Voltage support by distributed Capacitor Inductor Bank

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***Abstract*-This paper focuses on the design and implementation of power factor correction and voltage regulation using microcontroller (AT 89C51) by determining the power factor of the loaded power system, and generating proper action to calculate and add sufficient reactive power to various types of load. The transmission of electrical energy using AC started at the end of the 19th century and replaced smaller existing local DC distribution systems. By extending local supply areas and providing energy transfer over longer distances various problems regarding mainly voltage control and stability were observed caused mainly by reactive power unbalances in the systems. Switched reactive power compensation (shunt capacitors, shunt reactors) were primarily used to control the steady state system voltages. In AC transmission systems CAPACITOR INDUCTOR BANKs are installed presently. With further improvement of controls, development of semiconductors and new arrangements of VSC technology to-days reactive power compensation is a key method to establish a reliable AC power transmission. This paper is based on fact that when the strategy of using many, small distributed CAPACITOR INDUCTOR BANK located at distribution buses is more advantageous than a few large bulk CAPACITOR INDUCTOR BANK located at the transmission or sub-transmission bus.**

***Index Terms* - reactive power, microcontroller, Inductor-capacitor bank**

I. INTRODUCTION

Most of industrial electric loads have a low power factor not transcending from 0.8 and thus imparts to the distribution losses. Poor power factor can be the result of significant phase angle is generally the result of an inductive load such as an induction motor, power transformer or induction furnace. The existing of reactive power does not included in the electric bill yet this probably causes dissipation power lost at the load which results to an increment of electricity bill charge. Penalty charge is just one of the problems however there are more other problems occur if there is no proper voltage regulation and also power factor is low. Problems occur if there is no proper voltage regulation and if power factor is low they are as follows:- A) Extra losses in feeder cables B) Significant voltage drop C) Reduction of effective capacity of cables D) Voltage drop at the secondary of the transformer E) Losses in transformer Hence to reduce those problems we have to implement our project.
In order to achieve efficient and reliable operation of power system, the control of voltage and reactive power should satisfy the following objectives :

- Voltages at all terminals of all equipment in the system are within acceptable limits
- System stability is enhanced to maximize utilization of the transmission system
- The reactive power flow is minimized so as to reduce $R I^2$ and $X I^2$ losses.

It should be noted that the transmission system operates mainly for active power. It supplies power to a vast number of loads and is feeding from many generating units, there is a problem of maintaining voltages within required limits. As load varies, the reactive power requirements of the transmission system also vary. Since the reactive power cannot be transferred or transported over long distances, voltage control has to be effected by using special devices located through the system. Increasing requirements regarding both the supply reliability and quality of supplied power force using more modern (faster, more reliable, with a broader range of applications) devices.

In the present technological revolution power is very precious. So we need to find out the causes of power loss and improve the power system. Due to industrialization the use of inductive load increases and hence power system losses its efficiency. So we need to improve the power factor with a suitable method. Whenever we are thinking about any programmable devices then the embedded technology comes into fore front. The embedded is now a day very much popular and most the product are developed with Microcontroller based embedded technology.

II.OBJECTIVE

Our aim is to design distributed capacitor- inductor bank for distribution of electricity in regular manner without any disturbance like blackout and power failure which occured in 2012. To achieve this goal following are the objectives:-

1) Design power supply for entire circuitry which will give the supply +5V and +12v.
2) design the system circuitry in proteus software and run in this.

3) To start capacitor or inductor bank as per requirement.
4) To control the voltage of the system and maintain reliability.
5) To control the power factor using manual as well as automatic mode and optimize the power flow.

III.PRINCIPLE

Voltage Support device is developed basing microcontroller 89c51. The voltage and current sampled is converted in to square wave using a zero cross detector. The V and I sample signals are feed to the micro controller at INT0 and INT1 and the difference between the arrival of wave forms indicate the phase angle difference. The difference is measured with high accuracy by using internal timer. This time value is calibrated as phase angle and corresponding power factor. The values are displayed in the 2x16 LCD modules after converting suitably. The capacitor banks are switched as per the calibration in steps".

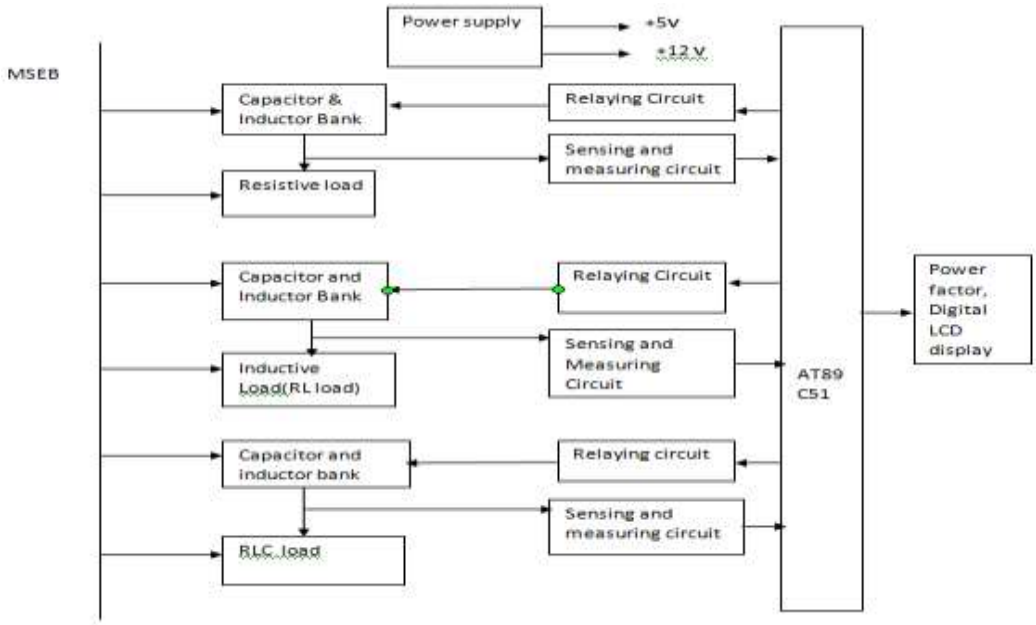

Fig. 1:Block Diagram for Voltage Support by Distributed Inductor-capacitor Bank

IV.ALGORITHM

Below is the algorithm for Phase angle Detection and correction.
Step-1:- Microcontroller started on interrupt mode.
Step-2:-INTX0 & INTX1 are enabled.
Step-3:-INTX0 given VOLTAGE (V), INTX1 given CURRENT (I) from sampling circuit.
Step-4:-Timer measures time interval between two interrupts.
Step-5:-Time interval calibrated as 0-5ms = 0-90 degree.
Step-6:-Calibrated data is converted from HEX to BCD, then to ASCII for display on LCD.
Step-7:-At the same time signals are released to relay driver circuit to operate inductor-capacitor bank.
Step-8:-Provide Delay of 0.1 ms going for next case.
Step-9:- Phase angle between the two signals are altered by changing the load connected.

V.RESULT

Figure 2 shows the outcome of the our project on voltage support by distributed inductor-capacitor bank. This paper shows an efficient & economic technique to control power factor of the load. To improve power factor of load, only shunt capacitor or static capacitor are used. But for reactive power control shunt inductor is required. By using this technique power factor & reactive power consumption of load can be improved.

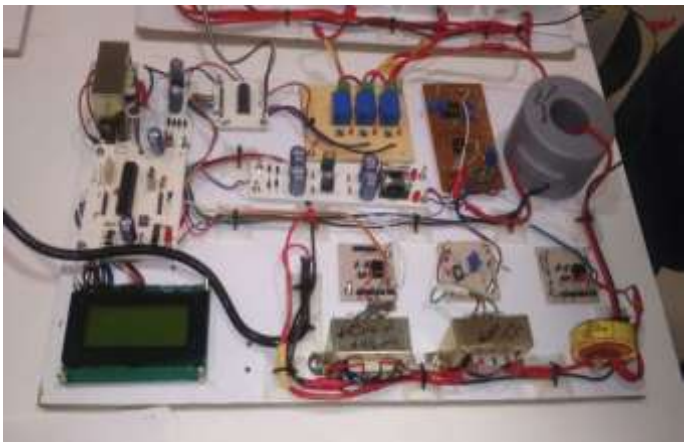

Fig.2: Image of Final Project

VI.ADVANTAGES AND AREA OF APPLICATION

Advantages:

- Costly high voltage transformers are no longer needed because the capacitor inductor bank can be connected directly to the low voltage distribution buses.
- An inductances and capacitances which may be fast controlled by semiconductors i.e. thyristor. The advantage of capacitor inductor bank compared to synchronous condensers is lower maintenance.
- Reduces electricity bill.
- Increases system capacity.
- Improves voltage regulation.
- Improves power factor.

Area of application:

- In residential voltage regulation and power factor management.
- In industrial facilities and official complexes.
- In the power distribution grid in remote rural areas.

VII.CONCLUSION

The energy market is changing fast. New energy providers are coming in the competition is growing. There is not only demand of energy increasing, but also for more power quality and efficiency is required. In most sensitive case where high losses are occur, capacitors are placed on load side to reduce losses. The capacitor and inductor switched are on and off as per requirement. It senses the voltage requirement and switches the capacitor and inductor on or off. The system is reliable and the power factors is maintained.

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