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SMART IRRIGATION DRIVE

K S L N Bharadwaj[1], Posham Lenin Reddy[2], Ch Sandeep Kumar[3]
[1,2,3]*(GITAM University, EEE, Visakhapatnam.)*

Abstract:- Smart Irrigation Drive involves running a single electric motor on both the phases (1phase & 3phase) which reduce the investment of farmers and increases the working hours (as 3phase or 1phase is available for most of the time). There is also a relay and cooling system designed for the motor in order to keep the windings safe from overheating , which will reduce the maintenance costs of the motor as it is operated well within it' s rated values. In order to conserve both water and electricity we are going to plant moisture sensor in the farm so that the motor turns off automatically when the farm is properly watered

Keywords:- Iinduction motor, Capacitor bank, Moisture sensor, Heat sensor, 1phase & 3phase supply, agricultural application

I. INTRODUCTION

Most of the agricultural loads are of 3phase but in developing countries, 3 phase supply is available for very short time and single phase is available for rest of the time. Due to this farmers having 3 phase machines are unable to run their electrical loads properly, resulting a huge loss to them. So, to have better duty period a farmer must use 3 phase machine during the availability of 3 phase and 1 phase machine during the single phase period. But this approach hugely increases the investment cost. Alternatively a farmer can opt 1 phase pumps for their pumping needs since 1 phase can also be taken from any of the phases from a 3 phase supply. But choosing 1 phase pump for agricultural need has two draw back firstly for same rating, 1phase motors have higher cost than 3 phase motors and secondly for same HP 1 phase motors are bigger in construction than 3 phase motors. As economy is of paramount importance in agriculture industry the only other alternative left is choosing 3 phase motor which is cheaper and compact in size compared to 1 phase induction motor. Since the availability of 3 phase supply is less, there should be an arrangement to make use of the 1 phase supply in running the 3phase motor. To overcome the above problems our proposed model "smart irrigation device" comprises of a 3 phase induction motor that runs either on 1 phase or on 3 phase supply. Due to this farmers can have better productivity and reduced investment cost. This model has hybrid cooling system which comprises of water and air as coolants. Yield of crop depends on various factors out of which watering of crop plays important role. So, good management of water is needed for getting better results. This *model has* efficient water management capability. It can automatically switch the unit on and off depending on the moisture content of the field. This largely saves not only water but also electrical energy.

II. MOTOR WORKING

There are two types of induction motors

3 phase induction motors: 3 phase induction motors run on 3 phase supply. They are self-starting since 3 phase supply produces rotating magnetic field. In 3 phase induction motors supply is given to stator. Stator gets magnetized and produces revolving magnetic field, this revolving magnetic field cuts the rotor windings. Since there is a relative motion between rotor and magnetic field an EMF is induced into the rotor Windings. As rotor windings are shorted current flows into these windings and in turn these windings produces a magnetic field. Due to this phenomenon 3 phase induction motors starts running with huge torque.

1 phase induction motors: 1 phase induction motors run on single phase supply. They are not self-starting since single phase supply does not produce rotating magnetic field. So we use different starting techniques to run single phase induction motors. Most commonly all motors use capacitors for their starting purpose. Capacitors produce a phase shift in a supply given to motor and thus it make capable of producing rotating magnetic field and motor starts running as in case of 3 phase induction motor.
In our project we use capacitor bank which helps in running the 3 phase induction motor on single phase supply. Capacitor bank provides the phase lag and also induces the supply in the third terminal of the 3 phase induction motor when single phase supply is given and thus helps in rotating motor with great torque.

III. COOLING SYSTEM:

In our project we use a capacitor bank to run 3 phase induction motor on single phase. When capacitors are used in operation of induction motor they help motor to run with high torque but at the same time they heat up motor winding very easily. Due to this insulation break down occurs and motor windings burns out which causes a huge loss to the farmers. So we designed a hybrid cooling system comprises of air cooling and water cooling which helps the motor windings to operate well within the rated values and reduces the risk of damage of motors. We also used heating sensor which is used to sense the temperature of the motor windings. If in case cooling system is unable to control the temperature of the motor windings and if they reach near the rated values then the heating sensor senses the temperature and it immediately pass a message to micro controller which cuts off the supply to the induction motor. By this we are eliminating most of the risks that causes damage to the motor windings due to the high temperature.

IV. SENSORS

Heat sensor:

As motor pumps work for a long time there may be case of excessive heating of windings which may not be controlled by designed cooling system. In this situation heat sensor will immediately sends message to the microcontroller which cuts off supply to the induction motor. Motor pump turns off automatically only if temperature of the windings reaches near the insulation breakdown. By this we save motor pumps from burning out.

Moisture Sensor:

Usually farmers switch on their motor pumps and goes to do other works due to this even though the field is completely watered motor continues to run till the farmer observes the field which is quite complicated. To avoid this we automated the system by planting moisture sensors at various positions in the field. When the field is completely watered motor turns off automatically saving precious electricity and water resources.

CIRCUIT DIAGRAM

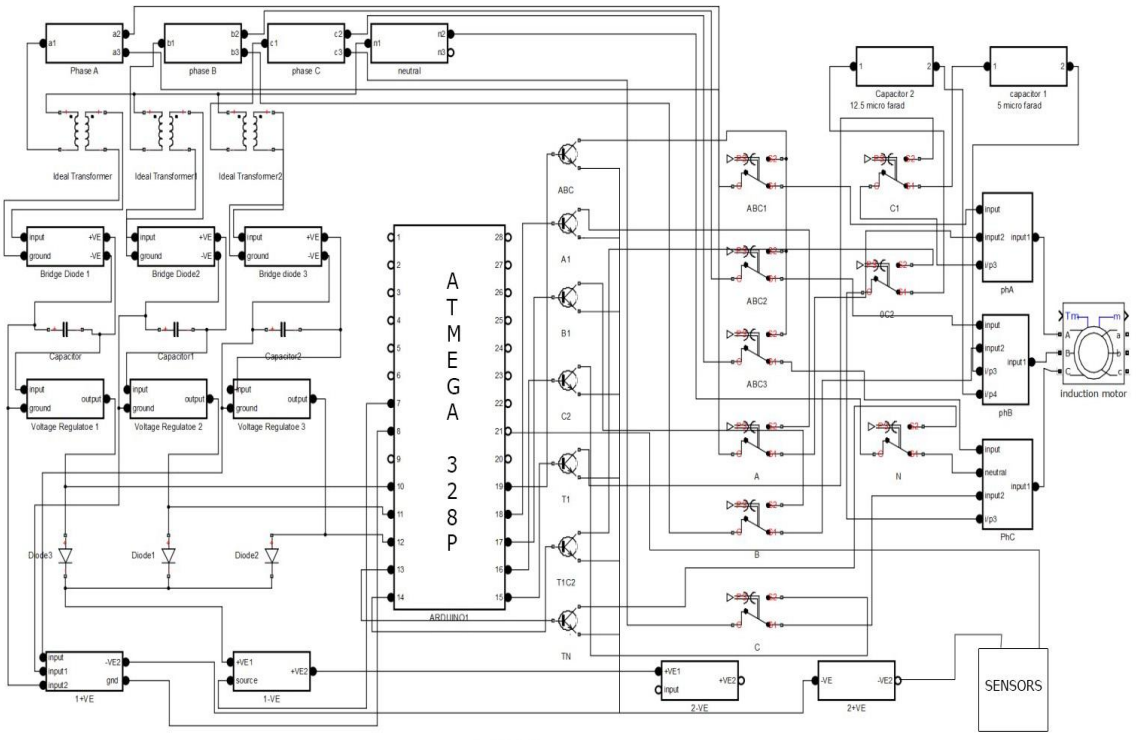

FIG (d)

V. CIRCUIT DESCRIPTION

1. **TRANSFORMER:** There are three transformers each helps in detecting the individual phase as well as powering the circuit.
2. **BRIDGE DIODE**: The Bridge Diode is used to convert AC to DC by full wave rectification.
3. **ELECTROLYTIC CAPACITORS**: These are used to filter the ripple content in the DC voltage.

4. **VOLTAGE REGULATORS:** This 5 volts DC voltage regulator is used stabilize the board voltage to 5 volts.
5. **MICRO CONTROLLER:** The micro controller automates the circuit by the help of different sensors and output devices like relays.
6. **RELAYS**: The relays acts as switches which are completely controlled by micro controller.
7. **TRANSISTORS**: These transistors are connected in common emitter configuration and are used to switch relays on response from micro controller.
8. **HEAT SENSOR**: The sensor used here is LM35 which gives accurate readings in centigrade scale and it is key sensor since it is used in predicting the possibility of insulation break down.
9. **MOISTURE SENSOR:** It is used in estimating the water content present of the field, which is very much essential in process of automation.

VI. CIRCUIT WORKING

The three transformers are used to step down the voltage from 230 volts to 12 volts. Which is converted to DC by Bridge Diode? However this DC voltage consists of ripples so to filter this capacitor filter is used. Then a 5V regulator is used to stabilize the voltage to 5V and also to power the board. The diode obstructs the reverse power flow.

When any of the phases are active the corresponding transformer possesses 12 V on the secondary side which constitutes for 5V at the voltage regulator terminal. So this is sensed by the micro controller and switches the relay according to the following case

OPERATION NO	ACTIVE PHASES	SWITCHING TRANSISTOR	SWITCHED RELAYS
1	R,Y,B	ABC	ABC1,ABC2,ABC3
2	R	A1,T1,TICI,TN	A,C10C2,N,
3	Y	B1, T1,TICI,TN	B, C1,0C2,N

The above table implies that if the three phase supply is available i.e. if phases R, Y, B are active then relays ABC1, ABC2, ABC3 are switched so the motor runs directly by three phase supply. If R phase is alone active then relays A, C10C2, N are turned on which is equivalent to the circuit in fig(a). If Y phase is alone active then relays B, C10C2, N are turned on which is equivalent to the circuit fig(b).

The moisture sensor consists of two galvanized nails separated by insulating material. A test on conductivity between these two nails when planted in the field decides the content of moisture present in the field. To provide optimum level of water to the field we choose a threshold value of 100 milli volts. If the voltage drop exceeds this threshold value the motor turns off the indicating that the water content in the field has exceeded the optimum level.

The temperature sensor used is LM35 a transistor which can give precise readings in centigrade scale. This sensor is attached to the casing of the motor. This sensor tracks the temperature of machine and if the temperature exceeds the insulation breakdown the microcontroller turns the machine off by switching all the relays off.

VII. MODES OF OPERATION

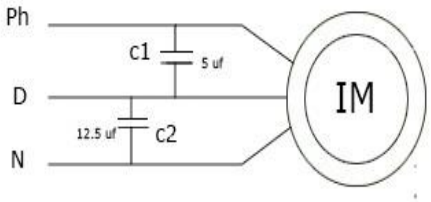

FIG (a)

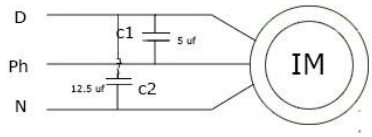

FIG (b)

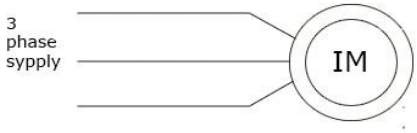

FIG (c)

When 3 phase supply is given mode of operation of induction motor is as shown in fig(c). In this mode of operation 3 terminals of 3 phase induction motor gets supply and motor rotates normally as 3 phase induction motor. In this mode of operation there will be no use of capacitor bank and it is omitted from the circuit.

When single phase supply is given to the 3 phase induction motor mode of operation is as shown in fig (b). In this we assume phase is present at middle terminal and neutral of single phase supply is present at third terminal. Now capacitor capacitor bank comes into play and creates supply in dummy(D) terminal. Due to this motor starts running with great speed and torque.

Now when we assume that phase of single phase supply is present at top terminal and neutral at bottom terminal then motor mode of operation is as shown in fig(a). . Now capacitor bank comes into play and creates supply in dummy (D) terminal. Due to this motor starts running with great speed and torque.

In modes 2 and 3 we can observe by looking at fig(b) and fig(b) that neutral is at the bottom and capacitor c2 is connected between same 1st and 2nd terminal the only change in both the modes is placement of c1 changes in fig(a) it is placed between 2nd and 3rd terminal whereas in fig(b) it is placed between 1st and 3rd terminals

VIII. CONCLUSION

[1]. Farmer can easily maintain his farm.
[2]. This automated system reduces the human guidance thus by reducing financial burden on farmer.
[3]. Farmer can track the status of the motor just by a message.
[4]. The use of heat sensor acts as over temperature protection thus by increasing the life of the motor.
[5]. It is much likely to attract the farmers because it is all in one irrigation system.
[6]. Productive time can be increased as it can be operated both on three phase and single phase.
[7]. Efficient handling of resources reduces the wastage of water and electricity.
[8]. Farmer can get the details about moisture content by a SMS.

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