Fault Analysis and Protection for Power Transformer Using Adaptive Differential Relay

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ABSTRACT - This project proposes a fault localization, isolation and restoration method for micro grids based on multi agent system (MAS) utilizing a communication network. The agents are located in the middle and the two ends of each section. The fault is detected through phase angle comparison of current signals at both sides of the distribution line and sends the trip signal to circuit breakers. This technique does not require voltage transformers or relays and does not transfer the data for long distances between agents to decrease the delay time for isolating the fault. We also performed power restoration process following fault clearance considering voltage, frequency and power flow constraints in the micro grid. Simulation studies were performed to validate the proposed protection scheme.

Keywords: multi agent system, MAS, Differential Relay, Power Transformer, Fault Analysis, MATLAB, Simulink.

I. INTRODUCTION

A multi-agent system (MAS) is a structure within an environment where entities called agents interact and work together to achieve the solution of a problem. An agent can be defined as a hardware or software (more usual) module that has at least at some level the following properties autonomy agents act without human intervention and have some control over their functions; reactivity [1]: perceive their environment changes and react to it; pro-activeness: defined as the ability to take the initiative to accomplish the tasks according to their goals. Social ability: the agent needs to be able to communicate with other agents [2]. Besides these fundamental features there are other properties that an agent may have, such as mobility to move to different places within a computer network, or being a trustful agent (always giving correct information). Benevolence is another feature that guarantees no conflicts to agent goals, which they always try to accomplish. The rationality of an agent can be defined as the ability to learn with previous experiences and to adapt to new environments, while always aiming at their goals [3].

II. EXISTING SYSTEM

The existing project presents a new, simple and efficient protection technique which is based on negative sequence currents. Using this protection technique, it is possible to detect minor internal turn-to-turn faults in power transformers. Also, it can differentiate between internal and external faults. The discrimination is achieved by comparing the phase shift between two phasors of total negative sequence current. The new protection technique has been studied via an extensive simulation study using MATLAB software in a three-phase power system and also has been compared with a traditional differential algorithm [4], [5]. The results indicate that the new technique can provide a fast and sensitive approach for identifying minor internal turn-to-turn faults in power transformers [6].

III. PROPOSED SYSTEM

Proposed system for Power transformers (PT) are one of the most important components in a transmission line. So they require proper analysis and protection during faults period to avoid PT damage. For economic and reliable operation of power supply to the consumer need proper protection schemes applied to power systems. It must fast tripping during faults and more reliable which discriminates the internal faults, external faults and other operating condition (like magnetic inrush current, CT saturation. On the other hand, the protection schemes to avoid mal function or false tripping during faults occurred out of the protection zone.

Differential protection is based on the fact that any fault within electrical equipment would cause the current entering it to be different, from that leaving it. Thus compare the two currents either in magnitude or in phase or both and issue a trip output if the difference exceeds a predetermined set value [7]. In recent trends technology aimed at improved selectivity, sensitivity, and operation time of differential relays has been presented to overcome the related problems. But they need large data's and operating time is more. In this paper an improved fuzzy logic based differential relay is proposed which is capable of differentiating between magnetizing inrush current, internal faults, external faults and reduced tripping time. Proposed protection scheme is fast and auto reclosing of circuit breaker after the removal of fault. Power system with Fuzzy Based Differential Relay is modeled using MATLAB-SIMULINK.

IV. SYSTEM DESIGN

a) Block Diagram

A multi-agent system (MAS) is a structure within an environment where entities called agents interact and work together to achieve the solution of a problem. An agent can be defined as a hardware or software (more usual) module that has at least at some level the following properties autonomy agents act without human intervention and have some control over their functions.
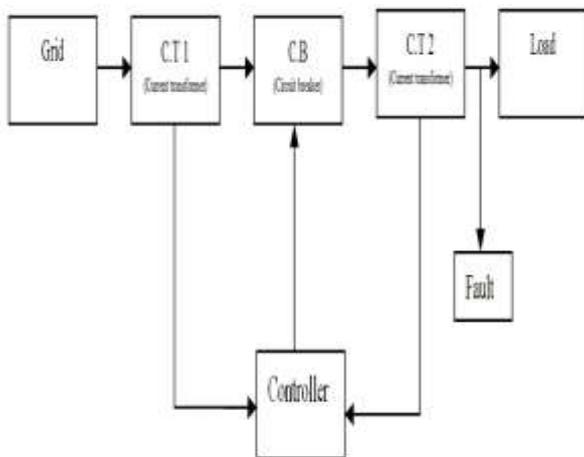

Figure-1: Block Diagram of Proposed System

Perceive their environment changes and react to it; pro-activeness: defined as the ability to take the initiative to accomplish the tasks according to their goals. Social ability the agent needs to be able to communicate with other agents.

b) Control Circuit

Besides these fundamental features there are other properties that an agent may have, such as mobility to move to different places within a computer network, or being a trustful agent (always giving correct information).
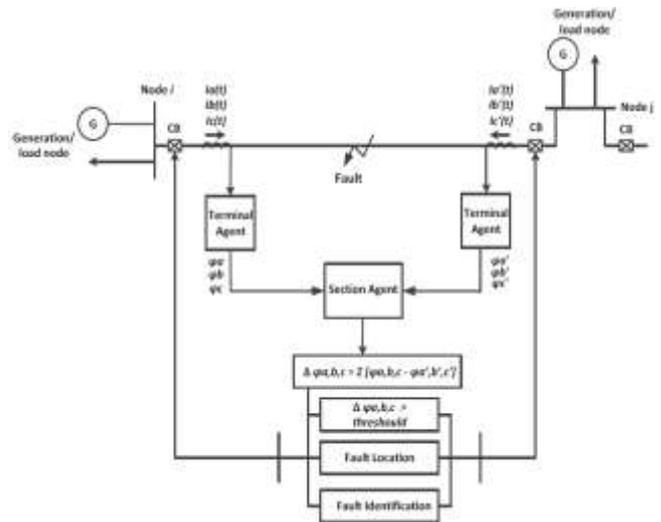

Figure-2: Control Circuit

Benevolence is another feature that guarantees no conflicts to agent goals, which they always try to accomplish. The rationality of an agent can be defined as the ability to learn with previous experiences and to adapt to new environments, while always aiming at their goals.

V. SOFTWARE SPECIFICATION & RESULT

a) Software Simulator: MATLAB

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

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b) Simulation Circuit
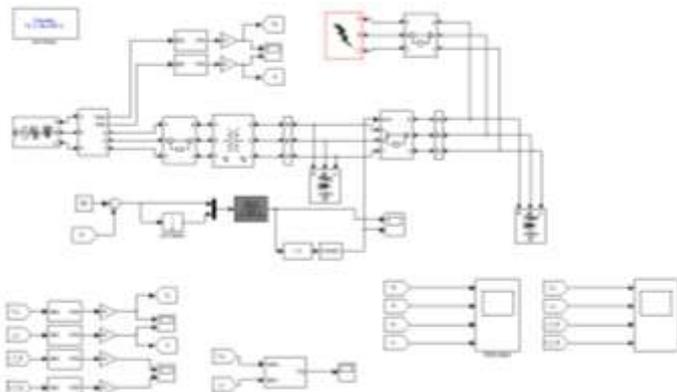

Figure-3: Simulation Circuit

Thus compare the two currents either in magnitude or in phase or both and issue a trip output if the difference exceeds a predetermined set value. In recent trends technology aimed at improved selectivity, sensitivity, and operation time of differential relays has been presented to overcome the related problems. But they need large data's and operating time is more.
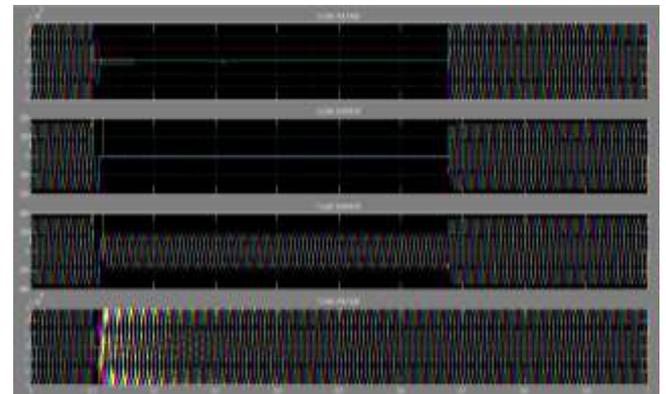
c) Result

The differential relay unit is simulated using MATLAB simulink and the obtained voltage and current waveforms are as shown in figure-4,5.
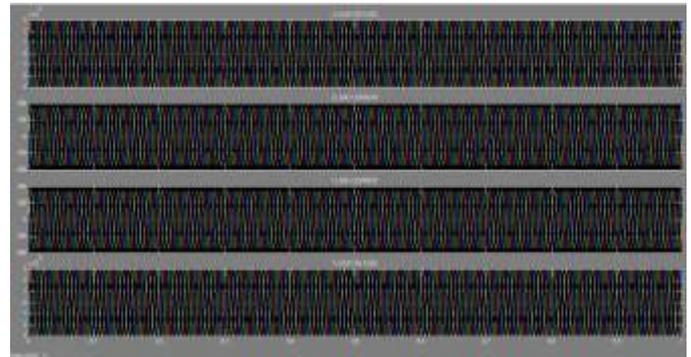
Figure-4: Output Voltage and Current
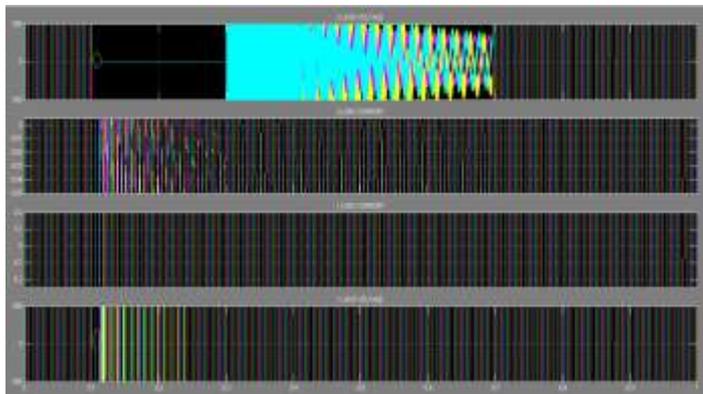
Figure-5(A): Error Voltage

Figure-5(B): Error Current

VI. CONCLUSION

In this paper, we applied the communication technology between transducers and agents to protect the distribution line. This technique studies the variation of phase current at both ends of the distribution line to accurate identify and isolate the faulted section in the system. This method does not need voltage transformers or relays and also improve pilot protection schemes. The communication between multi agents can be exploited to restore the power for different loads in the system as a result of changing the configuration of the system to keep the reliability of the system and improve the efficiency. Within the built MAS it is possible to have the task of determining adaptive relay settings being decomposed and performed by separate agents, which is considered an essential feature in this case.

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