

# Microcontroller Based Substation Load Monitoring And Control

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**Abstract** - Since the power systems are highly nonlinear, huge and complex, there will be a possibility of interruption of lines feeding to substation due to line faults, these results in overloading of other lines feeding to sub-station resulting in cascaded tripping. To avoid cascaded tripping due to overload of lines it is necessary to monitor the status of incoming & outgoing lines & to trip the outgoing lines based on the withstanding capacity of incoming lines. The purpose of this project is to monitor the status of incoming & outgoing lines using Microcontroller(8051) & to avoid cascaded tripping of incoming lines by initiating tripping of least priority utility outgoing lines in order to maintain load balance and hence there will be no overloading and the system works efficiently. The real time value of Frequency and the lines which are tripped will be displayed on the LCD.

**Index Terms:** Microcontroller (P89V51), Cascaded tripping, LED (Light Emitting Diode), LCD (Liquid Crystal Display), Relays.

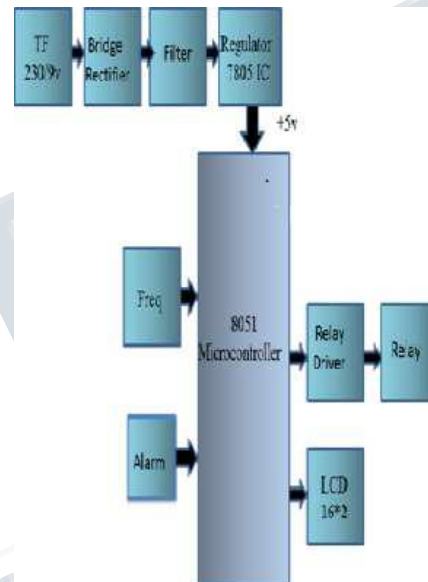
## I. INTRODUCTION

Electricity is an extremely handy and useful form of energy. It plays an ever growing role in our modern industrialized society. The electrical power systems are highly non-linear, extremely huge and complex networks [1].

System can be divided into two subsystems namely, transmission systems and distribution systems. As mentioned earlier the project is mainly on transmission systems where electric power is transmitted over a long distance[3].

In general the generators and loads are the general configurations of modern power systems and particularly in transmission systems it is necessary to balance the load in each electrical line[4]. So in order to avoid overloading of lines the project "MICROCONTROLLER BASED SUBSTATION LOAD MONITORING AND CONTROL" can be implemented where the devices can be monitored and Controlled using microcontroller[2]. The micro controller is programmed in such a way that when the load at a particular line increases the corresponding feeders of least priority will be tripped off to maintain the load balance and hence there will be no cascaded tripping and hence the substation works efficiently.

## II. PROPOSED BLOCK DIAGRAM

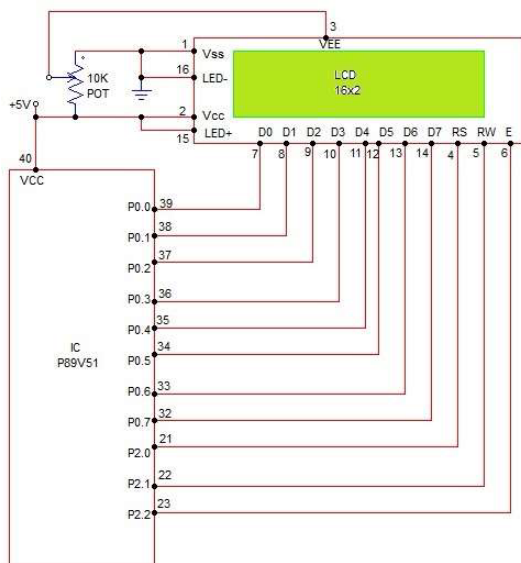


**Fig. a Block Diagram**

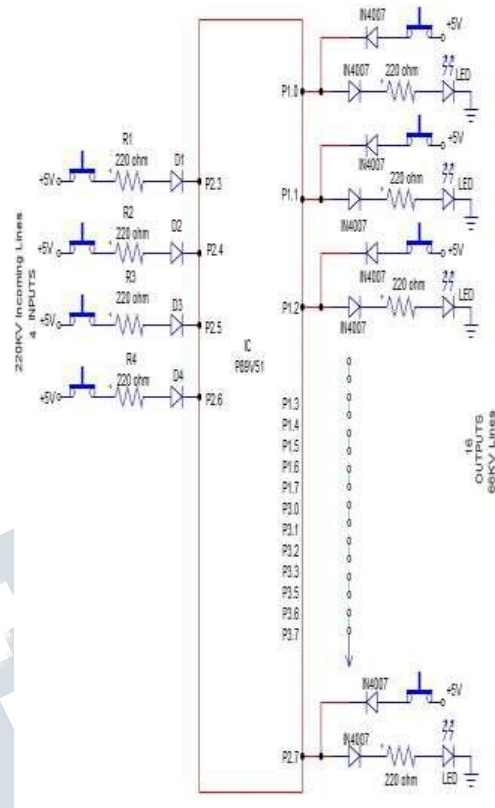
## III. WORKING

The above block diagram shows the rectifier circuit which rectifies AC voltage into DC voltage. In order to get DC voltage from the supplied AC voltage a Bridge rectifier is used which gives pulsating DC voltage. The pulsating DC voltage from the Bridge Rectifier will be smoothed by Filter circuit and it also removes Harmonics and finally gives the pure DC

output voltage. Regulator is a device which is used to obtain constant voltage level and IC 7805 is used to get +5V DC voltage from 6V which is required for the Microcontroller for its operation. As soon as when the supply is given to the microcontroller, LCD display will be initialised as per the program instructions dumped into the chip which is interfaced with LCD as shown in Fig. As per the reference of the typical 220KV substation, the status of all four incoming lines will be monitored by the microcontroller. If any incoming lines are tripped, these results in overloading of other incoming line, hence the corresponding feeders of starting from least priority will be tripped with the help of relays in order to maintain the load balance corresponding to number of incoming lines which are in charged condition [5]. There will be continuous measurement or monitoring of the system [6]. All the problems of the substation and its preventive measures will be taken [7]. The lines which are tripped will be displayed on LCD which is monitored by the microcontroller. In this project real time frequency is measured which can be used in future for tripping of lines based on frequency, When the line frequency reaches less than the specified limit, it is indicated by under frequency alarm which is interfaced with the microcontroller[6]. Hence the complete information about the tripped lines and the frequency values will be obtained.



**Fig. b. LCD Interface with the Microcontroller**



**Fig. c I/O lines Interface with the Microcontroller**

#### IV. MICROCONTROLLER (P89V51)

The P89V51 is a low-power, highperformance CMOS 8-bit microcomputer with 64K bytes of Flash programmable and erasable read only memory (EEPROM). The device is manufactured using Phillips's high-density non-volatile memory technology. Phillips P89V51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications. It has four I/O ports mentioned below, PORT 0(Pin 32 to 39): Port 0 is an 8-bit open-drain bi-directional I/O port. When 1s are written to port 0 pins, the pins can be used as high impedance inputs. Port 0 may also be configured as multiplexed low order address/data bus during accesses to external program and data memory. PORT 1(Pin 1 to 8): Port 1 is an 8-bit bidirectional I/O port with internal pull-ups.

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When 1s are written to Port 1 pins they are pulled high by the internal pull-ups and can be used as inputs.

**PORT 2(Pin 21 to 28):** Port 2 is an 8-bit bi-directional I/O port with internal pullups. Port 2 pins are pulled high by the internal pull-ups when „1“s are written to them and can be used as inputs. Port 2 sends the high-order address byte during fetches from external program memory and during accesses to external Data Memory. **PORT 3(Pin 10 to 17):** Port 3 is an 8-bit bi-directional I/O port with internal pullups. When 1s are written to Port 3 pins they are pulled high by the internal pullups and can be used as inputs.

**VCC:** Pin 40 provides supply voltage (+5V) to the chip.

**GND:**Pin 20 is ground.

**RST (Pin 9):** When high pulse is applied to RST pin, the microcontroller will reset and terminates all activities.

#### A. FEATURES

- 80C51 Central Processing Unit
- 5 V operating voltage from 0 MHz to 40 MHz
- 16/32/64 KB of on-chip flash user code memory with ISP (In System Programming) and IAP (In Application Programming)
- Four 8-bit I/O ports with three high-current port 1 pins (16 mA each)
- Eight interrupt sources with four priority levels
- Six clocks per machine cycle operation (standard)
- 12 clocks per machine cycle operation (optional).

#### V. LCD DISPLAY

A liquid crystal display (LCD) is a flat panel display that uses the light modulating properties of liquid crystals (LCs) which do not emit light directly. LCD Modules can provide textual information to user and its screen is more energy efficient.

It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in colour or monochrome.



*Fig.d LCD Display*

#### VI. SOFTWARE

##### A. KEIL VISION4

Keil is a window based software development platform that combines a robust and modern editor with a project manager. It integrates all the tools needed to develop embedded applications including C/C++ compiler, assembler, linker and a HEX file generator

##### 6.1.1 FEATURES

- Device database for configuring the development tool.
- Project manager for creating and maintaining the projects.
- Integrated make utility functionality for assembling, compiling and linking the embedded applications
- True integrated source level debugger with high speed CPU and peripheral simulator
- Flash programming utility for downloading the application program into flash ROM
- System viewer for changing the property values manually at runtime and displays information about peripheral registers.
- Multi-project manger allows combining vision projects which logically depend on each other, into one single multi-project. This increases the overview, consistency and

##### B. FLASH MAGIC:

Flash magic is a tool which is used to program hex code in EEPROM of microcontroller. It only supports the microcontroller of Phillips and NXP. It is used to

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burn hex code into those controllers which supports ISP(In System Programming) mode.

#### VII. ADVANTAGES

- Low power consumption
- Real time monitoring is possible
- Efficient and Low cost design
- Devices can be operated anywhere in the world

#### VIII. LIMITATIONS

- Loose connection in circuit may lead to maloperation.
- Accuracy is low in frequency measurement, can be improved by increasing the sampling rate.

#### IX. FUTURE IMPROVEMENT

- By interfacing with GSM, SMS can be sent related to tripping of lines.

#### X. APPLICATIONS

- ATM theft precaution system uses this to indicate the theft
- To control a robot
- Vehicle security system
- Automatic accident detection and indication

#### XI. RESULTS

The project "MICROCONTROLLER BASED SUBSTATION LOAD MONITORING AND CONTROL" was designed such that the devices can be monitored and controlled efficiently. The problem of cascaded tripping is avoided and the real time value of frequency and information about the system will be displayed on the LCD.

#### XII. CONCLUSION

All the hardware components used have been designed efficiently. The interfacing of Microcontroller with different components have been done. By doing load management there will be no cascaded

tripping. By using highly advanced IC's, the project has been successfully designed and implemented.

The present project is an economical as well as simple method of alarming the operator as well as safeguarding system from the cascaded faults. As cascaded faults are frequent to appear at the subtransmission level which if not avoided completely has an adverse effect on the performance of the system which in turn completely paralyzes the supply from the sub-stations to the load centres. Hence this is an effective low cost and a compatible system which presents the best solution for the cascaded faults as well as the nature of the fault can be clearly indicated to the power system operator.

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