

Detection of the Breakage of Low Voltage AC Distribution Over Head Conductors

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Abstract: We use low-voltage AC distribution conductors a lot in power systems because they are cheap and easy to install. These low-voltage AC distribution conductors can break easily because of ambient condition, age factor and due to object falling. When a low-voltage AC distribution conductor breaks it can cause the power to go out be a safety hazard, start fires and damage equipment. In power systems, it takes a long time to find the problem because we have to wait for someone to check it manually or for people to complain. This makes it take longer to fix and makes the electrical power system less reliable. This project is about making a system to find breaks in low-voltage AC distribution conductors. In our project we check the voltage, current all the time to see if something is wrong with the low-voltage AC distribution conductor. If it finds a break it sends an alert so we can fix the low-voltage AC distribution conductor fast. We want this system to be cheap, work well and be good for real-world use in low-voltage AC distribution systems. Our system is meant to make electrical power safer, reduce the time of power outage and makes the electrical power system work better. This project shows that we can use methods to find breaks in low-voltage AC distribution conductors in time. This means it could be used in the future and in smart power systems. Low-voltage AC overhead distribution conductors will be safer with our system.

Keywords: Low- Voltage AC Distribution System, Overhead Conductor Breakage Detection, Fault Detection, Electrical Safety, Voltage and Current Monitoring, Power System Protection.

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I. INTRODUCTION

Electrical power distribution systems are really important for bringing electricity from power plants to our homes, offices and factories. We usually use low-voltage AC distribution lines to get electricity to where it's needed. These lines are a choice because they are not too expensive easy to install and simple to maintain. You can see these lines a lot in areas that are not too rural and not too urban. However since they are outside all the time they can get damaged easily by things like weather, trees and other objects.

One major issue with low-voltage AC distribution systems is when the wires get broken. This can happen due to weather trees touching the wires, rust, too much stress on the wires, accidents, old age or too much electricity flowing through them. When a wire breaks it can stop electricity from getting to our homes. It can also cause dangerous things like electric shocks, short circuits and fires. Sometimes we do not know about the problem away because we usually find out about it when someone complains or when we check the lines manually. This delay can make it take longer to fix the

problem make the system less reliable and cause problems for people who use the electricity.

Because people want electricity to be safe and reliable we need a system that can find wires quickly and correctly. The systems we have now are usually made for high-voltage lines and can be very expensive or not suitable for low-voltage lines. So it is very important to make a system that's cheap and works well for low-voltage overhead wires.

Voltage AC distribution overhead conductors are what this project is focused on. The project is about making a prototype that can detect when low-voltage AC distribution overhead conductors break. The prototype will always check the electricity to see if something is wrong because of a wire. If it finds a problem it will send a signal or alert so that someone can fix it away. This system wants to make people safer reduce the time that electricity's out and make the electrical distribution network better and more efficient. Detecting breakage, in low-voltage AC distribution conductors is the main goal of this project.

II. LITERATURE REVIEW

Researchers have come up with ways to find and watch for problems in these systems. [1] Li, H., & Redfern M. A. "A Review of Techniques to Detect Downed Conductors in Overhead Distribution Systems." In this paper, Li and Redfern looked at methods to find broken conductors in overhead power lines. They found that traditional protection devices often struggle to detect these breaks because the fault current is usually very low. Regular relays and fuses might not catch these faults, which can leave the conductor energized, causing serious safety risks. The authors talked about ways to detect breaks, such as harmonic analysis, signal processing and relay-based methods. They said that we need monitoring and smart fault detection systems to reliably find broken conductors. The study showed that continuously monitoring parameters can improve safety and quickly detect faults in power distribution networks. [2] Sedighzadeh, M., et al. "Approaches in High Impedance Fault Detection – A Chronological Review." In this paper, Sedighzadeh and other people wrote about the history of finding high impedance fault detection methods in power distribution systems. These faults are really hard to find because they make small currents. This makes it tough for the usual protection systems to find them. The paper talks about how things changed from methods to more advanced things like looking at signals using wavelet transforms and using artificial intelligence, like neural networks and fuzzy logic. Sedighzadeh and other people think that using a mix of methods works better and is more reliable. We still need to find a perfect solution that works for everything. [3] Sarlak, M., et al. "High Impedance Fault Detection: A Review." This paper look at the ways that we need systems to find high impedance faults. They think these systems should be able to change and work in time to make sure the power system is safe. No single way of finding impedance faults works all the time so we need to make some improvements. High impedance faults and the systems to find them are very important, for power distribution systems. [4] Bindi, M., et al. "A Comprehensive Review of Fault Diagnosis and Prognosis Techniques in Electrical Power Lines." Bindi and his team have written a review of modern techniques used to diagnose and predict faults in electrical power lines. The need for a power supply is increasing and this has led to the development of advanced methods to monitor and diagnose faults going beyond traditional protection systems. The study looks at different approaches, including monitoring conditions using sensors, processing signals and intelligent systems to detect and predict faults in power lines. It also talks about using real-time data to improve how quickly and accurately faults are detected. The use of real-time data acquisition and analysis is crucial in improving fault detection speed and accuracy. However they also mention that there are challenges, such as costs, complex systems and limited use, in low-voltage networks. The review concludes that using sensors and intelligent algorithms together can make power lines more reliable.

➤ Problem Statement

We use low-voltage AC distribution overhead conductors a lot in power distribution systems in rural and

semi-urban areas. This is because they are cheap and easy to install. These conductors are often exposed to bad weather like storms and mechanical stresses such as tree falls, corrosion and accidental damage. These stresses can cause the conductors to break. When conductors break it can interrupt the power supply, create safety hazards for people and animals, cause fires and make the distribution network less reliable.

In distribution systems, we usually only find out about conductor breakage when people report power outages or maintenance teams manually check the lines. This approach takes a time to detect faults, delays repairs and increases costs. Available fault detection techniques are designed for high-voltage transmission systems and are too expensive for low-voltage distribution applications.

To solve these problems our project aims to design and build a prototype system to detect breakage in low-voltage AC distribution conductors. The prototype will keep monitoring parameters like voltage and current to spot abnormal conditions caused by conductor failure. If a breakage is detected, the system will send an alert to enable faster response and maintenance.

The goal of our proposed prototype is to show that a cost, reliable and efficient method for real-time conductor breakage detection can improve electrical safety reduce power interruption time and make low-voltage AC distribution systems more reliable. Low-voltage AC distribution systems are crucial, for power distribution. Our prototype focuses on improving their reliability. Conductors are components of these systems and detecting their breakage can prevent many issues.

III. PROPOSED METHODOLOGY

The purpose of choosing this project is to make a system that can find faults in time. This system is for low-voltage AC conductors. We should be able to tell when one of these conductors breaks. We will watch the current all the time to see if something is wrong with the conductor. If the conductor is broken the system will find it. The system uses sensors to make sure it can find faults quickly and correctly. The system, for low-voltage AC conductors is made to be fast and work well.

➤ System Overview

The system we are proposing is meant to find out when low-voltage AC overhead distribution conductors break away.

It uses voltage and current sensors to keep an eye on the distribution line and sends this information to a microcontroller for checking.

- The microcontroller then compares what it measured to limits that have been set to figure out if something wrong because of a broken conductor.
- When it finds a problem the system sends out a warning, shares details about the issue through a wireless module.

- This helps us find problems fast, makes the system more reliable and keeps people safer.
- The system does this by monitoring things all the time and reacting quickly when something goes wrong with the conductors.
- It is designed to make sure that when a conductor breaks we know about it away.
- The system helps in fast fault detection, improved reliability and enhanced safety because of the conductors.

➤ *Architecture Design*

The architecture we are talking about has main parts: sensing units, a processing unit, a communication module and an alert system. We use voltage and current sensors to keep an eye on the low-voltage AC distribution line all the time. These sensors send signals that get turned into data and are then looked at by a microcontroller.

The microcontroller checks the voltage and current values to see if anything is wrong like if conductors are broken. If it finds a problem it sets off an alarm, sends information about the problem to the monitoring station using a Wi-Fi communication.

The architecture also has a power supply unit to make sure everything works. This way the architecture design is better. It can help us deal with problems more easily.

➤ *Hardware Components*

The proposed system has the following hardware parts:

- Voltage Sensor: This measures the line voltage of the AC distribution system.
- Current Sensor (CT): It keeps an eye on the current flowing through the conductor.
- Microcontroller (ESP-32): This processes data from the sensors and checks for conductor breakage.
- Relay Module: This provides isolation and control.
- Buzzer: This gives a warning when there's a fault.
- Power Supply Unit: This supplies power to all the system components.

➤ *Fault Detection Algorithm*

The fault detection algorithm is always checking the voltage and current of the low-voltage AC distribution line. It takes the information it gets, uses the microcontroller to see if it is okay.

The microcontroller compares this information with the limits that were set before.

When a conductor breaks, the current suddenly drops or the voltage does something weird, the algorithm waits for a bit to make sure this is not just a temporary problem.

If the problem is still there after a while the system says yes the conductor is really broken. Then it turns on the alarm, sends a message to the people who are monitoring the system through the communication module. The fault detection algorithm does this to make sure the people know about the problem with the conductor breakage. The system is always watching for problems, like conductor breakage.

➤ *IoT Communication*

The system we are talking about uses communication to send information about faults in real time. When the system finds out that a conductor is broken it sends the details of the fault to a server or a place where people monitor things. It does this using a Wi-Fi communication.

The IoT platform lets people check on things, from away look at what is wrong quickly and tell the people who fix things right away through their phones or computers.

This way of communicating helps people react faster, makes the system more reliable and supports the use of grids to monitor things. IoT communication is really important for this system to work well. It helps with IoT-based monitoring all the time.

➤ *Circuit Description*

The proposed circuit for detecting breakage in low-voltage AC overhead distribution conductors has stages: sensing, processing, communication and indication. These stages are combined into one embedded system.

The voltage and current sensing part is linked to the distribution line. It continuously measures parameters in real-time. A current transformer senses the load current. A voltage sensor monitors line voltage.

These sensed signals go into an Analog-, to-Digital Converter. There they are changed into values that the microcontroller can process. The microcontroller is the main control unit. It runs the fault detection algorithm by comparing measured values with threshold limits.

When everything is normal, the system works with voltage and current readings. If a conductor breaks the current suddenly drops to zero or almost zero. The voltage might still be present. The microcontroller spots this condition. It confirms the fault after a delay to prevent false alarms.

Once the fault is confirmed the microcontroller turns on the indication unit. This could be a buzzer. It also sends an alert through a IoT module to the monitoring station. A regulated power supply gives DC power to all circuit parts. This ensures the system works reliably.

Overall, the circuit is designed to quickly and accurately detect conductor breakage.

IV. FLOWCHART

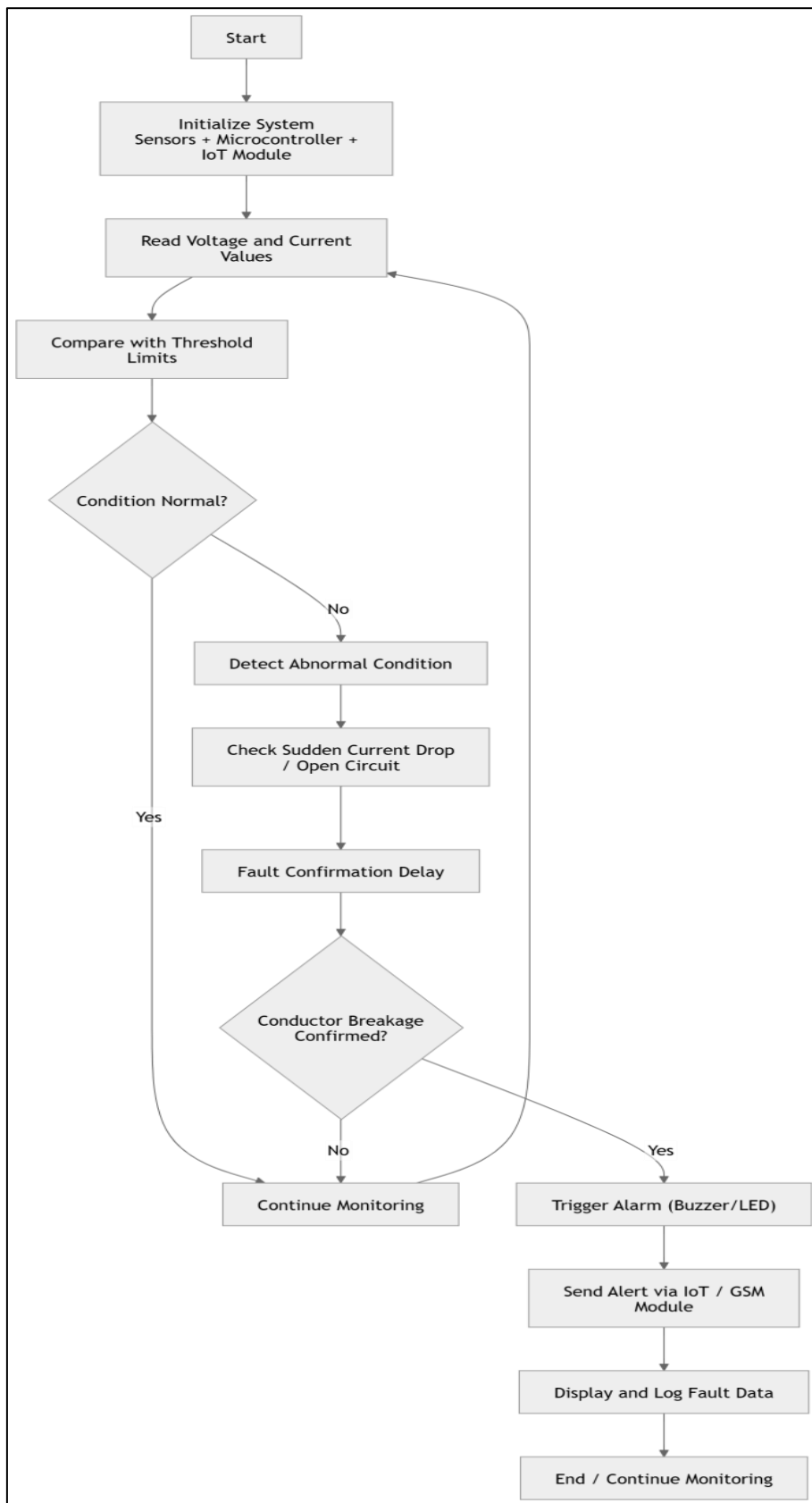


Fig.1 Flowchart of the Detection of the Breakage of the Low Voltage ac Distribution Over Head Conductors

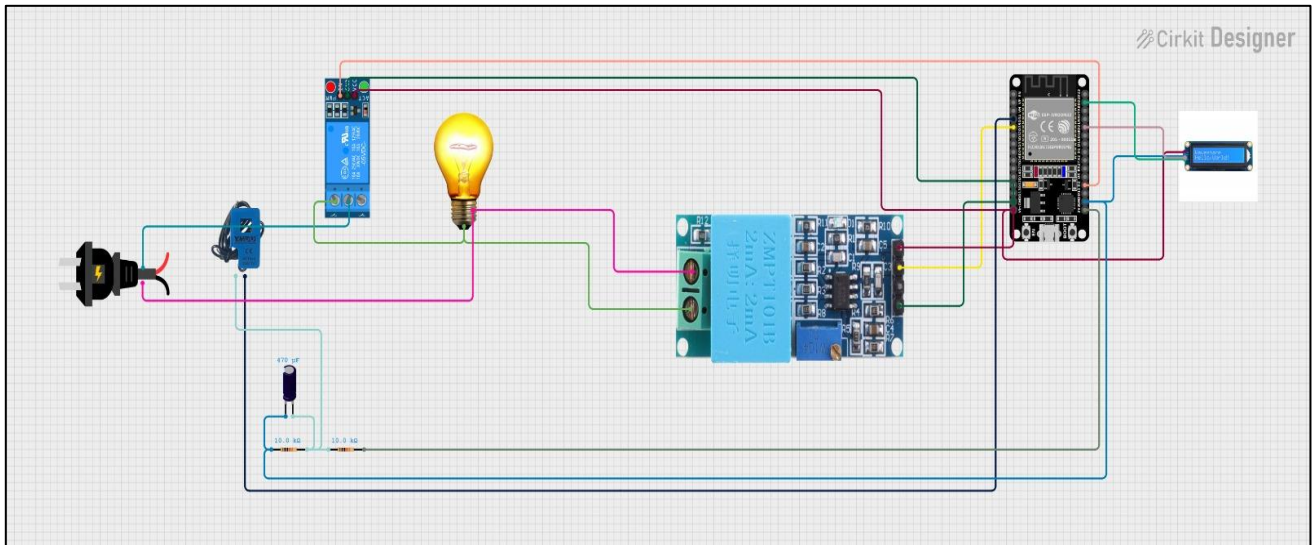


Fig. 2 Circuit Diagram

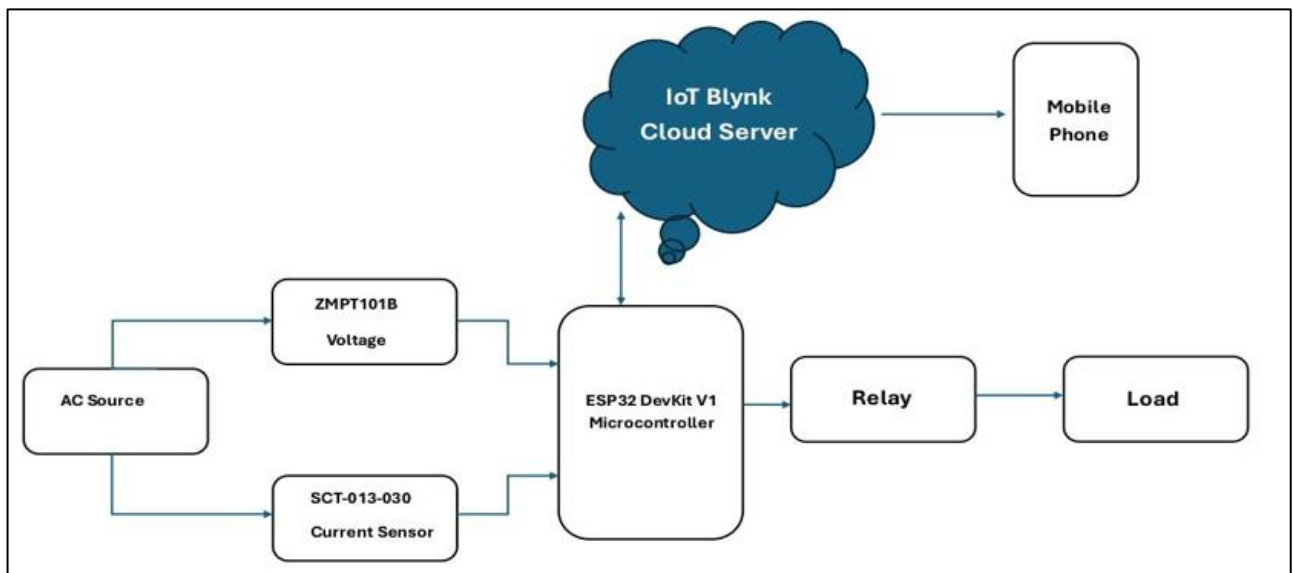


Fig. 3 Block Diagram

V. HARDWARE TESTING

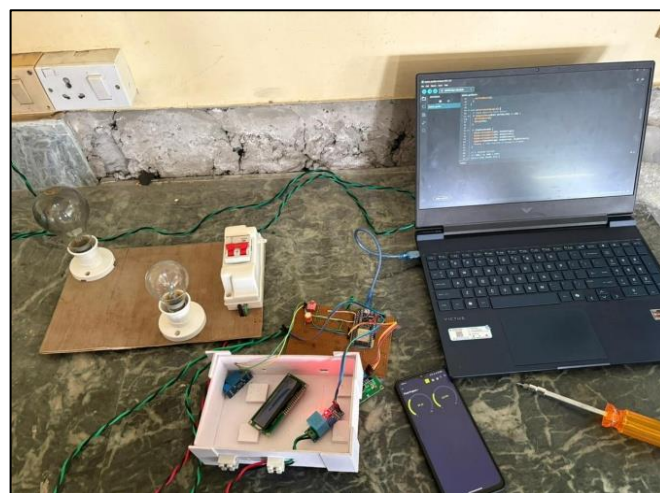


Fig. 4 Testing of Hardware

VI. RESULTS AND DISCUSSIONS

The system we made to find out when low-voltage AC overhead distribution conductors break was tested when everything was working normally and when we made it look like something was wrong on purpose. The system did a job of watching the voltage and current in real time and finding problems that meant a conductor had broken.

When everything was working normally the system gave us readings and did not send out any false warnings. This means that the sensors are working well and the threshold levels are set correctly. When we made it look like a conductor had broken by opening the circuit the current went down to zero right away but the voltage was still there.

The system reacted fast for things that need to happen in real time and it was able to send out a warning through the Wi-Fi communication. The buzzer on the system also went off away to let people nearby know that something was wrong.

The results show that our method is good at finding out when overhead conductors break with a level of accuracy and not many false warnings. The system is also reliable when the load on it changes. However how well it works can be affected by how accurate the sensors are how long it takes for the communication network to send messages and how the threshold levels are set.

Overall, we think that the system is good for finding faults in low-voltage distribution networks and it can be made better by adding more advanced ways to find the location of problems and using machine learning techniques. The low-voltage AC overhead distribution conductor's breakage detection system is suitable for this and the low-voltage AC overhead distribution conductor's breakage detection system can be improved more.

VII. CONCLUSION

The system we are talking about for finding breakage in low-voltage AC overhead distribution conductors is a way to identify problems in real time. It works by checking the voltage and current to find any unusual conditions that could be caused by a broken conductor. Then it uses a set of rules to confirm if there is really a problem.

The system uses a computer to process information and it can send alerts quickly to the people who need to know using the internet or a phone signal through Blynk IoT. This helps get things fixed faster and makes maintenance easier.

The way we are doing things makes the low-voltage distribution networks more reliable and safer. It is a way to automatically find problems and we can make it even better by adding new ways to find exactly where the problems are and using smart grid technologies. The system, for finding breakage in low-voltage AC distribution conductors is a good start and it can help a lot.

VIII. FUTURE SCOPE

The system we are talking about can be made better in the future. We can work on making it more accurate and able to handle data. We also want to be able to monitor everything in time especially in areas where the voltage is low.

In the future we can use technologies like machine learning and artificial intelligence to make the system better at finding faults and reducing false alarms.

The system can also be improved with GPS, which will help us find where the faults are on the distribution line. We can also use cloud computing to monitor everything from one place store all the data and use analytics to predict when maintenance is needed.

We can also use IoT sensors to build a smart distribution network that can check the health of the overhead conductors in real time. In the future we may also work on reducing delays in communication making the sensors more accurate and making the system more reliable, in weather conditions. The future scope of the system is to make it even better and more efficient. The system will be improved to make it more accurate and reliable.

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