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DESIGN OF EMBEDDED SYSTEM OF POWER GRID SYNCHRONIZATION FAILURE DETECTION

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Abstract: This paper presents the design of an embedded system to detect the synchronization failure of any external supply source with the power grid. It senses the abnormalities in frequency and voltage. A prototype has been developed and tested, the results in the form of pictures of LCD display are shown. For the project, range of frequency is 48Hz to 50Hz and voltage range is 200V-240V.

INTRODUCTION:

There are several power generation units connected to the power grid such as hydra, thermal, solar etc to supply power to the load. These generating units need to supply power according to the rules of the grid. These rules involve maintaining a voltage variation within limits and also the frequency. If there is any deviation from the acceptable limit of the grid, it is mandatory that the same feeder should automatically get disconnected from the grid which by effect is termed as islanding. This type of system can warn the grid in advance so that alternate arrangements are kept on standby to avoid complete grid failure. In this project, an embedded system for power grid synchronization and failure detection is designed.

Several designs have been reported in the literature where embedded systems are used for synchronization failure detection.

Ch H S Ravi Teja[1] reported that due to the increased number of DPGS connected to utility grid, instability of the DG systems and of the grid itself are subjected to instability problems. One of the important issues of the DPGS connected to the utility network is the synchronization with the grid voltage vector. The detection of the positive sequence voltage component at fundamental frequency is required for the control of distributed generation. The magnitude and phase angle of the positive sequence voltage is used for the synchronization of the converter output variables or for the transformation of the state variables into rotating reference. Regardless of the technique used in the system detection i.e. using a Zero Crossing Detector (ZCD) or a Phase Locked Loop (PLL), the amplitude and the phase angle of the positive sequence component must be fast and accurately obtained, even if the utility voltage is distorted or unbalanced. Among these techniques the voltage zero-crossing is the simplest one and the phase-locked loop (PLL)-based techniques are the state-of-the-art techniques in detecting the phase angle of the grid voltages. Also PLL method can easily be disconnected and we can rely on selective nature of basic method, which can be enhanced at the expenses of reducing the speed of response of overall scheme.

Laukik S. Raut, Shahrukh B. Pathan, Gaurav N. Pawar, Mandar V. Pathak[2] reported that in advance so that alternate arrangements are kept on standby to avoid complete grid failure. In this paper hardware controller In an alternating current electric power system, synchronization is the process of matching the speed and frequency of a generator or other source to a running network. An AC generator cannot deliver power to an electrical grid unless it is running at the same frequency as the network. There are several power generation units connected to the grid such as hydra, thermal, solar etc., to supply power to the load. These generating units need to supply power according to the rules of the grid. These rules involve maintaining a voltage variation within limits and also the frequency. If any deviation from

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limit of the grid, it is mandatory that the same feeder should automatically get disconnected from the grid which by effect is termed as islanding. This prevents in large scale brown out or black out of the grid power. So, it is preferable to have a system which can warn the grid-based system to identify the abnormalities and to disconnect the faulted part from the grid is proposed.

Rohan Solanki[3] proposed a methodology of Islanding Detection about the Photovoltaic Grid-Connected Generation Systems a the photovoltaic grid-connected generation system is rapidly developed and applied due to the cleaning, renewable and wide distribution of solar. This paper is to solve the problem about islanding detection brought by the photovoltaic grid-connected generation system. First of all, it analyses the reason happened and potential hazards of the Islanding and introduces the existing detection method and islanding detection. Then, in view of the insufficiency of the existing method, it put forward a new solution that combined the negative sequence voltage positive feedback voltage with active power positive feedback to the islanding detection. The amount of change of the frequency and the voltage is introduced to the voltage - active power positive feedback, which can effectively and fast detect the islanding.

Divyesh Patel[4] generated Detection And Protection of power grid synchronisation failure system in which they gave the idea if any deviation from the acceptable range limit of the grid it is mandatory that the some feeder should automatically get disconnected from the grid which in termed as islanding, these prevent in large scale brownout or blackout of the grid power so it is preferable to have a system which can warn the grid in advance so that alternate arrangements are kept on standby to avoid complete grid failure.

Zongjie Liu, Lifeng Zhu, Li Deng, Lijun Qin, Feng Jiao[5] reported a methodology of Islanding Detection about the Photovoltaic Grid-Connected Generation System as a the photovoltaic grid-connected generation system is rapidly developed and applied due to the cleaning, renewable and wide distribution of solar. This paper is to solve the problem about islanding detection brought by the photovoltaic grid-connected generation system. First of all, it analyses the reason happened and potential hazards of the Islanding and introduces the existing detection method and islanding detection. Then, in view of the insufficiency of the existing method, it put forward a new solution that combined the negative sequence voltage positive feedback voltage with active power positive feedback to the islanding detection.

Karan Gupta, Shreyas Gupta, Kummad Verma, Anil Singh, Abhimanou Sharma [6], reported an idea of Detecting Power Grid Synchronization Failure on Sensing Bad Voltage or Frequency Documentation in which they described in modern power system, electrical energy from the generating station is delivered to the ultimate consumers through a huge network of transmission and distribution. There are several power generation units connected to the grid such as hydro, thermal, solar, wind etc to supply power to the load. Thus, for satisfactory operation of loads, it is desirable that consumers are supplied with substantially constant voltage and frequency.

The hardware of the project consists of comparator (LM358), which will compare the voltage level and frequency of power line signal with the reference values. If the signal voltage and frequency exceeds or if it is less than the standard limit, the power supply will be disconnected. The abnormalities in voltage and frequency will be detected by this system. This will prevent hazards and power losses in the houses.

DESIGN METHODOLOGY:

Detecting power grid synchronization failure system on sensing frequency or voltage beyond the acceptable range is working on the principle of continuously sensing of voltage and frequency of supply sources. In this the system, the microcontroller senses the supply voltage and frequency with help operational amplifier, then these voltages and frequency are matched with the alternate supply voltages and frequency. If the both are matched, then the microcontroller gives the logic high signal to relay driver IC then, on which the lamp is directly connected. Similarly, if the both are not matched then the microcontroller turn off the output load through relay driver IC. Here for the demonstration purposes, we can easily change the alternate source frequency and voltages and check the working of this system by turn on or off the lamp. This system is directly connected to power supply and LCD display have been used here for seeing the supply voltages and frequency of both sources. The block diagram of the system is shown in Fig. 1. It consist of 1.Transformer

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2.Microcontroller(89S52)
3.Rectifier
4.Comparator
5.Relay
6.Capacitor
7.555 Timer

Pictures Of Hardware:

Frequency=50Hz on LCD display

Low Frequency=06Hz on LCD Display

Fig. 2(a) Power line frequency display on LCD

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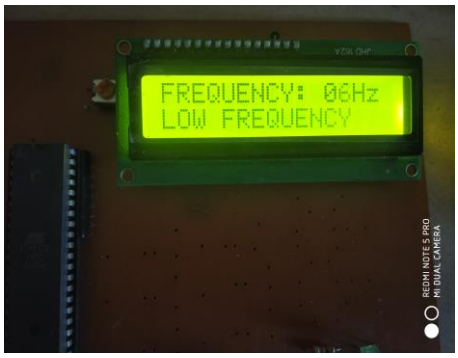

Fig. 2(b) Low Frequency indication on the on LCD Display

Fig. Fig. 2(c)High Voltage indication (System shutdown) on LCD Display

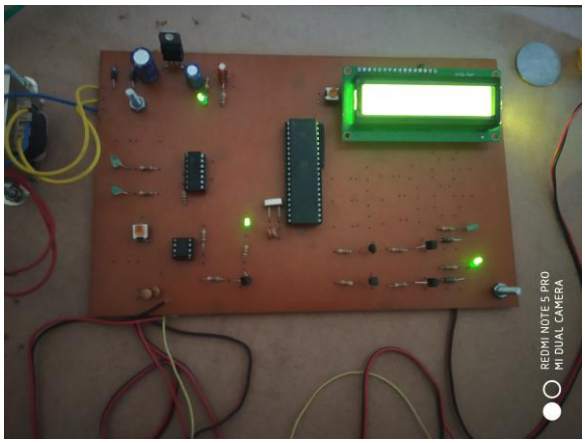

Fig. 3 Prototype of the project

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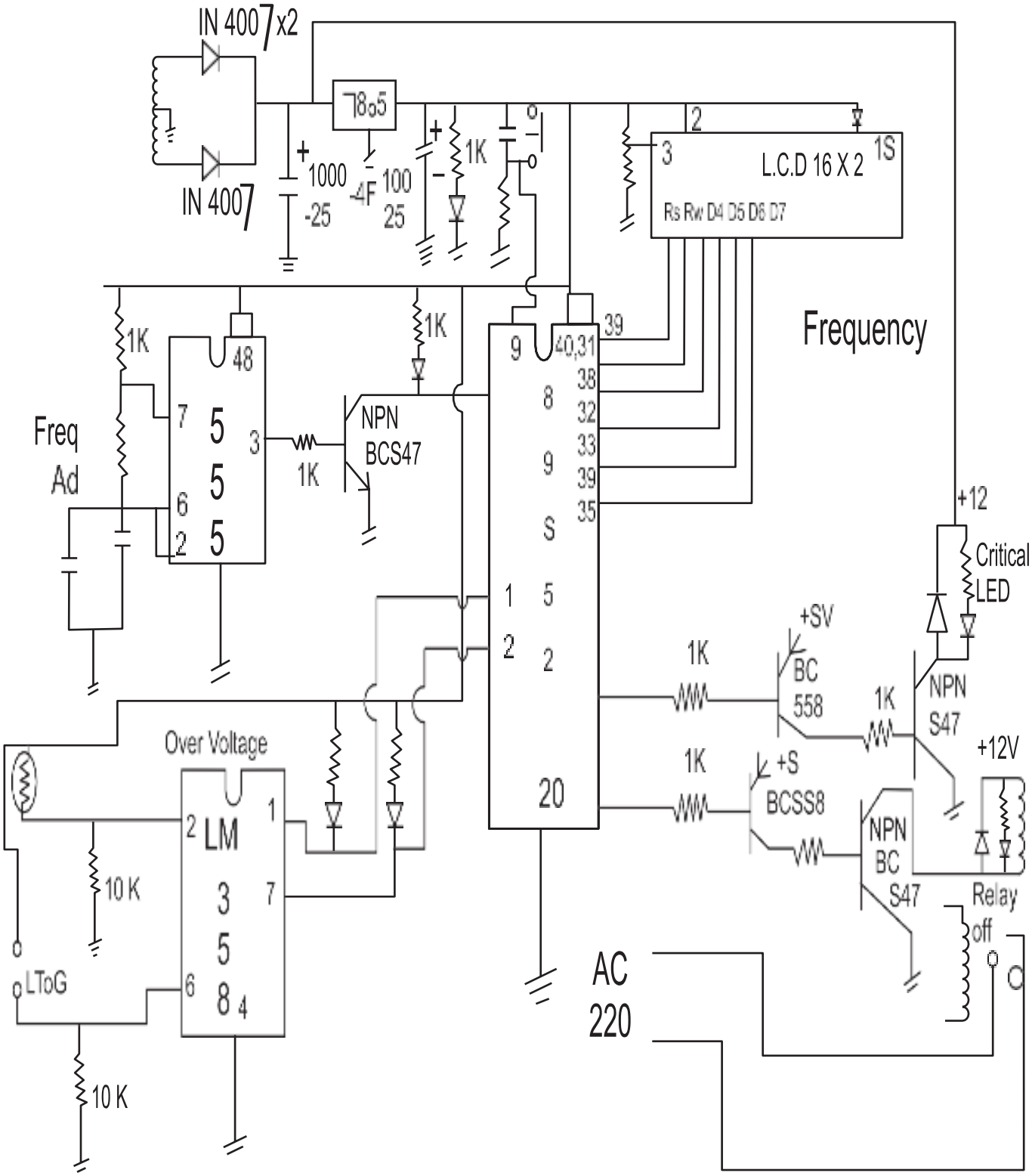
Block Diagram Of Project



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RESULT:

Frequency detection is by done by varying the rheostat after reaching the acceptable range. Figure 2(a) show the LCD display when the voltage reaches 50 Hz . Here continuous monitoring load and faults in frequency and voltage is done by using microcontroller. Table 1 shows the range of frequency change which can be detected with this device. Fig 3 shows the prototype of the proposed system.

Table 1. Frequency Detection Table:

Frequency(Hz)	LCD Display	Bulb Indication
<48	Display Frequency	OFF
48-50	Display Frequency	ON
>50	Display Frequency	OFF

CONCLUSION:

In this paper, we have discussed key features, applications, and working of power grid failure detection system. We have also discussed the significant benefits of our project.

The system has tremendous potential and is reliable in detecting voltage and frequency when it is either too high or too low. There is an LED that will reflect it. This will enable us to take necessary precautions. This implementation concludes that it is possible to have a power grid system that is smarter, more effective as well as efficient in its operation, thus proving to be more economical

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