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Detection of Phase Fault in 3-Phase System with Alert Notification

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Abstract:

With advancement of Technology, life is getting simpler and easier in all aspects. In today's world, Automatic systems are being preferred over manual system. IOT enables people and things to be connected anytime, anywhere, with anything and anyone. This project concentrates on saving time and energy of people by making the tedious task easier. The proposed idea is to operate a three-phase motor, check availability of three-phase current through the mobile application and notify the user about the phase failure instantly. In this paper, we aim to provide the user with remote control system and instant notification about the power failure. Three-phase motor is widely used in agriculture. Suppose, the farm is away from the farmer's house, typically a few kilometers away, the farmer has to travel by either foot or any mode of transport to turn on or turn off the motor. Farmers are unable to check the availability of three-phase current every time. We aim to provide a solution to this common problem. By Therefore, checking for three-phase current through their mobile phones is a faster and convenient approach.

Keywords **—3 phase motor, Controlling Motor, Blynk App, Phase Failure, Internet of Things.**

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I. INTRODUCTION

In this project, we are going to Design & Implement a Remote Control System to turn on and off a three-phase motor and also check the availability of the three-phase power supply. The user will get notified on his mobile if any of the three phases fails. Farmers cannot depend only on the climate and rainfall for irrigation. This is why the farmers use motors for irrigation purposes.

Three-phase motor is widely used in agriculture. Those motors are complex electro-mechanical devices utilized in most industrial applications for the conversion of power from electrical to mechanical form Traditionally the motors are manually operated by the user. Phase failure occurs when power is lost to one of the lines supplying power to a three-phase motor. Even when only one phase fails, motor can be operated in two phase. The motor will continue to operate but will draw an excessive amount of current. In this condition, the overload relay should cause the motor starter to disconnect the motor from the power line if the overload heaters have been sized correctly. Single phasing will cause the two phases that remain energized in a three-phase motor to increase the current by average. If the farmer's house is away from the farm, he is unable to check the three-phase failure at the moment.

A farmer depending solely on rainfall for the purpose of irrigation is long gone. Farmers these days opt for a three-phase motor for irrigation. However, the operation of the motor is done manually. In a situation where there is heavy rainfall and the motor is functioning, it not only leads to wastage of water but also there may occur destruction of crops. A lot of people are passionate about farming. For such people, it would be more convenient to operate the motor from a distance, conveniently from their mobile. This project will

help in conserving the time, energy and effort that is utilized in this process.

II. OBJECTIVE

The efficiency of a Project is measured in terms of time, budget and quality. A project dominated by budget restrictions will take longer to complete, probably with less functionality. Hence, it is important to develop a cost effective solution.

The objectives of our project are :

- To design and implement a remote control system to turn on and off a three phase motor.
- To check three phase current through a mobile application.
- To get notified by the system when the phase fails.
- To demonstrate the correct motor operation in a practical way.

III. SYSTEM WORKING

In this project we are going to control a three-phase induction motor through an android application and also implement the remote control system for the motor. In this proposed system we are connecting our system to a three phase motor with the help of a WiFi module which controls the motor using the concept of IoT. Here we are using the NodeMCU micro-controller board which has a built-in WiFi Module. With this we can turn on or off the motor. The Blynk Application should be installed in the user's mobile through which he can control the three phase motor. The user has to send commands (either on or off) through the Blynk app to the Nodemcu board. The ESP8266 micro-controller present in the Nodemcu board will read the command and accordingly operate the motor.

Arduino UNO is also connected in the system. The AT mega328P micro-controller is present in the Arduino board. It will check the voltage of each phase wire present in three phases for every few seconds. The voltage of the wire will be zero when no current is passing. The Arduino UNO and Nodemcu are connected for communication.

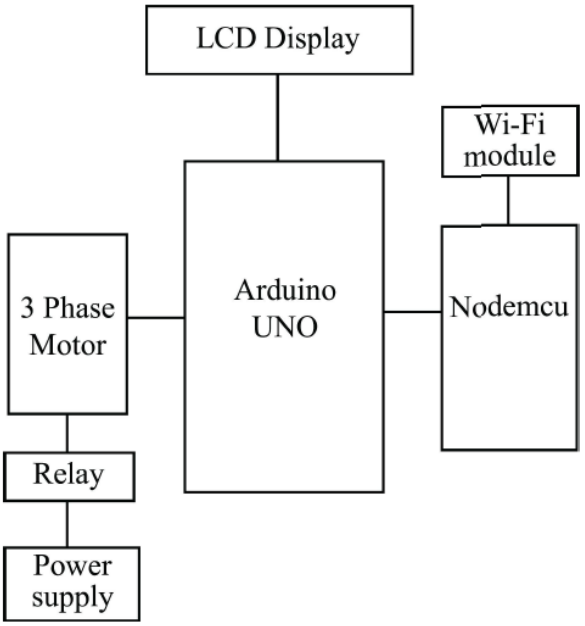

Fig.1 System Architecture

The above block diagram describes the circuit connection of the project. When any phase failure occurs, the Arduino will forward it to the Nodemcu which will be notified to the user in the Blynk Application. Along with this project setup, a LCD Display is also connected to the Arduino UNO Board which displays the Phase Failure Information. When one or more phase fails, LCD Board will display those phase failures information.

The use of mobile phones has become more common among the peoples and hence using our system would be very much effective to them. The in-built WiFi module in Nodemcu Board helps to connect to the Blynk app through the internet. The Blynk app should be installed from the app store and configured. The Arduino UNO Board will read the voltage of the wires of 3 phase supply. The user will be notified when the voltage drops down to zero. Thus, the working of this system is well simplified to be easily accessible by the user. Some of the important mention able advantages of this project include Reduction in manpower, less time consumption, fast operation and controlling.

IV. COMPONENTS REQUIRED

NODEMCU ESP8266

NodeMCU is an open-source firmware. It is a Lua based development board. It is specially designed for IoT based Applications. It includes ESP8266 micro-controller and also an inbuilt WiFi module. It can be programmed in the Arduino IDE by configuring the board in the IDE. The CH3406G driver has to be installed.

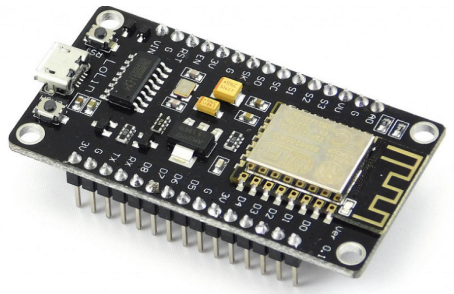

Fig.2 Nodemcu ESP8266

NodeMCU Board has Sixteen general purpose input-output pins. The NodeMCU is an open-source firmware and development kit that helps to Prototype IOT products within a few Lua script lines or 'C' codes.

NodeMCU ESP8266 Board has its own specifications with digital input pins, analog input pin, ground pin, 3.3V pin, digital output pins etc.. just like any other micro-controller boards. It also has a WiFi Module built in to connect directly to the internet to control things online using Nodemcu for digital network applications, which facilitates developers to code running on the Board, greatly speeding up Internet of Things application development process.

RELAY

A relay is an electronically operated switch. It is basically a switch that connects or disconnects two circuits. Electromagnetic Induction is the basic principle of which the Relay works on. When the current passes through the electromagnet present in the Relay, it induces a magnetic field around it. The electromagnetic field either connects or disconnects the circuit. Thus, the Relay acts as a switch to turn on or off the current flow. Relay is commonly available in 5V.

Fig.3 Relay

Relays are mainly used to minimize the damage due to high voltages and also protect the electrical system. These are used to control the high voltage circuit with low voltage signals. The 5V relay is directly connected to the Power supply and the motor. The relay has the pins NO (normally open), NC(normally closed) and GND.

Applications :

1. Relays are used to realize logic functions.
2. Home Automation projects to switch AC loads.
3. To Control Heavy loads at a predetermined time.
4. To control motors, doors etc. in automobiles

ARDUINO UNO

Arduino UNO Board is based on the ATmega328P micro-controller. It consists of six analog inputs, a USB link for programming the on-board micro-controller, 14 digital input/output pins, power jack, a reset button & an ICSP header. It works due to the 16 MHz crystal oscillator & contains everything needed to provide support to the micro-controller. It is easier to use as the user simply needs to connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to start functioning.

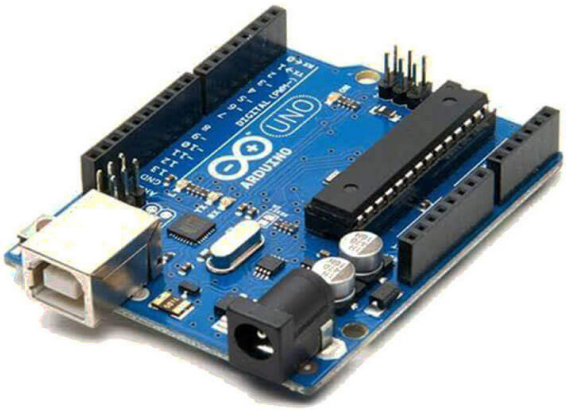

Fig.4 Arduino UNO Board

The micro-controller on the board is programmed using the Arduino development environment & Arduino programming language. It is an open source electronics prototyping platform based on bendable, easy-to-employ software and hardware. It is proposed for hobbyists, artists, designers & anyone interested in generating various designs for things or environmental purposes. The Rx and Tx pins of Arduino are connected to the Tx and Rx pins of Nodemcu respectively to enable the communication between them.

BLYNK APP

Blynk App can be used in both IOS and Android Platform to control micro-controllers like Arduino, Raspberry Pi, NodeMCU ESP8266 over the Internet/Bluetooth. Blynk is known as a digital dashboard in which we can build a graphic interface for our project by simply dragging and dropping widgets. Working of the Blynk App comes along with the Blynk Cloud like when we press a Button in the Blynk app, the message travels to the Blynk Cloud and magically finds its way to the hardware.

Fig.5 Blynk

Blynk Cloud is an open-source which is responsible for storing, forwarding data to any application or micro-controller. It is commonly used for data exchange that happens in the IOT Platform. Blynk is working based on the Virtual Pin concept. Virtual Pin is used to provide exchange of any data between hardware and Blynk mobile app. Virtual pins are different from Digital and Analog Input/output (I/O) pins. They are physical pins on micro-controller boards where we can connect sensors and actuators.

LCD DISPLAY

LCD Displays are commonly used for continuously displaying data which is acquired from sensors, applications, micro-controllers. The display contains 16 pins.

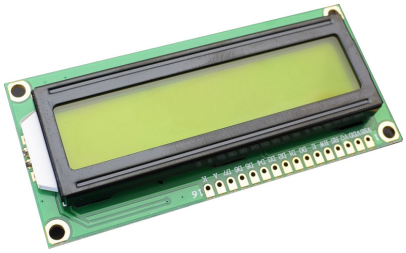

Fig.6 LCD Display

The data to be displayed in the LCD Display can be either 8-bit or 4-bit. Extra number of connections are there in 8-bit data mode, while 4-bit mode has less number of connections. 5V supply is given across the Anode and cathode pins of the LCD display. Pins 6 is for changing the brightness of the LCD display.

The LCD display has to be interfaced to Arduino 4 data pins, 2 control pins and 2 supply wires (i.e. 5V and Ground) must be connected to Arduino. The processed data is displayed in the LCD display one by one. Andalso the additional requirement of smooth motor operation is displayed.

ARDUINO IDE

The Arduino IDE is an open-source Software. Arduino IDE makes it easy to write code, debug

and upload it to the board. This software can be used with any Micro-controller board like Arduino UNO, Arduino mega, Nodemcu, Raspberry Pi etc... It is used to write, debug, run and upload the code to the micro-controllers.

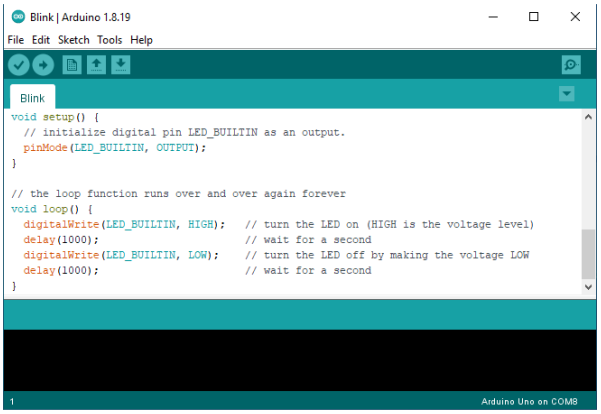

Fig.7 Arduino IDE

Arduino IDE uses wiring language framework for coding. The coding we use in the Arduino IDE is not real C code.

Arduino IDE helps the Hardware to connect, communicate and control things over Internet by uploading the code to the Micro-controllers. Arduino IDE has a console, toolbar, text editor and a message area. It has a minimal user interface which makes it easy for the newbies to understand and work in it. Arduino UNO works in offline. We need to install any additional drivers if the respective micro-controller board needs like non-native ones.

V. IMPLEMENTATION

The Hardware Components are connected first using Jumper wires. The Three phase wire connects with both arduino and nodemcu board. The Three phase wire is denoted as R, Y and B. Those three voltage of three phase wire is given as input for the Arduino. LCD Display is also connected with the Arduino Board.

The Arduino will detect the Three phase failure and display it in the LCD Display. The Arduino UNO and LCD Display are connected with the jumper wires. Various pins are connected that are listed below.

TABLE I

PIN CONNECTION FOR ARDUINO UNO AND LCD DISPLAY

Pins Connection of Arduino UNO and LCD Display	
Arduino UNO	**LCD Display**
~6	V0 (contrast)
2, 3, 4, 5	D7, D6, D5, D4
5V	Vdd
Gnd	Vcc, Rw, K
9	A (anode)
11	E (enable)
12	Rs (register select)

Motor will be operated remotely through Blynk, Nodemcu and Relay. Blynk will send data to the Nodemcu which make relay to turn on and off.

TABLE II

PIN CONNECTION FOR NODEMCU AND RELAY

Pins Connection of Nodemcu ESP8266 and Relay	
Nodemcu ESP8266	**Relay**
D1	Vin
3.3V	Vcc
Gnd	Gnd

Communication is enabled between Arduino UNO and Nodemcu by connecting the following pins.

TABLE III

PIN CONNECTION FOR ARDUINO UNO AND NODEMCU

Pins Connection of Nodemcu ESP8266 and Arduino UNO	
Nodemcu ESP8266	**Arduino UNO**
Tx	Rx
Rx	Tx
Gnd	Gnd

Blynk is installed in the user's mobile and then configured according to our project. The widgets are added to the App just by drag and drop. The Button widget is added to control the motor functions. The Notification and email widget is also added, so that the user will be notified and also able to track the phase failure with timestamp. The Blynk app is available for both android and iOS. The App can be configured easily.

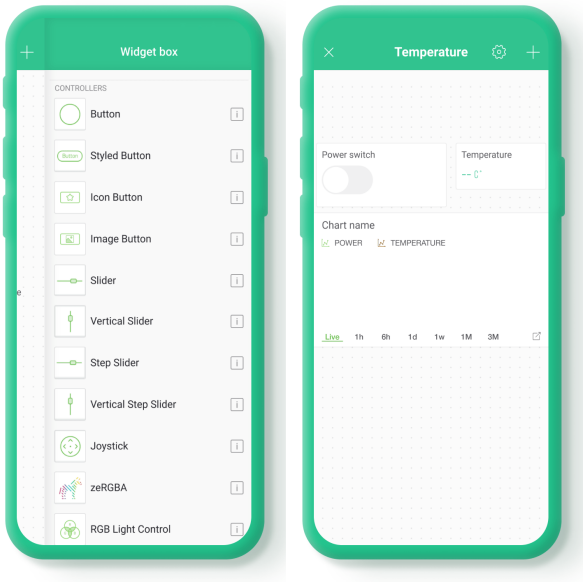

Fig.8 Blynk

The Hardware Components are connected. Then the code has to be uploaded in both the Arduino UNO and Nodemcu ESP8266 Board. The Arduino IDE is used to write, debug and upload the code to the micro-controllers. Nodemcu is an non-native Board, hence driver has to be installed in order to upload code in the Nodemcu Board. Arduino UNO is plugged with the A to B type cable to upload code. The setup is complete and ready to run and execute the project.

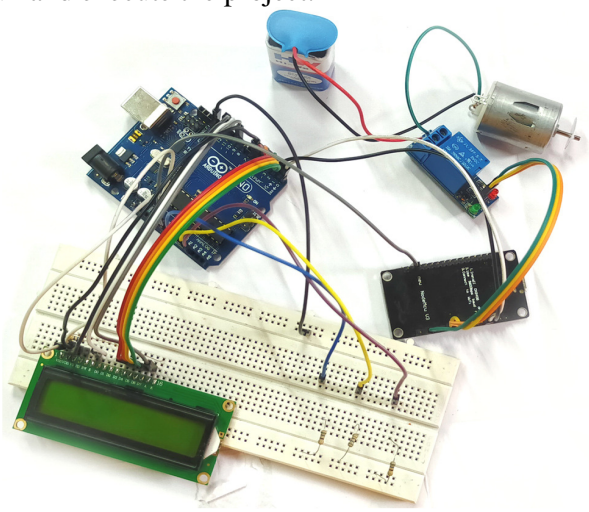

Fig.9 Project Setup

The setup of the project is depicted above. Thus, the demo of this project can be done. Output will be received in the Blynk App and the mail ID of the User. It is a small step for the implementation of this project in real-time.

VI. ADVANTAGES

- The safety of the motor is ensured by proper usage of the motor.
- Farmers can use this as they can receive messages through the Blynk app.
- People can continue by using the motor from any area.
- As irrigation is automated, this is very cost effective.

VII. LIMITATIONS

- Since ESP8266 is a WiFi based micro-controller, it works only in the presence of the internet.
- Farmers must have a smartphone in order to receive notifications and to control the motor.
- This problem can be resolved by implementing the GSM module. Since GSM works on 2G it sends messages to any simple mobile through which the motor is operated.

VIII. CONCLUSION

The developed system notifies the user about the phase failure occurred in the three phase system instantly. The input voltage of three phase wire is monitored by Arduino UNO. When the voltage drops to zero, the user will receive the phase failure message instantly through the LCD Display and the Blynk Notification System. Also, the user is able to control the motor through the mobile. The motor is controlled through Blynk Cloud. The designed system is cost efficient as it uses the Blynk App which is freely available to install. The requirement for the user is just a smartphone with internet connection. The implementation of the system will save large amount of electricity and greatly helps the user to

save time. This project can be used in small as well as large farms. The irrigation system of the farm can be controlled from the farmer's finger tips from anywhere. This project helps farmers to not only protect the motor but also saves power by turning it off anytime.

Modernization in agriculture is important. Farmers are required to utilize every drop of water. This project helps in the irrigation system like farm, green house, nursery etc., Making use of this Mobile Application farmer can protect his motor and thereby avoid future damages and losses. This is a very cost effective project which is easily affordable by the farmers. This project will be helpful in farmlands, Engineering Industries, Water Departments and Hazardous Industries.

IX. FUTURE ENHANCEMENT

Looking into the future, the system needs further advancement in the working. The app and system has to be enhanced in the following domains:

- The notification can be receive to the user's smart watch.
- We have to implement the voice based remote control system.
- The feature of viewing the statistics data of average usage of motor and the average number of times the phase failed can be added.

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