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Solar Fed Induction Motor Speed Control Through Wireless Communication

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ABSTRACT: Controlling induction motor speed through a smartphone using GSM is a new technology and, in this method, the motor speed will be controlled in 3 steps, i.e., low, medium, and high. 89c2051 controller chip is used to control the motor speed through the smartphone and relays are used to change the duty cycle of the PWM oscillator that is used to generate 230v from a 12v battery. The concept presented here is innovative which is very useful for industries to vary the speed of an induction motor from minimum speed to maximum speed. The main objective of this project work is to utilize a free power source of solar energy to drive the induction motor. For which a high-power rechargeable battery is used and thereby the system can be energized when required. PWM (Pulse Width Modulation) based open loop technology is used to vary the speed of the motor in which the dual output duty cycle delivered by the oscillator circuit can be varied very linearly to vary the motor speed. PWM is a method of reducing the average power delivered by an electrical signal. Which chopper technique will be employed to vary the on and off timings of the duty cycle by which motor speed will be varied linearly? If the on time and off time both are the same (50% duty cycle), the motor will be rotated at maximum speed, similarly keeping the on time as 10%, and whereas the off time is 90%, the motor will be rotated at minimum speed.

KEYWORDS: 89c2051 controller chip, GSM device, Relays, Z44 NPN power MOSFET's, Induction motor, 12V-10Watts solar panel, High power rechargeable battery.

I. INTRODUCTION

In general, an induction motor is a constant-speed motor, and depending on its ratings in no-load or full-load conditions change in speed of the motor is quite small. The speed of a DC motor can be varied easily with good efficiency, but in the case of induction motors, it is a little complicated due to power losses or poor efficiency. As induction motors are widely used in industries for different applications, their speed may require varying according to the application. Different speed control methods of induction motors are in use, but in this project work, the most popular technology of PWM is implemented to vary the speed of induction motors from minimum to maximum linearly. In general AC to AC control circuits are in use for single-phase AC motors, but in this project work a low voltage 12v DC source is used to generate a high voltage of 220v AC, and PWM technology is used to vary the speed linearly [1]. Since the application is to utilize the free power source of solar energy, here 12v solar panel is used for demo purposes. Since it is a prototype module, a lower rating panel is used and its output is used to charge a high-power rechargeable battery of 12V and 7.5 Ah. The basic oscillator circuit is constructed with PWM IC 3524 operates at a 12v DC source and generates AC pulses to drive the power drive stage designed with power MOSFETs and inverter transformer [2-3]. A detailed description of PWM based inverter circuit is explained in the following chapters.

In general in industries, induction motors are among the most widely used electric motors that help engineers convert electrical energy into mechanical energy, and these AC motors work by the principle of electromagnetic induction. Electric current in the rotor is obtained from the rotating magnetic field in the stator winding and this electric current is then used in producing the desired shaft rotation. Induction motors offer several advantages such as simple construction, durability, high efficiency, and starting torque[5]. However the difficulty is how to control its speed, in this regard, this project work is designed to control the speed using the simple technique of PWM – Pulse Width Modulation[6].

One major aspect of the project work is, using solar energy to drive the induction motor and controlling its speed. The conventional energy supplied by the electricity department is dependent on thermal power stations, in some places nuclear power plants are in use, both are not safe, and they are hazardous to the environment hence it is essential to utilize solar energy to create a green energy source[7-8]. In this regard, this project work is taken up, which is aimed at utilizing solar energy for driving the induction motor[9].

II. METHODOLOGY

Battery charging time=Battery rating/Charging current through solar panel.

$$R_{\text{ef vol}}=(R_2/R_1+R_2) * V_{\text{cc}}.$$

(1)

Efficiency=Output power/Input power.

Battery backup time = Battery rating/System current consumption.

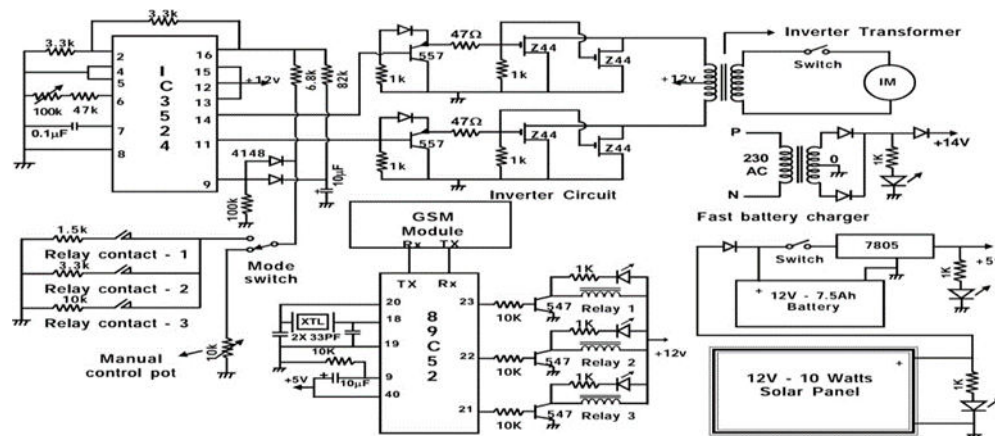


Fig. 1. Block Diagram of proposed Work

III. CONTROL STRATEGIES

a. Solar power management

Implement a battery management system to store excess solar energy for later use when sunlight is insufficient. This ensures continuous operation of the motor even during low-light conditions.

b. Induction Motor Speed Control

Implement a Variable Frequency Drive (VFD) or a Pulse Width Modulation (PWM) technique to control the speed of the induction motor. VFDs and PWM techniques vary the frequency and voltage supplied to the motor to control its speed efficiently.

c. GSM Module Integration

Develop a communication protocol (e.g., SMS-based or GPRS-based) to send commands and receive status updates from the motor controller via the GSM network.

The algorithm automatically generates mask image without user interaction that contains only text regions to be in painted.

IV. EXPERIMENTAL RESULTS

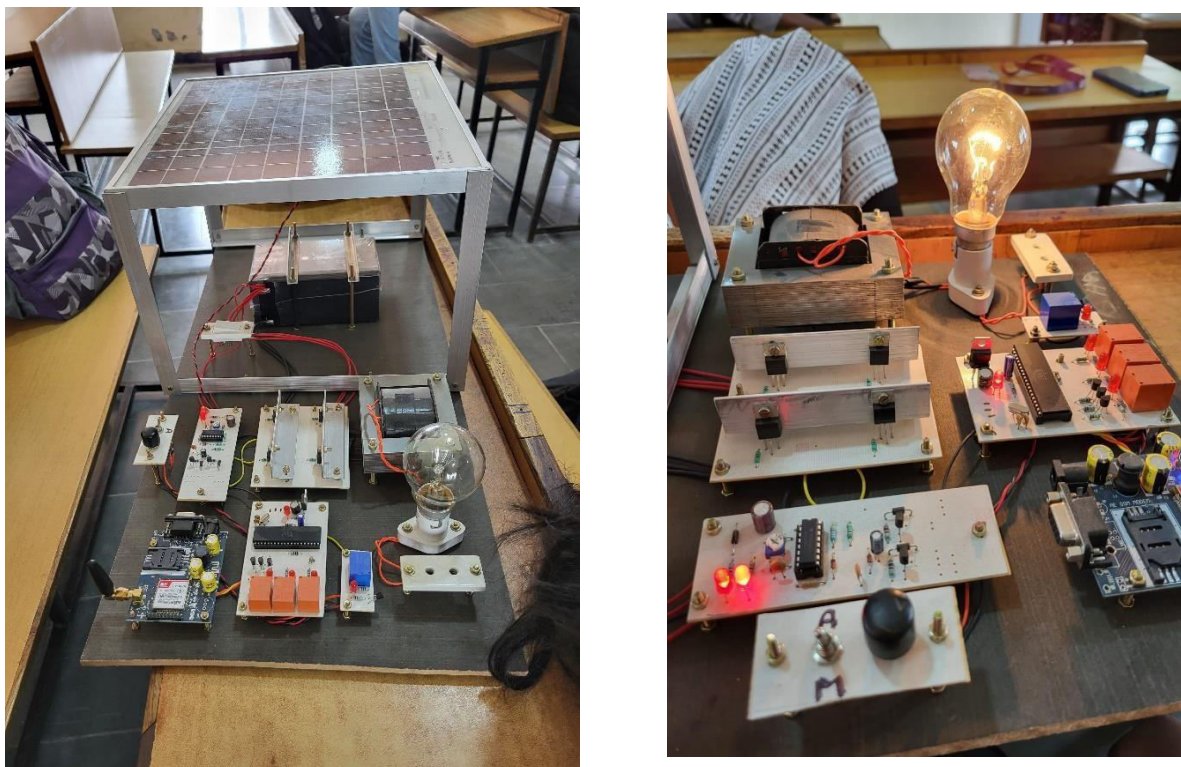


Fig. 2. Experimental set up for proposed work

The motor can be operated in three modes during manual operation low, medium, and high by giving commands through mobile. Likewise, we can operate in manual and automatic mode by differing the speeds required on ranges.

V. CONCLUSION

Solar and GSM based speed control of induction motor” is successfully designed and tested and a demo unit is fabricated. Since it is a demonstration unit, a low-power inverter is designed which can able to deliver a maximum current of 800 milliamps at 220V at the system output. But for practical applications, a higher-rating inverter can be designed which can be used to drive heavy-duty motors.

The main purpose of the Paper is to control the motor speed linearly by varying duty cycles. The PWM IC used here has dual inverted output by which the drive stage is designed with NPN power MOSFETs and it is configured in a push-pull mode of operation by which switching losses can be minimized and high efficiency can be obtained from the power system. In our trial runs we found that greater than 80% efficiency is achieved. As the power system is designed to deliver less power, protection circuits are not included. In general, the higher-rating inverters are equipped with thermal protection overload cut-off circuits, etc. With the help of a load monitoring circuit often designed with CT, the load applied to the inverter will be monitored continuously, whenever the load exceeds more than the rated value, immediately system will be shut down. After reducing the load and by activating the reset button power will be resumed. Similarly, a thermal protection system also protects the power system from burning due to the temperature. These are the features to be added to our feature work.



In this Paper solar energy is used for charging the battery, this is one type of method, that comes under the non-conventional method of power generation. The sun is the primary source of energy; the energy radiated by the sun is in the form of electromagnetic waves. The winds produced by nature are used to drive small power generators called as windmills. Such generators are also can be used for charging the batteries. The great advantage of using the above two methods in nonconventional energy resources, the energy produced by these two methods is plentiful, inexhaustible, and non-polluting and it does not require an operator and also does not require any maintenance. These kinds of systems are very rugged systems so that during the long run they may not create any problems.

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