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Uninterrupted Power Supply to Load from Different Sources by Using PLC

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ABSTRACT: The main purpose of this project is to provide continuous power supply to a load, by selecting the supply from any of the four sources namely AC mains and solar, wind, and hydro automatically in case if one the source is absent. The need of electricity is increasing day by day and the frequent power cuts of electricity are causing many problems in different areas like banks, colleges/schools, hospitals, houses and industries. Thus there is requirement for an alternate arrangement of power supply.

When a source, say mains fails, the supply automatically shifts to next priority source. On failure of the mains supply the load gets supply from the next available source, say an inverter. If the inverter also fails it switches over to the next available source and so on. As it is not feasible to provide all three different sources of supply, one source with alternate switches are provided to get the same function. The complete switching operation can be controlled by using the plc. The sources which are not delivering the power to the load are given to micro grid and BESS (Battery Energy Storage System)

KEYWORDS: PLC, Sources, BESS, Micro Grid.

I.INTRODUCTION

Electricity is most needed in our day to day life. Now a day's electrical energy is generated by the conventional sources like coal, diesel, nuclear etc. and soon the will be exhausted and then we will need other alternatives to generate electricity. But we can extend the life of fossil fuels by managing our demands and using other sources to fulfil our need of electricity. There are many non-conventional energy sources like solar, wind, hydro etc.These non-conventional energy sources are costlier than the conventional sources so, completely replacing the use of conventional sources is not the best option.

An important requirement of electric power distribution systems is the need for automatic operation. In particular, the rapid and reliable transfer of the system from one power source to another during certain system events is important to achieving the reliability goals for such systems and the facility serves. In the existing system, they made four switches to demonstrate the corresponding failure of that power supply. By pressing any one of the switch, absence of that particular source can be found out. The switches are connected as input signals to PLC. In recent years, extensive research has been dedicated towards the design of uninterruptible power supply (UPS) systems to provide clean, conditioned, and uninterruptible power to equipment in critical applications such as servers and storage systems, personal computers, medical equipment, telecommunication systems, industrial and commercial controls, etc. under essentially any normal or abnormal utility power conditions.

In order to supply continuous power to the load in the absence of utility power, energy storage systems such as batteries. Many energy resources will be used in this project. Like AC mains solar, wind, hydro, and others will be universally compatible.

The benefits of this project is

- Meeting end-user needs by ensuring UPS for critical loads, controlling power quality and reliability at the local level, and promoting customer participation through demand-side management and community involvement in electricity supply.
- Enhancing the integration of distributed and renewable energy resources that help to reduce carbon emissions, peak load congestion, and line losses by locating generation near demand.

In addition to the intended benefits, new innovations for advanced micro grids can be applied to provide secure and advanced automated or dispatched controls for today’s legacy electric grid.

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The advanced micro grid will initiate changes to the grid that will contain nearly self-healing sectors in the event of natural disasters or other massive grid failures.The advanced micro grid systems will use new communications methods that have integrated security and surety for immunity from outside events or adversaries.
A list of the objectives:

- Supports power quality enhancements for connected loads.
- Provides VAR/frequency controls and support for interconnectivity.
- Improves reliability for critical loads.
- Balances distributed and central control.
- Enables price-driven demand response.
- Reduces peak loads for the interconnected grid.

Fig 1 Solar panel and Wind turbine

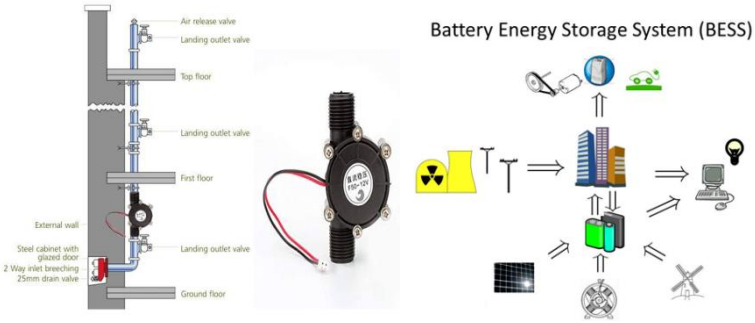

Fig 2 Hydro turbine and BESS

II. PROPOSED MODEL AND NOTATIONS

- **Notations**
- S - Solar power plant
- W - Wind power plant
- H - Hydro power plant
- AC - AC mains
- B - BESS (Battery Energy storage system)

- In Relay modules we have 5 terminals they are
- Com - Common terminal
- NO - Normally Open
- NC - Normally Closed
- C - coil terminal

PLC as the input and output modules &the following are the terminal

Input module terminals

- X3 - Solar power plant input pulse
- X4 - Wind power plant input pulse
- X5 - Hydro power plant input pulse
- X6 - AC mains input pulse
- X7 - BESS input pulse
- X0 - Minimum load condition input pulse

Output module terminals

- Y0 - Solar power plant output power
- Y1 - Wind power plant output power
- Y2 - Hydro power plant output power
- Y3 - AC mains output power
- Y4 - Battery Energy Storage System output power
- Y5 - Buzzer

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- X1 - Medium load condition input pulse
- X2 - Maximum load condition input pulse
- L - LEDs (they are connected to show the output is ON and Input is ON

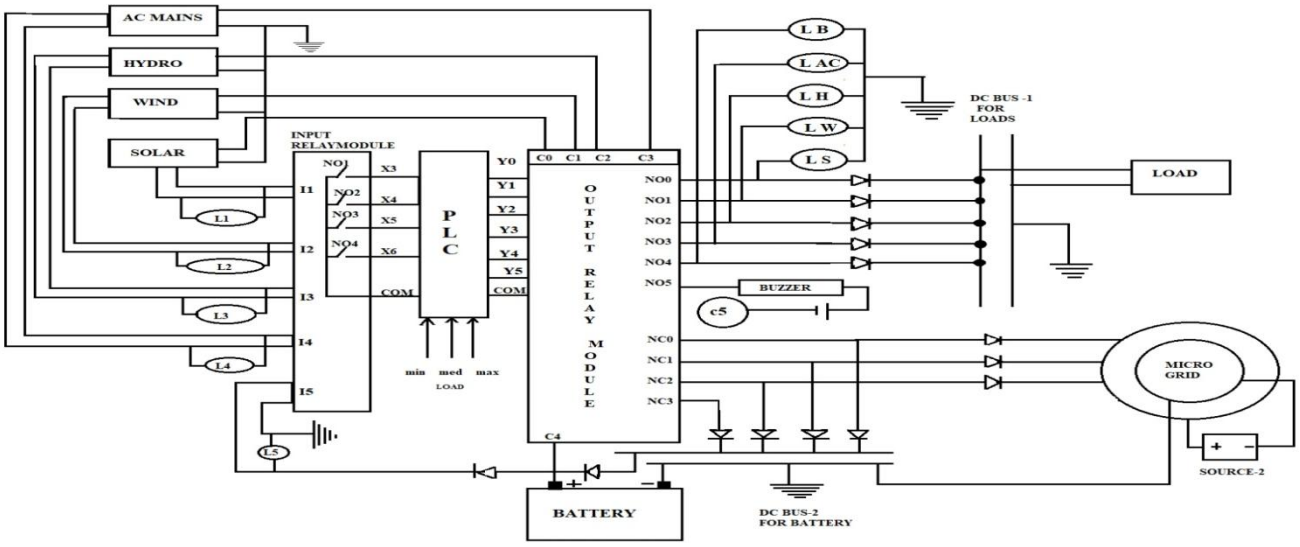

Fig 3 Block diagram and proposed model

III. SOURCES CORRESPONDING TO LOAD CONDITIONS

Load conditions

- In practical conditions the PLC reads the analog value of load. Based on the load or power consumption value the sources will switch lo load.
- As this is prototype model and power generation is less and loads are also less, so reading the analog values is difficult. For this reason we are taking 3 load conditions as follows
  1) Minimum load.
  2) Medium load.
  3) Maximum load

For the above three load conditions we are taking three set of loads and switch them.

Sources corresponding to loads

- The sources which are switching bases on the load conditions.
- We have 5 sources with their priority order they are
  1. Solar 2. Wind 3. Hydro 4. AC mains 4. Battery energy storage system (BESS)

Minimum load condition	**Medium load condition**	**Maximum load condition**
In minimum load we required any one of the source from their priorities. If no source is in active and all are failure the buzzer is switched on	As the name indicate the loads are medium so we are switching the any two sources from the below list	As the load is maximum and the amount of power consumption is more so the sources need to be switched is increased to any 3 sources
-Solar - Y0	Solar and Wind - Y0 and Y1	Solar, Wind and Hydro - Y0, Y1 and Y2
-Wind - Y1	Solar and Hydro - YO and Y2	Solar, Wind and BESS - Y0, Y1 and Y4
-Hydro - Y2	Solar and BESS - Y0 and Y4	Solar, Hydro and BESS - Y0, Y2 and Y4
-AC mains. - Y3	Wind and Hydro - Y1 and Y2	Wind, Hydro and BESS - Y1, Y2 and Y4
-BESS - Y4	Wind and BESS - Y1 and Y4	AC mains - Y3
-Buzzer - Y5	Hydro and BESS - Y2 and Y4	
	AC mains - Y3	

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IV. FLOW CHART

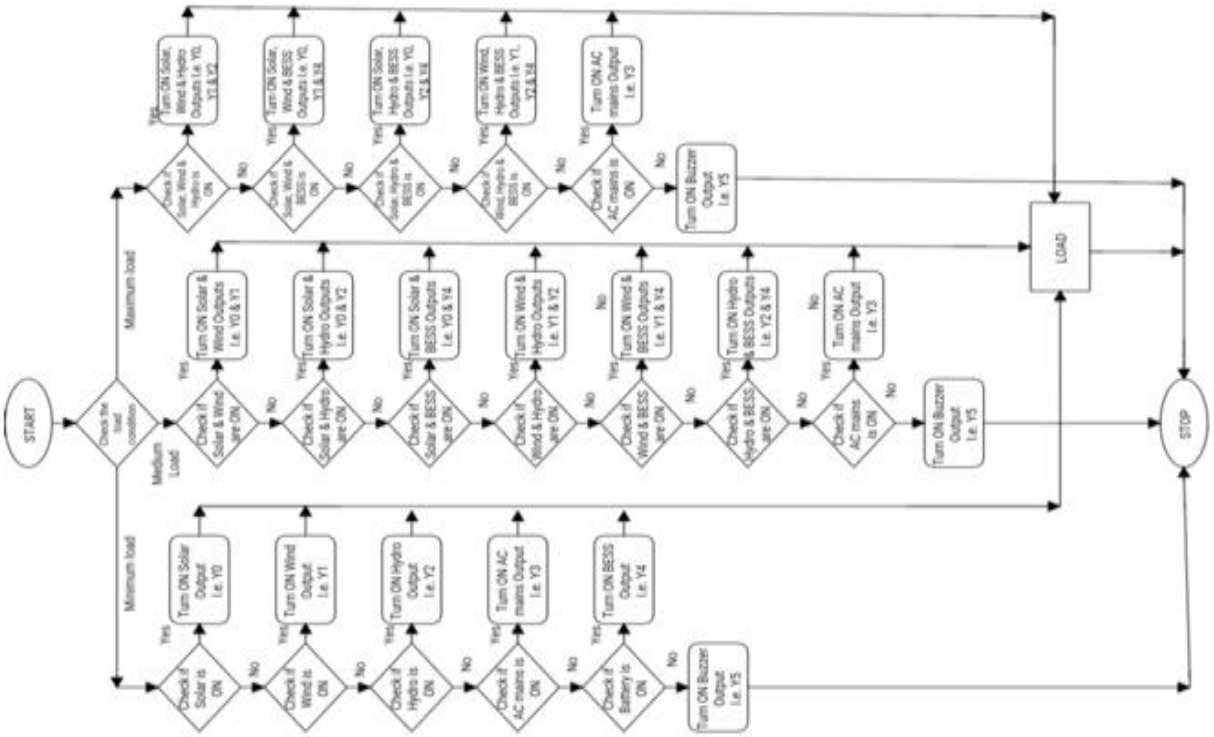

Fig 4 Flow Chart

V. WORKING

- The PLC will read the input pulse from the source. The pulses will indicate with LEDs in the project.
- As the generation is continuous and difficult to turn off the generation we connected the switch. When we turn on the switch corresponding input pulse will turn ON.
- The input pulses will read by the PLC.
- Before input pulses of sources PLC checks the load condition pulses.
- According to load condition PLC will check the sources pulses and turns ON the corresponding output based on program.
- To show which output is turned ON there are LEDs to show the corresponding output is turned ON.
- If the remaining sources output is of for the DC bus-1, then they are given to charge the battery i.e., DC bus-2 and micro grid.
- For micro grid solar, wind and hydro generated power is given.

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VI. PLC PROGRAM

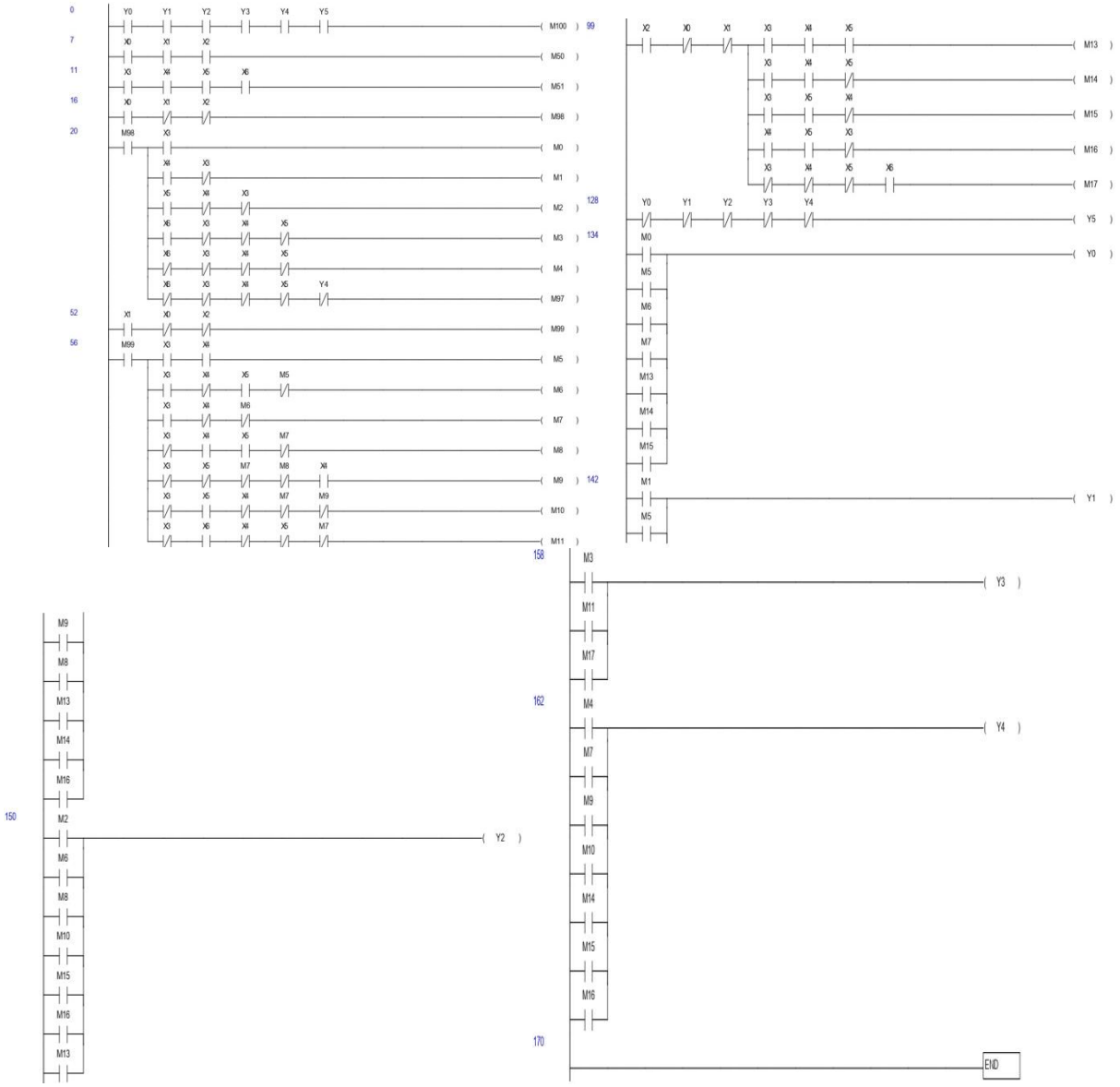

Fig 5 PLC Program

★ Type of PLC: DELTA PLC

Program explanation

- In first row program all are output of PLC which are sources to switch to load and buzzer output.
- In second row they are inputs to PLC which are load conditions (minimum, medium and maximum).
- In third row ther are inputs to PLC which are sources pulse inputs to PLC.
- Remaining program is divided into 3 parts which works on load conditions.
- M0 to M100 are the memory address to store the row status.
- When X0 is high i.e. minimum load condition is high, then power will flow to row 4 and row 5. In row 5 remaining program for minimum load condition source is there.
- According to the input pulses the output is stored in memory address.
- Similarly if X1 is high i.e. medium load condition is high, then power will flow in line 6 and 7.
- In line 7 there is a program for medium load condition, where the output is stored in memory based on input pulses.
- Similarly if X1 is high i.e. maximum load condition is high, then power flows in line 8.

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In line 8 there is a program for maximum load condition, where the output is stored in memory based on input pulses.

- All the memory address stores the data to turn on the specific output.
- Now all the address which stores the data of output Y0 to turn on are connected in parallel.
- Similarly all the address which stores the information of particular output to turn on is connected in parallel to turn on the particular output.
- In last end is connected to end the program.

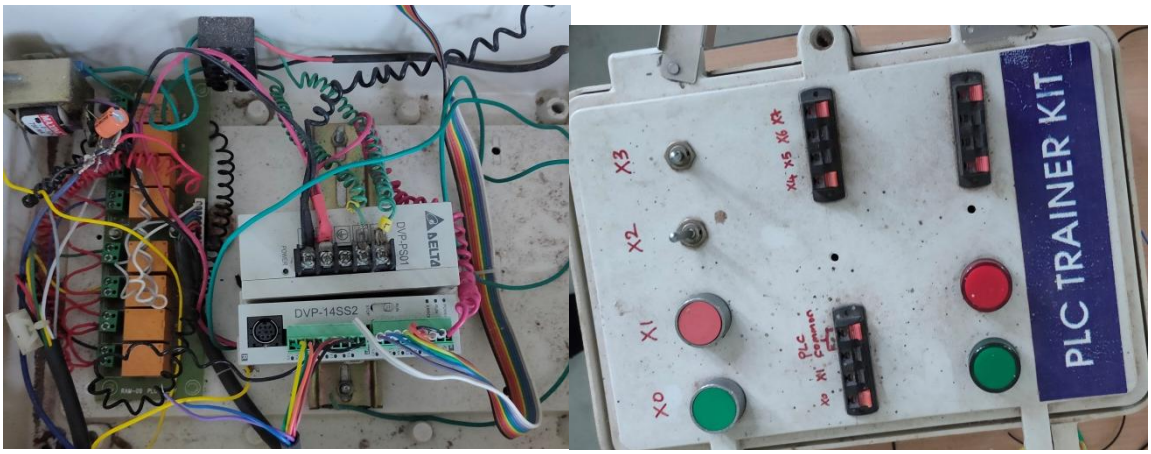

Fig 6 DELTA PLC

VII. RESULT

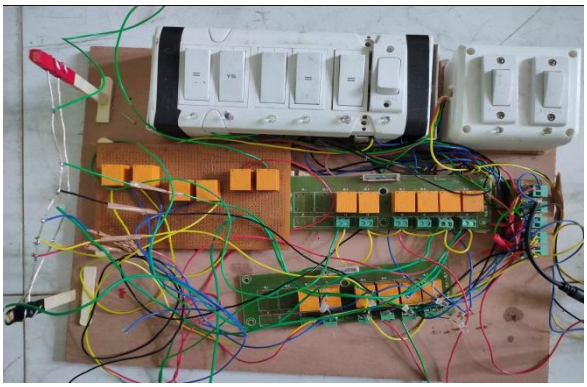

Fig 7 Controller and Load Bus

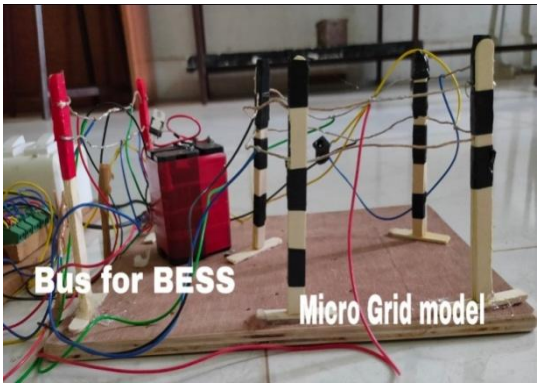

Fig 8 Bus for BESS and Micro Grid

The power is generated from the sources and the load is connected to the load bus where the load bus receives the power from the sources according to the controller. At the same the excess power will store through BESS and supply to micro grid

VIII. CONCLUSSION

In the "Power supply from four different sources: Ac mains, Solar, and wind, hydro" has been explained in this project with all its features and details. The significance of this project lies in its various advantages and wide places of applications such as Industries, Hospitals, Banks; etc. It has been developed by integrating Colleges/Schools, etc. and integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.

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