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Remote Control, Protection and Monitoring of Pump for Agricultural Purposes

Neetika Sengar, Arun Parakh

Abstract**:** ***With the increasing pressure on our natural resources and diminishing soil quality, there is a need to make better efforts to conserve them. This project aims to help control the irrigation in a small field. The motor pump set equipped at the field is prone to a variety of operational issues like Power Quality issues, Reverse run of the pump, Irregular Power Supply. Using an ATMEGA Microcontroller equipped with GSM Module for connectivity, this model is able to provide the user with remote control for the motor pump set equipped at his field. Additionally, this model comes with protection schemes for detection of Input Phase Sequence Supply and protection against Over Voltage and Over Current. This system aims to reduce the man power requirement in the field by providing remote or at home control of the pump set applied on the field with cost effective and easy control which can be used by unskilled operators as well.***

Keywords: ATMEGA328, Internet of Things, Remote Control, Smart Irrigation.

I. INTRODUCTION

The share of Agriculture in Global water usage accounts to approximately 70% of the total water usage.[1],[7] In addition to this, with the increase in population over the upcoming years it is expected that the global food production must double by 2050 to meet the demand [1],[8]. The depleting water resources, diminishing arable land availability, food wastage and increase in food demand are few of the reasons why there is a need to make a change in current usage of our resources. The deployment of Internet of Things (IOT) technologies in plethora of fields has brought an impressive change in them. The advent of IOT as a newly developed technology, right from the earliest example of a modified Coke Machine in 1982 to Device-to-Device Communication in 1999 to the current convergence of wireless communication, sensors and embedded systems (2019) as a single IOT based system has happened in a very fast way and has helped in reducing human work hours by providing easy automated solutions to variety of fields globally. On the other hand, the small farmers of India are still at a disadvantage, owing to lack of new farming practices, lack of technology to support them and varying climate conditions. In the present scenario, a typical farmer in India working at a small farm needs to commute to his/her farm to operate the irrigation motor-pump set at inconvenient hours of the day and stay till it is ensured that tank has been filled or the farm has been watered and then turn off the motor manually. This leads to extra man power requirement or more work hour for an individual. In addition to this, there are some technical issues associated with the operation. The pump set used at the field is prone to operational problems such as Power Quality issues, Dry Running, Reverse Run of the pump, and/or Irregular Power Supply. If a 3-phase motor pump set is fed with a 3-phase supply with wrong phase sequence, then the motor can run in the reverse direction. If the phase sequence is reversed i.e., any of two leads of a 3 phase supply are interchanged, then the rotating magnetic field developed in the motor is in the opposite direction which will make the motor to rotate in the opposite direction.This in turn, will make the impeller run in the opposite direction, reducing the outflow of the pump set and might also damage the pump set in the long run. Also, if the motor suffers breakdown, then by the time it gets repaired, the farmer may lose the sowing season or his crop might get damaged.

II. OBJECTIVE

The main objective of this project is to provide simple and cost effective system to a small time farmer for monitoring, control and protection of pump with the use of a microcontroller, GSM Module and Sensors etc., and to help reduce the work hour requirement for watering the field.
Through this project, an attempt is made to continuously monitor the electrical parameters of the motor, provide the user with an ON/OFF remote control of the motor, create a database of the electrical parameters of motor and create alerts in case of faults.

III. LITERATURE SURVEY

[2]Andrea Zanella et al. have presented a case study of 'PadoVa Smart City' of Italy and discussed various applications and bottlenecks associated with the implementation of IOT such as non-interoperability of the heterogeneous technologies used in various models, lack of a business model to help grow the IOT market and adverse global economic situation. In [3], a model aimed to provide export and import of electrical energy in micro-grids was proposed by Mr. Agari and authors. This model was based on MQTT client server model and provided an end user to monitor his apparatus remotely on a website hence reducing the dependence of physical man power requirement. In the paper [4], an innovative, power efficient and highly scalable IOT agricultural system was presented. The system was based on LoRaWAN network having capability of working for long range and with for low power consumption data transmission from the sensor nodes to the cloud services. The advantages of using revolutionary technology were also mentioned.

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Some security issues were also mentioned like node replication, base station cloning, selective forwarding, eavesdropping, and bit flipping. Moreover, it was suggested that unauthenticated data or loss of data or lack of availability of data can cause false data analysis reports.

Muhammad Ayaz et.al. [1] have highlighted the need for technology to evolve to help ease the current agrarian crisis and meet the global Food Demand. The author has talked about how in the conventional farming methods, 70% of the farmers time is spent in monitoring and understanding the crop states instead of doing actual field work. The paper suggests implementation of IOT technology in various agriculture practices like Soil Sampling and Mapping, Irrigation, Fertilizer, Crop Disease and Pest management, Yield monitoring and predicting etc.

[5] Ramaprased S S and authors have proposed an intelligent irrigation system using moisture sensors and Arduino microcontroller which has the capability of controlling the water supply to the field based on the moisture content in the soil of the field. An IR sensor was also employed to detect intruders in the field. Rana Johar and authors [6] have talked about how agriculture is a major consumer of water and wastes most of it through inefficient irrigation techniques. This paper talks more about how implementation of new irrigation pattern of fields controlled by IOT based solutions can help reduce the inefficient use of our water resources and help in conserving the natural state of our soil.

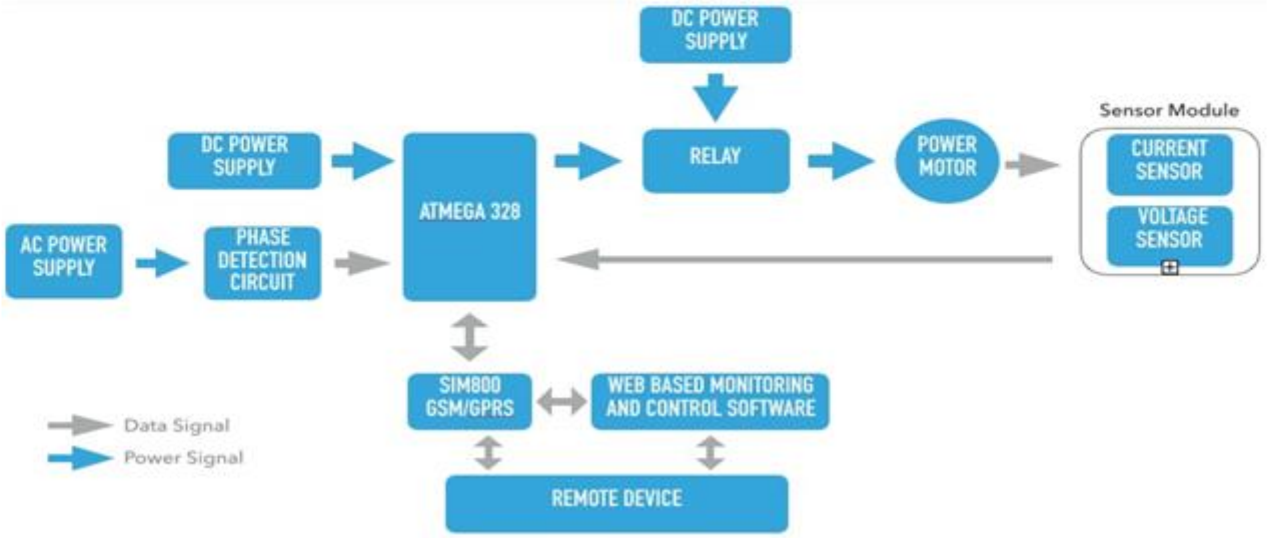

Figure 1 Block Diagram of proposed Model

IV. METHODOLOGY

In order to provide remote control of the motor pump set, the following model depicted in Figure (1) is proposed. The system can be said to constitute 4 parts:

i) sensors to sense the current through the motor and the voltage across the motor
ii) the microcontroller ATMEGA328 for processing
iii) the GSM800 module for communication and
iv) Relays to control the motor.

The sensors will collect the necessary data which will be then sent to the microcontroller for processing. These values will be then sent to the web based support wherein we will provide necessary checks and create a database of them.This system enables real time monitoring of electrical parameters and provides control and update of the pump. The model is intended to provide a cost effective and easy controllable solution to the operator. The advantage with this system is that even though the existing systems used similar components, they were not used for providing protection to the motor which can be easily done by employing certain additional components to the system as proposed in this system.

To ensure prevention of the case of reverse run of the motor pump set, the system includes a phase sequence detection circuit as shown in the figure (2).

It includes 3 Octo-coupler PC817 ICs in the design, which are used to detect the presence of phase at any instance and it additionally provides electrical isolation between the Input Supply and the proposed system. The system contains electrically sensitivecomponents which will benefit from having isolation. The output of this circuit to the microcontroller is pulled up by using a resistor to 5V and this data is used to detect the phase sequence of the supply. 3 status LEDs are also used in the circuit to show the presence of each phase in the circuit.

Based on the timing by which the microcontroller receives the input signal from the Octo-coupler ICs connected to each phases, the micro-controller is able to detect the phase sequence of the supply.

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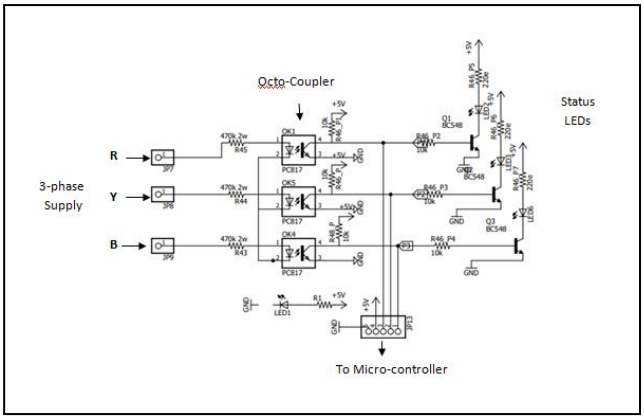


Figure 2 Circuit diagram of Phase Sequence Detection Circuit

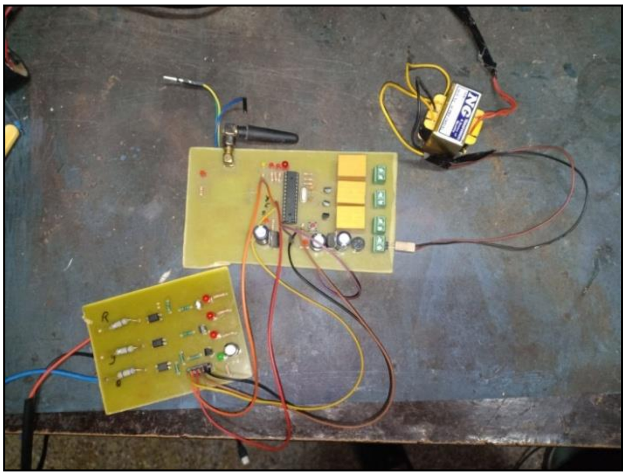
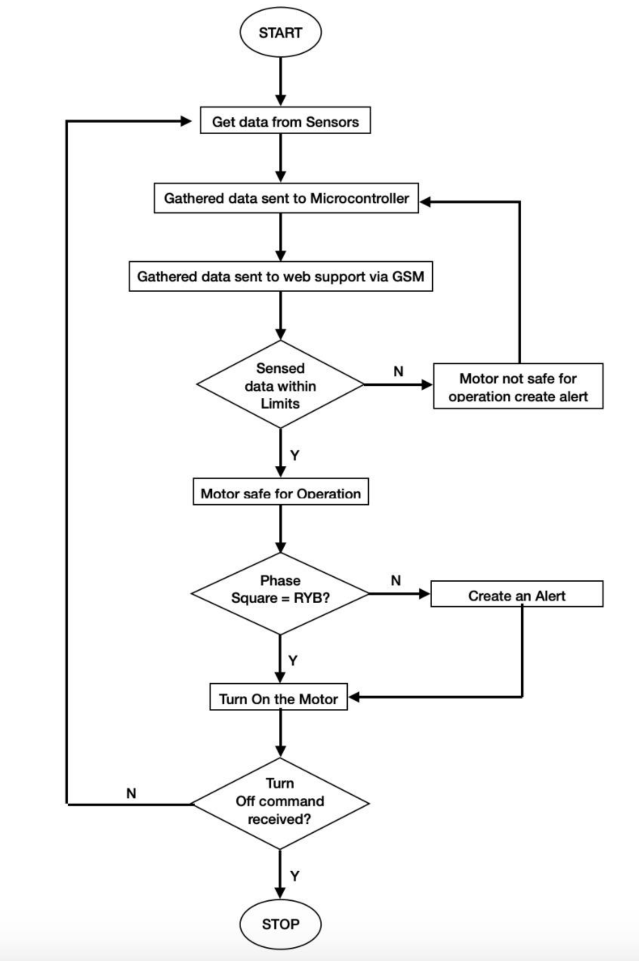


Figure 3 Experimental Setup

V. FLOW CHART



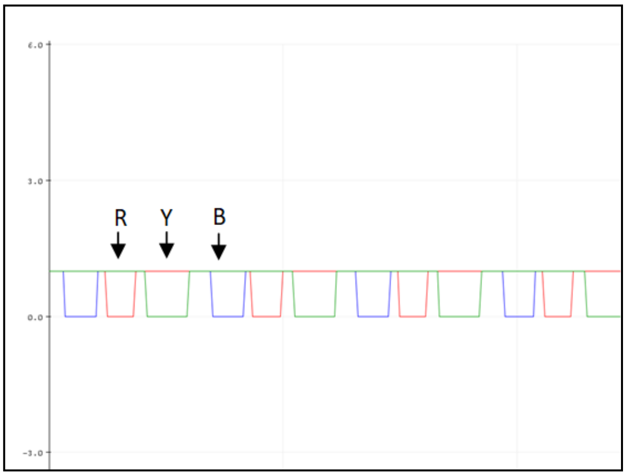


Figure 4 Phase Sequence RYB

VI. RESULTS AND DISCUSSIONS

To develop the proposed system, we have used ATMEGA328, with a GSM 800 module with sensors connected to motor. A phase sequence detection circuit was employed to check the phase sequence of the incoming 3-phase supply. We have used Arduino IDE 1.6 to program the microcontroller. The experimental setup for the proposed system is shown in the figure (3).

The phase sequence detection test was performed on the setup with result being obtained on Arduino IDE.

Here, in this figure (4) we can see the phase sequence obtained in the Arduino IDE software is RYB. This result shows that the sequence is matching the requirement of the motor pump set. This result will not be used to generate an alert. The figure (5) depicts the case of occurrence of phase sequence RBY. This sequence will result in reverse rotation of the motor pump set. Even though this will not render the pump useful, it will affect the net water outflow. Hence, this situation will be used to generate an alert. The alert will notify the user to get the connections checked and the motor will still be operational till then.

The figure (6) shows the result in the case of one phase turned off. This case depicts any one phase of 3-phase supply asswitched off. This will lead to uneven magnetic field generation in motor and the motor pump set will not work properly. In order to achieve smooth operation of the motor pump set, we wish to achieve a RYB phase sequence.

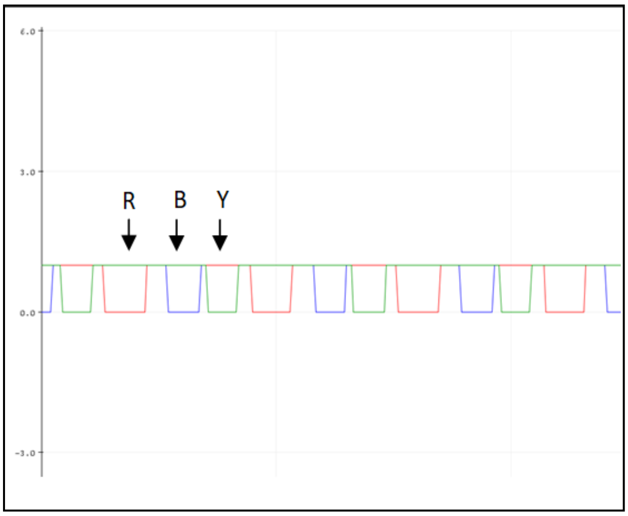


Figure 5 Phase Sequence RBY

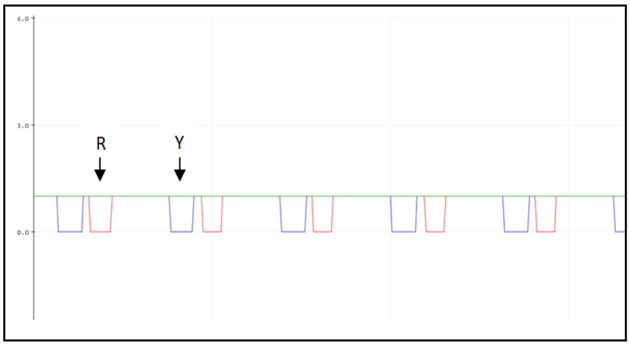


Figure 6 One Phase absent

VII. CONCLUSION

The phase sequence detection circuit used in the model is able to detect the phase sequence of the 3-phase supply provided to the motor pump set. The inappropriate phase sequence, if applied will generate an alert based on which the user can get it fixed. This will help in increasing the outflow of the pump set. The system is also able to provide remote control of the motor pump set. This system helps in reducing

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