IIOT Based Transmission Line Fault Monitoring System – Smart Grid

[1]Harnish T. Patel, [2]Monil P. Patel, [3]Sunny R. Logad, [4]Prof Ishit Shah
[1,2,3,]B. tech Student, [4]Assistant Professor Electrical Engineering,
[1,2,3,4] IITE, Indus University, Rancharda, Ahmedabad-382115

Abstract : A novel technique for the fault detection & protection of 11kv distribution lines is proposed, to improve distribution reliability via detection of distribution faults and determination of their location. The proposed system uses different protective equipment's, Fault passage indicator (FPI), Data Communication Unit (DCU), SCADA (System control & Data Acquisition) and GPRS/HSPA module. The latest fault detection system involves an integration of FPI, DCU, and SCADA systems to provide distribution dispatchers with a graphical display of possible locations for faults. The faults like all series & shunt faults get detected according to characteristics condition of current & voltage at the occurrence of fault in the three phase overhead lines. The sensed signals are given to Data Communication Unit for detection of faults. Also, wireless mobile communication technique i.e. GPRS is used simultaneously to notify to responsible person operating SCADA system. Simultaneously system gets isolated using protective devices (Air break switch).

IndexTerms **- Transmission Line, Fault Monitoring, Industrial Internet Of Things (IIOT), Fault passage Indicator (FPI), Data Communication Unit (DCU), System Control and Data Acquisition (SCADA) system**

I. INTRODUCTION

In power transmission systems, the majority of voltage and current signal distortions are caused by faults. Faults that occur in power transmission lines can cause an interruption of power supply. The time required to locate a fault is drastically reduced, as the system automatically and accurately provides accurate fault location information. This will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers from damage and disasters. An IIOT based fault monitoring and location system is used to adequately and accurately indicate and locate where fault had occurred. The system uses a Fault passage indicator, a Data Communication Unit, SCADA system and Air break Switch. The system automatically detects and analyse these faults and then, sends the exact longitude & latitude coordinates to the person in the control room and from the control room using an Air break switch faulty section can be isolated. In this project presentation of design and implementation of a distributed monitoring and centralized control system. The master slave communication with the Modbus protocol is implemented. The FPI will communicate with the DCU through transmitter-receiver system and by using wireless GPRS/HSPA technology. It will communicate to the operator in the substation using SCADA system. GPRS/HSPA network has made an attractive option for wireless communication applications. This network provides reliable communication quality with nationwide coverage. Each Data control unit has a SIM CARD with Unique identification number and commands can be transmitted in the wireless communication network.

Types of faults:

Power system's faults may be categorized as symmetrical and unsymmetrical faults.

1. Symmetrical Faults: A fault involving all the three phases on the power system is known as symmetrical fault or three-phase fault. In such types of faults, all the phases are short-circuited to each other and often to earth.

Types of Symmetrical Faults:

- Triple line to ground (LLLG) fault
- Triple line (LLL) fault

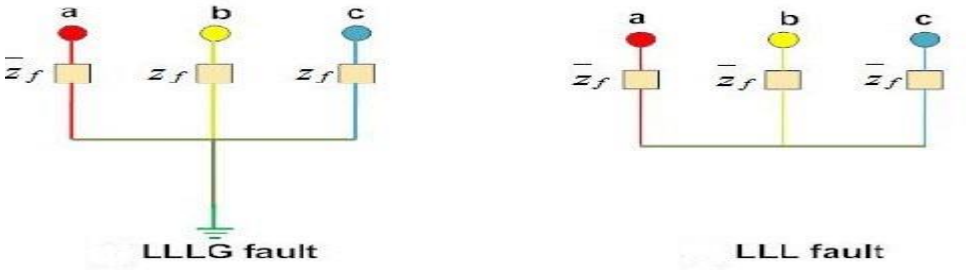

Figure 1: Symmetrical Fault

2. Unsymmetrical Faults: A fault involving one or two phases is known as unsymmetrical fault. The unsymmetrical faults occur due to presence of an open circuit or short circuit of transmission or distribution line.

Types of Unsymmetrical Faults:

- Single line to ground (LG) fault
- Line to line (LL) fault
- Double line to ground (LLG) fault

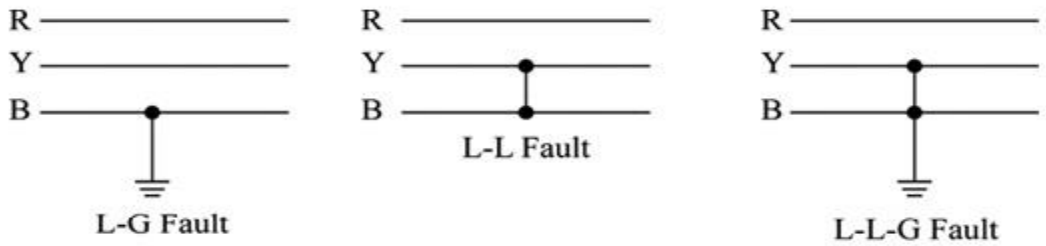

Figure 2: Unsymmetrical Faults

Single line to ground fault is the most frequently occurring fault (60 to 75% of occurrence). This fault will occur when any one line is in contact with the ground.

Double line fault occurs when two lines are short circuited. This type of fault occurrence ranges from 5 to 15%.

Double line to ground fault occurs when two lines are short circuited and is in contact with the ground. This type of fault occurrence ranges from 15 to 25% of occurrence.

II.PROPOSED METHOD FOR MONIORING, DETECTION AND LOCATION OF FAULT

Current method used for finding the exact location of fault in overhead distribution is very complex because of the tappings used in the electrical distribution network. In this proposed method we are going to use Fault Passage Indicator connected in each phase of line. FPI located on the transmission line will communicate with the DCU via transmitter receiver system or wireless radio frequency. DCU will be powered up with 24v DC using SMPS (Switch Mode Power Supply), SMPS is a Rectifier which will convert 230v ac into 24v Dc. Threshold value in the FPI can be set accordingly as per the requirement. This FPI's will be installed in selected strategic locations, where the load isolators are present. In case of faults the value of current will exceed the threshold value in the FPI and DCU will communicate real time data to the operator in the substation through the SCADA system.MQ Telemetry Transport (MQTT) system is used as a broker between DCU and SCADA system to publish any commands or to change the time stamp of the data which is received by the SCADA system through MQTT protocol. With the help of the SCADA system, the faulty sections in the line will be automatically isolated using air break switch and as a result outage time will be drastically reduced.

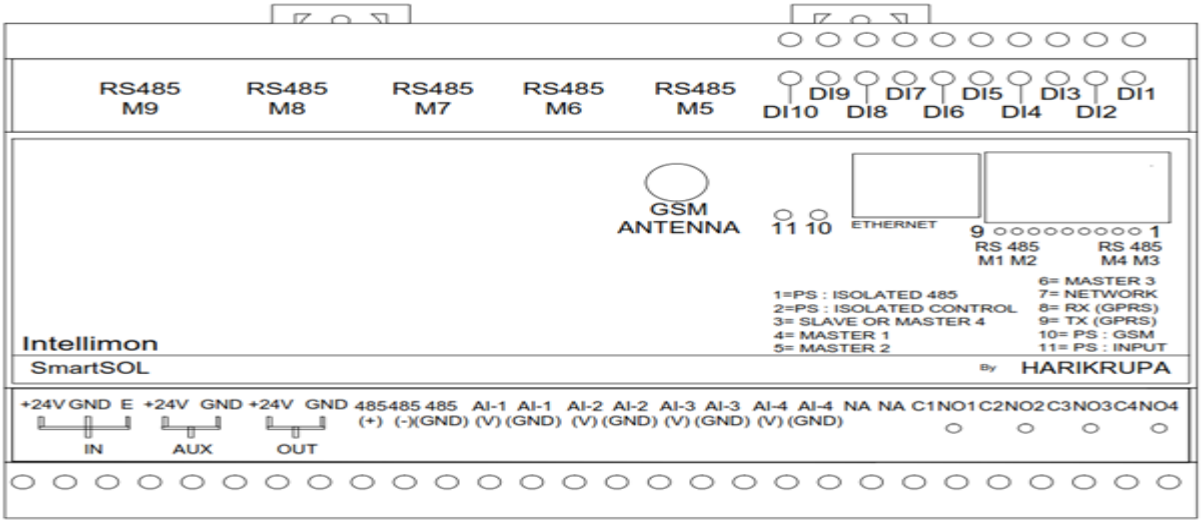

Figure 3: Data Communication Unit

Figure 4: Fault Passage Indicator

III. RESULT

The analysis of fault monitoring and location in electrical distribution network. Earth faults and Phase faults can be detected and located. When fault get occurs on the feeder line the signal is send to the substation or to the operator of the SCADA system through a Data Communication Unit. The faulty section gets isolated without human intervention remotely through Air break switch. MQ Telemetry Transport (MQTT) system is used as a broker between DCU and SCADA system to publish any commands or to change the time stamp of the data which is received by the SCADA system through MQTT protocol.

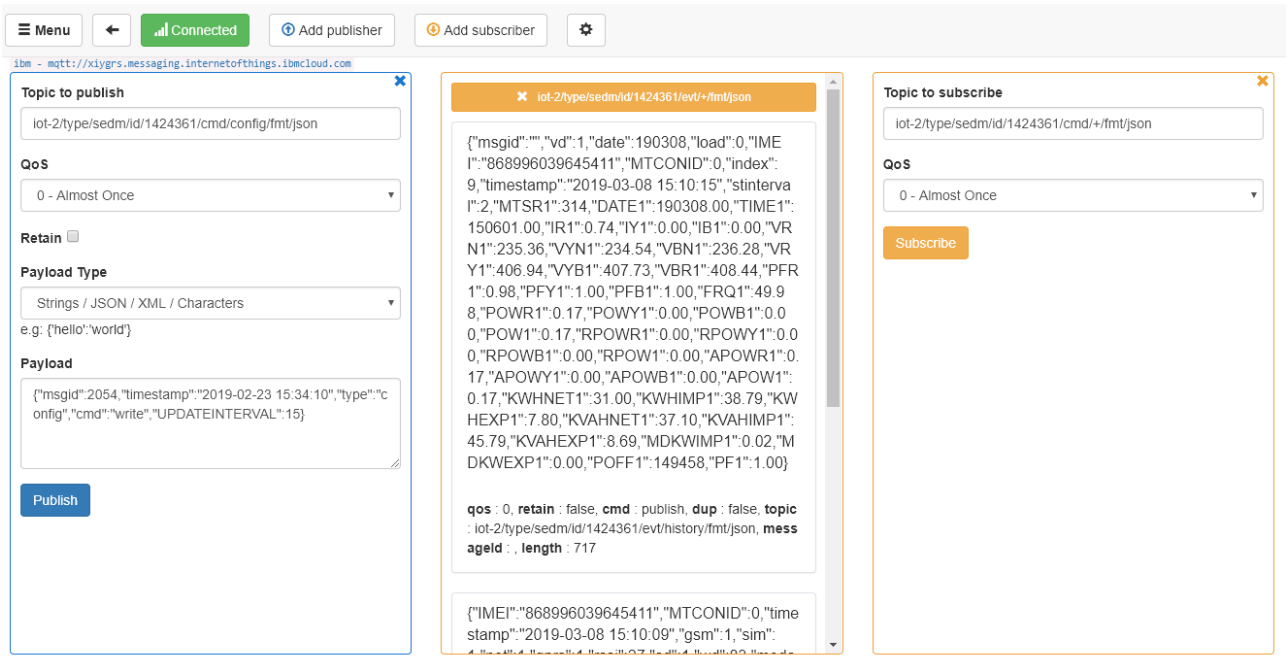

Figure 5: Result

IV. CONCLUSION

Here, in this project we have designed a IIOT based transmission line monitoring system that sends information of the same to substation via SCADA system. The implemented system design mainly concentrates on the distribution system. It provides the way to detect the fault which in turn reduces the outage time. The system continuously monitors various parameters of the system. It also helps to detect the fault at the appropriate time and hence avoids illegal use of electricity. The project automatically monitors, analyses and records on the PC screen through SCADA system. The project has continuous monitoring system using the GPRS/HSPA communication technology, MQTT protocol and the SCADA system. It also represents the hardware architecture and the software flow. The implementation of this system will reduce the outage time and also remotely isolate the faulty sections of the line without human intervention.

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