sound emitted by the alarm system. This ensures that the alarm signals were effectively directed towards the intended recipients, minimizing the risk of missed alerts. The alarm system has an integrated distance sensors to automatically adjust the volume or sound clarity based on the user's proximity to the system. This ensures optimal performance across varying distances without requiring manual intervention. The system provides feedback to users to indicate successful activation of the alarm and acknowledgment of the fault detection. This feedback helps reassure users that the system was functioning properly, even at a distance.

Table 4. Operating Performance of the Automated Electrical Circuit Fault Protector with Alarm System in Terms of Sound Clarity in Four Varying Distances.

Sound clarity in four varying distances	**Trials (in meters)**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**MEAN**	**Remarks**
5 meters	1	1	1	1	1	1	1	1	1	1	1	Clear
10 meters	1	1	1	1	1	1	1	1	1	1	1	Clear
15 meters	1	1	1	1	1	1	1	1	1	1	1	Clear
20 meters	1	1	1	1	1	1	1	1	1	1	1	Clear

Legend:

1-Clear *-if the automated electrical circuit fault protector with alarm system can be heard in four (4) varying distances*

0-Not Clear *-if the automated electrical circuit fault protector with alarm system cannot be heard in four varying distances*

Stability of the Automated Electrical Circuit Fault Protector with Alarm System in terms of Voltage after Short Circuit Occurred

Table 5 displayed thee stability of automated electrical circuit fault protector with an alarm system after a short circuit was stable after the short circuit occurred this was due to design of the circuit that plays a crucial role in its stability with appropriate components and protection mechanisms maintains stability after a short circuit and the fault protector was capable of quickly detecting the short circuit and isolating the faulty section of the circuit. This helps prevent further damage and ensures the stability of the rest of the system. The response time of the fault protector was critical and able to react swiftly to the short circuit and minimize the impact on the system's stability coupled with an effective voltage regulation system which can help maintain stability by ensuring that the voltage levels remain within safe limits even after a short circuit occurs. After the short circuit was resolved, an automatic reset mechanism helped restore the system to its normal operating state, further enhancing its stability.

Table 5. Stability of the Automated Electrical Circuit Fault Protector with Alarm System in Terms of Voltage after Short Circuit Occurred

Stability of the voltage after short circuit		**Trials**											
		1	2	3	4	5	6	7	8	9	10	Mean	Remarks
Test Instrument	**Tested voltage**												
Analog Multi-Tester	219 Volt	1	1	1	1	1	1	1	1	1	1	1	Stable

Legend:

1-Stable *-if the measured voltage does not show fluctuation and within the working voltage level condition*

0-Not stable- *if the measured voltage show fluctuation and not within the working voltage level condition*

Acceptability of the Automated Electrical Circuit Fault Protector with Alarm System in Terms of Design, Construction, Operating Performance, and Safety

Table 6 showed the acceptability of the design and development of automated electrical circuit fault protector with alarm system in terms of design, construction, operating performance and safety was "Very Acceptable." Overall, the acceptability of an automated electrical circuit fault protector with an alarm system hinges on its design, construction, operating performance, and safety features. A well-designed, robustly constructed, reliable, and safety-compliant system was more likely to be accepted and trusted by users in various applications, ranging from residential and commercial settings to industrial environments. Regular maintenance, testing, and adherence to best practices further enhance its acceptability and effectiveness over time.

Table 6. Acceptability of the Automated Electrical Circuit Fault Protector with Alarm System in Terms of Design, Construction, Operating Performance, and Safety.

Acceptability	Mean	Verbal Interpretation
Design	4.85	Very Acceptable
Construction	4.80	Very Acceptable
Operating performance	4.87	Very Acceptable
Safety	4.89	Very acceptable
Grand Mean	4.85	Very Acceptable

Legend:

Range	*Verbal Interpretation*
4.21-5.00	*Very Acceptable*
3.41-4.20	*Acceptable*
2.61-3.40	*Moderately Acceptable*
1.81-2.60	*Less Acceptable*
1.00-1.80	*Least Acceptable*

Conclusions

Based on the findings of the study, the following conclusions were drawn:
The device exhibited sensitivity in detecting short circuits and overloads, effectively responding to simulated scenarios. However, there were limitations in sensitivity for detecting lower wattage loads, particularly in the range of 100 to 1,200 watts.
The wireless remote control demonstrated sensitivity across varying distances, allowing for convenient operation up to 20 meters from the device. Users can control the automated electrical circuit fault protector with ease from a distance of up to 20 meters, allowing for flexibility in placement and usage within a room or building. It also eliminates the need for users to physically interact with the device, enhancing convenience, especially in situations where the device is installed in hard-to-reach or inaccessible areas. By enabling operation from a distance, the wireless remote control enhances safety by reducing the need for users to approach potentially hazardous electrical environments to manually control the device. Users can quickly and efficiently manage the device without the need to navigate through physical obstacles or wiring, saving time and effort in operation and maintenance tasks. The ability to control the device from a distance opens possibilities for various applications and environments, including residential, commercial, and industrial settings, where convenient operation is essential.
The device's alarm system provided clear and audible alerts within distances ranging from 5 to 20 meters, ensuring effective communication of fault occurrences. The clear and audible alerts ensure that users were promptly informed of any fault occurrences, allowing for immediate action to be taken to address the issue. By effectively communicating fault occurrences, the alarm system enhances safety by alerting users to potential hazards such as short circuits or overloads, enabling them to take necessary precautions or evacuate the area if needed. The audible alerts can be heard within a wide range of distances, ensuring that users throughout the vicinity were made aware of any faults, regardless of their location relative to the device. The reliability of the alarm system provides users with peace of mind, knowing that they will be alerted to any electrical faults even if they are not in close proximity to the device. Lastly, the ability of the alarm system to communicate effectively within a range of distances makes the device suitable for various environments, from small residences to large commercial or industrial facilities.

The device provides stable voltage and free from fluctuation after the automatic reset and the voltage stability was maintained post short circuit events, with the voltage remaining stable and within normal working levels. The advantage of maintaining voltage stability post short circuit events, with the voltage remaining stable and within normal working levels, was crucial for ensuring uninterrupted power supply and preventing damage to electrical equipment The stable voltage levels prevent voltage fluctuations that can damage sensitive electrical equipment, such as computers, appliances, and industrial machinery, thereby extending their lifespan and reducing maintenance costs. Thus, maintaining stable voltage levels ensures that electrical devices continue to operate smoothly even after a short circuit event, minimizing downtime and ensuring uninterrupted productivity in industrial or commercial settings. The consistent voltage levels reduce the risk of electrical hazards, such as fires or electrocution, which can occur due to voltage surges or fluctuations resulting from short circuits. Likewise, stable voltage levels promote energy efficiency by ensuring that electrical equipment operates optimally within its specified voltage range, thereby reducing energy wastage and lowering utility costs. The assurance of voltage stability post short circuit events instills confidence in users, knowing that their electrical system can withstand unexpected faults and continue to function reliably.

Overall, the device was deemed "Very Acceptable" in terms of design, construction, operating performance, and safety. User satisfaction and confidence were high, indicating that the device met or exceeded expectations in terms of its functionality and safety features.

Recommendations

Based on the findings of the study the following recommendations are forwarded:

The automated device can be used and the magnetic relay, ac plug, convenience outlet, magnetic contactor, and others electrical parts, electrical wires the change after one (1) year of use in order to maintain and improve the sensitivity of the design and development of automated electrical fault circuit protector with alarm system.

In terms of operating short and overload circuit occurrence, the magnetic contactor be used to increase the current capacity of the automated device was recommended a larger buzzer for farther distance and audible alarm may also be provided. And another recommendation to convert the automated device from single phase to three phase line.

The device casing and cord may be cleaned using unused paint brush and slightly damp cloth before using this device, examine the cords wires connection contactor relay for any damage and replace it if necessary.

Based on the importance of safety and reliability in electrical systems there was a need to evaluate safety standards to ensure that the protector complies with relevant safety standards and regulations to guarantee the highest level of safety for personnel and equipment.

Consider compatibility to choose a system that is compatible with the specific electrical circuitry, appliances, and equipment in your application to ensure seamless integration and optimal performance so there was a need to modify the system that should be within the specific wattage that the user need to energize.

Prioritize systems known for their reliability in fault detection and alarm activation to minimize the risk of false alarms or missed faults and look for a system with fast response times to detect faults promptly and initiate protective actions to mitigate potential hazards quickly.

Consider systems with remote monitoring and control capabilities, allowing operators to manage the system from a distance and receive real-time alerts about faults and select a system that is easy to install,

operate, and maintain to minimize downtime and ensure efficient operation.
Choose a system that can accommodate future expansion or modifications to the electrical system to ensure long-term viability and flexibility that has Opt for a system from a reputable manufacturer that offers comprehensive support and service options to address any issues or concerns that may arise during installation or operation.
Lastly, since the device was cost-effectiveness it balance the initial investment cost with the long-term benefits and savings associated with enhanced safety, reliability, and reduced downtime.
By considering these recommendations, you can select an automated electrical circuit fault protector with an alarm system that meets your specific safety, reliability, and operational requirements.

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