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MONITORING AND CONTROL OF POWER DISTRIBUTION SYSTEMS USING SMART PHONES

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***Abstract*-Power distribution systems should meet demands such as high reliability, efficiency, and penetration of renewable energy generators (REGs) in a smart grid. In general, power distribution systems are radial in nature. One-way power flow is the advantage of a radial system. However, the introduction of REGs causes bidirectional power flow. Furthermore, there are limits to improvements in reliability and efficiency in a radial system. Therefore, the upgrading of primary feeders from a radial to a loop configuration has been considered in the Korea Smart Distribution Project. An advanced power distribution system (APDS), in which primary feeders operate in a loop configuration. Enormous number of accidents occurs all over the world in substation and power grids. In such cases, the whole accident may go unnoticed and by the time it is discovered, it may have been too late to control the fire and voltage sorts. Even though in power distribution system there is no system to intimate the accident causes due to the high temperature, improper oil maintenance, high voltage and low voltage problems. Hence an automatic system is required to handle such situations. In this proposed work, we are implementing the automation in smart grid that is in loop configuration for monitoring and controlling the parameters of the transformers and relays using an android application in smart phones.**

***Keywords*-Loop power controller, advanced power distribution system, distribution automation system, Renewable energy generation, Short message service.**

I.INTRODUCTION

In this modern world automation was widely implemented in many areas. Automation is nothing but operating a system without human's interface. Then in that embedded automation plays a vital role in real time systems. Currently automation with mobiles is an emerging trend in embedded system.In Embedded Automation & control system there are two ways one is ON the system and OFF the system. ON the system performs the automation and control at the same place itself. Whereas, OFF the system performs the automation and control from remote places that is nothing but the mobility. We are going to use the second category that is OFF the system.

II. ADVANCED POWER DISTRIBUTION SYSTEM CONFIGURATION FOR SMART GRID

Global power distribution system is in radial nature and the existing system [1] proposes a novel method called loop configuration. Radial system in power distribution consists of uni-directional power flow.

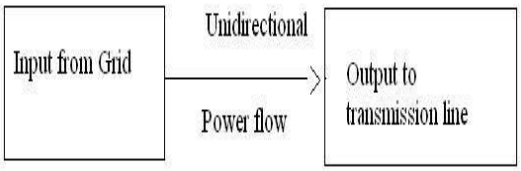

Figure 2.1 Global power distribution system

Whereas, in loop configuration the power flow is in bi-directional. An advanced power distribution system (APDS), in which primary feeders operate in a loop configuration, has been explored in this paper. First, the design scheme of a conventional power distribution system configuration that adopts distribution automation is introduced. Subsequently, an upgrading scheme of loop configuration using normally opened tie switches and a tie switch selection algorithm for loss minimization are described. Then APDS should meet the demands of power distribution system such as efficiency, reliability and penetration of REG (renewable energy resources).

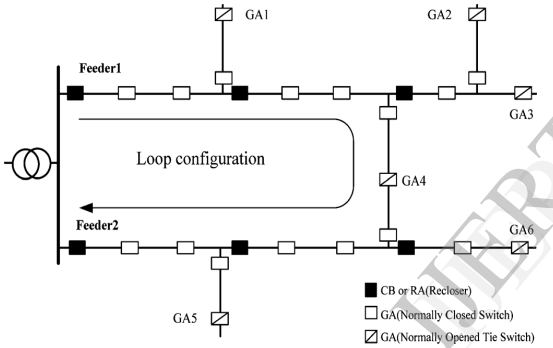

Figure 2.2 Advanced power distribution system

A fault occurrence in a feeder or lateral that is connectedto an REG leads to its interruption. For stable reclosing operationand maintenance crew safety, the REGs must detect islandingoperation and be disconnected within 0.5 s according to the interconnecting manual. Furthermore, REGsshould wait 5 min to re-connect after the distribution systembecomes stable [2], [3]. Therefore, the reliability of the powerdistribution system is important for REGs as well as for customers.

III.HYBRID FAULT DIAGNOSIS SCHEME

Power distribution automation and control areimportant tools in the current restructuredelectricity markets.Unfortunately, due to its stochastic nature, distribution systemsfaults are hardly avoidable. This paper proposes a novel faultdiagnosis scheme[3] for power distribution systems, composed bythree different processes: fault detection and classification, faultlocation, and fault section determination. The fault detection and classification technique is wavelet based. The fault-locationtechnique is impedance based and uses local voltage and currentfundamental phasors. The fault section determination methodis artificial neural network based and uses the local current andvoltage signals to estimate the faulted section.

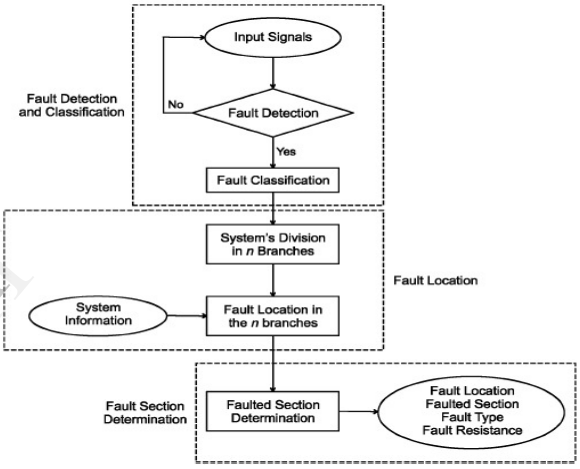

Figure 3.1 Fault diagnosis scheme overview

IV.LOADING BALANCE OF DISTRIBUTION FEEDERS WITH LOOP POWER CONTROLLERS CONSIDERING PHOTOVOLTAIC GENERATION

Loading balance of distribution feeders is important for reducing power loss and mitigating power flow overloading. In this paper[6], a loop power controller (LPC) is applied for the control of real power and reactive power flows by adjusting voltage ratio and phase shift so that the loading balance of distribution feeders can be obtained. To incorporate photovoltaic (PV) power generation in feeder loading balance, a Taipower distribution feeder with large PV installation is selected for computer simulation. Daily loading unbalance is determined by analyzing PV power generation recorded by the SCADA system and

by constructing daily power load profiles based on distribution automation system (DAS) data.

The load transfer required to achieve loading balance and the line impedance of distribution feeders are used to derive the voltage ratio and phase shift of the LPC.

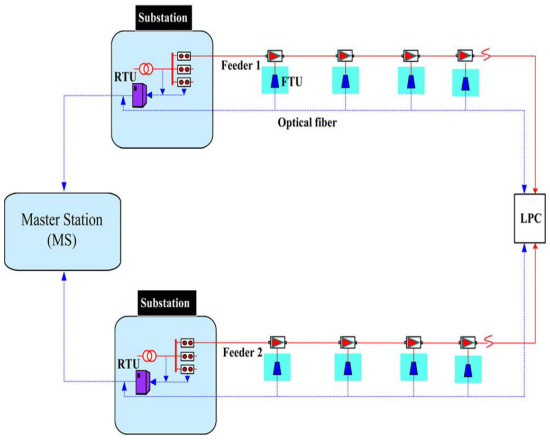

Figure 4.1Distribution automation system with a loop power controller.

V.OVERVIEW SUBSTATION AUTOMATION

Electric utilities, especially in developed countries, continuously encounter the challenge of providing reliable power to the end-users at competitive prices. Due to several reasons such as equipment failures, lightning strikes, accidents and natural catastrophes, power disturbances and outages in substations occur and often result in long service interruptions. Thus, the substations should be properly controlled and monitored in order to take the necessary precautions accurately and timely. In this respect, substation automation, which is the creation of a highly reliable, self healing power system that rapidly responds to real time events with appropriate actions, ensures to maintain uninterrupted power services to the end users.

VI.OVERVIEW OF THE PROPOSED SYSTEM

This system proposes a new technology in embedded automation is that automation and control of substation in power distribution system can be controlled with help of android application. In this proposed system, substation parameters can be monitored and controlled using smart phone for that an android application havebeen developed and it is communicated with GSM(Global system for mobile communications) modem to give the commands to microcontroller which is used to control and monitor the prototype such as temperature, oil level, voltage, current of transformers and circuit breakers/relays used in substation. Whenever it detects the fault or the error value, the feedback is given to the android application via GSM technology. Smart phones are very useful for ease access and its main advantage is mobility wherever the users they can control and monitor the parameters. The occurrence of faults can be intimated to users through SMS (Short Message service). Hence the accidents can be prevented at the right time and can also intimate to the superiors as soon as possible.

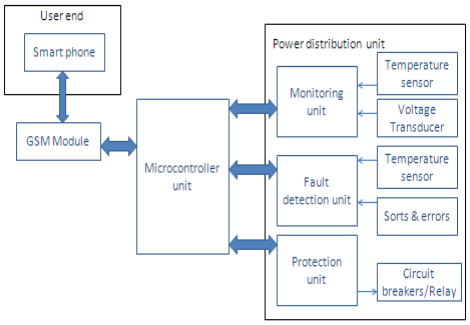

Figure 5.1 Block diagram of the system.

VI.RESULTS

The general GUI (Graphical User Interface) of the system is given below with three modules of distribution system

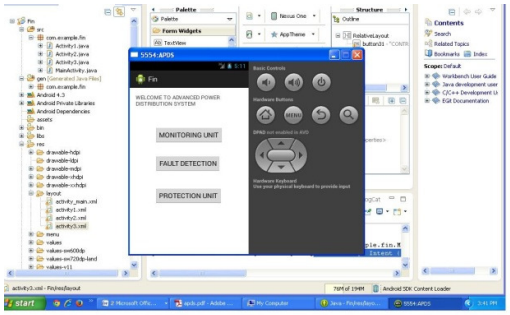

Figure 6.1 Front page of the application.

In this above home menu the three modules of the system was given by on clicking each options the appropriate wizard will be opened. After selecting the modules it will perform the required operation of system. Each button of menu will be linked to different XML pages of the module. From that required operation will be performed which are given below in screenshots.

6.1 MONITORING UNIT OF THE SYSTEM

In this unit parameters of the substation can be monitored in the smart phone itself by using the developed android application. The parameters are developed as prototype and it can be monitored by dragging the specified option in the android application given below.

In this below screen as per the user wish can view the parameters such astemperature of the transformer, oil level, voltage(V) and current(A) of transformer by on clicking the option and also can view the status of circuit breaker and relays.

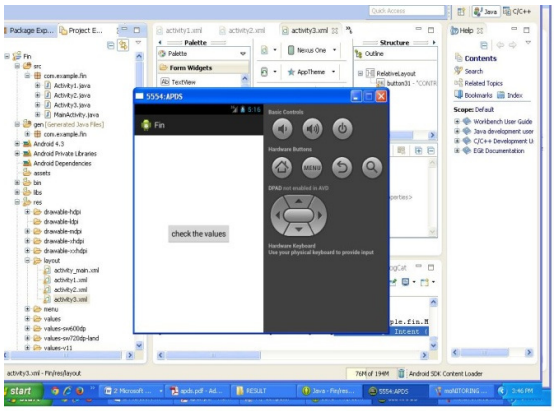

Figure 6.2 monitoring the parameters of transformer.

6.2 FAULT DETECTION UNIT

In this module whenever the vulnerable event occurs such as over voltage or under voltage, high temperature and overload of the transformers then the feedback that is error message will be sent to mobile which will be useful for higher authorities for getting the message as soon as possible even though they are in remote places also.

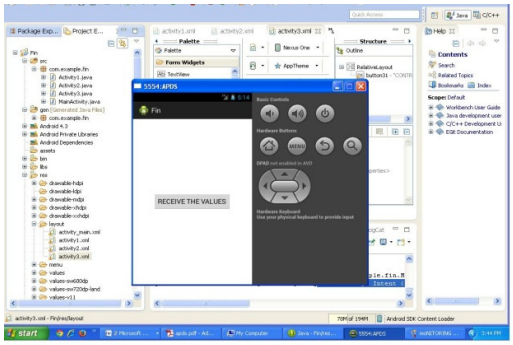

Figure 6.3 Receive the values and intimate faults of the system.

In this above screen whenever the vulnerable event occurs such as over voltage or under voltage, high temperature and overload of the transformers then the feedback that is error message will be sent to smart phone which will be viewed in this screen only.

6.3 PROTECTION UNIT

In this module after recovering the faults in the distribution line or in substation the circuit breakers or relay can be opened/ closed in android application itself by selecting the prior option. So, that automation can be done and distribution system will be reliable.

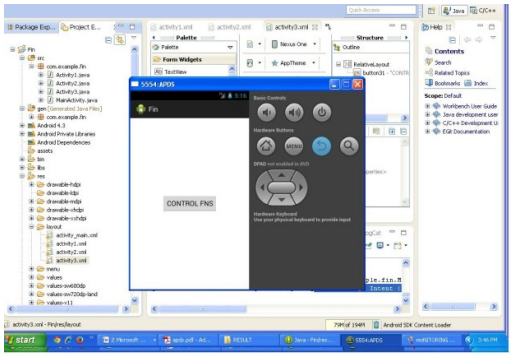

Figure 6.4 controlling the relays/circuit breakers of the system.

In this above screen after detecting the fault in power distribution system the circuit breakers/relays will be opened for the predefined set of delay time and after rectifying the fault it will be closed to restart the power distributions which are all done by using the above option control functions.

VII. CONCLUSION AND FUTURE ENHANCEMENT

In this work embedded automation was made easier using smart phones by the android application for power distribution system in substation. GUI(Graphical user interface) was created where user can give the commands to the system by selecting prior options. Then the developed application was dumped into the smart phone to make communication. The communication was made between android application and GSM modem by means of SMS (Short message service). Transmitting message from application and receiving from the GSM modem was done successfully.

In future the system will be interfaced with the hardware unit its block diagram was given above as figure5.1. The control of substation parameters will be controlled and error message will intimated to the smart phone. From the smart phone itself the temperature, oil, current, voltage of the substation can be monitored and also the control of relays and circuit breakers can be done using the android application.

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