Vol. 5, Issue. 2, 2018, ISSN 2349-0780

Overload Protection of Inverter with Priority Based Load Switching Algorithm

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Abstract: Today's electrical equipment needs protection from over and under voltages and over currents. However, frequent power cuts demanded usage of inverters. With overloads on the inverter, entire loads that are connected to the inverter are tripped which interrupts power reliability. So, to maintain the supply we introduce a concept called load switching based on priority decided by Arduino. In this project we use Arduino to sense output voltage of supply and current that is drawn by loads. Current is measured by acs712 which is a Hall-effect sensor, whereas voltage is measured by a potential divider circuit. Each load is assigned with a unique number that indicates priority of particular load; loads are connected to their respective relay's that are controlled by Arduino. If the voltage exceeds the limit value, Arduino trips all loads to prevent damage to the loads. If inverter is not able to deliver enough current demanded by loads, Arduino trips the loads based on algorithm provided to the microcontroller and checks load current. When light intensity is low or temperature is high, humidity is low then corresponding load is high priority. If every condition is satisfied then motor load is switched off first, followed by fan and in worst case light load is tripped. If in any case smoke is detected, all the loads are switched off. Statuses of loads, voltage, current values are displayed on LCD. As it is not feasible to provide various loads, five lamp loads with different ratings are provided for the same function. The main objective of the project is to protect inverter and loads from over voltage, over current and for priority switching of loads when current exceeds set value.

Keywords: Arduino, Hall Effect sensor.

I. INTRODUCTION

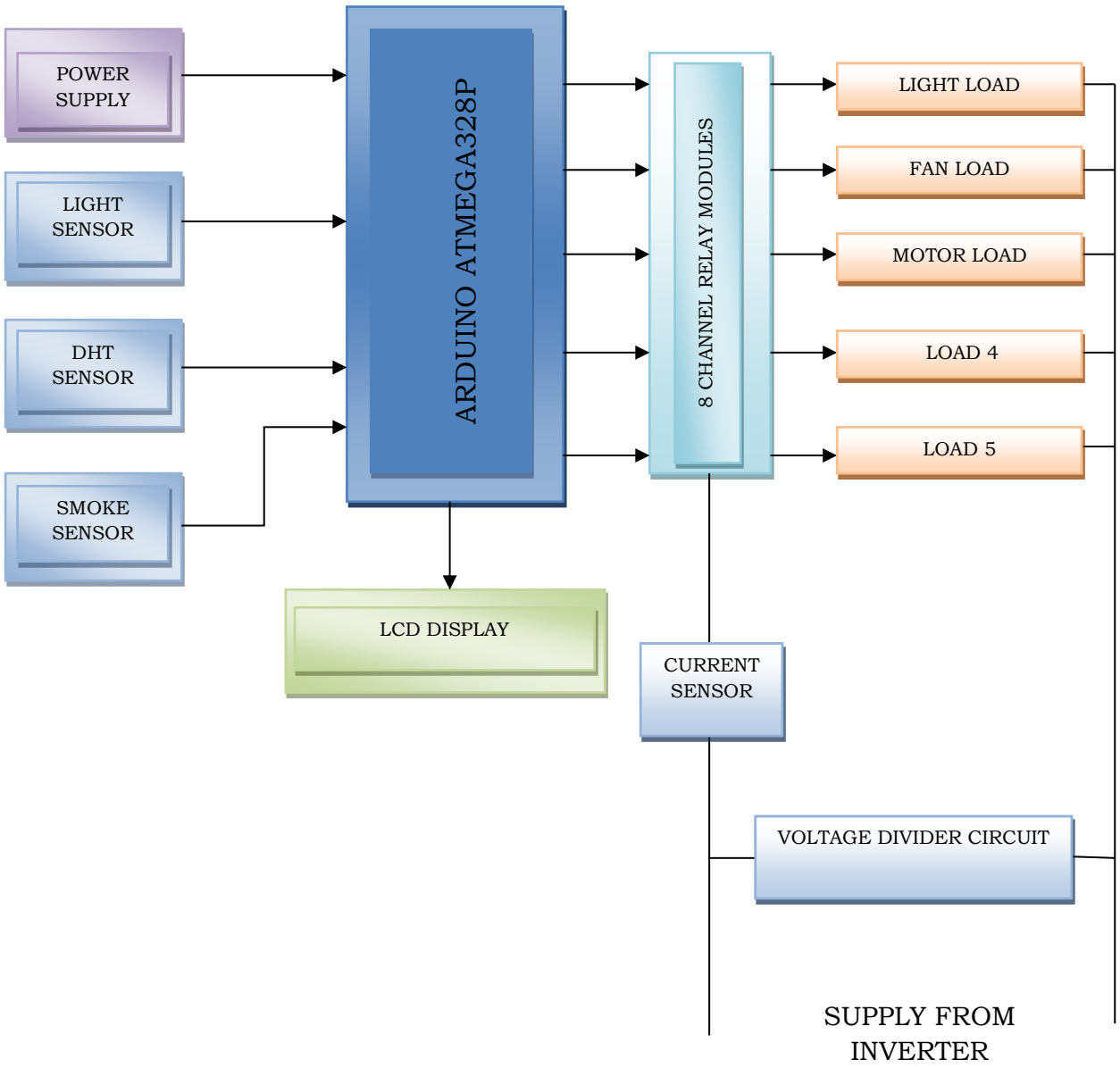
In recent days usage of renewable sources is increasing day by day. When these inverters using renewable sources are overloaded then entire loads that are connected to the inverter are tripped. So, this interrupts power reliability. This may be a serious problem and can be worst in some areas like hospitals where continuous supply is essential. Even inverters using regular supply may not deliver enough current due to battery capacity, Using these inverters in household may disturb entire work.

This project aims at designing an inverter protection system with priority load switching algorithm. When inverter is overloaded then loads are tripped based on priority decided by Arduino. Most of the inverters are suffered from voltage variations, in this project when any voltage variation occurs then microcontroller will switch off all loads connected to the inverter irrespective of the priority. Relays are used in between Arduino and the load; relay is switched on when the signal from Arduino is low and switched off when the signal from Arduino is high. Inverter voltage, battery voltage, load current, temperature, humidity are continuously monitored using Arduino and are displayed on liquid crystal display. Microcontroller reads the data and decides the switching action of electrical devices connected to

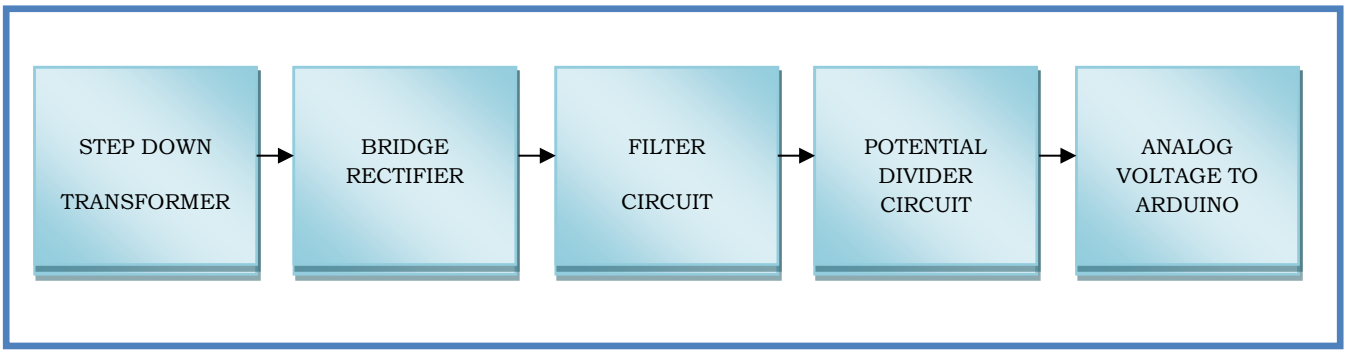
it through Relays and switches. The Microcontroller is programmed used embedded Arduino Programming language.

DESIGN OF THE PROJECT

BLOCK DIAGRAM



BLOCK DIAGRAM FOR VOLTAGE MEASUREMENT



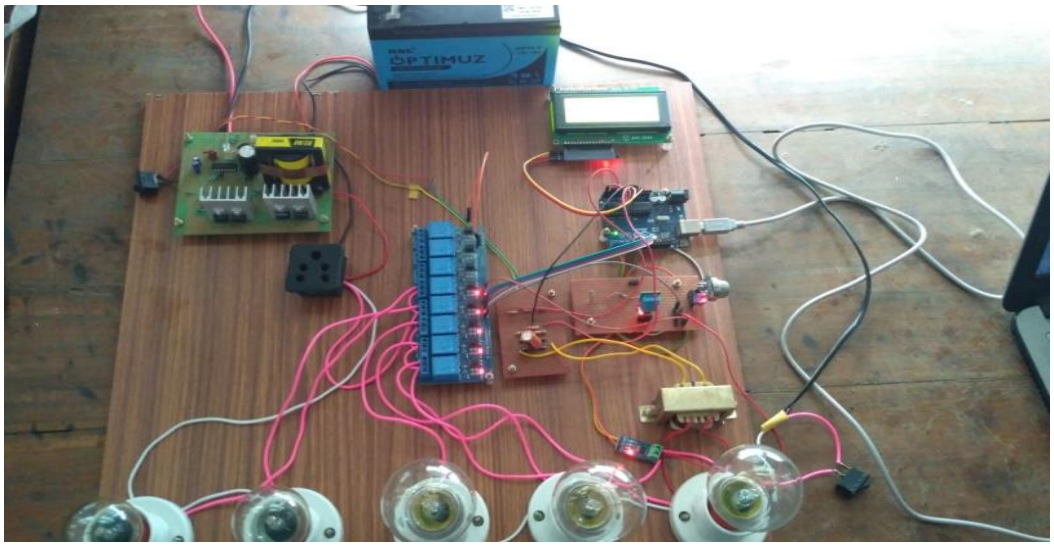
COMPONENTS FOR VOLTAGE MEASUREMENT

S.No	Name of Component	Rating
1	Step Down Transformer	230/6V AC
2	Bridge Rectifier	6V AC-6V DC
3	Filter Circuit	Capacitive Filter Circuit (1000uF)
4	Potential Divider Circuit	100k resistors
6	Analog Voltage	(0-5)V DC

Voltage Divider Circuit

COMPONENTS USED IN THE PROJECT

S.No	Name Of Component	Quantity
1	Arduino	1
2	Relay module	1
3	Transformer	1
4	Light sensor	1
5	DHT sensor	1
6	Gas sensor	1
7	Current sensor	1
8	Bulbs	5
9	LCD 20*4	1
10	I2C LCD board	1



Hardware Kit

Low Voltage Indication

Smoke Indication

ALGORITHM

STEP1: Initializing the LCD through LCD commands and Initialize the ports of Arduino for serial communication and set the port for relays and make them as output ports.

STEP2: Begin the serial communication and printing the project title on the LCD screen.

STEP3: Read voltage of the supply and current drawn by the loads.

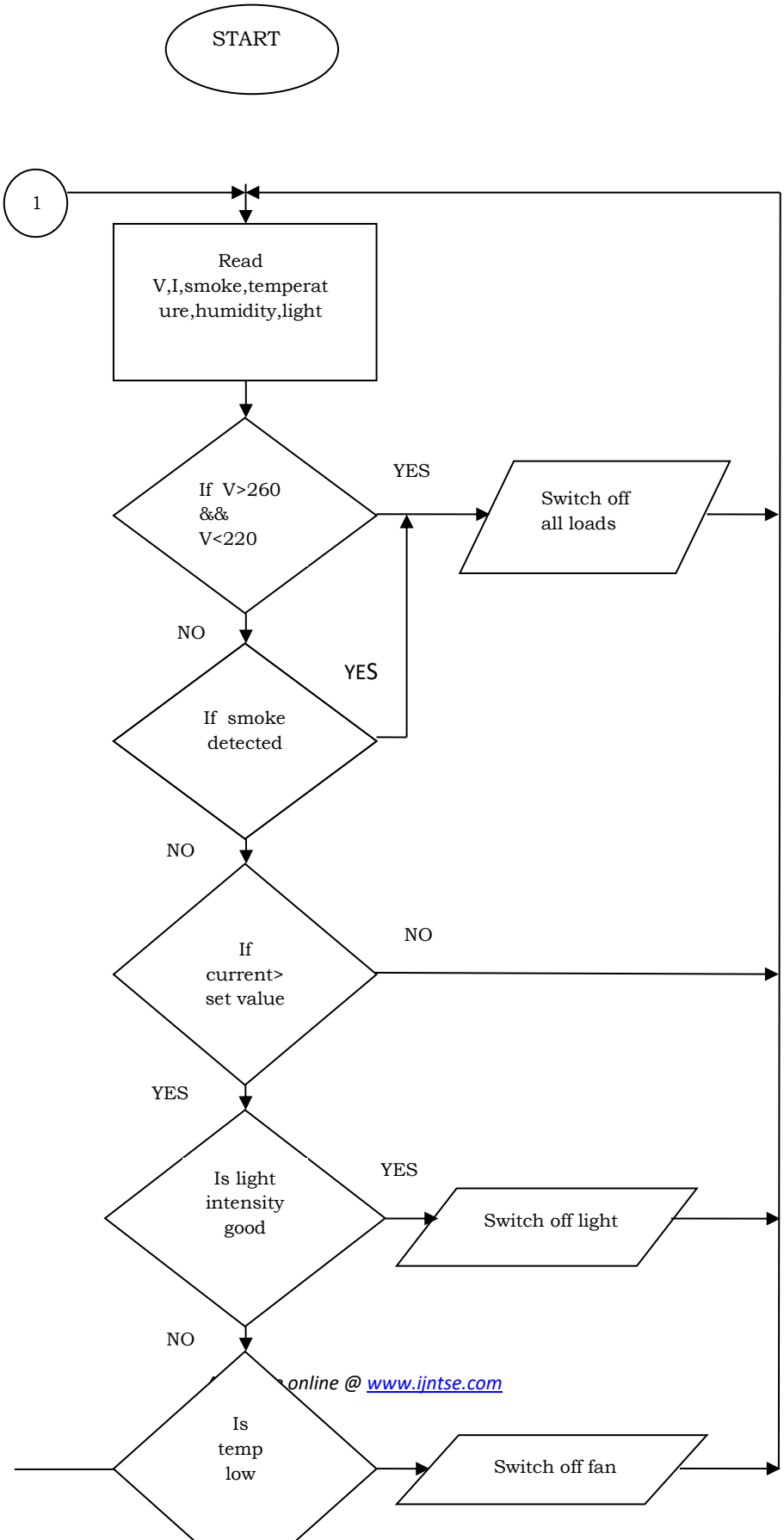
STEP4: If voltage exceeds limit, then switch off all loads. If smoke is detected then switch off all loads.

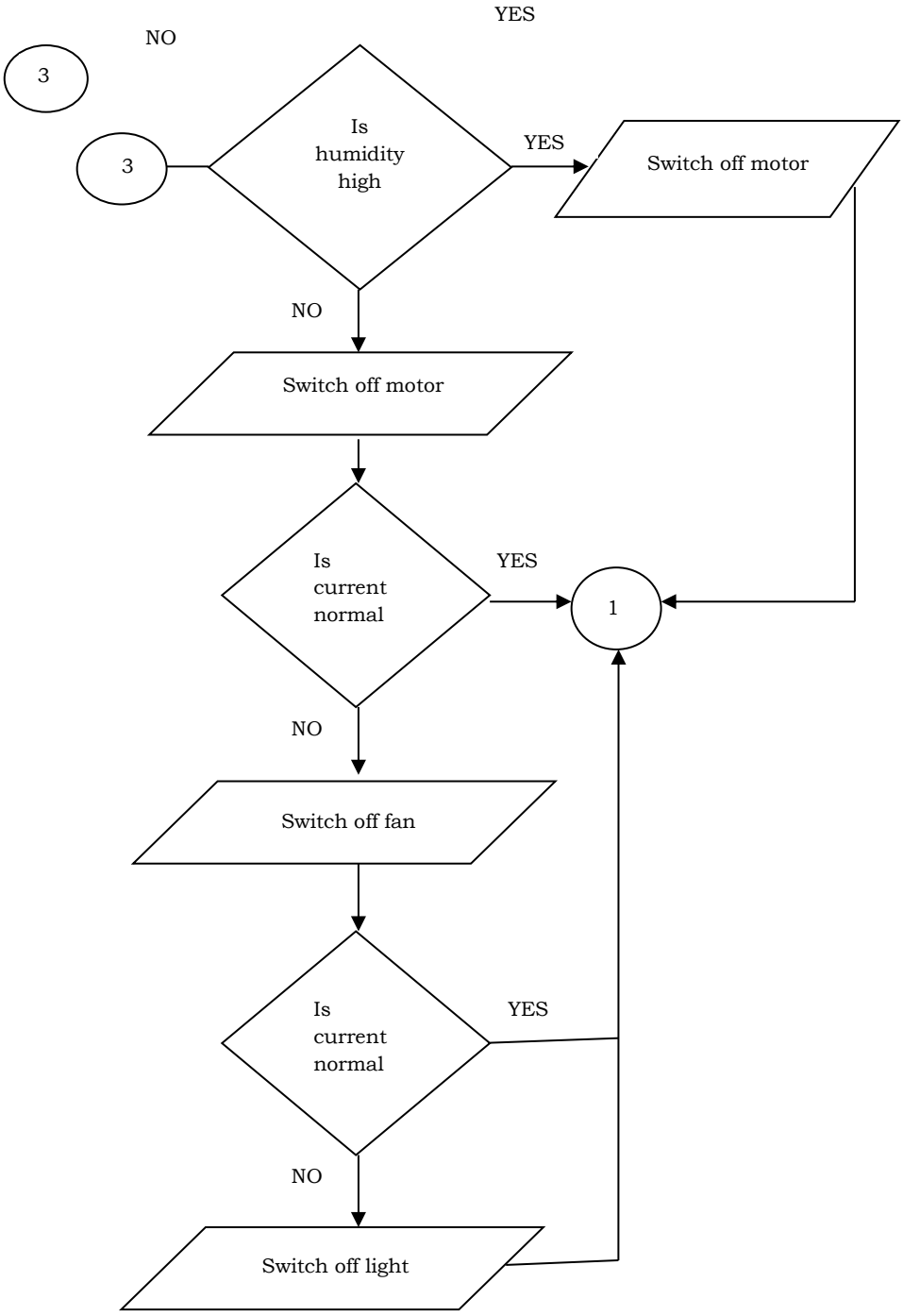
STEP5: If current drawn by the loads exceeds the preset value, then check for the light intensity, if light intensity is good then switch off light load or else check temperature, if temperature is low then switch off fan load or else check humidity, if humidity is high then switch off motor load.

STEP6: If every condition is satisfied that is, if light intensity is not good, temperature is high and humidity is low, then switch off motor load first and then checks the current. If the current is within limits then exit the loop or else switch off fan load followed by light load.

STEP7: Voltage value, current value, temperature, humidity are displayed continuously on LCD.

FLOW CHART


START
1
Read V,I,smoke,temperature,humidity,light
If V>260 && V<220
YES
Switch off all loads
NO
If smoke detected
YES
NO
If current> set value
NO
YES
Is light intensity good
YES
Switch off light
NO
Is temp low
Switch off fan


YES
NO
3
3
Is humidity high
YES
Switch off motor
NO
Switch off motor
Is current normal
YES
1
NO
Switch off fan
Is current normal
YES
NO
Switch off light

When the power is turned on, current sensor gets the 5V DC supply and it starts measuring load current and it sends the current value to Arduino microcontroller. Also the voltage measuring circuit gets turned on and it sends analog signal to the Arduino. With the supply provided to the gas sensor, DHT sensor, light sensor they starts sensing the conditions of the respective sensor.

Now microcontroller is ready to protect the inverter system. First of all microcontroller measures voltage of the supply, if the voltage exceeds the limits then Arduino trips all loads connected to the supply or else it senses whether the smoke is detected. If smoke is detected from the gas sensor then microcontroller trips all loads connected to the supply. There after Arduino measures current continuously from the ACS 712 current sensor. When the inverter is overloaded then Arduino trips the loads based on priority decided by it. Priority is decided based on environmental conditions such as light intensity, temperature, humidity. If light intensity is good enough then Arduino switches off light first, if light intensity is not good then it gives high priority to light load and then checks temperature. If temperature is low then Arduino switches off fan first, if temperature is high then it gives high priority to fan load and checks humidity. If humidity is high then Arduino switches off motor load first, if humidity is also low then it gives highest priority to motor load. When every condition is satisfied then Arduino trips motor load first and checks load current, even if current is not within the limits then it trips fan load and again checks the load current. In the worst case it finally trips light load.

CONCLUSION

This project provides a complete protection system for domestic or industrial purpose inverters. Among all the inverters this inverter with priority based load switching is the most promising alternative for medical and industrial application. Arduino microcontroller is chosen to control the loads and to gather information from the sensors because of its simple clear programming environment. The working results of the hardware kit are provided as pictures in chapter 6. It is clear that by implementing this type of protection system to the inverter, usage of renewable sources for inverter can e used in medical and industrial purposes without the fear of power cut.

REFERENCES

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