Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 4, April : 2025

AI Based Motor Pump Switching System

1. MALLAGUNDLA PRADEEP KUMAR, 2. GONDIPARLA PURUSHOTHAM, 3. KANTU GOPI,

4. MADAGONI BHAVANI, 5. BALLIKURA VENKATA CHIRU

[1,2,3,4,5] *UG Student, Department of Agriculture Engineering, ABR College of Engineering and Technology, Andhra Pradesh, India.*

Under the Guidance: T. Saida Reddy - Assistant Professor , Email: saidareddy9640@gmail.com

Abstract— Automation has eased the life of many peoples. Installation of electric motor for waterpump/bore well on the agricultural land for irrigation purpose has fulfilled the basic need ofwater supply, resulting in an increase in the production of crops. To switch the motor on/off,take too much time to travel, especially when the field and pump/motor switch are far awayor placed at some distance. Along with that frequent power cut/off is one of the major issuesin the ruler areas. The bore well motor runs on the three-phase power supply. However,failure in any of the phase line causes to damage the electric motor. Most of the farmers areunaware about the phase line failure and the power supply fluctuations. To solve the abovementioned issues, an artificial intelligence (AI) based water-pump switching system hard-ware device/prototype/product/kit is design and demonstrated in the present manuscript.The farmer got a message from the proposed device regarding power cut, coming of powersupply, and any phase failure on their non-android mobile phones wherever and wheneverhappened. The production cost of the proposed device is around one thousand Indian ru-pees only which is very less as compared to the present smart switches available in themarket 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 justonly provide fault detection as they are using it currently. Along with that in the proposeddevice we use Arduino and GSM module, so it makes to install camera in the kit very easily.This helps farmers to detect theft at the field. Hence, it provides security too. The proposeddevice makes farmer stress free so that they focus more on their crops rather wasting theirtime to switching on/off the motor and the repairing time when it fails due to the unevenpower fluctuations or power cut, ultimately it increases the production of crops. The pa-per presented the component description, working principle, block/circuit diagram of theproposed prototype/device, and show the real images of the prototype.

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

1 INTRODUCTION

Most of the switching systems to control the electrical devices/appliances at homes/offices/industriesare manually controlled [1-2]. This means human being is involved to ON/OFF/regulate theappliances. Recently, new advancement has been introduced in the traditional manual controlswitching systems and the old switching systems are replaced by the smart switches [3-4]. These smartswitches are controlled by the software apps which are installed in the android phones [5]. But, thesmart 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 areconnected to single phase line [6-8]. So, the phase detector circuit is not required for that. But, whenthere is a three phase line is present then we require a phase detector circuitry in the smart switches todetect which phase is ON.In line of these, the proposed model is a smart switching system which can be used to automate theelectrical appliances and give freedom to the user to run the electrical appliances with their choice andconvenience with just a phone call. This is an Arduino based switching system

which receives input onthe GSM based module which gives signal to the relay and the relay acts as a switch for the applianceattached to it.The switching system is equipped with a three-phase line detector to detect any fault inthe line and protect the appliances from any damage. The switching system is also equipped with afeedback system which gives the information to the user about the running status of the appliance, andsend 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 circuitdiagram of the proposed prototype is presented and explained in Section 2. Working principle isdiscussed in Section 3. Advantages and limitation of the proposed prototype is mentioned in Section 4.The article is concluded in Section 5.

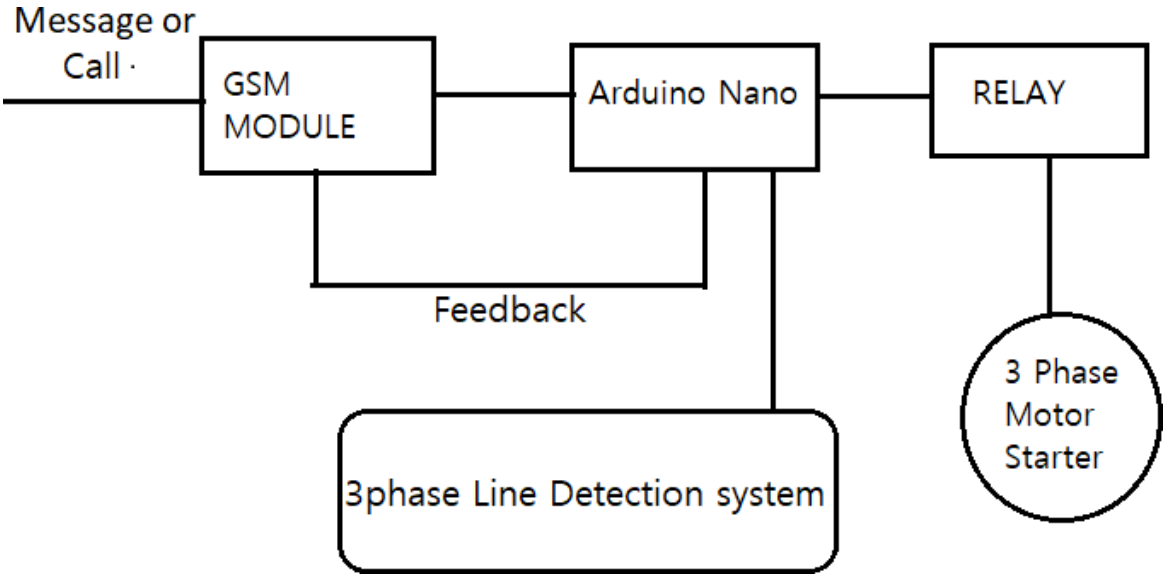
2 Component Description, Block- and Circuit Diagram ofProposed Prototype

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 IDEsoftware [9], [10].
- SIM 800L GSM Module– We use SIM 800L GSM module in place of mobile phone whichreduces the cost of the product/model. SIM 800L GSM module supported 2G, 3G, and allowsGPRS transmission for sending and receiving SMS, and making and receiving voice calls. Dueto its small size and low cost it becomes a perfect solution for any project that requires longrange connectivity [9].
- Relay- Relay is a switch that open and close the circuits electronically. It controls oneelectrical circuit by opening and closing contacts of other circuit. 5V DC supply voltage isrequired for the proper working of relay [2].
- Power Deliver/Supply- This system operates on 12V DC power supply and it consumes 2Acurrent. Also, we connected 11.1V DC lithium ion 1000 mAh capacity battery pack for powerbackup 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.



Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 4, April : 2025

Figure 1: Block diagram of AI based motor/water pump switching system

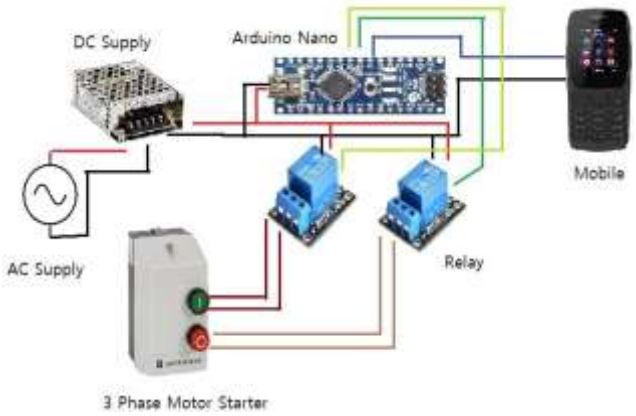


Fig. 2 Circuit diagram of AI based motor/water pump switching system

3 Working Principle of Proposed Prototype

The present section mainly focuses on the working principle of the proposed prototype. This prototypeworks on the principle of Robot automation where, the Arduino acts as a brain to the automationsystem and when it receives signal from the GSM based module, the Arduino acknowledge the inputsignal 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 Arduinoprocesses 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 currentcarrying wire produces a magnetic field around it and according to Faraday’s Law when magnetic fieldinteracts 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 show in Fig. 3 in which we use asimple mobile phone for call and SMS for the generation of vibrations. These vibrations are used forfurther process or detection of phase. The cost of this project is high.

Fig. 3 Image of 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.

CONCLUSION

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

REFERENCES

[1] Yamauchi M. and Nakagome Y. (1972). Electronic Switching Systems in Japan. In EEETransactionsonCommunications,vol.20,no.4,pp.746-752.DOI:10.1109/TCOM.1972.1091233.

[2] Gurevich V. (2005). Electric Relays: Principles and Applications (1st Ed.). CRC Press. DOI:https://doi.org/10.1201/9781315221168.

[3] Emilio M.D.P. (2020). AI-based soft-switching controller enables more efficient powerconverters. In Power Electronics News, Available Online on EE Time, 27 April 2020.

[4] Sadeghkhani I., Ketabi A. and Feuillet R. (2013). Artificial-intelligence-based techniques toevaluate switching overvoltage during power system restoration. In Advances in ArtificialIntelligence, vol. 2013, Article ID 316985, pp. 1-8. DOI: https://doi.org/10.1155/2013/316985.

[5] Paul S., Das M., Sau A., and Patra S. (2015). Android based smart water pump controller withwater level detection techniques. In International Journal of Advanced Research in Computerand Communication Engineering, vol. 4, no. 12, pp. 1-8, Dec 2015.

[6] Kumar S. Raja P. and Bhargavi G. (2018). A comparative study on modern smart irrigationsystem and monitoring the field by using IOT. In IEEE Int. Conf. on Computing, Power andCommunication Technologies (GUCON), Greater Noida, UP, India, pp.628-632. DOI:10.1109/GUCON.2018.8675026.

[7] Namala K. K., Prabhu K. K. AV, Math A., Kumari A. and Kulkarni S. (2016). Smart irrigationwith embedded system. In IEEE Bombay Section Symposium (IBSS), pp. 1-5. DOI:10.1109/IBSS.2016.7940199.

[8] Ziegler S., Woodward R.C., Iu H.H. and Borle L.J. (2009). Current sensing techniques: Areview. In IEEE Sensors Journal, vol. 9, no. 4, pp. 354-376. DOI:10.1109/JSEN.2009.2013914.

[9] Louis L. (2016). Working principle of Arduino and using it as a tool for study and research.International Journal of Control, Automation, Communication and Systems (IJCACS), vol. 1,pp. 121-29.

[10] Okafor K.C. and Ononiwu G. (2017). Development of Arduino based IoT metering system foron-demand-energy monitoring. International Journal of Mechatronics, Electric and ComputerTechnology (IJMEC), vol. 7, pp. 3208-3224.

[11] Liu Y. H. (2011). Research on Producing Low-power Low-voltage DC Power Supply with High-voltagePowerBus.EnergyProcedia,12:1068-1073.DOI:https://doi.org/10.1016/j.egypro.2011.10.139.

[12] Saslow W. M. (2002). Electricity, Magnetism, and Light. Chapter-12 Faraday's Law ofElectromagnetic Induction.Academic Press, 505-558. DOI:10.1016/B978-012619455-5.50012-7