SPEED CONTROL OF SOLAR POWERED INDUCTION MOTOR

B. Sravan Kumar[1]
Dept of Electrical & Electronics Engg,
Guru Nanak Institutions Technical Campus
Hyderabad, INDIA

Santosh Yadav[2]
Technical Trainer
Kwatts solutions private limited
Mumbai, INDIA

Abstract – Induction motor is widely used motor in the world, and has many Applications. In this Paper, we have used a charge controller to get a constant output from the solar panel. DC is converted to AC and then is fed to the induction motor. Arduino provides the required PWM Pulse to the Inverter. Pulse Width Modulation or PWM technology is used in Inverters to give a steady output voltage of 230 AC irrespective of the load. The Inverters based on the PWM technology are more superior to the conventional inverters. Speed of the Induction motor is varied from 80 RPM to 1500 RPM.

Keywords : Induction motor, Arduino

1. INTRODUCTION

An Induction motor or asynchronous motor is an AC Electrical motor in which torque is obtained by electromagnetic induction from the magnetic field . An induction motor's rotor can be either wound type cage type. Single-phase induction motors are used for operating domestic loads. Although traditionally used in fixed-speed service, induction motors are increasingly being used with different speeds.

An induction motor can run only at its rated speed when it is connected directly to the main supply. However, many applications need variable speed operations ie., input is directly proportional to the speed of the motor. In applications like the centrifugal motor operation for water pump, a speed reduction of 20% results in an energy savings of approximately 50%.Driving and controlling the induction motor efficiently are prime concerns in today's energy conscious world. With the advancement in the semiconductor fabrication technology, both the size and the price of semiconductors have gone down drastically.

2. BLOCK DIAGRAM OF THE SYSTEM

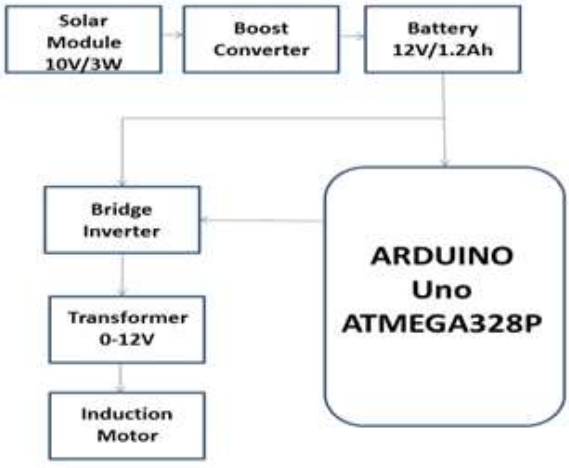

Fig1. Block Diagram of the Proposed System

Fig.1 shows the configuration of the proposed Photovoltaic based single phase induction motor drive. It consists of Solar panel, boost converter, inverter, Battery, Transformer, Induction Motor. The output of solar panel is fed to the DC to DC Boost Converter to increase the voltage level of DC supply, and then to the lead acid battery. This DC output is converted in AC supply with the help of an inverter. The output of this inverter is fed to the single phase induction motor.

3. COMPONENTS OF THE PROPOSED SYSTEM

A. Solar Panel :

Fig. 2. Solar Panel

Fig.2 shows solar panel. Solar panel consists of large number of solar cells connected in series. In each solar cell, Crystalline silicon is sandwhiched between two conductors. When Photons incident on these panels, electrons are released from their respective bondings, and travel freely in the circuit. Most efficient solar cell converts about 45% of solar energy into Direct current. In this Project, we have taken a 9 watts solar panel. Table 1 shows name plate parameters of the solar panel.

Table 1; Solar panel parameters

Rated power (Watts)	9
Rated Voltage (volts)	6
Open circuit voltage (volts)	7.2
Rated Current (Amp)	1.50
Short circuit current (Amp)	1.72
Tolerance	+ or – 3 %

B. Boost Converter

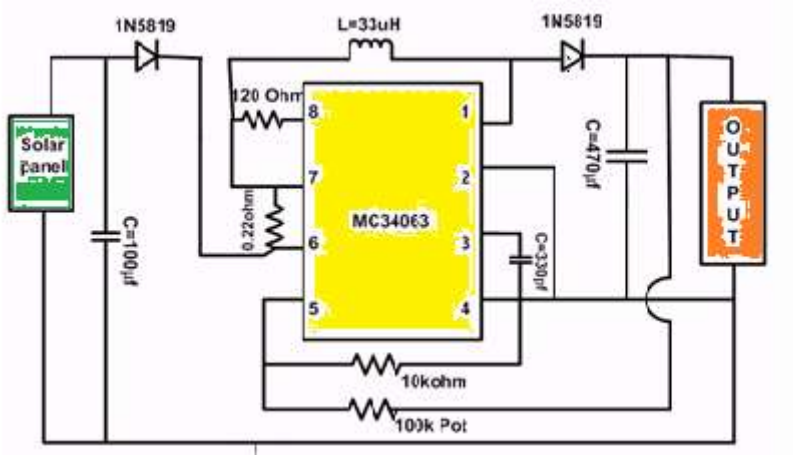

Fig 3. Boost Converter

Boost converter is used to increase the input voltage from the solar panel using MC34063IC.

C. Inverter

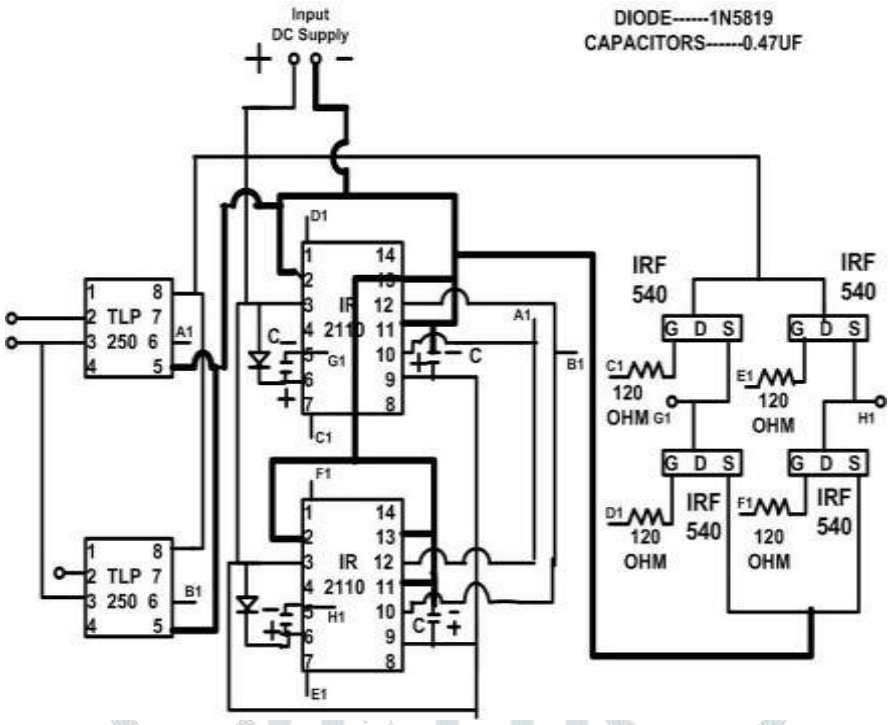

Fig. 4. Inverter

A power inverter, or inverter, is an electronic device or circuitry that changes Direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source. A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. Static inverters do not use moving parts in the conversion process. Pulse Width Modulation or PWM technology is used in Inverters to give a steady output voltage of 230 or 110 V AC irrespective of the load. The Inverters based on the PWM technology are more superior to the conventional inverters. The use of MOSFETs in the output stage and the PWM technology makes these inverters ideal for all types of loads. In addition to the pulse width modulation, the PWM Inverters have additional circuits for protection and voltage control.

In the above Inverter circuit, MOSFET IRF 540 is used. High speed mosfet driver IR2110 is used.

D. Battery

Fig. 5. Lead Acid Battery

Lead and lead-dioxide are good electrical conductors. The conduction mechanism is via electrons jumping between atoms. The electrolyte contains aqueous ions (H^+ and SO_4^{-2}). The conduction mechanism within the electrolyte is via migration of ions via diffusion or drift. Oxidation-reduction (Redox) reaction transfers charge from ions in solution to conducting electrons in the electrode. Charged sulfate ion approaches uncharged lead atom on surface of electrode. Lead atom becomes ionized and forms ionic bond with sulfate ion. Two electrons are released into lead electrode. In the fully charged state, the negative plate consists of lead, and the positive plate lead dioxide, with the electrolyte of concentrated sulfuric acid. Overcharging with high charging voltages generates oxygen and hydrogen gas by electrolysis of water, which is lost to the cell. The design of some types of lead-

acid battery allow the electrolyte level to be inspected and topped up with any water that has been lost.

E. Arduino

Fig. 7. Arduino

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

F. Induction Motor

Fig. 8. Induction Motor

An induction motor (IM) is a type of asynchronous AC motor where power is supplied to the rotating device by means of electromagnetic induction. The induction motor with a wrapped rotor was invented by Nikola Tesla Nikola Tesla in 1882 in France but the initial patent was issued in 1888 after Tesla had moved to the United States. In his scientific work, Tesla laid the foundations for understanding the way the motor operates. The induction motor with a cage was invented by Mikhail Dolivo-

Dobrovolsky about a year later in Europe. Technological development in the field has improved to where a 100 hp (74.6 kW) motor from 1976 takes the same volume as a 7.5 hp (5.5 kW) motor did in 1897. Currently, the most common induction motor is the cage rotor motor. An induction motor is sometimes called a rotating transformer because the stator (stationary part) is essentially the primary side of the transformer and the rotor (rotating part) is the secondary side. Induction motors are widely used, especially polyphase induction motors, which are frequently used in industrial drives. In this paper, A Single Phase Induction Motor is used.

4. PWM TECHNIQUE

Pulse-width modulation (PWM), as it applies to motor control, is a way of delivering energy through a succession of pulses rather than a continuously varying (analog) signal. By increasing or decreasing pulse width, the controller regulates energy flow to the motor shaft. The motor's own inductance acts like a filter, storing energy during the "on" cycle while releasing it at a rate corresponding to the input or reference signal. In other words, energy flows into the load not so much the switching frequency, but at the reference frequency. PWM is somewhat like pushing a playground-style merry-go-round. The energy of each push is stored in the inertia of the heavy platform, which accelerates gradually with harder, more frequent, or longer-lasting pushes. The riders receive the kinetic energy in a very different manner than how it's applied. In this Paper,
Arduino provides the required PWM pulse.

5. SOFTWARE PROGRAM

```
int delay1,delay2,delay3,delay4;
  void setup() {
  // put your setup code here, to run once:
pinMode(8, OUTPUT);
pinMode(9, OUTPUT);
pinMode(6, INPUT);
pinMode(7, INPUT);
digitalWrite(6, HIGH);
digitalWrite(7, HIGH);
}
void loop() {
check_speed();
  // put your main code here, to run repeatedly:
digitalWrite(8, LOW);
digitalWrite(9, LOW);
delayMicroseconds(delay1);
digitalWrite(8, HIGH);
digitalWrite(9, LOW);
delayMicroseconds(delay2);
digitalWrite(8, LOW);
digitalWrite(9, LOW);
delayMicroseconds(delay3);
digitalWrite(8, LOW);
digitalWrite(9, HIGH);
delayMicroseconds(delay4);
}
void check_speed()
{
  if(digitalRead(6)==LOW)
  {
    delay1=10;
    delay2=9990;
    delay3=10;
    delay4=9990;
    }
  if(digitalRead(7)==LOW)
  {
    delay1=2000;

    delay2=8000;
    delay3=2000;
    delay4=8000;
```

```
  }
}
```

7. RESULTS AND CONCLUSION

The Induction Motor Drive for single phase induction motor is successfully developed and tested in the power electronics laboratory. Speed of the induction motor is varied from 80 RPM to 1500 RPM.

Figure 10. Photograph of the complete designed system with a view of induction motor.

8. REFERENCE

[1] Ned Mohan, Torre M. Undelad, William P. Robbins, "Power Electronics Converters, Applications and Design", 4th edition, John Wiley & Sons, New York, 2003.
[2] Muhammad .H. Rashid, power electronics circuits, devices and applications, 3rd edition, Prentice-Hall of India, New-Delhi, 2004.
[3] B. Madan Lal and D. V. Rao, "Speed control of solar powered Induction motor drive using SPVWM Technique", innovation journal on Recent and innovation trends in computing and communication" Volume 2, Issue 6, 2014.
[4] Sudhir Sharma and Vikas Sharma "Control of Induction Motor fed from solar photovoltaic Array", proceedings of the European journal of Advances in Engineering and Technology, 2015.
[5] Atul Sharma and Dr. Arun Parakh, "Design of Solar Powered Induction Motor Drive for Pumping Application", International Journal of Latest Trends in Engineering and Technology, 2016.