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Optimization of Power Grid Using Fuzzy Logic

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***Abstract*- In this paper, four grids are considered. Out of four two are based on conventional source of energy (thermal and nuclear) and two are non conventional source of energy (solar and wind). The power sent by all these grids is sent to central bus which is configured in ring main fashion. Now by using fuzzy logic in MATLAB, multivalued code which will decide that which grid to be turned ON/OFF and how much power has to be drawn from each grid.**

***Keywords*- Fuzzy logic, AI, load sharing, ring system, non conventional source of energy.**

I. INTRODUCTION

Energy is needed for our industrial, commercial and day-to-day activities and energy is utilized in different forms. The available forms of energy, electrical energy is the important one as it can be generated, efficiently, transmitted easily and utilized ultimately at a very reasonable cost. The components needed for generation, transmission, and large-scale distribution of electric energy form a huge complex system termed as Electric Power System [1]. For economical and technological reasons individual power systems are organized in the form of electrically connected areas or regional grids. Each area or regional grid operates technically and economically independently, but these are eventually interconnected to form a national grid so that each area is contractually tied to other areas in respect to certain generation and scheduling features.

In India, there are five regional load dispatch center namely Northern region, North-Eastern region, Eastern region, Western region and southern region. These all grids are interconnected forming a national grid. Interconnection has the economic advantage of reducing the reserve generation capacity in each area. Under the condition of sudden increase in load or loss of generation in one area, it is immediately possible to borrow power from adjoining interconnected areas. It provides capacity savings by seasonal exchange of power between areas having opposing winter and summer requirements. It permits capacity savings from time zones and random diversity. It facilitates transmission off peak power. It also gives the flexibility to meet unexpected emergency loads [2].

II. PROBLEM FORMULATION

In recent grid system there are certain shortcomings such as uncontrolled power flow, resources for power generation are not utilized in efficient way, no encouragement to establishment of micro grids at consumer level, no smart decision making capabilities in the system.

III. PROPOSED METHOD

For the stated problem, we have designed such a system in which the grids are connected in ring mains fashion and we have invoked Artificial Intelligence in the system which will help us to overcome above shortcomings. The problem of uncontrolled flow of power can be sorted out by limiting the upper and lower limit of power. The whole system is synchronized in such a way that priority is given to the renewable sources of energy so that dependency on the non-renewable sources such as thermal power is reduced and precious resources such as coal and diesel can be preserved for longer period of time. The generation of power can be encouraged at domestic level so that consumers can be able to sell the power which they are generating. As we are invoking Artificial Intelligence in the system by use of fuzzy logic so the system become optimized and self healing of the grid can be achieved.

We have shown the basic block diagram of our proposed work in fig. 1 . The various power supplies in the project is shown in fig. 2, fig. 3 & fig. 4 . In fig.5 we have shown the pin diagram of microcontroller we have used. Fig.2 shows the power supply diagram for wind power plant. Fig. 3&4 shows the power supply to central grid as well as the values of voltages & current from solar, wind, thermal & nuclear power plants.Various components are used in the proposed work that is shown in table I.

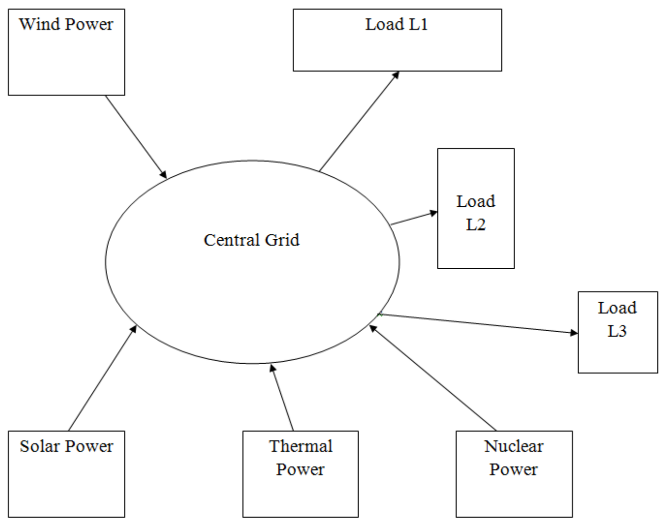


Fig.1 Block Diagram of the Proposed Work

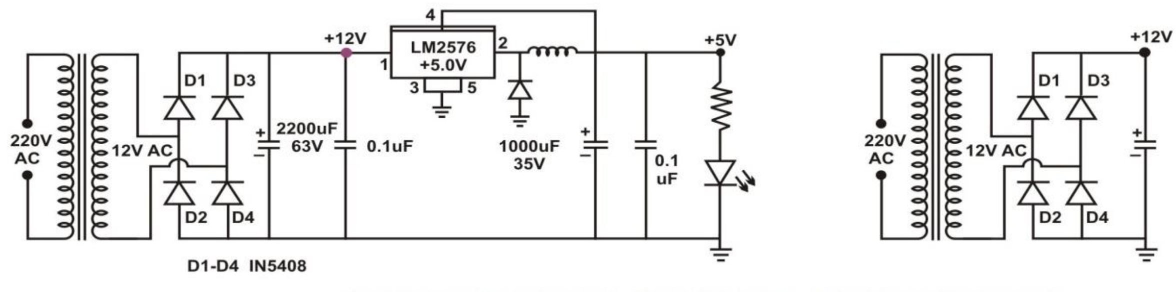


Fig. 2 Wind Power supply

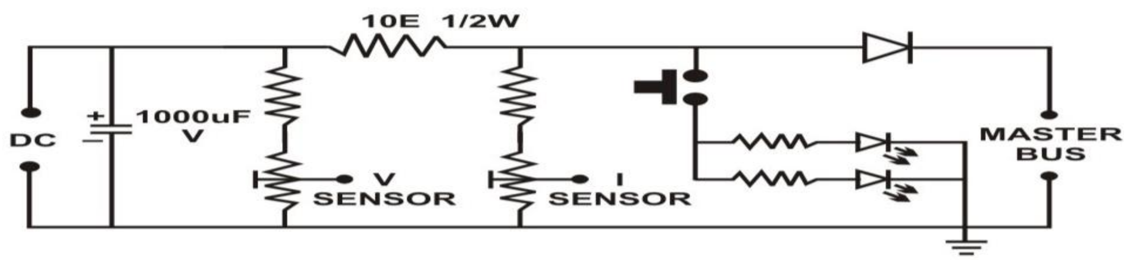


Fig. 3 DC Sensing Card for Wind Plant & Solar Section

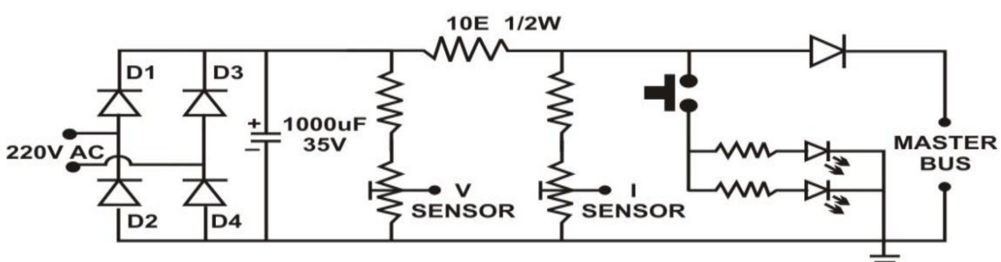


Fig.4 AC Sensing Card for Super Thermal & Nuclear Section

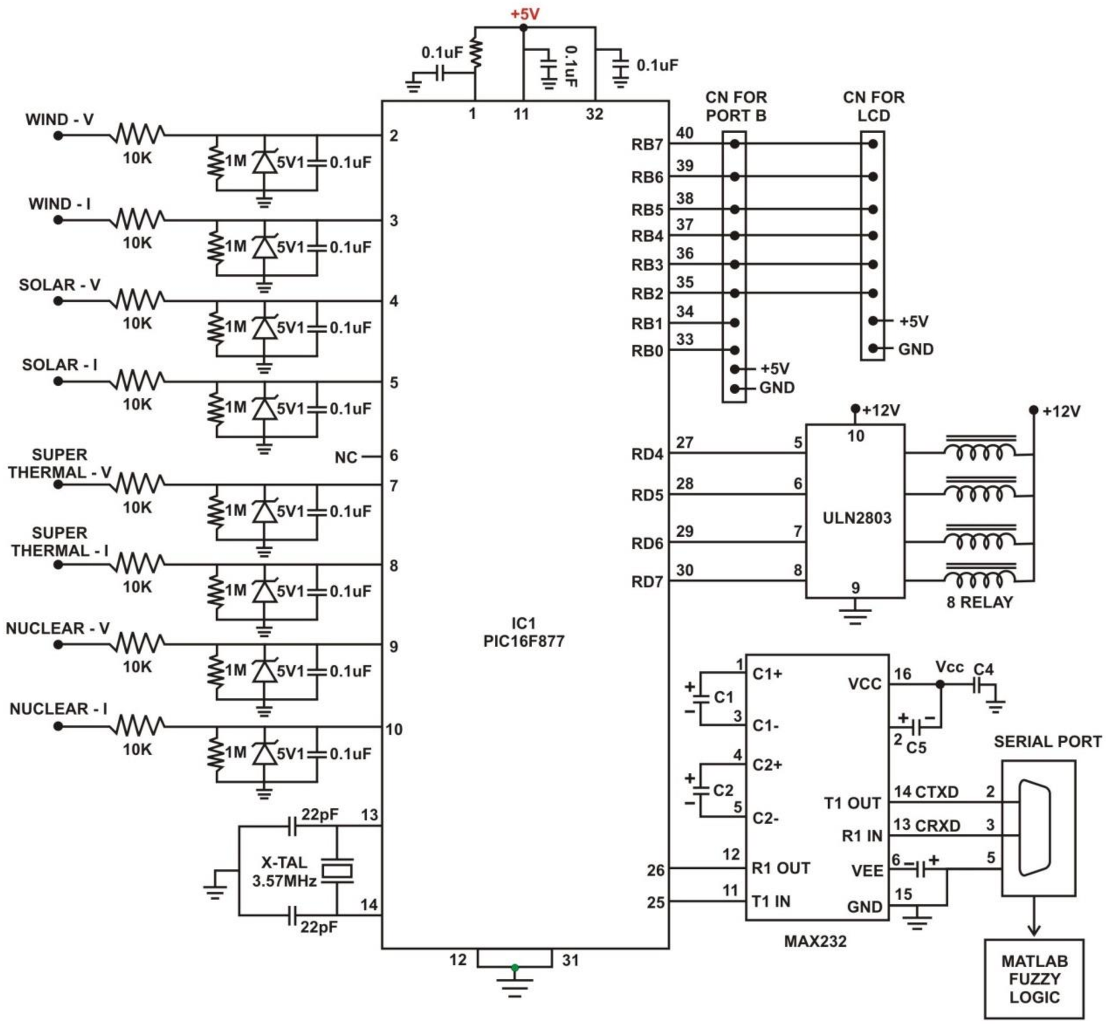
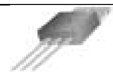
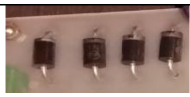
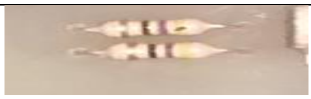
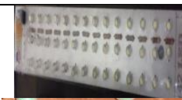
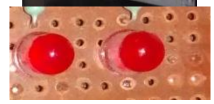
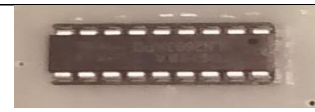
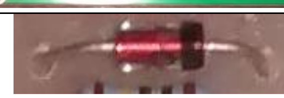


Fig. 5: Micro-Controller Pin Diagram

TABLE I
LIST OF COMPONENTS

S. No.	Name Of Components	Rating	Qty.	Purpose	References	Image
1	Transformers	12 Volts 1 Amp.	4	Power supply	[3]	
2	DC Motor	150 rpm 12v	2	As power source	[4]	
3	SMPS	220V-5V	1	Power supply	[5]	
4	Voltage Regulator LM7805	17V-5V	1	Constant voltage	[6]	
5	Diode	-	27	Rectifier	[7]	
6	Diode	-	5	Rectifier	[7]	
7	Capacitors	1000 µF 35v	6	Filter, charge storing device	[8]	
8	Capacitor	1000µF 16v	2	Filter, charge storing device	[8]	
9	Resistors	1kΩ 5%	58	Voltage drop	[9]	
10	Resistors	10Ω 5%	3	Voltage drop	[9]	
11	Resistors	100Ω 5%	1	Voltage drop	[9]	
12	Resistors	10kΩ 5%	9	Voltage drop	[9]	
13	Resistors	2.2kΩ 5%	1	Voltage drop	[9]	
14	Resistors	47Ω 5%	2	Voltage drop	[9]	
15	Varistor	-	1	Speed regulator	[10]	

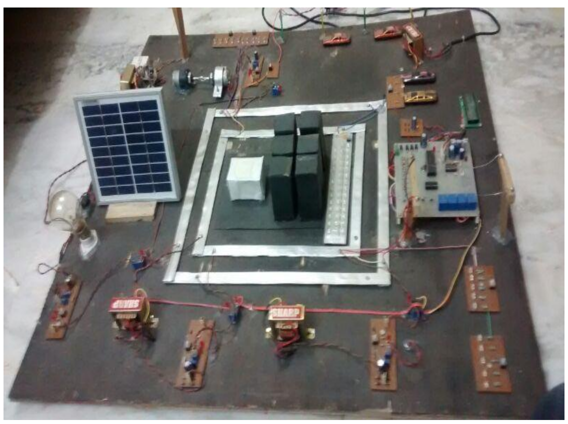
16	L.E.D.	-	89	As load	[11]	 
17	Micro Controller	PIC 16F877	1	System controlling	[12]	
18	ULN 2801	-	1	Serial port communication	[13]	
19	MAX 232	-	1	For relay switching	[14]	
20	Relay	7A-250v~/10A 125 VAC	8	As switch	[15]	
21	Trim Port	-	8	To vary voltage level	[16]	
22	Rocker Switch	-	8	On/off switch	[17]	
23	SPST Switch	-	2	On/off switch	[18]	
24	Solar Panel	12V	1	Power source	[19]	
25	LCD Display	-	1	Display values	[20]	
26	Zener Diode	5V	8	For protection	[21]	
27	Paper Capacitor	-	20	As filter	[22]	
28	Heat Sink	-	1	Dissipation of heat	[23]	
29	Cristal Oscillator	3.5 MHz	1	Provide frequency to microcontroller	[24]	

IV. WORKING OF THE PROJECT

In our project we have made four grids two renewable and two non renewable that are solar, wind, thermal & nuclear. The power generated by all the four grids is

sent to the central bus which is configured in Ring Mains. Priority is given first to renewable sources of energy i.e. solar and wind power. These two units will supply the loads up to their maximum capacity.
Now if load is further increased and these two grids are not able to supply the load demand non-renewable sources i.e. thermal & nuclear will switch their power on central bus to fulfil the required demand.

Now by using fuzzy logic (AI) in MATLAB we have made a multi valued code which will decide that which grid is to be turned on/off and how much power has to be drawn from each grid. Here we have shown LEDs as loads. The hardware of our project is connected to the computer trough hyper terminal. In computer we have programmed a code in MATLAB which is basically a algorithm which will control and decide how the grids to be operated.



V. TEST RESULTS

Before Interconnection

Initially all grids (renewable and non-renewable) are not connected to each other so large spinning reserve capacity is required, reliability of power supply is very low, dependency on non-renewable source is very high, manual reaction to critical network situation, chances of blackout of individual grid is more in case and the overall system is uneconomical.
After interconnection

Now all grids are interconnected through ring main so overall system became robust, spinning reserve capacity is reduced by considerable amount, there can be exchange of peak loads, renewable source of energy are utilized in more efficient manner and dependency on non-renewable source of energy is reduced. Blackout prevention by automated counter measures, as artificial intelligence is used in the system so it can take smart decision.

VI. CONCLUSION

Dependency on the non renewable source of energy is reduced appreciably. The stability of the system is increased due to control flow of power using proposed work. Limitations of renewable source have been overcome by interconnection of grid with conventional sources.

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