An Intelligent single phase to three phase smart control system for efficient power distribution management using Embedded System

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Abstract: *Pure electricity is a primary need for today, rather to say 4th necessity after the food clothes and shelter. Impure power supply affects many times because of undershoot or overshoot of power supply and may damages the power based equipments either laboratory based, industrial based or home appliances and the mostly affected devices are the induction motors. There is a tremendous development to maintain the ac pick voltage and the current these days. But these systems are not so effective on site when sudden changeovers in the ac waves. There may be some drawback of the system methodologies implemented by that time. But the things are going to replacing so fast now days, to overcome these drawbacks which is not suitable for to satisfy the end users need.*

To ensure system stability and availability during disturbances, industrial facilities equipped with on-site generation, generally utilize some type of load shedding scheme. In recent years, conventional under frequency and PLC-based load shedding schemes have been integrated with computerized power management systems to provide an "automated" load shedding system [1]. However, these automated systems lack in operating knowledge and are still best-guess methods which typically result in excessive or insufficient load shedding. An intelligent load shedding system can provide faster and optimal load relief by utilizing actual operating conditions and knowledge of past system disturbances. In this research paper presents the need for power control based an intelligent, automated load shedding cum single to three phase changeover control system for an efficient power management called an automotor system.

I.   INTRODUCTION

Gas turbines are very sensitive to critical speeds affecting their physical low pressure blades. These critical speeds may be close to the rated operating speed leaving a small margin on the allowed frequency range before reaching a protective changeover. Typically a protective instantaneous low-speed changeover on gas turbines may be set at 96% of the nominal system frequency. Furthermore, system generation and stability are at risk as the frequency drops. This is specially the case for a thermal generation plant where power output mostly depends on motor-driven auxiliary loads, such as boiler feed water pumps, coal crumble of fine particles, and draft fans. The drop in system frequency instigates a rapid fall of power output to the auxiliary loads, causing further reduction of the energy input to the turbine generator. This sequence of events further deteriorates the system frequency endangering the entire plant stability [2].

To halt the drop in frequency, it is necessary to intentionally, and automatically disconnect a portion of the load equal to or greater than the generation deficiency in order to achieve balanced power economics while maintaining system stability. Automated load shedding systems are necessary for industrial power systems since sudden disturbances can plunge a system into a hazardous state much faster than an operator can react. These automated schemes must be designed and implemented to possess in-depth knowledge of system operating physical parameters and must rely on time sensitive monitoring and control communication networks in order to achieve the desired outcome of fast and optimal load shedding at the onset of a disturbance.

Industrial motor or agro pumps also require to be protecting from overload conditions & require 3 phase supply. This **controller** is a system in which the relays pick up when the changeover is required as per time set. This changeover not only protects the overload current changeovers but also manages the load balancing [3]. In the past years the detection of changeover have been the objective of active study worldwide, and several methodologies have been investigated, but now using relays with microcontroller, the changeover detection is become very fast and efficient. A changeover in electrical equipment is defined as a defect in its electrical circuit due to which the current is diverted from the intended path [4]. Solutions are studied in this

research paper in order to improve the current state of changeover diagnosis. This current changeover system may damage to the working of costly devices. To balance the three phases, avoiding the changeovers and abnormal conditions are essential in order to protect the devices from damages. The characteristics provide optimum circuit switching; the Inverse and Definite Time Characteristics called **IDTC** characteristics which may form part of study for future aspects [5]. It is also useful on systems that have a multiplicity of local generators at the distribution voltage. This work has taken care of few abnormal conditions, which are protecting the affect of the life of devices tremendously.

II.   WORKING

The microcontroller PIC18F452 works on 20 MHz gives the 4 inputs through push to ON type keys, analog PT sensors and RTC DS1307. The relays will switch into various given modes according to the program built in to the microcontroller memory. The timing information and the mode of operation will be displayed on the 16x2 LCD display.

As the controller is switched on, initially need to feed timing data for various operating modes using the menu, enter, scroll-up and reset keys. The timing and mode information gets displayed on the LCD display simultaneously. The 12V dc power supply circuitry is to operate actuators (relay) and 5V supply get through the regulator circuitry provides for to operate the proper working of microcontroller and LCD display as shown in the following controller system block diagram, figure-1. The microcontroller compares real time with the timing displayed on the LCD and makes the relays to switch according to the desired modes. Thus we get no power for MODE-0, single phase power for MODE-1 and 3 phase power for MODE-2.
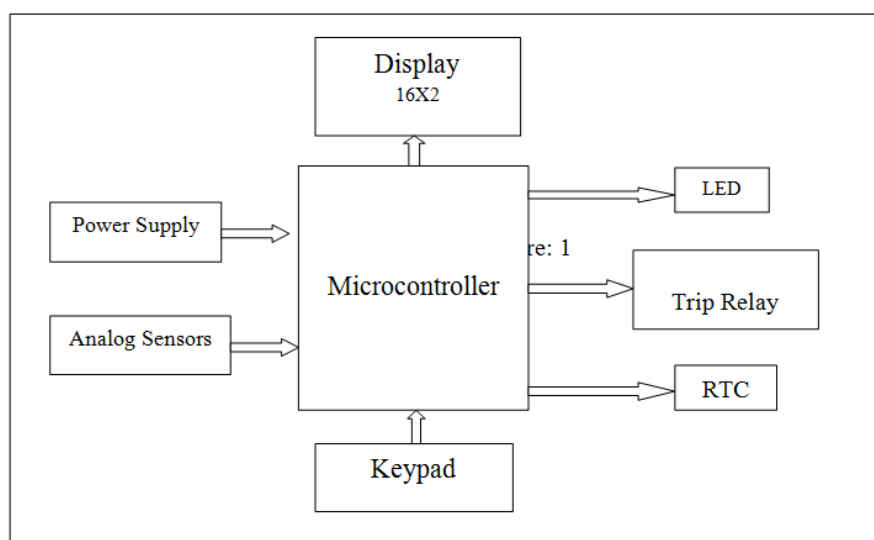

Fig.-1 Block Diagram of Smart Phase Control System

III.   WORKING MECHANISM CUM FEATURES

3.1 Over Voltage Switching.

"Over voltage switching in which the relays pick up when the magnitude of voltage exceeds the pick-up level". The over voltage condition occurs when at least one channel has reached the voltage limit. The system detects this condition as a changeover. Over-voltage switching includes the switching from overloads. This is most widely used switching." For a single characteristic device the very inverse characteristic is most likely to provide optimum circuit switching. If selectivity with fuses and recloses is a requirement, the extremely inverse characteristic is well suited for applications. The inverse characteristic is useful in those rare applications in which selectivity with other inverse or definite time relays is a concern. It is also useful on systems that have a multiplicity of local generators at the distribution voltage.

In this project work, we are setting time as a value digitally which again conversely compared with the present time value in order to detect changeover conditions. Changeover will occur when the present line voltage rises above the set value. This voltage changeover is auto resettable when voltage again falls by value which is   5 volts down to sated one.

3.2 Under Voltage Switching.

"Under voltage switching in which the relays pick up when the magnitude of voltage falls down the set level of voltage". As the home & agricultural electrical device may contain the inductive as well as capacitive

loads, a low voltage condition leads to heavy load currents which may cause larger inrush currents & damages the device.

In our project work we are setting under voltage value digitally which is compared with the present line voltage value in order to detect changeover condition. Changeover will occur when the present line voltage falls below the set value. This voltage changeover is auto resettable when voltages again rise by value which is 5Volts above to sated one. We can set low voltage condition in the wide range of the value from 150V to 199V.

3.3 Over Current Switching.

"Over current switching in which the relays picks up when the magnitude of current exceeds the pick-up level". The over current condition occurs when at least one channel has reached the current limit. The system detects this condition as a changeover. Over-current switching includes the switching from overloads. This is most widely used switching." Overloading of a machine or equipment is taking more current than its rated current". Though over current relays are available with inverse, very inverse, or extremely inverse characteristic, we are using simple inverse modes for operation as our device tends to be useful for home & agricultural devices. In simple inverse mode of operation, time to changeover the system decreases with the increase in changeover value. Thus larger the changeover, smallest is time to cut which prevents device from getting damage.

Like voltage changeover setting, over current value is also settable from menu digitally in which current value is getting compared to detect & generate changeover conditional operations. Unlike voltage reset conditions current changeover need to be reset manually by using the reset key provided.

IV.   RESULT

As per the theoretical aspect we have found the most positive results executed practically through this system. We got so much satisfaction when system works absolute and properly. Hence it satisfies the basic need of profile for switching, display & Indicative actions & hence the instrument developed for this view is working up to the mark & satisfactorily. Following table works properly in all three modes from the single phase operation to the three phase operation along with the actual photographs of the system from mode0 to mode3.

Mode	Time Set For ON	Time Set For OFF	Observation on Device
M0 (OFF)	12:40minutes	12:42minutes	Relay ON for specified time.
M1 (1 Phase)	13:10minutes	13:20minutes	Relay ON for specified time
M2 (3 Phase)	13:30minutes	13:45minutes	Relay ON for specified time
M3 (OFF)	14:25minutes	14:45minutes	Relay ON for specified time

Mode M0:-   Mode M1:-

Mode M2:-   Mode M3:-

V. CONCLUSION AND FUTURE SCOPE

In this research work a newly developed system has lot to offer in multi monitoring aspects & applications because of following reasons:

1. Low cost deployment and redeployment
2. Multi protective systems to cover entire commercial & agricultural electrical devices.
3. It can be an Open standard with multiple vendors

• The project is implemented for display & all necessary data transfers as well as it has wide scope to utilize embedded system for improved control & operations.

• With the development of different gateways this instrument can be further used for forming the different web servers & can be employed to DBMS.

As a part of future developments system can be:

a)   It can be utilize for home electrical security system for home appliances.
b)   It can be utilize as a stabilization system for home, laboratory and industrial equipments.
c)   If required can be attached with advanced data communication interfaces for precise operations.
d)   GSM /GPRS or a ZIGBEE module can be attached to operate the equipments.
e)   It can be communicate to the personal computer using RS232 port.

Acknowledgment:

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