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AUTOMATION OF RING MAIN UNIT

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Abstract: The development of communication networks in distribution grids, within the framework of evolving Smart grids, makes it possible to possess a significant amount of information on an entire electrical grid, for the purpose of manual or automatic operation or for making decisions in terms of maintenance and grid development. Active management and protection of distribution networks are beginning to take a foothold in utilities in the world. In this regard, Fault Location, Isolation, and Service Restoration (FLISR) scheme is a prevalent smart grid functionality for enhancing the reliability performance of a distribution system. At the high level, FLISR facilitates faster sectionalization of a distribution feeder during a failure event and reliability improvement is achieved by limiting the exposure to or duration of outage experienced by customers connected to the feeder i.e., Self-Healing. This project introduces a Heuristic Method suitable for FLISR scheme implementation: select manually operated medium voltage isolation switches are upgraded to automated and/or tele-controllable Ring Main Units (RMU). The method assigns a Reliability Value that can be readily calculated for any manual switches under consideration. The result shows that the reliability performance with RMU is most sensitive to feeders with longest length attributes and least sensitive to the feeders with lowest capacity attributes in the network.

Index Terms **- FLISR, RMU, Smart grids, reliability, distribution system, Self-Healing, automated, feeders.**

1.INTRODUCTION

In an electrical power distribution system, a ring main unit (RMU) is a factory assembled, metal enclosed set of switchgear used at the load connection points of a ring-type distribution network. It includes in one unit two switches that can connect the load to either or both main conductors, and a fusible switch or circuit breaker and switch that feed a distribution transformer. The metal enclosed unit connects to the transformer either through a bus throat of standardized dimensions, or else through cables and is usually installed outdoors. Ring main cables enter and leave the cabinet. This type of switchgear is used for medium-voltage power distribution, from 7200 volts to about 36000 volts.

Ring main units can be characterized by their type of insulation: air, oil, or gas. The switch used to isolate the transformer can be a fusible switch or may be a circuit breaker using vacuum or gas-insulated interrupters. The unit may also include protective relays to operate the circuit breaker on a fault. The overhead lines are replaced by underground cables in some areas due to their advantages like less power outage and safety. With the introduction of underground cables, Ring Main Unit (RMU) came into existence. It is a compact, enclosed switchgear used for medium voltage power distribution.

This paper mainly focuses on monitoring of the RMU. A monitoring and controlling system for RMU is necessary to minimize the time taken to find the fault. The present RMUs installed do not have a monitoring and controlling system. Hence, there is a requirement for a device that continuously monitors the status of the relay and circuit breaker present inside the RMUs. This project proposes a device that overcomes the problems faced by unmonitored RMUs. This device checks the status of each feeder of the RMU and intimates to the concerned officers if any change occurs. This device minimizes the time taken to detect the fault in the feeders by reflecting the changes immediately which will in turn reduce the outage of the power supply.

Fig 1.1 Ring main unit (RMU)

The component is utilized across:

- tunnels
- light mining
- office buildings
- underground railways
- hospitals
- shopping centers
- residential housing complexes
- distribution utility networks
- wind farms and;
- airports

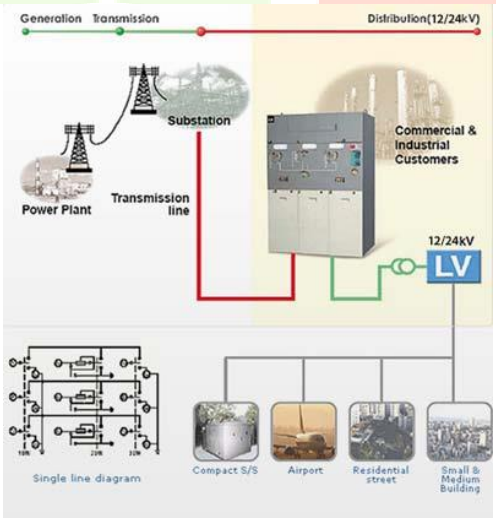

Fig 1.2 Ring main unit in substation

1.2 OBJECTIVES

To design and develop a device for automation of RMU which serves the following purpose:

1.Remote monitoring of RMU.

2.Remote controlling of RMU.

3.Dashboard for status updates as well as alerts.

4.Cloud storage for future data analysis.

2. METHODOLOGY

1. ESP32 is used as the microcontroller in the proposed system.
2. The main reason behind using ESP32 as the microcontroller is it has inbuilt Wi-Fi which makes it suitable for our IoT application.
3. The ESP32 Microcontroller can connect to an Access Point and get internet access which can be used for remote monitoring as well as controlling purpose.
4. Here we plan to use ZMPT101B AC Voltage Sensors that are used to sense the status of the RMU.
5. The microcontroller pushes the data collected from these sensors to the cloud storage.
6. Here we are using ThingSpeak Cloud Storage.
7. ThingSpeak provides Read and Write API Keys for accessing cloud.
8. Controlling of the RMU is done using the same cloud storage by providing commands from the GUI developed using Python.
9. PySimpleGUI module of Python is used for designing the GUI for controlling and monitoring the RMU.
10. The hardware system developed can read data from cloud and take actions while it can write sensor data to cloud.
11. The Graphical User Interface can read sensor data and display it while can write data to the cloud to control the actuators on the hardware system.

3.LITERATURE SURVEY

Over the last two decades, there are no changes on the distribution network mainly in secondary distribution (11kv/440v). The traditional type of 11/22 kV distribution adopts mainly radial system, the combination style of radial type and tree-style as a supplement. As a result of multiusers to connect to one power cord, any occurrence such as power line maintenance or failure will lead to all users' power off that are connecting on the power line of electricity. Hence, it gives poor power supply reliability. Ring type and multiloop distribution of regional opening and closing station should be widely used in the present scenario to assign the power load to each terminal [2]-[3].

The 11/22kV box-type ring main unite can act its function as the branch, sub-section and sub-connection so has been use vary widely [4].

Now a day's many technologies are developed in distribution side to improve the performance of the system. In distribution side generally radial system is used but the recent trades is use of ring main system for the better performance. Thus, the implementation of RMU (Ring Main Units) technology in distribution side converts radial feeder in to ring main system. This modification saves the time of fault clearance of overall feeder, reduce the power loss and maintain the continuity of power supply to the load.

[5] In present days, the overhead lines and somewhere underground cables are used for distribution system. In ring main system, feeders outgoing from the substation and the primaries of distribution transformers form a close loop. Loop circuit starts from the substation bus-bars, makes a loop by covering the area to be served, and return to the substation. In this topology, if the fault occurs in the closed loop, then the faulty part is disconnected from the system and continuous supply is maintained from alternative path to the connected load [6].

The main advantage is that, the voltage fluctuations at consumer's terminals are less and system is very reliable as each distributor is fed via two feeders [7], [8].

The common practice in distribution protection is to use overcurrent relaying schemes which provides complete protection for all types of distribution configurations. These overcurrent relays use different characteristics and combination of them provides security and sensitivity [9]-[10].

4.SYSTEM DESIGN

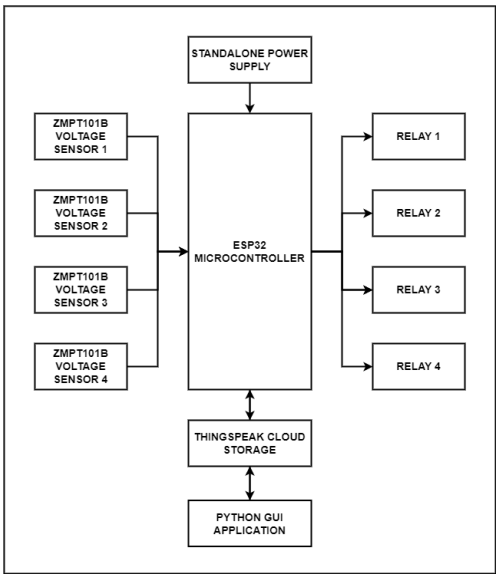

Fig 4.1 Block Diagram (System Architecture)

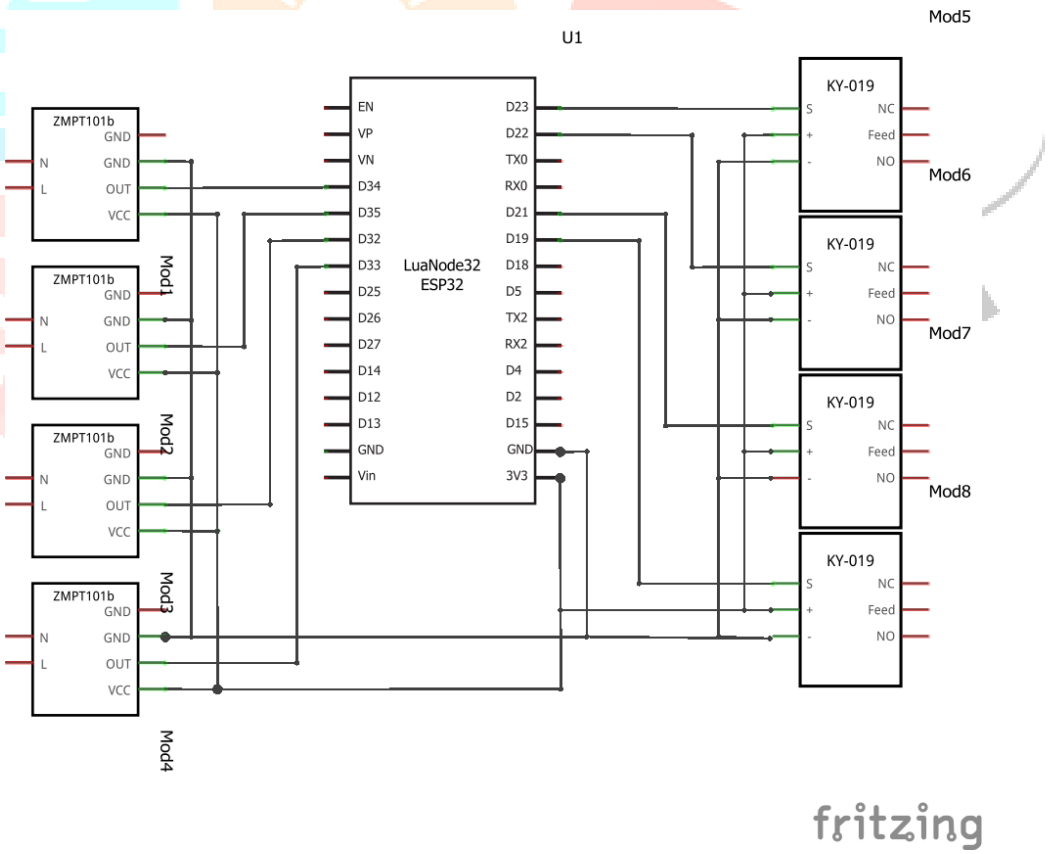

Fig 4.2 Circuit Diagram

5. HARDWARE REQUIRED

1.ESP32 Microcontroller

2. Voltage Sensor ZMPT101B

3. Relay Module.

4. Zero PCB (Perf Board)

4. Jumper Wires

4. Connecting Wires

6. SOFTWARE REQUIRED

6.1. Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board. The source code for the IDE is released under the GNU General Public License, version. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution.

6.2 Fritzing

Fritzing is an open-source hardware initiative that makes electronics accessible as a creative material for anyone. We offer a software tool, a community website and services in the spirit of Processing and Arduino, fostering a creative ecosystem that allows users to document their prototypes, share them with others, teach electronics in a classroom, and layout and manufacture professional pcbs

6.3 ThingSpeak

According to its developers, "ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates".

ThingSpeak was originally launched by ioBridge in 2010 as a service in support of IoT applications. ThingSpeak has integrated support from the numerical computing software MATLAB from MathWorks, allowing ThingSpeak users to analyse and visualize uploaded data using MATLAB without requiring the purchase of a MATLAB license from MathWorks.

6.4. Python IDLE

Python is an interpreted high-level general-purpose programming language. Its design philosophy emphasizes code readability with its use of significant indentation. Its language constructs as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. Python is dynamically-typed and garbage-collected. It supports multiple programming paradigms, including structured (particularly, procedural), object-oriented and functional programming. It is often described as a "batteries included" language due to its comprehensive standard library. Guido van Rossum began working on Python in the late 1980s, as a successor to the ABC programming language, and first released it in 1991 as Python 0.9.0. Python 2.0 was released in 2000 and introduced new features, such as list comprehensions and a cycle-detecting garbage collection system (in addition to reference counting).

7. CONCLUSION

The device designed here can be used for both monitoring as well as controlling the RMU using the Python GUI Application specifically designed for this device. Since a cloud storage is used, we can perform these operations remotely and hence there is no need of being physically present near the RMU. Data is logged on the cloud storage and hence it can be also used for further analysis of the system. Indication alerts are provided within the system.

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