National conference on Engineering Innovations and Solutions (NCEIS – 2018)
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 4 | Issue 6 | ISSN : 2456-3307

Analysis of Power System Using Plc

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ABSTRACT

Building automation is a vital part of many cases related to energy efficiency and smart living in the context of smart cities. The operation and control of the next generation electrical grids will depend on a complex network of computers, software and communication technologies. The goal of our project is to design a user friendly automation system which can be easily integrated into the existing system. This project presents the design and implementation of a monitoring and control system for the demand side management for various loads based on Programmable Logic Controller (PLC) technology. Also, the data for the implementation of the hardware and software for monitoring and controlling the load, using PLC, is obtained from the substation. The PLC correlates the operational parameters to the load required by user and then monitors the system. This system saves energy by efficient power management which employs certain controlling mechanisms managed by a Programmable Logic Controller (PLC) as the most efficient control can be implemented by the use of the Programmable Logic Controller (PLC).

I. INTRODUCTION

Energy saving in any system deals with minimization of energy wastage. To achieve this the system needs to be improved. Estimating loadability of a generation and transmission system is of practical importance in power system. Construction and enhancement of generation or transmission systems requires huge amount of capital investment. Regardless of whether or not capital investment is available for constructing systems and enhancing their capacities, efficient utilization of existing power facilities is always desired for both economical and environmental concerns. Conceptually estimating loadability of a system is a generalized mathematical programming problem. It is not a standard mathematical programming problem because of certain constants (specifically dynamic security constants) which have to be expressed not in algebraic forms, but rather in the form of differential equation. Analytically estimating loadability of a power system is somewhat similar to the so called generation rescheduling problem. However, there are a few important distinctions.

First, computational effort of estimating loadability is several times more than that of generation rescheduling.Second, loadability of a power system is dependent upon the pattern of load increasing.

II. BLOCK DIAGRAM OF POWER SYSTEM

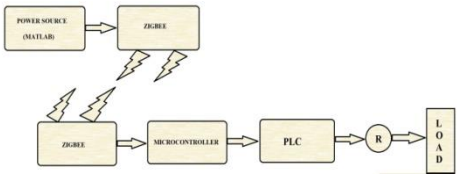

Figure 1. Block diagram of power system

A power system is simulated in MATLAB with desired number of generators and loads. The loads

are further divided into different sectors, i.e. large scale industries, small scale industries, educational and domestic sectors.

Logic is created in order to trip the loads on priority basis. The output generated in MATLAB is given to ZIGBEE for wireless transmission. The data from ZIGBEE is passed on to the microcontroller for serial communication of data to the PLC. The plc is programmed on certain preset values upon which the relays are sent signal to trip a particular load on priority basis.

IMPLEMENTATION

Figure 2. Hardware Implementation

A power system is created in MATLAB with desired number of loads and generators. Logic is created in MATLAB in order to trip the loads on priority basis. The four load sectors created as per the chosen priority are;

1. Large scale Industries
2. Small scale Industries
3. Educational sector
4. Domestic sector

The current and voltage profiles are generated and observed and based on the waveforms decision making for tripping of the particular relay(s) is carried out.

The output of the Matlab generated in the system is sent to Zigbee C2500 R4, using USB-UART, for the wireless transmission of data. This analog data is stepped down from 230V to 12V through a step-down transformer present on the board .And then the 12V from transformer is brought down to 5V . This 5V analog data is converted into its digital form, and serial communication takes place with the help of microcontroller 8051 transferring bytes of data at 9800 baud rate.

This data is given to the PLC AC31GRAF which then works upon the presetconditions.The PLC sends signal for the relay to trip the particular load.

III. RESULT

FEEDER CURRENTS AND VOLTAGE

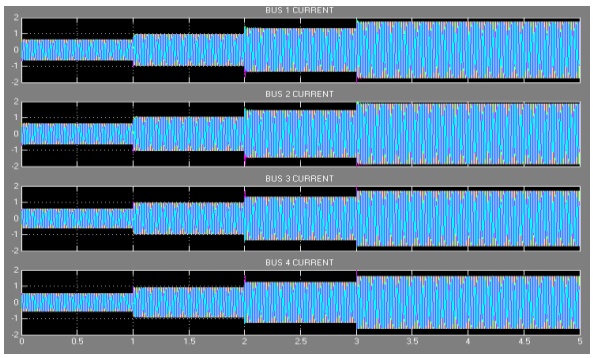

Figure 3. Feeders Current

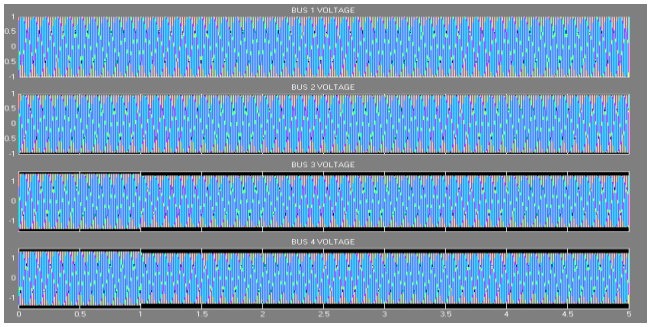

Figure 4. Feeders voltage

LARGE SCALE INDUSTRY

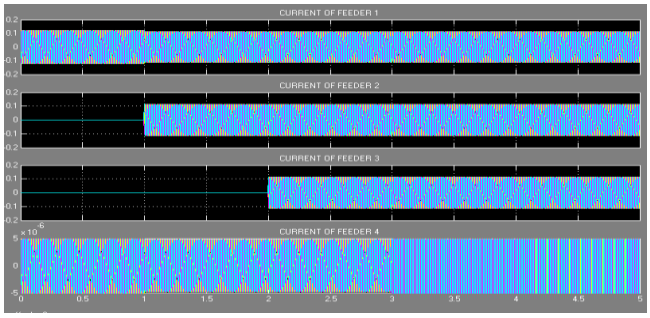

Figure 5. Currents profile inlarge scale industry

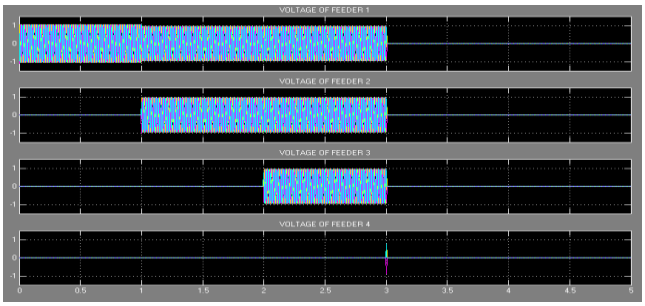

Figure 6. Voltage profile in large scale industry

SMALL SCALE INDUSTRY

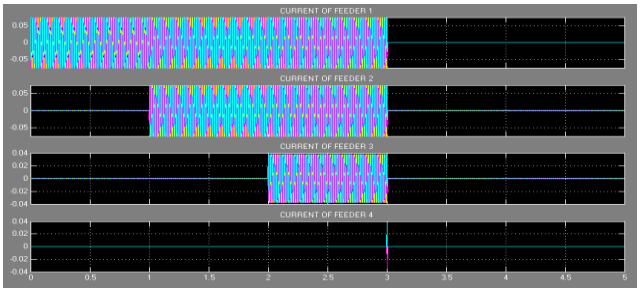

Figure 7. Current profile of small scale industry

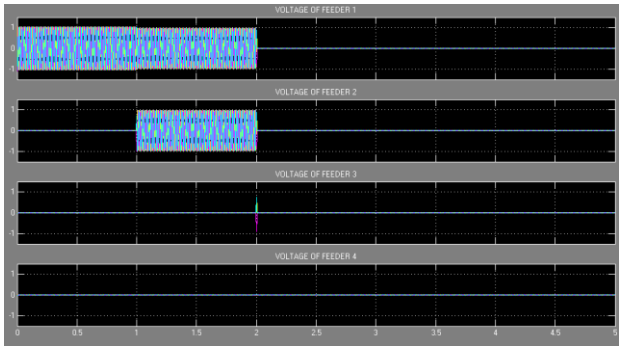

Figure 8. Voltage profile of small scale industry

EDUCATIONAL

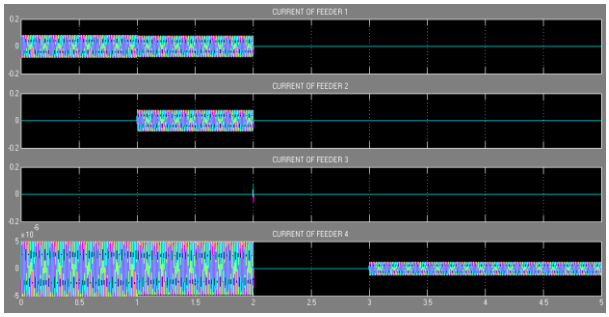

Figure 9. Current profile of educational sector

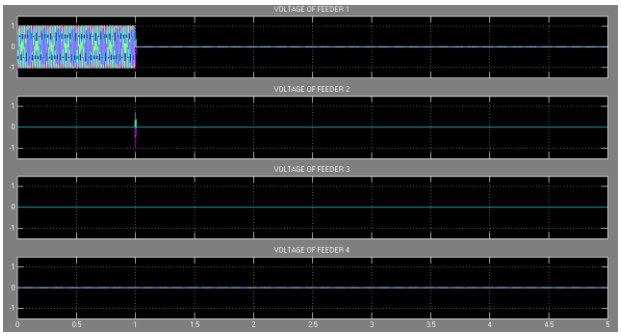

Figure 10. Voltage profile of educational sector

DOMESTIC

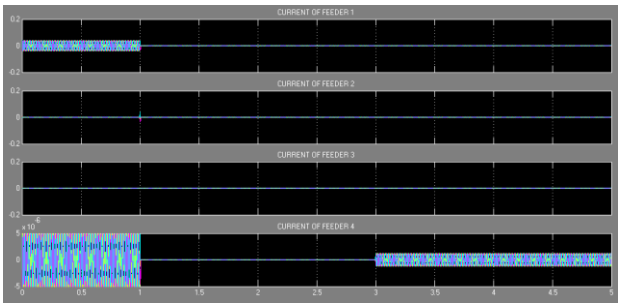

Figure 11. Current profile of domestic sector

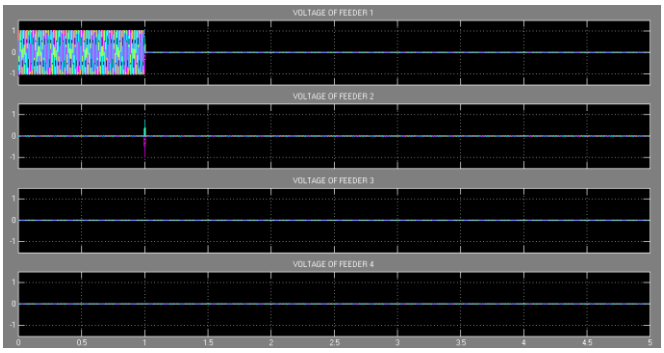

Figure 12. Voltage profile of domestic sector

CONTROL SIGNAL

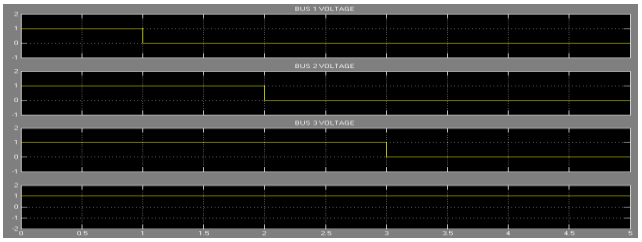

Figure 13. Control signal profile

The graphs of four load sectors are shown above. One the basis of these graphs we can analyze that;

- For the time period 0 – 1, the power flow is continuous for all four load sectors, i.e. 'Large

Industries', 'Small Industries', 'Educational Sector', and 'Domestic Sector'.

- For time period 0 – 2, the supply for domestic sector is tripped, while the power flow is uninterrupted in the other three sectors.
- For time period 0 – 3, the power is continuously supplied for only 'Large Industries', and 'Small Industries', while it is tripped for 'Educational Sector'.
- For time period 0 – 4, power flow is cut for 'Small Industries', while the powerflow for 'Large Industries' stays continuous.

Table 1. Logic of load shedding.

Sl no	GENERATION(MW)	LOADS				TIME INTERVAL	REMARKS
		L	S	E	D		
1	14.4	3	2	2	1	(0,1)	Generation >Demand
2	14.4	3	2	2	1	(0,2)	Generation <Demand
3	14.4	3	1	2	1	(0,3)	Generation< Demand
4	14.4	3	1	2	1	(0,5)	Generation< Demand

IV. CONCLUSION

Successful experimental results were obtained from the described scheme indicating that the PLC can be used in Automated systems.

This aims to emphasise on Automating the power system using Programmable logic controller i.e, minimizing the manual errors caused due to human interference and reducing the risk during faulty conditions. It also involves demand side management by prioritising demand control, which is the huge problem faced in the present envelope of problems in power system.

Comparative to previous RTU's used in power management which required racks of electronic equipments for its working, PLC based system are highly reliable and only a single base controller works efficiently. Without changing any hardware connection, rather just by simply changing the program in the PLC, we can change the operation of system. It requires less hardware compared to any microcontroller or microprocessor based system. Widely used in Substation control because they are inexpensive, easy to install and very flexible in applications. A PLC interacts with the external world through its inputs and outputs.Through loadability analysis, simulation, and tests, we can conclude as follows .On priority basis, the various loads are tripped. Load shedding can be planned as per the requirement.

V. REFERENCES

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