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RESEARCH ARTICLE

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SCADA BASED SINGLE PHASE POWER DISTRIBUTION SYSTEM

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ABSTRACT

SCADA is the acronym for "Supervisory Control and Data Acquisition". SCADA systems are widely used in industry for supervisory control and data acquisition of industrial processes. The project is based on microcontroller and configuration software, and the SCADA power distribution monitoring system is designed. The system uses CT and PT to get electrical parameters of distribution line. They will be transferred to SCADA with the help of serial interface circuit

The objective of this project is to design automated distribution of power in city and country power grids which will provide automatic sequential power cutoff provision for various areas so as to implement load shedding in most effective way. Now a day only industries use the SCADA system so we are trying to show here commercial buildings can also use this system and save power and get facilities using this system. In this project we are trying to make one simple model which helps the user to at a very ease. For all we are attempting to make the power management model for the almost comfort and maximum facilities to the user.

Keywords - SCADA, Microcontroller, Power Distribution, Real Time clock.

I. INTRODUCTION

The use of Electricity is increasing as the population of the world is increasing; also we have to increase the power generation to meet this increasing demand of electricity this power generation is mainly done in the Thermal power stations, a very small power is generated in the solar power plant[4].

At present, there is acute shortage of power. On average basis, the shortfall of power during peak and non-peak hours is approximately 3600 MW to 2200 MW respectively. This shortfall is after considering all the avenues available to MSEB including the purchase of costly power. The shortage of power is extremely acute during peak hours.

MSEB on its part has taken several actions on its own and as per the guidelines/directives issued by the Honorable Commission. Some of the actions undertaken by MSEB are as under:

- MSEB is planning to associate Energy Services for monitoring and advisory issues in Energy Conservation.
- MSEB is taking extremely tough steps to reduce unauthorized connections and thefts.
- The concept of load sharing is being introduced in cities where specific areas will be encouraged to restrict their loads within prescribed limits at specific time and avoid normal load shedding.[8] Under this actions we can use our project to atomize

load shedding to reduce man hour cost and to reduce theft of electricity.

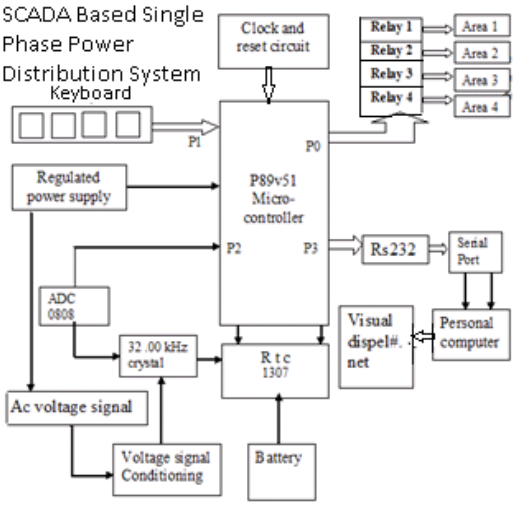
SCADA (supervisory control and data acquisition system) refers to the combination of telemetry and data acquisition. SCADA encompasses the collecting of the information via a RTU (remote terminal unit), transferring it back to the central site, carrying out any necessary analysis and control and then displaying that information on a number of operator screens or displays. A SCADA system gathers data from sensors and instruments located to remote sides. Then, it transmits data at a central site for controller monitoring process. Automation systems are used to increase the efficiency of process control by trading off high personnel costs for low computer system costs. They also contribute to improve performance by taking advantage of faster computer control instead of human reaction times. These automation system are often referred to as supervisory control and data acquisition (SCADA) systems, and the widespread use of such systems makes them critical to the safe, reliable, and efficient operation of many physical processes.[5]

Data acquisition system plays a vital role in measuring real world physical signals. These systems can be broadly classified into two categories, namely the stand alone data acquisition systemsand the computer based data acquisition systems. Once signal is acquired by the device, many communication methods exist to transfer data to computer for further processing. Commonly used communication interfaces for data transfer are: serial communication (RS232 port), parallel port, USB port, Ethernet and wireless networks.

For this project, we first tried to look for need of the MSEB, to reduce the man hour cost and time. We are implementing this project by considering benefit of both distribution system & customer. Now a day, load shedding is done by the manually, that increases man hour and cost. To reduce this cost we are atomizing that load shedding through this model. To avoid the crime of electricity these project is beneficial because this project gives the real time reading to the operator of particular line. As load occurs, operator can visit that site and control it. The effective way of deciding thisproject is to provide flexibility in operation, operator must easily understand the shortage in power distribution. Hence it saves the power by using SCADA based system. This project also improves service reliability, power quality and reduces power loss and it requires less maintenance.

II. METHODOLOGY

A. Block Diagram and description



It consists of the micro controller 89C51 as the central processing unit. Push button keyboard is provided at the input port. Also, an ADC is used to process the voltage and current provided to the system. The real time can be set from micro controller and keyboard. Relays are used at the output port. These are operated as per the time schedule programmed inside the micro-controller memory. This will provide the provision of the power distribution continue or dis-continue for a particular area. The LCD display is used for the local display of the time & the voltage supply to the load & current consumed by the load. For PC interface the serial communication at port3 max 232 interface is provided. Through this hardware interface and properly sleeted serial software protocol the micro-controller data is transferred to the PC to show on the screen. The input for SCADA that is voltage and current parameters are sensed with CT and PT, then corresponding signal goes to ADC for processing. After processing in micro-controller, these parameters are displayed on LCD display as well as on PC by using serial interface.

The RTC time will show on LCD as per the time schedule programmed, if the first set time is

reached the particular output relay corresponding to that time turns on. This relay supplies electrical power to respective area in that time. The 89C51 micro-controller is used & programmed to display the voltage & current being the data acquisition is done on PC the entire system is combine known as "SCADA BASED SINGLE PHASE POWER DISTRIBUTION SYSTEM".

III. STRUCTURE

A. Components Required

1)*Micro controller:* The AT89C51 is a low power, high performance 8 bit Microcontroller with 4K bytes of flash programmable and erasable read only memory. The on chip flash allows the programmed memory to be re-programmed in a system or by a conventional nonvolatile memory programmer .By combining a versatile 8 bit CPU with flash on a monolithic chip the Atmel AT89C51 is a powerful micro-computer which provides a highly flexible and cost effective solution to many embedded control applications[1].

2) *Real Time Clock:*IC DS1307 from Maxim (Dallas Semiconductor) is a serial RTC chip with calendar function. The chip also incorporates 56bytes of NV RAM. Data and addresses are transferred serially through I2C bidirectional bus, which obviates the need for a large no. of interface lines. The bidirectional data is read and written with the help of just two I/O interface lines.In this chip, the clock operates in either 24 or 12 hours format with AM/PM indicator. In calendar mode, end of month is adjusted for the months with less than 31 days and leap year compensation is valid up to year 2100.

3) *IC MAX232:*The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on chip charge pumps and external capacitors. The receivers reduce RS-232 inputs to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V. MAX232 IC will convert a TTL Logic 0 to between +3 and +15V, and it will convert a TTL Logic 1 to between -3 to-15V, and vice versa for converting from RS232 to TTL[7].

4) *Relay Driver ULN2003*: Relay Driver ULN2003 is a high voltage, high current Darlington transistor array containing seven open collector Darlington pairs with common emitters. It consists of seven NPN Darlington pairs that feature high voltage outputs with common cathode Clamp diodes for switching inductive loads. The collector current rating of a single Darlington pair is 500mA. For higher current capabilities, the pairs can be paralleled. ULN2003 is used to interface relays with the microcontroller since the maximum output of the microcontrolleris 5Vwithtoo little Current delivery and is not practicable to operate a relay with that voltage.

5) Liquid Crystal display: Liquid Crystal Display (LCD) consists of rod-shaped tiny molecules sandwiched between a flat piece of glass and an opaque substrate. These rod shaped molecules in between the plates align into two different physical positions based on the electric charge applied to them. When electric charge is applied they align to block the light entering through them, whereas when no-charge is applied they become transparent. Light passing through makes the desired images appear. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines.

B. Circuit diagram and description

Circuit diagram explanation the project scads based electrical distribution system is the combination of hardware implementation and software implementation. The hardware part consists of the µ-controller based system with it devices, electrical transducers, their signal conditioning and the output relay board & at the o/p part, the pc interface is there. The detailed hardware description is given below. Transducers & their signal conditionings port is given in single phase power black box. It is the current transducer. It converts the current passing through the cable to step down current. The CT used for current sensing have to ratio of 1:1 i.e. for one ampere current it will output 1mA current. It is then connected across the resistor to convert the AC current into AC voltage. The AC current in the form of AC voltage is converted to dc voltage with the help of precision rectifier circuit. This is because; the AC voltage may be below 0.7V in case of current sensing because the current is measured in fractions. The precision

rectifier consists of an operational amplifier with two PN junctions' diodes and a 10 k resistor. This is the standard configuration for rectifier. The signal conditioning part is followed by analog to digital converter. The ADC 0808 is used. It is 8bit ADC with 8 i/p channels and inbuilt multiple is provided to select the specific channel independently. The select lines are provided on 28 pin IC. Ref is provided with a fixed reference generated from 5v supply with potential divider network. Specifically, we set the ref = 2.5V in order to display 1 unit for 10mv input to ADC. The separate clock is provided IC 555 with astable multi-vibrator. The clock frequency near to 200kh2. The selection lines are controlled by the microcontroller with so tare programming. At the output of ADC, 8bit data D0 –D7is available. This data is given to input port of the microcontroller ADC 0808. The main decision making block of the system is micro-controller p89v51RD2. It does multitasks simultaneously. The signal is then transmitted to the serial interface IC MAX 232 from port3. MAX 232 make the signal compatible to the Personal Computer. The signal from the MAX 232 is given to the PC through serial port's TXD pin.The signal at RS 232 is displayed on to the SCADA software by using dot net framework. On other side, the input is given by keyboard to another microcontroller. It provides the key board data to RTC & time is shown on LCD display. It reads the memory time schedule and gives output to port2.The output from the port2 is given to the relay driver IC ULN2003. This increases the level of the signal and makes it capable of driving the relays. The relays are connected to the output pins of the ULN 2003.

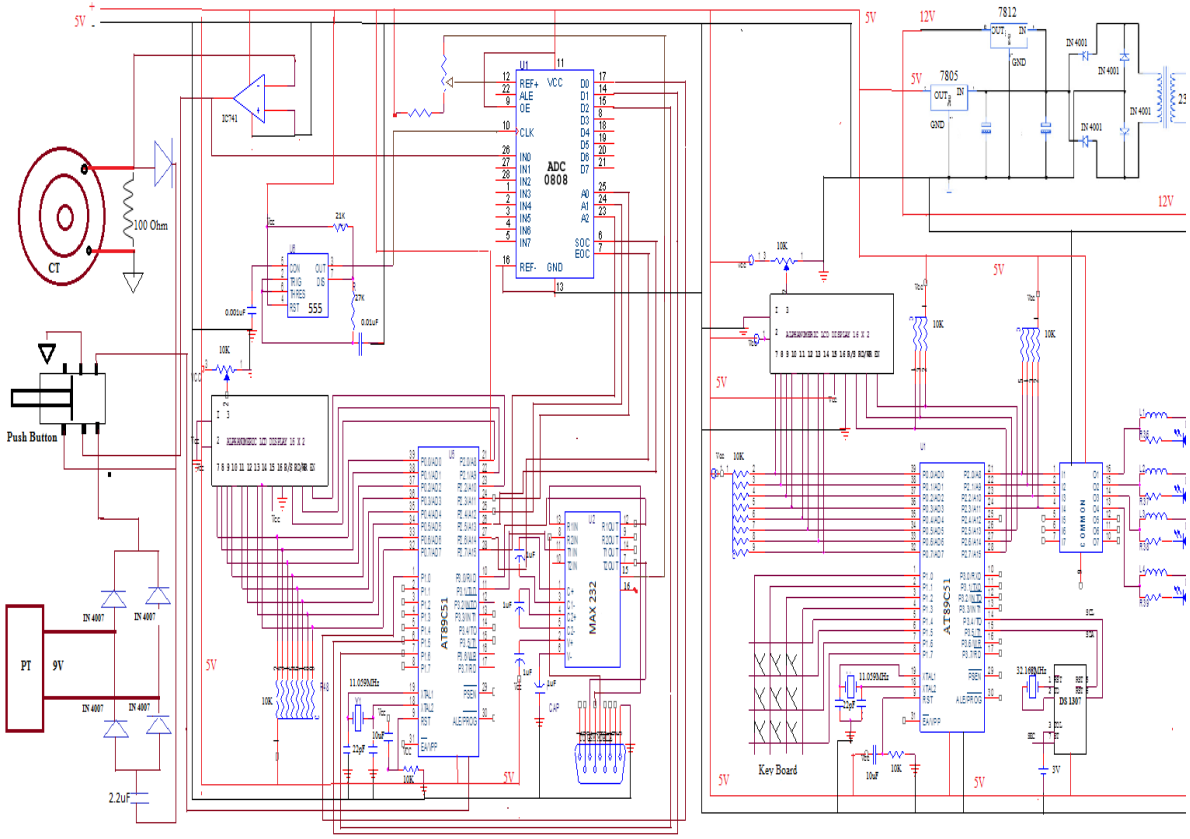


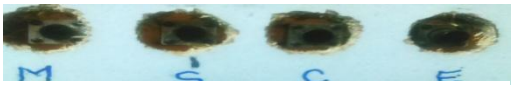
Fig:2 Circuit diagram

IV. Experimental results

A. Diagrams given below shows the overview of project.

Fig3: Overview of project

B. Function of Keyboard



Mode Shift Change Enter

Fig 4:Function of keyboard

1)*M- Mode*: To select time and to show set time of relays, by using long press of M we can set time when project is started.

2)*S – Shift*: To shift digit to be changed.

3)*C – Change:* To increase or decrease the digits (time).

4)E – Enter: To save the timer on – off times.

C. *Operation*

1) At power on the system will start and will display the message on LCD 1 "SCADA Power Distribution" and on LCD2 "SCADA POWER MONITOR". The microcontroller by default will set all its output to high logic level.

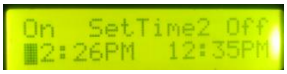
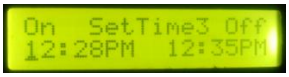
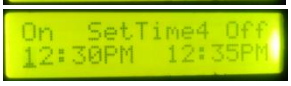
Fig 5: Start up displays on LCD1 and LCD2 respectively

2)Then the RTC time will be show on LCD as per the time schedule programmed. Time input is given through keyboard.

Fig 6: LCD is showing RTC time

3) For example if we set timer of four relays as shown in table.

Table 1: Set time for ON and OFF of timer relays

Area	ON Time	OFF time	Actual on Project
1	12:24PM	12:35PM	
2	12:26PM	12:35PM	
3	12:28PM	12:35PM	
4	12:30PM	12:35PM	

4)If the first set time 12.24PM is reached the output relay1 is turned on. For that time the electrical supply is provided to that respective area1.

Fig 7: Display ON time of first area is reached

Fig 8: Electrical supply is provided to area

Fig 9: Electrical supply is provided to area 1 on 12:24PM

5)If the OFF time is reaches all relays turned off and supply to all areas get turned off and as per the time schedule, the distribution system works.

6)The voltage and current taken by the load tested with potential transformer and current transformer respectively. The transformers output is signal conditioned and as per microcontroller programming given to PC through serial interface IC MAX232. To get this results we have to connect serial port 9 pin connector to PC. Then we have to install .net framework and then SCADA software.

7) Software shows readings as shown in fig10 given below.

I. Software showing date and time, readings are updated for every 1 minute.
II. When no load is started
III. When push button(to select voltage/current) is selected in current mode i.e when it is not pushed, voltage is showing constant and current is varying.
IV. When push button (to select voltage/current) is selected in voltage mode i.e. when it is pushed inside, screen is showing voltage

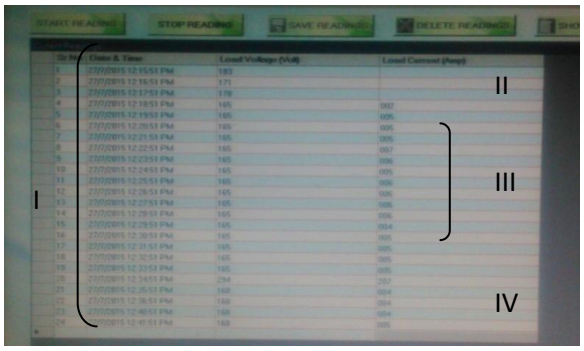


Fig 10: Screen showing SCADA software

V. CONCLUSION AND FUTURE SCOPE

We have developed SCADA based power distribution System for Electricity automation purpose. We have used micro-controller in which for programming assembly language is used. For Communication with PC I have used RS232 serial port. This project helps in making documentation of load on a particular power line. The project is working successfully and we have achieved our goal of distributing power automatically.

The project has a lot of potential and hence can be developed and enhanced in the future with a lot of possibilities like as follows:

As microcontroller is used modification in program can improve the operation. Now the drawback this project is that it can detect current from whole line. This drawback can be minimizing in future by using the current transformer for individual relay. It can detect the crime in every relay. If we replaced relay by other output devices such as motor actuator, we can used these system in automation for different application in different field. The buzzer can be installed for abnormal conditions. With the help of GSM module we can turn off the system from anywhere for abnormal conditions.

References:

[1]. Muhammad Ali Mazidi, Janice GillipieMazidi, Rolin D Mckinlay "The 8051 Microcontroller and Embedded System," Pearson Prentice Hall Publication, Second edition.2006

[2]. U. A. Bakshi, A. P. Godse, A. V. Bakshi – "Integrated circuits and Applications" from Technical publication pune, pp: 4.1 - 4.244.

[3]. Dr. K. ShantiSwarup – "Energy management System and SCADA" from National Programme On Technology Enhanced Learning, Electrical Engineering, chapter 1.

[4]. MrsBhavnaPancholi, DamorMehulManubhai – "Scada Based Power Control System Using PLC" from International Journal of Scientific Engineering and Technology (ISSN : 2277-1581)Volume No.3 Issue No.9,Sep 2014, pp : 1129 -1131.

[5]. Pankaj K. Gakare1, Prashant Y. Shenda"Power Optimization using PLC and SCADA," Progress In Science and Engineering Research Journal, Volume 02, Issue: 03/06 May- June, pp: 171-178.

[6]. Khin Thu Synopsis, Hla MyoTun -"Design and Implementation of SCADA System Based Power Distribution for Primary Substation (Control System)" in International Journal of Electronics and Computer Science Engineering, ISSN -2277-1956, Volume 3, No 3, pp254-261.

[7]. Tarun Kumar Sharma, Padmakar Singh Parihar - "Network Based Data Acquisition and Logging System using PIC Microcontroller" in International Journal of Engineering (IJE), Volume 8, Issue 2, 2014, pp: 22-29.

[8]. S. R. Balan, P. Sivanesan1, R. Ramp -"GSM Based Automatic Substation load Shedding and Sharing Using Programmable Switching Control" from Singapore Journal of Scientific Research, Volume 6, No 2, pp 59-61.

[9]. The letter given by Maharashtra State Electricity board"Prakashgad", 5th Fl., St.Road, Bandra (East), Mumbai - 400 051 to The Secretary, Maharashtra Electricity Regulatory Commission, Cuffe Parade , Colaba, Mumbai- 400 005 with sub Principles and Protocol of Load Shedding by MSEB dated16/05/2005