ISSN NUMBER (ONLINE) – 2368-1209 & (PRINT) – 2691-5944

Automated Transmission Line Fault Detection using Distance Locator

Subhamoy Dey, Barnali Kundu, Member, *IEEE,* Souvik Pal, Aniruddha Sengupta, Manoshi Biswas

***Abstract*-- Faults play an important role in affecting the reliability of power system. More than 80% of the power system faults occur in transmission sector which badly effect the reliability of supply and causes damage to the system. So, it is compulsory to monitor the transmission lines in normal and faulty conditions and clear the fault as soon as identified. The main aim of this proposed research is to design a circuit which will have a capability of determining the type of fault and exact location of fault. From the results of simulations, it has been concluded that the four types of faults such as L-G, L-L and L-L-G have been detected with their location remotely. Afterwards, transfer its data to the utility mobile phone of the user with the help of GPS and NodeMCU.**

***Index Terms*-- Transmission line, faults, distance locator,microcontroller**

I. INTRODUCTION

Nowadays the electrical control set-up is very weak against many forms of natural and unkind physical events, which canbadly affect the general performance and constancy of the grid. Many electrical transmission companies have mostly depended on circuit indicators tofind out the fault sections of their transmission lines. Though, they are still facing the challenge of finding the exact location of these faults. While fault indicator technology has prepared a positive stable way to localize the permanent failure, the technical squad spends lengthy hours to check the equipment and detect the defective parts of transmission lines. During the early years, long transmission lines and overhead lines were an "indissoluble binomial" for the AC Power Systems [1]. Faults are considered as the total breakdown or loss of synchronism of power system network which does not exclude the environmental hazards such as electrocution and a devastating fire outbreak [2]. Network design is a integral thing of sensor based transmission line monitoring due to giant scale. Once the fault occurs in the overhead transmission line, the voltage and current immediately changes at the point & the fault current become comparatively where the fault occurs. Power flow is diverted to the fault and supply to the adjacent area is affected, the voltage becomes unbalance. The consistency and safety of the electrical system is the most important things. The main important thing of the protection is fault categorization and find out the fault location. Faults are however meant to be located and cleared as fast as possible to forestall further loss of revenue and discomfort from the customer end [3]. Faults in electrical transmission line are occurred in between lines, line to ground, two lines and ground or between three lines.

II. LITERATURE REVIEW

This section of the report provides an extensive literature, core reason and principle of power system protection (especially transmission lines). Initially, the general protection of power system is discussed, followed by common faults which occur in transmission lines. After this, protection of transmission lines is brought into discussion along with the comprehensive analysis of the proposed work. Due to gradual expansion of transmission and distribution grid, it becomes a troublesome work to identify the faults location as well as the fast detection is also a biggest necessity for the electricity distributors. Electricity is supplied to the customer end through the overhead electrical wires which are founded in the remote areas where the repair work are very much exhaustive for the repair persons. In this regard, the fault location identification is an ultimate way to initiate the restoration. It will

Subhamoy Dey is with the Electrical Engineering Department is with Guru Nanak Institute of Technology, Kolkata, India (e-mail: dey.subhamoy223@gmail.com)
Barnali Kundu is with the Electrical Engineering Department is with Guru Nanak Institute of Technology, Kolkata, India (e-mail: barnali.kundu@gnit.ac.in)
Souvik Pal is with the Electrical Engineering Department is with Guru Nanak Institute of Technology, Kolkata, India (e-mail: souvikpal363@gmail.com)
Aniruddha Sengupta is with the Electrical Engineering Department is with Guru Nanak Institute of Technology, Kolkata, India
Manoshi Biswas is with the Electrical Engineering Department is with Guru Nanak Institute of Technology, Kolkata, India (e-mail: manoshi6102@gmail.com

Volume 2, Issue 1
https://doi.org/10.15864/ajac.21014

reduce the cost of manpower and materials used for the fault inspection and save the time. Early detection fault location in the electrical grid is playing a vital role towards the reliability of the electrical system. Many researchers have thrown the lights in this area. They were aimed to establish dedicated fault position identification systems by calculating the response from the transmit point to the fault location [4]. Although, for the accurate detection of fault range, the distance relays weren't really precise enough. After that, the first generation of wave-based fault detection equipment were implemented in the field [5]. The fault detection techniques were used to evaluate the time of passing the wave at the fault location. At that time these travelling wave-based techniques were impressively successful relative to 'Reactance Based' techniques however, they were eventually discardedbecause of the consistency and reliability concerns and the budgetary factor [6]. This research will allow to understand different types of faults that can occur in real time transmission lines. Moreover this research will also enable us to study different parameters of the transmission line. With the help of this research, the basic knowledge regarding microcontroller GPS and NodeMCU will be provided which are the core components of this project. The data gathered from this study would enable the authors to produce benchmark research papers, theories and fault detection system which will be improved versionof the existing electrical power system. Preliminary researches which have recommended strategies for the protection of transmission lines, mostly rely upon the travelling waves [7]. Even though such systems have the potential and ability to distinguish and find faults on the distribution lines yet these systems are unable to determinethe exact location of the fault. Simple analog methods wereintroduced by various researchers in the past and they were mostly based on waves to detect the faults in the system [8]. The methods using analog advancements have various limitations which is the reason for working on new innovations [9].The approach used in this project, for the development of fault detection system, uses a variety of hardware equipment's including GPS, NodeMCU, Arduino, ACS712 Current Sensor Module, LCD display. The system can determine the fault location accurately by using the GPS module [10]. Faults which can be identified by the system are: single line fault, single line to ground fault, double linefault and double line to ground fault. Consequently, when a fault occurs in the transmission line, GPS will detect the location of the fault and then a message will be sent to the control room via NodeMCU for immediate response and all this information will also be displayed on the LCD screen. In future, it is recommended to utilize further advance algorithms such as Artificial Intelligence, Machine Learning or Deep Learning in the monitoring of power systems and detection of fault location in transmission lines accurately [10].

A. Objectives of the proposed research work

The main aim of this proposed research is to design a circuit or a device in software simulation which will have a capability of determining the type of fault, exact location offault and transfer its data to the utility mobile phone and desktop of the user with the help of GPS and NodeMCU. Also, to monitor the transmission lines under normal and faulty conditions and clear the fault as soon as identified.

III. PROPOSED METHODOLOGY

This proposed work focuses on locating fault in transmission line and their location then sending this information to Control Room via Proteus and Android app. Four current sensors are connecting in series with the sending end of transmission line and the output of current sensors is attached at the input side of the Microcontroller. When the fault occurs in transmission line the Microcontroller find the fault type and their location utilizing the GPS which is also attached with the micro- controller [6]. The arrangements of the activity can be seen in figure below which shows the steps (flow diagram) of how this project works, the framework can be summed up into these successions: Initially the microcontroller ensures that if there is any fault or not, if the controller didn't find any error in the transmission line then it works in a normal way, however if any fault occur in the transmission line then the system go to next arrangement. Display the detail of faults on the LCD incorporates the lines where failure occurred. In the third step, GPS identify the area of fault with its coordinates. lastly, WIFI Module sent all the information to the Android app and web.

IV SIMULATION OF TYPES FAULT OCCURRENCES AND IT'SLOCATION IN TRANSMISSION LINE

The approach employed in this project for the development of system integrated for the detection of faults in transmission lines composed of various hardwarecomponents including Arduino mega micro-controller, ACS712 Current Sensor Module, Liquid crystal display (16x2) and 5v Piezo Buzzer. This project is design to detect 4 types of faults and their locations in overhead transmission line. The project can identify faults in following ways.

- Single Line to ground fault(L-G).
- Line to Line fault(L-L).

ISSN NUMBER (ONLINE) – 2368-1209 & (PRINT) – 2691-5944

- Double Line to ground fault(L-L-G).
- Three phase fault (L-L-LG).

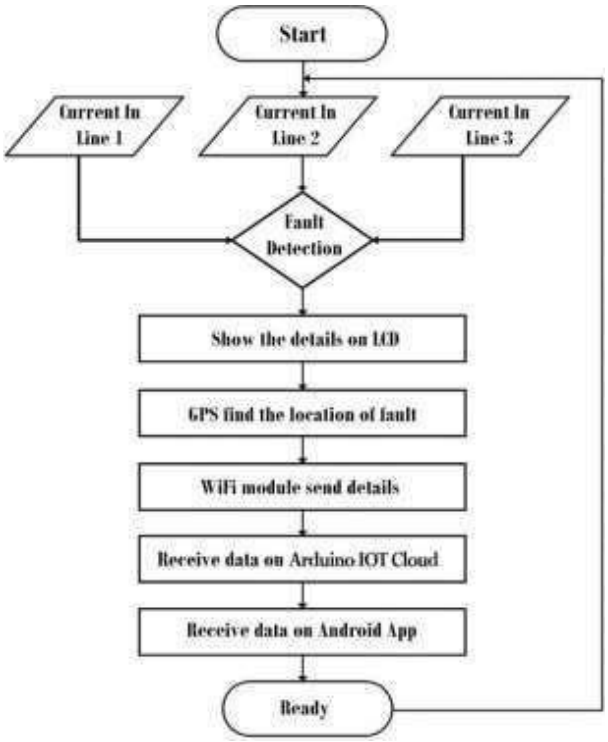

Fig-1. Flowchart of Locating Fault in Electrical Transmission line

A. Case: 1 Single Line to Ground Fault

Whenever any of the single line is short with ground wire single line to ground fault occurs. The LCD in Fig.2. shows type of fault (single line to ground fault) and in which line fault is occurred with providing the distance of the faults in Fig.3.

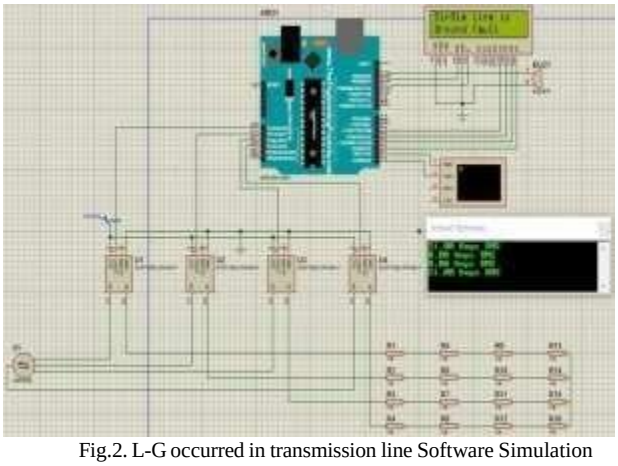

Fig.2. L-G occurred in transmission line Software Simulation

Fig.3. LCD display during Line to Ground (L-G) fault

B. Case: 2 Line to Line Fault

Fig. 4. represents that the line-to-line fault occurs when two lines are short with each other. The LCD shows type of fault (line to line fault) and in which line fault occur with providing the distance of the faults in Fig 5.

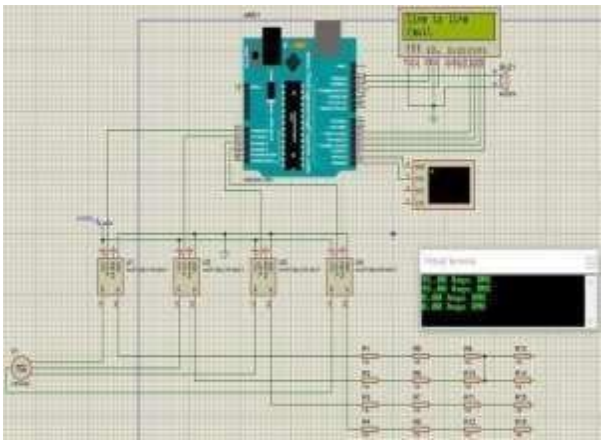

Fig.4. L-L occurred in transmission line

Fig.5. LCD display during Line to Ground (L-L) fault

C. Case: 3 Double Line to Ground Fault

Fig. 6 represents double line to ground fault occurred when two lines are short with each other and are in contact of ground wire. The LCD shows the type of fault is represented in Fig. 7

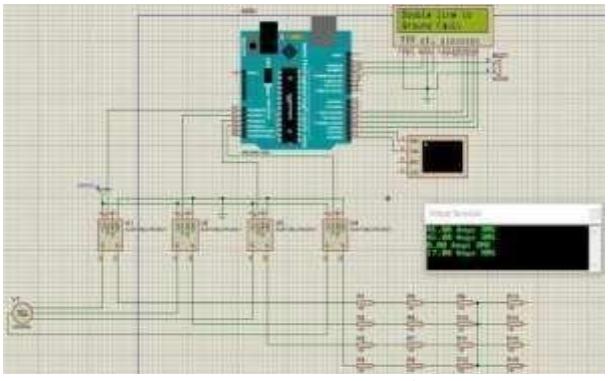

Fig.6. L-L-G occurred in transmission line Software Simulation

https://doi.org/10.15864/ajac.21014

Fig.7. LCD display during L-L-G fault

Software Simulation to validate the results of software simulation, a hardware circuit has been developed which consists Arduino Uno, ACS712 20A Current Sensor IC, LCD, transformers and relays. In Fig. 8, the photo of hardware model has been given which depicts the validation of the software simulation of the different kind of faults.

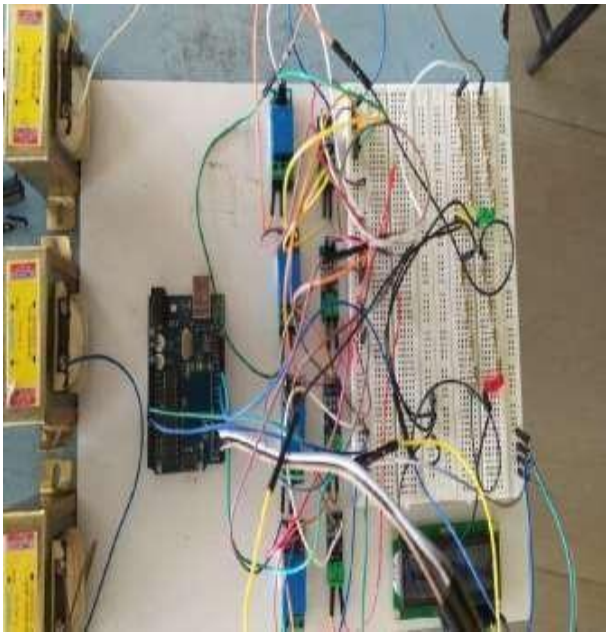

Fig.8: Circuit Simulation in hardware Module

It gives the value of fault current in three phases for each of the fault i.e. L-G, L-L, and L-L-G. Also the hardware is able to detect the location of faults in transmission line. Table I shows the fault currents and the location for each case.

Table I
Summary of fault Currents with its distances

Faults	**Currents in Transmission Line**			**Distance (In kms)**
	LINE-1	LINE-2	LINE-3	
L-G	0.208	0.121	0.112	8
L-L	0.326	0.331	0.116	6
L-L-G	0.298	0.279	0.143	4
3-phase	0.422	0.419	0.418	2

V CONCLUSIO

detected with their location remotely. This will facilitate in the overhead transmission line fault detection and give an alarm to alert. This present research anticipated a display system which is showing the line fault occurred with the distance of the faults from the starting of transmission line.

VI. REFERENCES

[1] Roberto B, Antonio P, “EHV AC Undergrounding Electrical Power: performance and planning”, Springer, 2010, pp- 1-175.

[2] Abdulkareem A., C.O.A Awosope, Awelewa A.A (2016) “The use of three-phase fault analysis for rating circuit breakers on Nigeria 330KV Transmission Lines”. Journal of Engineering and Applied Sciences, 11(12): 2612-2622.

[3] Awelewa A.A, Mbamaluikem P.O, Isaac A. Samuel (2017) “Artificial neural networks for intelligent fault location on the 33KV Nigeria Transmission Line”. International Journal of Engineering Trends and Technology, 54(3).

[4] Mukherjee A., Kundu P. K., and Das A. J. J. o. T. I. o. E. S. B., (2021) "Transmission line faults in power system and the different algorithms for identification, classification and localization: a brief review of methods", vol. 102, no. 4, pp. 855-877.

[5] Singh M., Panigrahi B., and Maheshwari R. (2011), "Transmission line fault detection and classification," International Conference on Emerging Trends in Electrical and Computer Technology, pp. 15-22: IEEE.

[6] Rahnema M. J. I. C. m., (1993) "Overview of the GSM system and protocol architecture,"vol. 31, no. 4, pp. 92-100.

[7] Baseer M. A. at al, (2013) "Travelling waves for finding the fault location in transmission lines," vol. 1, no. 1, pp. 1-19.

[8] Gale P., Crossley P., Bingyin X., Yaozhong G., Cory B., and Barker J., (1993) “Fault location based on travelling waves,” in Fifth International Conference on Developments in Power System Protection, pp. 54-59: IET.

[9] Z. Bo, Weller G., Jiang F., and Yang Q. (1998), "Application of GPS based fault location scheme for distribution system," in POWERCON'98. 1998 International Conference on Power System Technology. Proceedings, vol. 1, pp. 53-57: IEEE.

[10] Goh H. H, at al. (2017), “Transmission Line Fault Detection: A Review” Indonesian Journal of Electrical Engineering and Computer Science Vol. 8, No. 1, pp. 199 -205.

[11] Liu X, **(**2021), "Research on Transmission Line Fault Location Based on the Fusion of Machine Learning and Artificial Intelligence," vol. 2021, pp. 1-8.

ISSN NUMBER (ONLINE) – 2368-1209 & (PRINT) – 2691-5944

Subhamoy Dey has completed his Bachelor Degree in Electrical Engineering from Guru Nanak Institute of Technology, Kolkata. He has published few research papers in national and international conferences. He has participated in technical fests in college events. He has a life member of Institute of Engineers (India).

Barnali Kundu received the bachelor's Degree in Electrical Engineering, the master's Degree in electrical engineering with specialization in electrical machines, and the Ph.D. (Engg.) Degree from Institute of Engineering Science and Technology IIEST) Shibpur, India In 2003, 2007, and 2018, respectively. She is a Professor in the Department of Electrical Engineering, Guru Nanak Institute of Technology, Kolkata, India. She is guiding two Ph.D. scholars. She has received a number of Sponsored Research Projects from AICTE and has rendered Expert Services in Consultancy Projects. She authored or co-authored many research papers in international and national journals and conferences. Her current research interests include power system operation, monitoring and control, power market economics, and applications of AI. She has a professional membership of IEEE, IE (India) and SESI.

Souvik Pal passed his Bachelor Degree in Electrical Engineering from Guru Nanak Institute of Technology, Kolkata. He has published few research papers in national and international conferences. He has participated in technical fests in college events. He has a life member of Institute of Engineers (India).

Annirudha Sengupta passed his Bachelor Degree in Electrical Engineering from Guru Nanak Institute of Technology, Kolkata. He has published few research papers in national and international conferences. He has participated in technical fests in college events. He has a life member of Instituteof Engineers (India).

Manoshi Biswas passed hers Bachelor Degree in Electrical Engineering from Guru Nanak Institute of Technology, Kolkata. He has published few research papers in national and international conferences. She has participated technical fests in college events. He has a life member of Instituteof Engineers (India).

https://doi.org/10.15864/ajac.21014