IOT BASED CONTROL AND PROTECTION OF BOREWELL MOTOR

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Introduction:

Agriculture is the main source of food grains and plays an important role in the economic development of agricultural countries. India is an agriculture country with 70% of population depending on agriculture or related fields. The primary requirement for any crop growth is the sufficient and uninterrupted water supply. In many parts of the country, due to inadequate rainfalls the irrigation systems were developed that stores the water during heavy rainfall and releases to the farm field for the crop growth whenever required using single phase or three phase motors that need to be operated manually by farmer. Usually, the distance from farm field to water source ranges in few kilometres and farmer need to walk all the way in order to operate the motor. In some cases, due to insufficient water present in borewell, motor runs in dry state and leads to complete failure. And, fluctuations in electrical supply are resulting in voltage variation of higher than ±10% of prescribed nameplate rating also leads to motor failure. All the above stated reasons will significantly decrease the efficiency of agriculture production. Integration of modern technologies with agricultural methods will reduce the burden on farmer and improves overall efficiency.

We present an implementation of Automated Motor Starter Unit (AMSU) that monitors the power status and sends SMS to farmer's mobile using Global System for Mobile Communication (GSM), depending on the status of the power, farmer can turn on/off motor using his mobile just by pressing a button in the mobile application or also by time scheduling from remote place.

Objectives:

The main objective of this project work is to control the borewell motor in terms of switching ON/OFF by auto starting or by time scheduling and protecting the motor under faulty condition like dry run, over load, single phase tripping and motor failure condition from remote place.

- The proposed system is an IoT based device to control, schedule and micro-manage the watering cycle in the irrigation.
- The system consists of wireless controllers and mobile application interface in regional languages.
- Increasing the efficiency of irrigation and making sure that the crops get the right amount of water at the right time.
- This system is very advantageous for small and marginal farmers, minimizing the human intervention in farming.

Methodology:

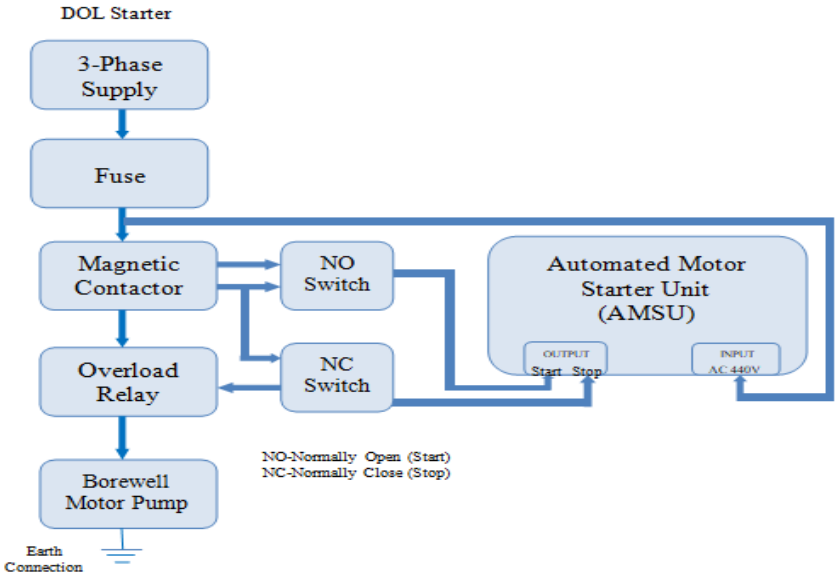

Fig: Block diagram of IoT based control and protection of Borewell Motor

In this proposed system, the main components used are microcontroller, GSM shield and relay circuit. Arduino Pro mini as microcontroller has been used which is based on ATmega328.The relay circuit consists of two 12V relays, LM2596S Voltage regulator, 470µF 35V Aluminum Electrolytic Capacitor, 47µF 25V Aluminum Electrolytic Capacitor, 100KΩ, 1KΩ Resistor and 1N4007 diodes. The proposed system consists of sim holder for placing sim card, antenna for better signal output, 7.4V 2000mAH Lithium Ion Battery slot, 440V to 12V, 2A Step-down transformer, Bridge Rectifier, and Analog to Digital Converter (ADC).

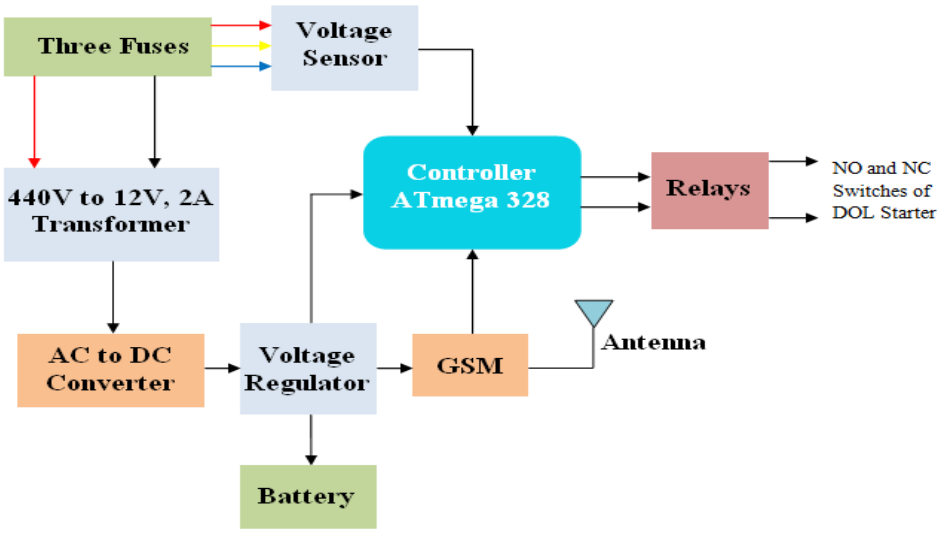

Fig: Block Diagram of Automated Motor Starter Unit

Working :

- AMSU is installed at the field level by connecting it to the Control Unit (CU) which is already connected to the three phase motor in the field.
- The present module works with three phase supply and ground, which provides 440V ac supply which is stepped down to 12V 2A supply which is fed to the Chipset.
- Power to the AMSU module is supplied by connecting it to the three phase supply which is already given to the existing CU.
- Only registered contact numbers can get access to the AMSU.
- A registered contact can add any number of contacts to operate it. (Limited to SIM memory).
- Once a number is registered and the power in the farm field is available, then AMSU will automatically turned ON and sends a message about the POWER STATUS to the registered mobile numbers.
- The AMSU can be operated by mobile application or by an SMS to the number that is placed in AMSU.
- The system consists of external antenna for better signal output.
- If water is not pumped by the motor then the AMSU will detect it through the dry running the motor. A message is sent to the farmer mobile, stating that motor is off and water is not available (AMSU will continuously read the status of the power level and keep itself updated). If farmer tries to switch on the motor without sufficient amount of water in the borewell, AMSU will not switch on the motor.

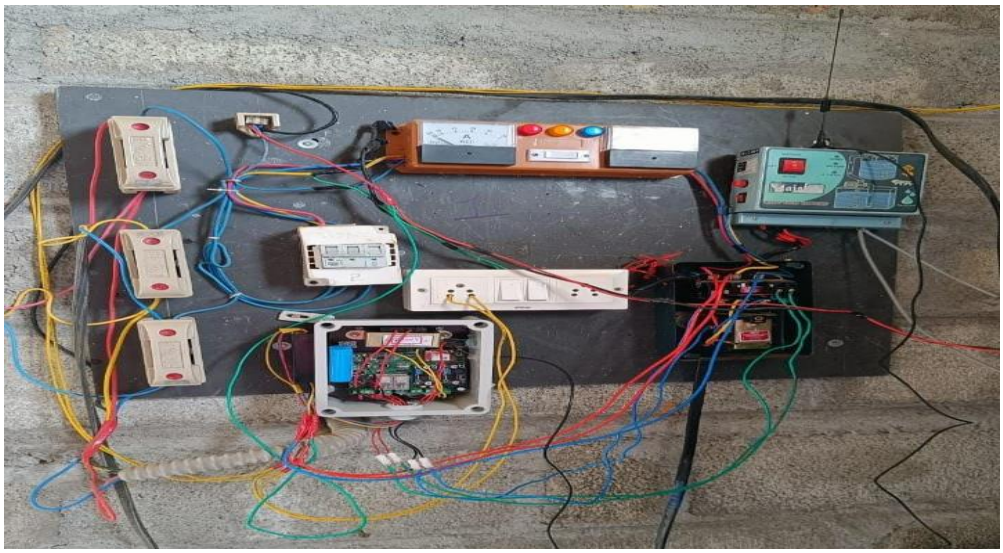

Fig: Automated Motor Starter Unit connected to Borewell Panel Unit

Fig: Automated Motor Starter Unit

❖ **IoT Based Motor Starter Control:**

The main objective of this project is to control the starter. The control is done by wireless signal transmission.

❖ **Motor Control:**

The starter can be turned on or off by using the button which is created on a webpage. The signal is transferred to the receiving side through a GSM Sim module which is connected to Node MCU. The starter is turned on or off based on the signal.

❖ **On/Off State Detection:**

The signal received from the webpage enables the Node MCU which in turn operates the relay through the circuit. The relay thus controls the on/off state of the starter depending upon the signal received.

❖ **Motor Protection:**

The voltage sensor's output is given as feedback to the ATMEGA328. If the voltage value exceeds the specified limit then the relay will automatically cut off the

starter.

Results:

In this project, an attempt has been made towards the control and monitoring of Borewell motor under normal working and fault conditions operated with remote control. IoT based smart technology will be implemented for practical working conditions. Motor is started after tapping on the application for ON/OFF. It takes 1 to 2 seconds to start. After starting motor works normally and shows the power status through messages. If any of the phase's cut-out motor will turn off automatically and shows result through SMS.

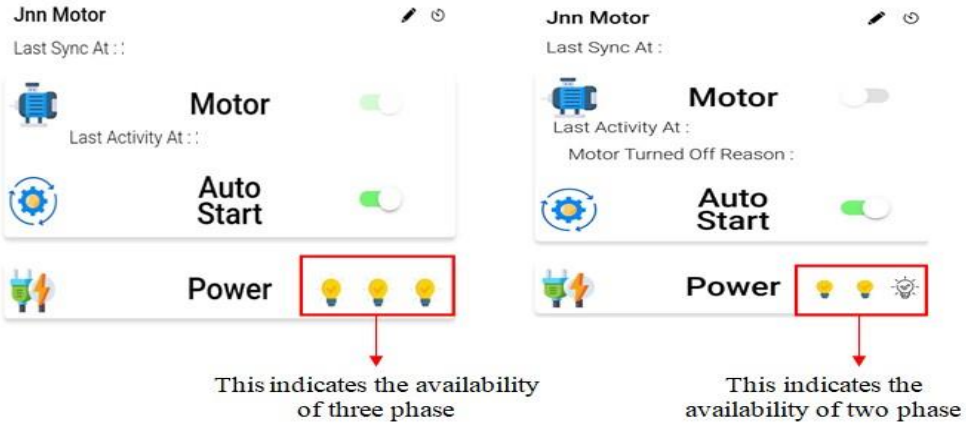

Fig: Indications in Mobile Application

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Sl no.	When Auto Switch is ON	
	Condition	Power Status
1.	During Power cut-off condition	Power Down, No Phase Available
2.	During Power on condition	Three Phase Available, Motor Turned On
3.	During Connections problem condition	Two Phase Available

Table: Table of results when Auto Switch is turned ON

Sl no.	When Auto Switch is OFF	
	Condition	Power Status
1.	When Motor Button is pressed in Mobile Application	Motor Turned ON Successfully
2.	Again when Motor Button is Pressed in Mobile Application	Motor Turned OFF Successfully

Table: Table of results when Auto Switch is turned OFF

Conclusions:

- The automatic motor starter unit effectively initiates and controls the operation of a motor without manual intervention.
- The system can be operated from any remote places with good mobile network and also by time scheduling the motor running condition.
- It ensures smooth and safe motor operation by managing start-up, stopping and protection functions automatically.
- This enhances efficiency, reduces manual labor and minimizes the risk of motor damage due to improper handling.

What is the innovation in the project?

There have been several innovations in automated motor starter units, including:

- **Remote Monitoring and Control:** Many modern motor starter units offer remote monitoring and control capabilities, allowing users to monitor the status of motors and control their operation from anywhere with an internet connection.
- **Smart Connectivity:** Integration with IoT (Internet of Things) technology enables motor starter units to communicate with other devices and systems, providing data insights and enabling automation and optimization of processes.
- **Safety Features:** Enhanced safety features, such as built-in overload protection

and short-circuit detection, help to protect equipment and personnel from harm.

- **Integration with Industrial Automation Systems:** Motor starter units can be seamlessly integrated with industrial automation systems, enabling advanced control and coordination of multiple processes within a manufacturing or industrial environment.
- **Valve Controller:** The valve controller is an additional component integrated into the system to regulate the opening and closing of a valve. It receives signals from the control system, which could be manual inputs, programmed commands, or signals from sensors monitoring the process.

Overall, integrating a valve controller into an automatic motor starter unit adds a layer of control over fluid flow, allowing for automated and precise operation of industrial processes. This setup enhances efficiency, accuracy, and safety in various applications.

Scope for future work:

- We can improve this technique by embedding IoT sensors in pumps to monitor performance and send data to the cloud for analysis. This can help submersible pump manufacturers and users identify potential problems before they occur, improve maintenance practices, and optimize pump performance. IoT sensors can provide real-time information on a range of parameters, such as flow rates, pressure, temperature, and vibration.
- Pumps can be integrated with renewable energy sources, such as solar panels, to reduce reliance on grid power
- Also automated pumps can be programmed to adjust their speed and flow rate based on changes in demand, further optimizing energy consumption.