

Centralize Monitoring, Operation and Management of Electrical System

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Abstract - Centralize monitoring, operation & management of electrical system is one which can centrally monitor, operate and manage electrical loads or electrical devices in system through software interface. System can also perform some more intelligent functions. With increasing demand of electricity, it is essential to manage electrical loads. So load management concept is key feature of project. Here load management is done by monitoring load current not by energy. So this is the new concept in load management. The advantage of this concept is that we don't need energy meter for each device or electrical load & hence reduction in the cost of system. This system is complete package of software and hardware. The project will develop the GUI interfaces in LabVIEW or SCADA Project and the essential display screens for load control. The project will also develop completely automated system with features like report generation, load scheduling, Priority management and many others. This project also develops relay based control of electrical devices (load) through software interfacing according to need of system. The control of the electrical load or devices is established via a RS-232 interface coupled to the PC through a RS-232 to USB interface.

Index Terms - Centralize monitoring, electrical load, LabVIEW, Load Management

I. INTRODUCTION

This project describes the development of complete system through which we can monitor, operate and manage electrical load in the system. So system is complete development of software and hardware implementation. Aim is also to design hardware in such a way it will be economical. In software part, development of serial protocol to MODBUS converter in LabVIEW is also challenging problem.

Design graphical user interface in LabVIEW or SCADA Project for controlling and monitoring the electrical load. Advantage of GUI or SCADA Project is from the trend analysis, we can take any action to manage load. Project is also about to develop some features like Load scheduling, Priority management, Trends, Report generation, Alarms, Shedding of non-essential loads, etc. This project is both analytical & experimental.

Motivation behind system development has many technical benefits as well as economical benefits. As project is mainly focus on load management concept. With increasing need of electricity, it is essential to come up with such a system which can help to meet demand as well as balance complete electrical system. Main advantage of such a system which works between energy distributor and industrial consumer is to watch on load which will help to industries to avoid penalties on excessive load usage as well as it is economical to industry. [3]

II. LOAD MANAGEMENT

Load management is defined as sets of objectives designed to control and modifies the patterns of demands of various consumers of a power utility. This control and modification enables the supply system to meet the demand at all times in most economic manner. Load management can be applied to all the loads experienced by a power utility including Industrial loads, cooling loads, heating loads and lighting loads. These loads vary by day month and season. This means that load on the system is always changing with the time and is never constant. Thus power utilities always keep an eye on the average load and maximum load of their system. [2]

III. IMPORTANCE OF LOAD MANAGEMENT

The demand of electricity has increased with the new developments in the world. This has put the pressure on the power utilities to meet the increasing demand of the customers. One simple way for them to meet this demand is to install more generating units. But the induction of additional generating units especially thermal not only increase the cost per for the consumers but also contribute in pollution to the environment which is a global concern. In such a scenario the best solution is to go for load management and make best use of the available generating capabilities of a power utility.

Load management is essential in today's age because of increasing demand of electricity day by day. We need to think about some solution to meet demand of electricity & load management is one of the solutions to meet this demand. Load management avoids the requirement to increase transformer, cable sizes and generator capacity. Load profile is generally more efficient, controlling peaks. As peaks are likely to coincide with periods of most expensive electricity prices, either individual industries will become more competitive or prices will be forced downwards. It is environmentally more acceptable due to an effective use

of resources. Load management is also used for stabilization of grid system which is problem in today’s world as demand of electricity increasing. [1]

Load management can be implemented by using many techniques like peak clipping, valley filling and Load shifting. There are many other implementation methods are also available. But in this paper focus is on some smart strategies for load management.

IV. BLOCK DIAGRAM OF SYSTEM

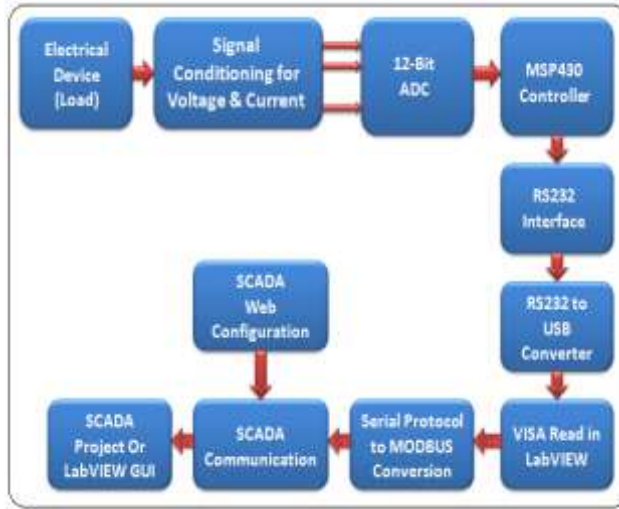


Fig 1: Block diagram of system

Fig 1 shows the block diagram of system. It also shows the complete project flow of system. As shown in figure, input stage is consisting of signal conditioning for voltage & current channel. Output of signal conditioning part is in voltage form that will given to controller ADC. Output of controller is in some fixed string format like #D1C1V2.1258 #D1C2I1.369.

This will work as input to software part, now task is to convert this serial data to MODBUS slave. So we need to develop serial protocol to MODBUS converter. Then this value is directly displayed on SCADA project via SCADA communication.

V. HARDWARE SIMULATION RESULTS

Signal conditioning for 5A AC current Multichannel:

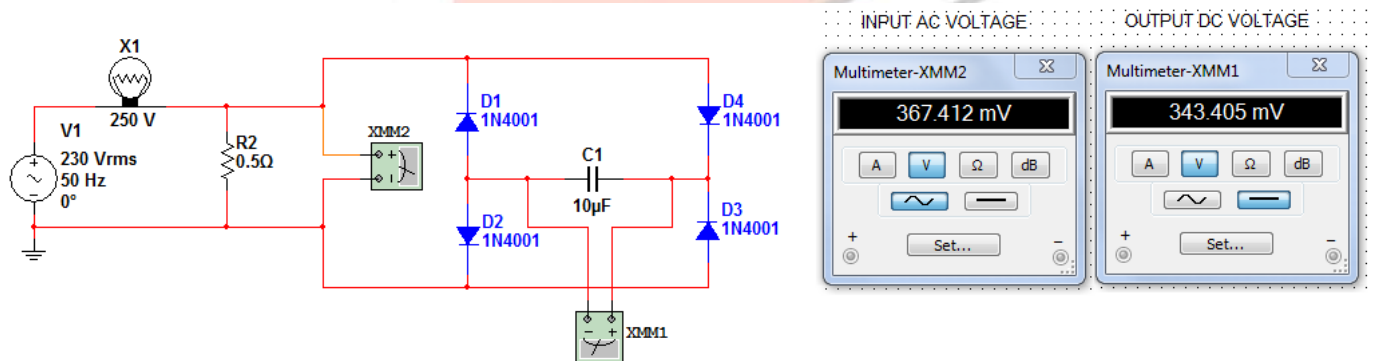


Fig 2: Schematic of Current Monitoring & Simulation Results

This circuit is used for signal conditioning for 5 A AC Multichannels. Here to monitor load current, current is converted to voltage using shunt resistor concept. Output of shunt resistor will work as input to ADC of microcontroller. AC output voltage across shunt resistor is converted to dc using bridge rectifier circuit to achieve constant dc output. As load will increase then current through shunt resistor is also increased and voltage across shunt resistor is also increase by experiment.

Signal conditioning for 230V AC Voltage Multichannel:

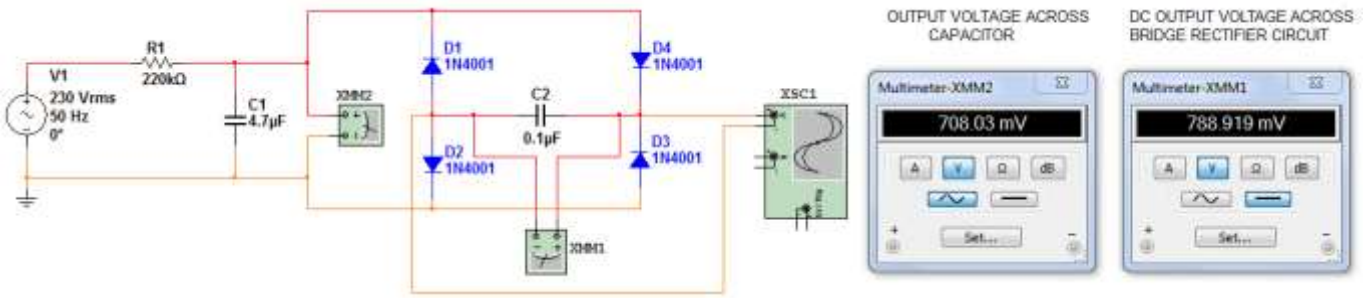


Fig 4: Schematic of Voltage Monitoring & Simulation Results

VI. SOFTWARE DEVELOPMENT

In software part task is to design Serial Protocol to MODBUS converter in LabVIEW.

Serial Protocol to MODBUS converter:

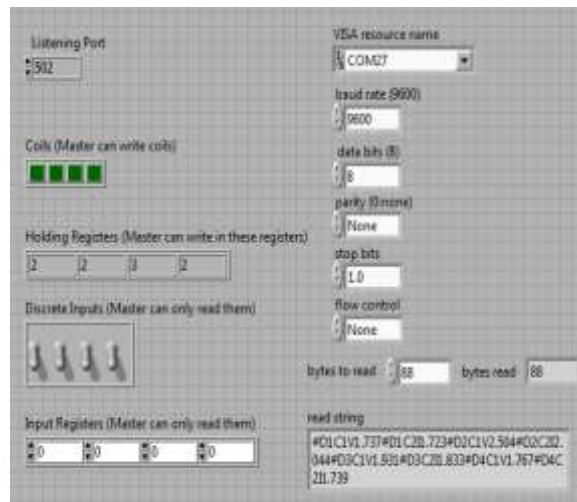


Fig 6: Serial Protocol to MODBUS converter

Serial protocol to MODBUS converter is used to read string coming from hardware. Converter is used to acquire data only. String input to converter is in some defined protocol decided by user. So converter is developed as per requirement of user.

VII. ELECTRICAL LOAD MONITORING

Electrical load monitoring is required to meet demands of electricity. We need to observe all data values on SCADA for continuous monitoring of electrical load.

Analog Module GUI:



Fig 7: Analog Module

Analog module is the GUI which is used to analyze all analog data of hardware. All analog values which are configured in SCADA can be seen in the Analog module and analyzed. So from this module we can monitor each electrical load and from this operator can take corrective action.

Trend analysis:

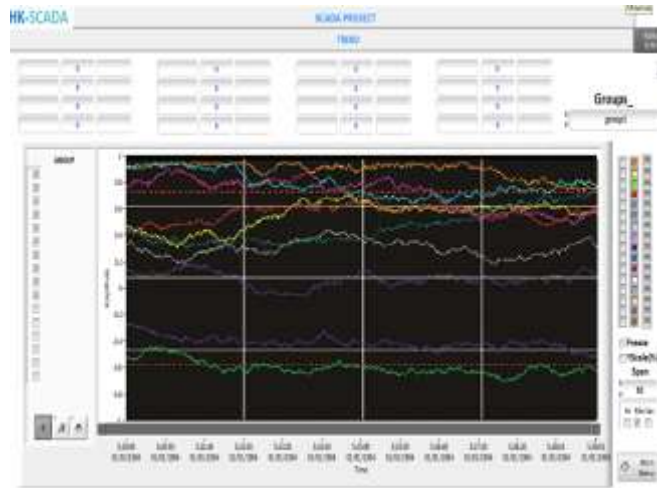


Fig 8: Trend analysis

Trend analysis is one of the most important features for load monitoring. From trend analysis, we can know patterns of load changes. We can compare actual load patterns with desired load patterns and from that can develop such decision making system which will help to control load and to meet all demands of electricity with load management concept. [1]

VIII. LOAD CONTROL & MANAGEMENT

Challenges for conventional control:

1. No ability to address & control individual fixtures or small lighting zones.
2. No workspace or task specific control
3. Lack of centralized intelligence to allow deployment of combined energy management strategies.
4. Limited ability to integrate or share data with other building systems such as HVAC, Security, and Fire/Life Safety
5. Lack of granular (small zone) control increases cost to reconfigure lighting when space needs to be reconfigured
6. Lack of granular (small zone) control eliminates ability to provide personal control and the associated benefits (energy savings and productivity improvements)

Smart strategies for control:

1. Smart time scheduling
2. Task tuning
3. Variable load shedding
4. Personal control
5. Occupancy control

LabVIEW development:

Scheduling of Load:



Fig 9: Front panel for Scheduling

Front panel shown is used for configure Scheduling. According to controls shown on head scheduling will be configured. For update configuration first of all user need to set date and time as per schedule.

Group configuration of Load:

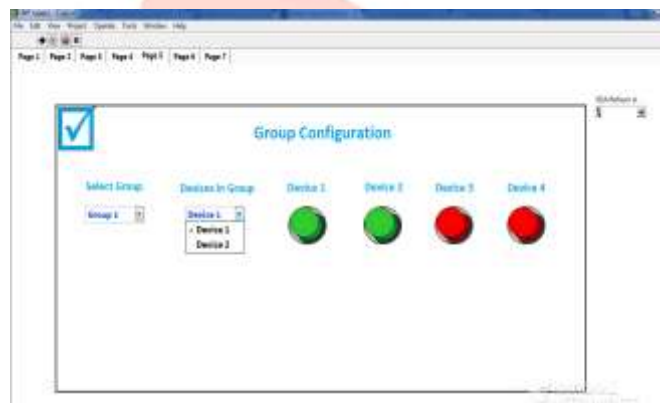


Fig 10: Front panel for Group configuration

Front panel shown is used for Group configuration. According to controls shown on head Group configuration will be configured. For update configuration first of all user need to select the Group form Select Group Popup Menu and accordingly group configured devices will be selected.

Suggested configuration:

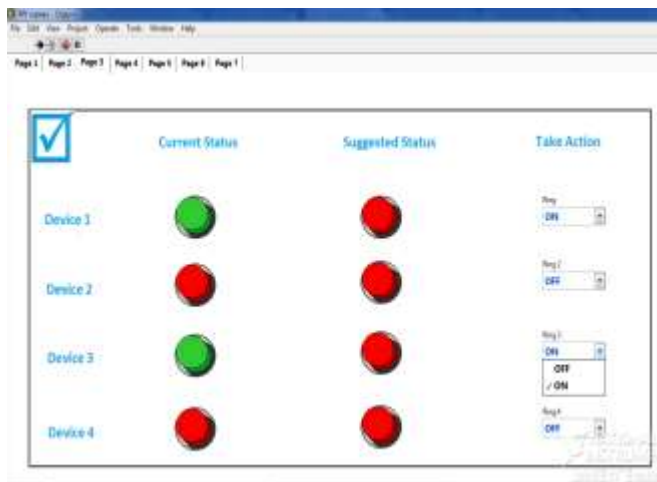


Fig 11: Front panel for Suggested configuration

Front panel shown is used to take action to meet the load demand. Front panel shows the current status of device and suggested status of device, if both are unmatched then from take action popup menu we can take action to meet the load and can manage load.

IX. ACCESSORIES OF SYSTEM



Fig 12: Front panel for Group configuration

Front panel shown above is shows directly total connected load. It will calculate amount of units used according to total load. It can also calculate total amount units used per month. It comprises with features like Consumption calculator, Bill report generation with different tariff and type of customer. It also shows maximum demand status.

Below are different features of system.

Consumption Calculator:



Fig 13: Consumption Calculator

Consumption calculator is feature which is used to calculate consumption of calculator. To calculate consumption of electricity, customer need to select type of equipment, its rated capacity in Watt, Number of Appliances and daily usage in hour. By entering all these value and pressing Calculate button on front panel you can know energy used by customer.

To select multiple equipments, first reset all values and press Add button shown in front panel and then do the same procedure as discussed above.

Know Your Bill report:



Fig 14: Know your Bill front panel

Front panel shows the type of customer you are. From drop down box, customer need to select category and then press run button of VI then it will generate bill report as per tariff plan and type of customer.

Figure shown below shows the layout of bill report with all details of customer.



Fig 15: Layout of Bill report & Maximum Demand Status

Maximum Demand status:

This facility is used to indicate maximum demand status. When total load used is more than maximum demand, alarm will generated as shown in front panel of system.

X. REVIEW

An Electrical power system consists of three components:

1. Generating stations
2. Transmission systems
3. Distribution systems

These three components of power system are integrated together to supply electricity to consumers.

So system is about development of hardware and software integration in such a way by which we can monitor and manage electrical load. System will works between distribution system and consumers which can monitor and control load.

Load management is one of the good alternative of generating more power. So by using load management, we can meet demands of electricity with available energy we have. By implementing smart strategies we can save energy up to 60 to 70 %.

System can also be developed with the more features to make it more rich and attractive. Some of the accessories like consumption calculator, bill report, maximum demand status is developed.

XI. CONCLUSION

In conclusion, with increasing demand of electricity, this system is very useful to manage load and also useful for industries to watch on load and to manage load as well as this system provides many other advantages. Penalties to industries on excessive usage can be prevented using this system. This system is also useful for stabilization of Grid system. By this system we can save energy up to 60 to 70 %.

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