Islanding System Model using Microcontroller

Harsh Mehta1, Rohan Raut[2], Raj Gite[3], Mukesh Mali[4], Sangeeta Jain[5]
Department of Electrical Engineering[1,2,3,4]
Assistant Professor Department of Electrical Engineering[5]
Atharva college of Engineering, Malad (w), Mumbai

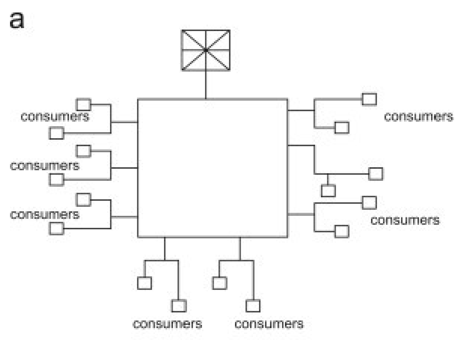
***Abstract:* - It is important to understand that at every moment of time, supply and demand on the power system must be balanced, otherwise blackouts can occur. If there is a significant imbalance in portions of the system, both the frequency and the voltage are impacted. If there is more consumption than supply in an area, then, the frequency and voltage drops. If there is more supply than demand in an area, then frequency climbs. Different parts of the system can experience these same events simultaneously and can swing against each other, with the transmission system acting as sort of a spring, and can cause a cascading blackout. Therefore, Islanding System is used to avoid these incidents from taking place and causing damage to the grid system as well as to human life. Islanding refers to the condition in which a distributed generator (DG) continues to power a location even though electrical grid power from the electric utility is no longer present.**

***Keywords- Microcontroller, ADC08080, Distributed Generator (*DG).**

I. INTRODUCTION

The Power Grid Corporation of India sees overall the distribution of power via its transmission network spread across the whole country. It has 95,009 circuit-km of transmission network 28,000 MW inter-regional power transfer capacity. India is divided into five electrical regions zone, namely, Northern (NR), Eastern (ER), Western (WR), Southern (SR) and North-Eastern (NER). Of the four zones NR, ER, WR and NER are inter-connected, and form which is known as the New Grid. There is a load dispatch centre in every zone that sees the overall transfer of power from the generating plant to the states and further. Depending on the need and requirement, every state then buys power and has to

Adhere to the withdrawal limit. The distributed generation (DG) concept is introduced at the distribution level to explore the benefits of small local renewable generation. The resources are generally of wind farms, micro hydro turbines, photovoltaic's' (PV), and other generators are supplied with biomass or geothermal energies. The differences between traditional and embedded distribution network systems are shown in Fig. 1. In an embedded distribution network system, additional DG resources are supplied near the local body load compared with the traditional network system. The application of multiple DGs in the distribution system is becoming a day to day practice with the modification of DG resource. This practice is caused by the advantages of DG such as environmental benefits, increased efficiency; ignorance of transmission and distribution (T&D) losses. However, numerous problems should be tackled before the DG units are applied to the networks. These problems include frequency stabilization, voltage stabilization, and power quality issues. It is important to understand that at every moment in time, supply and demand on the power system must be balanced, or blackouts can occur. If there is a significant imbalance in portions of the system, both the frequency and the voltage are impacted. If there is more consumption than supply in an area, then, the frequency and voltage drop. If there is more supply than demand in an area, then frequency climbs. Different parts of the system can experience these same events simultaneously and can "swing" against each other, with the transmission system acting as sort of a spring, and can cause a cascading blackout .The formation of the micro grid (MG), which is cause by the disconnection from the main grid without stopping the energy generation from the DG sources is called islanding, which can be either intentional or unintentional.[1] The purpose of intentional islanding is to construct a power "island" which supplies power to its customer during system disturbances, which are commonly introduced due to faults.[2] However, the active part of the distribution system should sense the disconnection from the main grid and shut down the distributed generator in countries where island mode operation is not allowed. Undetected island MG is generally called "unintentional islanding".[3]



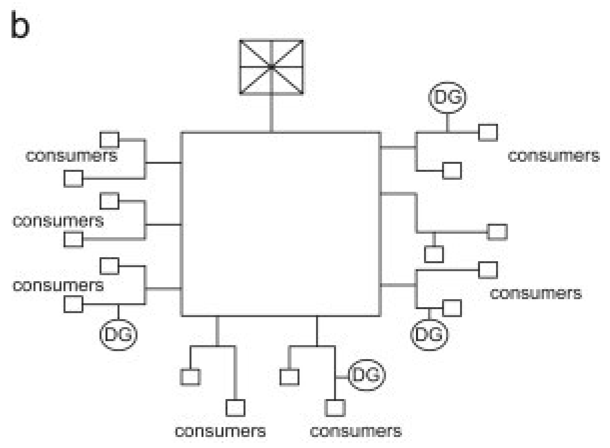


Fig. 1 (a) Traditional distribution system (Traditional Grid System), (b) Generation embedded (Micro grid Networks).

II. CASE STUDY OF NORTHERN GRID FAILURE

On July 30, 2012 parts of North India came to a standstill, crippled with power failure that affected the states of Delhi,

Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Rajasthan and Jammu & Kashmir. This power failure was attributed to exhaustive drawing of power by some states. However, that has not been confirmed yet. While authorities of electricity board were working continuously to restore the Northern Grid, and were successful in partially restoring power back in many parts after 15 hours of hard work, the northern grid collapsed again on the next day. This time, a cascading effect saw the collapse of the Eastern and North Eastern power grid as well. This cascading effect affected the states of West Bengal, Odessa, Jharkhand, Bihar, Sikkim, Assam, Mizoram, Manipur, Nagaland, Meghalaya and Arunachal Pradesh. This was termed as the massive power failure in Indian history, three inter-state transmission networks collapsed together, plunging most of northern India into darkness and disrupting the daily lives of over 500 million people.

The cause of the failure was that the certain states in the northern region overdrew power, which led to the tripping and ultimate collapsed of the Northern Grid. A blame game was going on with states accusing each other for the mayhem caused. It is being observed that Uttar Pradesh, Haryana and Punjab overdrew power, but they have disprove these claims. One of the possible reasons for overdrawing power is the deficient or low rainfall, which meant increased used of electric pumps to withdraw water for farming in these agricultural states. But how did this failure turned into a major power crisis that affected over 20 states? What happened on 30 July 2012 is the classic example of what happens when limits are not adhered to. The generation plants, the power grids and the sub-stations have to work in pairs. An overload in a power system results in the system failure. In spite of the warning issued by electricity board, several states continued to overdraw power from the already existing generation system. The overdrawing of power caused a slight escalation or increase in the grid frequency range, the permissible limit of which is defined by the Indian Electricity Grid Code (EGC) is 49.5 Hz to 50.2 Hz. The escalation in the frequency ultimately caused the power failure in north India on 30 July, 2012. As there is free flow of power in the four zones that comprise the New Grid, 31,

2012 tripping of the Northern Grid had a cascading effect on the North Eastern and Eastern power grids.

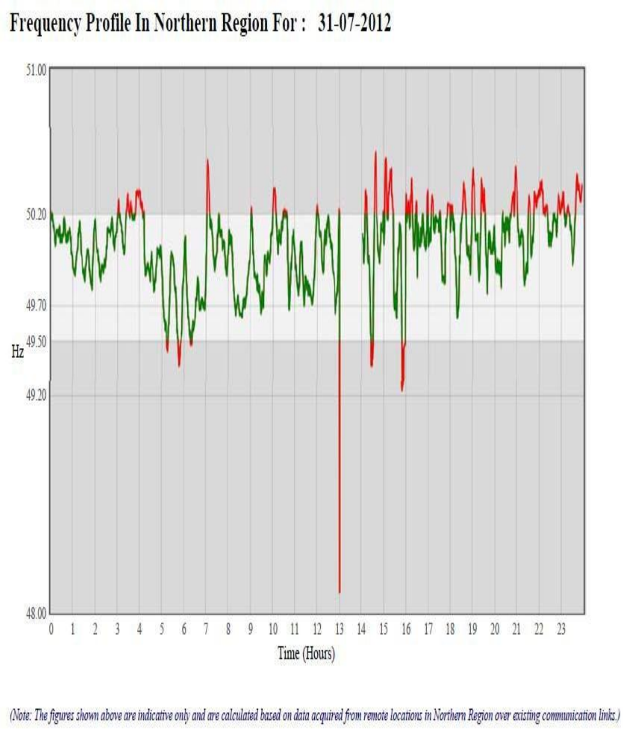


Fig. 2 Frequency Profile for the Northern Region on July 31, 2012:

The data above indicates that the blackout occurred around 13.00 hours. Note that the frequency is oscillating before and after the event happened.

III. MICRO-CONTROLLER (89S51)

The AT89S51 is a high-performance; low power CMOS 8-bit microcontroller with 4K bytes of in System Programmable Flash memory.AT89S51 is a powerful microcontroller which provides accosts effective and a highly-flexible solution to many embedded control applications. It is a four port device which works as an address data convertor with 16x4 LCD display having 16 character and two rows are connected to port0. Port1 gives the addresses and latches on to ADC0808. A 8-bit digital output of ADC0809 is provided to port2 and a HC-05 Bluetooth module is connected to port3which is used to transfer acquired data to the mobile. To enhance the performance of the system, Relay drivers are used for adjusting the parameters of the system.

Configuration Features:

4K Bytes of In-System Programmable Flash

Memory – Endurance-10,000 Write/Erase Cycles 4.0V to 5.5V Operating Range • Fully Static Operation: 0 Hz to 33 MHz

ISSN: 2278-0181

Two 16-bit Timer/Counters

Three-level Program Memory Lock

128 x 8-bit Internal RAM

Dual Data Pointer

32 Programmable I/O Lines Watchdog Timer Six Interrupt Sources

Low-power Idle and Power-down Modes

Full Duplex UART Serial Channel

Two 16-bit Timer/Counters Interrupt Recovery from Power-down Mode

Fast Programming Time

Flexible ISP Programming (Byte and PageMode)

Power-off Flag

Green (Pb/Halide-free) Packaging Option [4].

Fig. 3 AT89S51 Pin Diagram

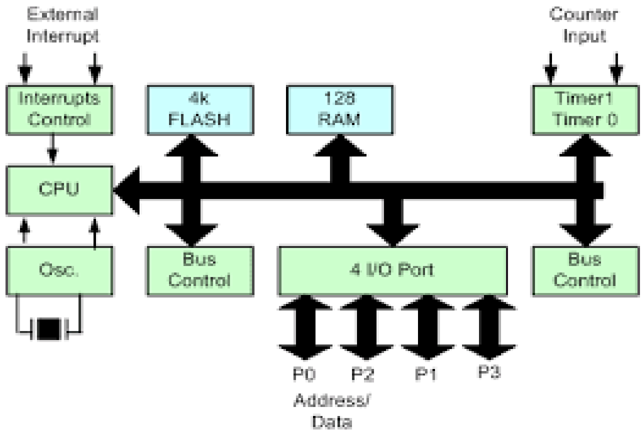
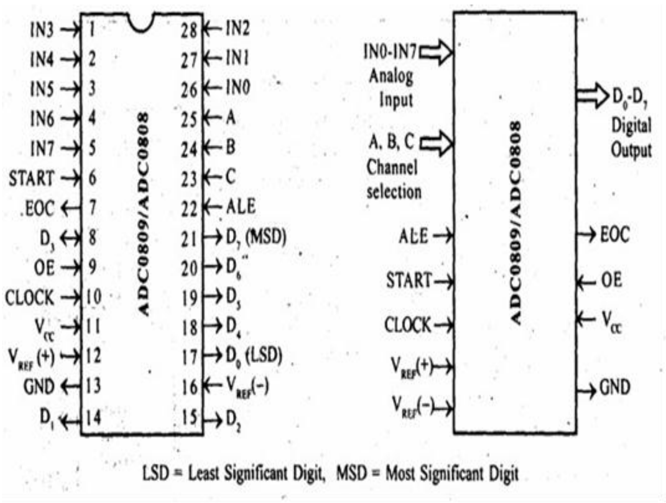


Fig. 4 Wiring Diagram of AT89S51

IV. ADC0808

Analog inputs are allocated by IC1, a 8-bit analog-to digital converter from National Semiconductors. It has eight analog inputs for interface the analog sensor like temperature, humidity, pressure etc. the successive approximation A/Converter, converts the analog output of the multiplexer to an 8-bit digital word. The output of the multiplexer goes to one of two comparator inputs. The other input is obtained from a 256R resistor ladder, which is tapped by a MOSFET transistor switch tree. The converter control logic controls the switch tree, funneling a particular tap voltage to the comparator. Based on the outcome of this comparison, the control logic and the successive approximation register (SAR) will decide whether the next tap to be selected should be more or less than the present tap on the resistor ladder. This algorithm is implemented 8 times per conversion, once every 8-clock period, yielding a total conversion. When the conversion cycle is finished the resulting data is loaded into the TRI-STATE… output latch. The data in the output latch can then be read by the host system any time before the end of the next conversion. The TRI-STATE capability of the latch allows uncomplicated interfaces to bus oriented systems. The operation of these converters by microcontroller control logic is very simple. Analog Sensor Light, Humidity, Temp. ADC Microcontroller 89S51 Power supply-5V Clock ,Reset LCD Display Relay Board Solar Panel,15V Battery -12V Pump- 12VDC Hemant et al., International Journal of Advanced Research in Computer Science and Software Engineering 2 (11), Nov - 2012, pp. 407-410 © 2012, IJARCSSE All Rights Reserved Page | 409 . The controlling device first chooses the desired input channel. To perform this, a 3-bit channel address is placed on the A, B, C input pins; and the ALE input is pulsed positively, clocking the address into the multiplexer address register. To initiate the conversion, the START pin is pulsed. On the rising edge of this pulse the internal registers are cleared and on the falling edge the start conversion is commenced. [5] The ADC0808/ADC0809, can be functionally split into 2 basic sub circuits. These two sub circuits are an analog multiplexer and an A/D converter. The multiplexer uses 8 standard CMOS analog switches to provide for up to 8 analog inputs. The switches are discerningly turned on, depending on the data latched into a 3-bit multiplexer address register [6].



PIN DIAGRAM OF ADC808

IN0-IN7: Analog Input channels

D0-D7: Data Lines

A, B, C: Analog Channel select lines; A is LSB and is MSB

OE: Output enable signal

ALE: Address Latch Enable

EOC: End of Conversion signal

Vref+/Vref-: Differential Reference voltage input

Clock: External ADC clock input

V. RELAYS

Nowadays, the modern society has come to depend heavily upon uninterrupted and reliable availability of electricity and a high quality of electricity too [7].Applications such as processing industries, banking and telecommunication networking cannot function without a reliable and efficient source of electric power. Thus, maintaining a continuous flow of electricity is essential for industries without electric supply fail to deliver. This is where power system protection becomes a significant asset. In general, power system protection the main functions are to safeguard the entire system to maintain continuity of supply,

Minimize damage and repair the costs where it senses a fault and ensure safety of personnel [8].These requirements are necessary for early detection, localization of faults and prompt removal of faulty equipment from the service. Since power system developments change its structure, the power system protection becomes extremely important. The continuous of power systems expansion with inconsistent increase of transmission load ability leads to protection systems which are required to perform with reliability and security in the network [9-11].In order to carry out power system protection main functions, protection must satisfy the following criteria; reliability, selectivity, sensitivity, stability and speed. Besides of power system protection requirements, protective relays are the most important in power system. In electrical engineering, a protective relay is a complicated electromechanical apparatus, designed to calculated the operating conditions on an electrical circuit and trip the circuit breaker when the fault is detected. For designing the protective relaying, understanding the fault characteristics is needed. Related to this, protection engineer should be familiar about tripping characteristics of various protective relays. The design of protective relaying has to ensure that relays will be able to detect abnormal conditions and then trip the circuit breaker to disconnect the affected area without affecting other undesired areas. According to the statistical evidence, large numbers of relay tripping are due to irregular or inadequate settings rather than genuine fault

Types of Protective Relays are

Over current relays

Directional relays

Differential Relays

Distance Relays

Pilot Relays

A. Over-Current Relay Coordination

Basically, over current relay (OCR) is a type of protective relay which operates when the load current limit exceeds a preset value. It has a single input in the form of ac current. The output of the relay is normally open contact and can become closed state when the relay trips. Relay has two settings which are commonly known as time setting and plug setting. The function of time setting is to decide the operating time of the relay. The over current relay is widely used in many protection applications throughout power systems and control applications. When a fault occurs, a large amount of current flows which may damage the power system components. Therefore, over current relay must reenergize the faulted line as soon as possible to protect the system from the faults. Over current relay is connected to a current transformer and calibrated to operate at or above specific current level and is used for over current protection. When the relay operates, one or more contacts will perform and energize the trip coil in Circuit Breaker (CB) and open the CB simultaneously.

VI. CONCLUSIONS

For security against electricity failure national grid has been developed. If the person handling the power flow in the grid does not follow the simple protocol i.e. Utilization should be equal to power generation and if there is a violation in this protocol it may lead to the failure of whole national grid resulting in total blackout. Hence to overcome or avoid such a catastrophe, a scheme known as ISLANDING should be adopted which restrains the total blackout.

By implementing Islanding Scheme:

A. System restoration can be quicker if part of a system is in service.

B. At the time of fault, important loads such as hospital, railways, etc can be kept in service.

C. If it is adopted at individual grid or state level, total blackouts can be avoided

REFERENCES

[1] Llaria A, Curea O, Jimenez J, Camblong H, Recherche E, Superieure E,et al. Survey on microgrids: analysis of technical limitations to carry out new solutions. Power Electronics and Application (EPE′09); 1–8.

[2] Moradzadeh, M, Rajabzadeh, M, Bathaee, M, Novel, A. Hybrid islanding detection method for distributed generations. In: Third international conference on electric utility deregulation and restructuring and power technologies; 2008. p. 2290–2295.

[3] Ezzt, M, Marei, M, Abdel-Rahman, M, Mansour, M., A hybrid strategy for distributed generators islanding detection. In: IEEE powerengineering society conference and exposition in Africa—PowerAfrica; 2007. p. 1–7.

[4] Nikita Shingre, ReemaNagwekar, Rupa Roy, TruptiShendkar, Rupinder Kaur for Review on Mobile Phone Based SCADA for Industrial Automation.In:International Journal of Technical Research and Applications(March 2016).

[5] W. Lawrance, B. Wichert, and D. Hgridge, Simulation And performance of a photo-voltaic pumping system,‖ Power Electronicsand Drive System, vol. 1, pp. 513- 518, 1995.

[6] Priyanka D. Hande and Prof. S.S. Kulkarni, Microcontroller based Irrigation International Journalof Microcircuits and Electronic. Volume 3, Number 1 (2012), pp. 1-6

[7] .Y. G. Painthakar, Bhide, S.R., "Fundamentals of Power System Protection," 5th ed: Prentice-Hall of India Private Limited, New Delhi, 2007.

[8] .L. Hewitson,"Practical Power System Protection for Engineers and Technicians," Rev. 8.1, IDC Technologies, 2011.

[9] .E.A. Conde, M. E. Vazque,"Operation logic proposed for time overcurrent relays," IEEE Transactions on Power Delivery, vol. 22,pp.2034-2039, 2007.

[10] .L. Senghu, D Ming,D. Shaowu, "Transmission loadability with field current control under voltage depression," IEEE Transactions on Power Delivery,vol. 24, pp. 2142-2149, 2009.

[11] . M..Barzegari, Bathaee, S.M.T., Alizadeh, M. , "Optimal coordination of directional overcurrent relays using harmony search algorithm " iN 2010 9th Conference on Environment and Electrical Engineering, EEEIC 2010, 2010, pp. 321-