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Abstract

Automation has eased the life of many peoples. Installation of electric motor for water pump/bore well on the agricultural land for irrigation purpose has fulfilled the basic need of water supply, resulting in an increase in the production of crops. Switching the motor on/off, take too much time to travel, especially when the field and pump/motor switch are far away or placed at some distance. Along with that frequent power cut/off is one of the major issues in the rural areas. The bore well motor runs on the three-phase power supply. However, failure in any of the phase lines causes to damage the electric motor. Most of the farmers are unaware of the phase line failure and the power supply fluctuations. To solve the above-mentioned issues, an artificial intelligence (AI) based water-pump switching system hardware device/prototype/product/kit is designed and demonstrated in the present manuscript. The farmer got a message from the proposed device regarding power cuts, the coming of power supply, and any phase failure on their non-android mobile phones wherever and whenever happened. The production cost of the proposed device is around one thousand Indian rupees only which is very less compared to the present smart switches available in the market because it does not require any smart/android phone for controlling them. Also, the traditional switches will not have to use the auto-switching characteristic, which just only provides fault detection as they are using it currently. Along with that in the proposed device, we use Arduino and GSM modules, so it makes installing a camera in the kit very easy. This helps farmers to detect theft in the field. Hence, it provides security too. The proposed device makes farmers stressed free so that they focus more on their crops rather than wasting their time switching on/off the motor and repairing time when it fails due to uneven power fluctuations or power cuts, ultimately it increases the production of crops. The paper presented the component description, working principle, and block/circuit diagram of the proposed prototype/device, and show the real images of the prototype.

Keywords: Automation, Artificial Intelligent, Irrigation System, Smart Switching System, Arduino UNO.

1 Introduction

Most of the switching systems to control the electrical devices/appliances at homes/offices/industries are manually controlled [1-2]. This means human being is involved to ON/OFF/regulate the appliances. Recently, new advancement has been introduced in the traditional manual control switching systems and the old switching systems are replaced by the smart switches [3-4]. These smart switches are controlled by the software apps which are installed in the android phones [5]. But, the smart switch and android phone is expensive and could not be affordable by most peoples/farmers.

Also, most of the smart switches in irrigation system are able to control the devices which are connected to single phase line [6-8]. So, the phase detector circuit is not required for that. But, when there is a three phase line is present then we require a phase detector circuitry in the smart switches to detect which phase is ON.

In line of these, the proposed model is a smart switching system which can be used to automate the electrical appliances and give freedom to the user to run the electrical appliances with their choice and convenience with just a phone call. This is an Arduino based switching system which receives input on the GSM based module which gives signal to the relay and the relay acts as a switch for the appliance attached to it.

The switching system is equipped with a three-phase line detector to detect any fault in the line and protect the appliances from any damage. The switching system is also equipped with a feedback system which gives the information to the user about the running status of the appliance, and send an alert message to the user in case of a power cut/failure.

Rest of the paper is organized in different sections. Component description, block diagram and circuit diagram of the proposed prototype is presented and explained in Section 2. Working principle is discussed in Section 3. Advantages and limitation of the proposed prototype is mentioned in Section 4. The article is concluded in Section 5.

2 Component Description, Block- and Circuit Diagram of Proposed Prototype

2.1 Components Description

- **Arduino UNO-** Arduino UNO is a microcontroller board based on the ATmega328P (datasheet). It is an open-source microcontroller and it's coded with help of Arduino IDE software [9], [10].
- **SIM 800L GSM Module**– We use SIM 800L GSM module in place of mobile phone which reduces the cost of the product/model. SIM 800L GSM module supported 2G, 3G, and allows GPRS transmission for sending and receiving SMS, and making and receiving voice calls. Due to its small size and low cost it becomes a perfect solution for any project that requires long range connectivity [9].
- **Relay-** Relay is a switch that open and close the circuits electronically. It controls one electrical circuit by opening and closing contacts of other circuit. 5V DC supply voltage is required for the proper working of relay [2].
- **Power Deliver/Supply-** This system operates on 12V DC power supply and it consumes 2A current. Also, we connected 11.1V DC lithium ion 1000 mAh capacity battery pack for power backup when domestic supply failure [11].

2.2 Block- and Circuit Diagram of Prototype/Model

In this section, we presents the block and circuit diagram of our prototype in Fig.1 and Fig. 2, respectively. The block diagram contains GSM module, Arduino UNO, relay, 3-phase detection system, and 3-phase motor starter.

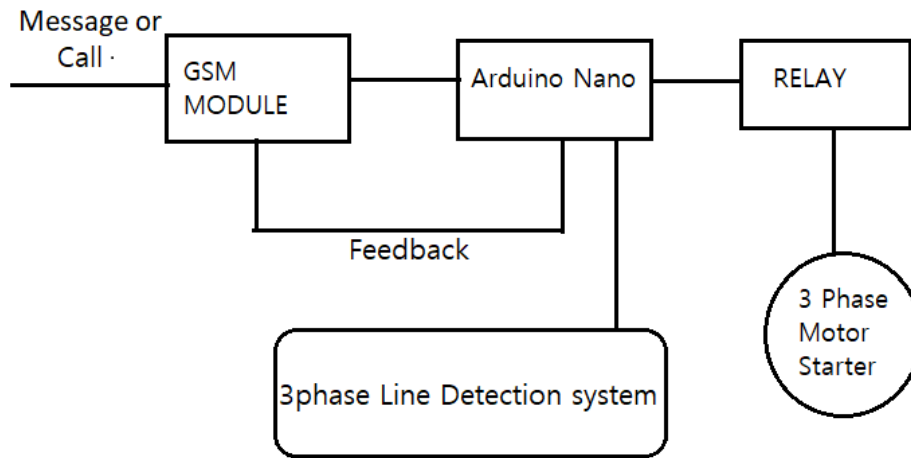


Fig. 1 Block diagram of AI based motor/water pump switching system

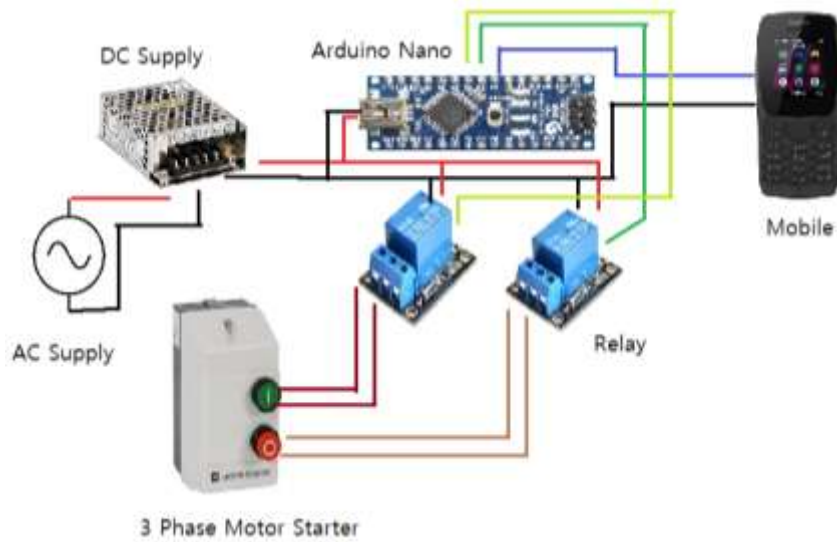


Fig. 2 Circuit diagram of AI based motor/water pump switching system

3 Working Principle of Proposed Prototype

The present section mainly focuses on the working principle of the proposed prototype. This prototype works on the principle of Robot automation where, the Arduino acts as a brain to the automation system and when it receives signal from the GSM based module, the Arduino acknowledge the input signal and acts accordingly as assigned in the Arduino code.

Technically, when we call the SIM800l GSM module it gives signal to the Arduino then the Arduino processes the signal and send it to the relays which act as a switch for our motor/water pump.

The three-phase detection system works on the principle of the “Faraday’s Law” [12]. A current carrying wire produces a magnetic field around it and according to Faraday’s Law when magnetic field interacts with electric circuit, an electromotive force is produced and this detects the line fault in the system.

The first image of our working smart switch model/prototype is shown in Fig. 3 in which we use a simple mobile phone for call and SMS for the generation of vibrations. These vibrations are used for further process or detection of phase. The cost of this project is high. So, we further modified our prototype with a new one whose image is shown in Fig. 4. The modified prototype is compact in size and low cost. Here, we replace a simple mobile phone with a GSM module whose cost is less as compared to a phone.



Fig. 3 Image of first prototype



Fig. 4 Image of second modified prototype

4 Advantages, Application and Limitation of the Proposed Prototype

4.1 Advantages and Applications

- This prototype does not require any android phone to ON/OFF motor. We can make a phone call with an ordinary/simple phone or SMS.
- This system can be used in remote areas like villages where power cut is frequent and farmers have to go again and again to turn on their tube well.

- This system is also useful in urban areas for home automation. People can monitor their electrical appliances even when they are not at home.

4.2 Limitation

- When there is a network issue with the SIM800l module then, this system will not work.

5 Conclusion

In irrigation system, AI based motor/water pump switching system will make farmer's/people's life easier by giving them access to turn on/off their electrical appliances with just a phone call. In this work we have addressed two major issues arrives in the present smart switching system. The first is the timing issue to switch ON/OFF the water pump motor, when the switch is located far away from the actual cropping land, and the second is the unknown and random failure or power cut in any of the phase line this may cause the damage of electric motor. To solve the above issues we have designed a prototype model. The cost of our prototype is less as compared to the android phone based smart switching system. Although, it has a drawback in the hilly regions where network issue is prominent but, it will cater the needs of various other people far from no-network areas.

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