Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
February 2024 5(2), 853–860

HYDRAULIC PUMP CONTROLLER THROUGH IOT BY SENSING MOISTURE CONTENT IN SOIL

Dr. B. Vishnuvardhan Reddy [1], T. Mani Mohan [2]

[1] Asso. Professor, Department of Mechanical Engineering, Mohan Babu University, Tirupati, Chittoor Dist. Andhra Pradesh, India
[2] Asst. Professor, Department of Mechanical Engineering, Annamacharya Institute of Technology and Sciences, Rajampet, Annamayya Dist. Andhra Pradesh, India

ABSTRACT

This work proposes a system for controlling a pump through IoT by sensing soil moisture content in soil. The system aims to optimize water usage and improve plant growth by measuring the moisture content in soil and turning on/off the pump accordingly. The system consists of soil moisture sensor, Arduino uno, an IoT device, and a cloud-based server or a local computer. The Arduino UNO coded with some set of instructions it will take the data from system i.e, status of pump and soil. Arduino UNO passes the instruction to system to pump on/off to make soil wet/dry. The sensor measures the moisture content in soil. The Node MCU is connected with internet to transfer the data from system to server or user. The user can check the status of pump and soil by using thing cloud open software and the status displayed on system LCD display also.

Keywords: The proposed system has the potential to control pump or a mechanical device

Corresponding Author

Dr. B. Vishnuvardhan Reddy,
drbvvnaidu@gmail.com

DOI
10.29121/shodhkosh.v5.i2.2024.3550

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

1. INTRODUCTION

In this modern world, most of the farmer lack proper knowledge regarding farming and agriculture making it more erratic. Most part of farming and agricultural related activities are based on prediction and forecasting. When it fails, the farmers have bear huge losses and some end up committing suicide. Since we are aware of the benefit of quality of soil and air, irrigational and in the growth of crops such parameters such as temperature, moisture cannot be neglected.

Agriculture is the backbone of a countries economic activities, as India's major source of income is from the agriculture sector and more than 60 percent of farmers solely depend on agriculture. Agriculture is an important aspect in the development of any country as in Indian economic survey 2017-18 had key implementations for the agriculture sector that it employs more than 50 percent of the total workforce in India and contributed around 17-18 percent of India's GDP. As about half of the workforce is engaged in agriculture and its related sectors, farmers have started to apply

new methods, agricultural techniques like fertilizers, pesticides, enhanced seeds, and various irrigation methods such as drip irrigation and ditch irrigation, but in some places, it is decreasing due to exploitation and overuse of resources.

In order to achieve more production, the need is to change this manual method to automation to reduce human intervention so that the workforce could be utilized in other sectors and ease of use. This system could be used as a consequent soil monitoring tool with a potential benefit of increased yields, low operating cost and less consumed resources this innovative strategy is known as "Precision Farming". This system utilizes trending and advanced technology to increase the crop production, in the proposed system different parameters like temperature, humidity, and soil moisture are constantly monitored using Wi-Fi module connected with all the required sensors which are programmed to send data to an IoT platform where these data can be read, analyse and stored. The prime objective is to provide a useful and errorfree system to the user, the user can either be an individual or any commercial organization. This system is designed in such a way that it is easily accessible with a smartphone.

It is the interconnection or network of physical devices that is interrelated computing devices, digital and mechanical machines, people or animals, objects that can sense, accumulate and transfer data over web without any human involvement. Everything is provided with unique identifier. It is a progressed examination and mechanized frameworks which uses detecting, organizing, enormous information and man-made consciousness innovation to convey total framework for an administration. Basically IoT is about extending the power of internet beyond smart phones and computers. IoT has changed today's world. Smart cities, smart car, smart homes everything around us can be turned into a smart device with the help of IoT. It also has applications in agriculture, business sectors, healthcare, transport and logistics.

There are four main components of IoT-

Low power embedded system- High performance and less battery consumption are the inverse factors that play an important role in design of electronic system.

• Cloud computing- Data collected from devices is stored on reliable storage servers so here cloud computing comes into action.

• Availability of Big Data- As IoT is highly dependent on sensors that are real time. So the usage of electronic devices is spread throughout every field that is going to trigger a massive flux of data.

• Network connection- For communication, internet connectivity is necessary where each physical object is assigned by an IP address. A network connection is build between the devices with the help of these addresses.

Methodology:

The basic building blocks of an IoT System are Sensors, Processors and applications. So the block diagram below is the proposed model of our project which shows the interconnection of these blocks. The sensors are interfaced with Microcontroller; data from the sensor is displayed on the mobile app of the user. Mobile app provides an access to the continuous data from sensors and accordingly helps farmer to take action to full fill the requirements of the soil. The basic building blocks of an IoT System are Sensors, Processors and applications. So the block diagram below is the proposed model of our project which shows the interconnection of these blocks. The sensors are interfaced with Microcontroller; data from the sensor is displayed on the mobile app of the user. Mobile app provides an access to the continuous data from sensors and accordingly helps farmer to take action to full fill the requirements of the soil.

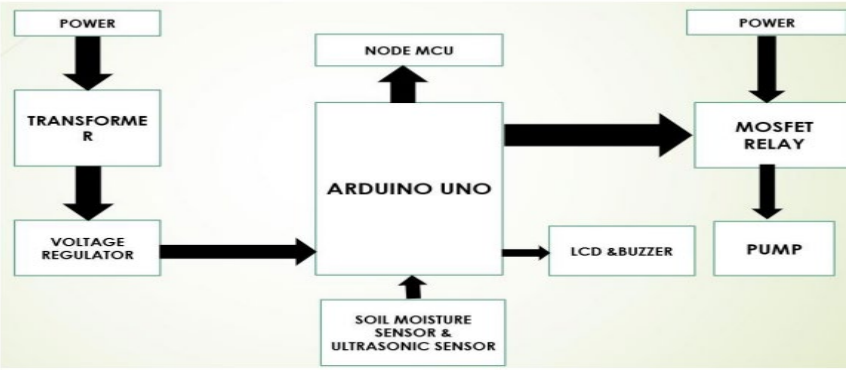

Fig:4.1

Methodology 1. We used ESP32s node MCU, which is wireless and Wi-Fi enable. 2. On breadboard, we connected the ESP and DHT11 temperature and humidity sensor, soil moisture sensor, buzzer, LEDs and SI1145 Digital UV Index / IR / Visible Light Sensor with the help of jumper wires. 3. ESP32 goes to sleep after every 18 minutes, wakes up, takes the reading, upload it on the Blynk app cloud to feed the live data and goes to sleep mode again. 4) The LEDs retain the state so when the farmer passes through if he didn't hear the sound or got the notification on phone can look the LEDs to take the necessary steps. Where turning red, blue or violet will give different indications. Same as one buzzer sound signals something, two means something else. 5 In the prototype model, bucket is used. Here the soil moisture sensor is fitted at the bottom and temperature humidity sensor, Digital UV Index sensor and the buzzer are placed at the top by putting a whole in the cover. When the data of different sensors that are humidity, temperature, soil moisture is acquired it is sent to the mobile of the user and if the water content in the soil is less than the cut off value then an alert message is received on the app of the user and motor gets switched on automatically using relay

Hardware Tools

NodeMCU It is an open sources firmware and development kits to build IoT products. It includes firmware that run on ESP8266 WiFiSoC and hardware that has an ESP-12 module. The kit has analog (A0). It also has digital (D0-D8) pins on the board. It even assists serial ports communications such as SPI, UART, I2C etc. Features •The version of the Node MCU used here is DevKit1.0. • It can be used on a breadboard easily. • It is small and light weight. • It supports Arduino C programming language. • Node MCU is operated at a voltage of 3.3V and can be powered using USB. • It has a wireless protocol that is 802.11 b/g/n. • It has a PCB antenna on the ESP-12E chip. • It also contains built-in capabilities.

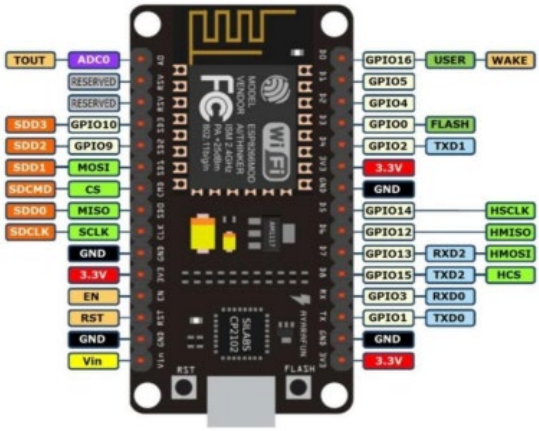

Figure: Pin Diagram of Node MCU

The above figure gives the description about the different pins of the microcontroller Node MCU. There are 17 GPIO pins that are for general purpose input output functions with P a g e 14 transmitter and receiver pins. All the sensors are attached to different analog and digital pins of this microcontroller to acquire the data.

Soil Moisture Sensor

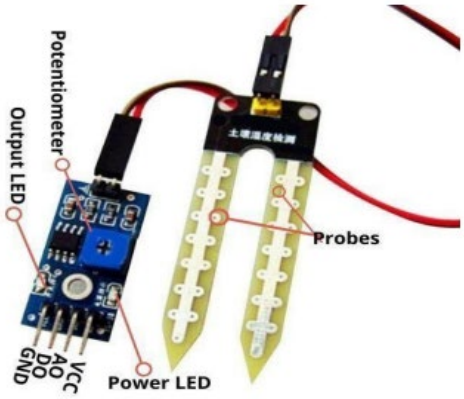

Figure: Soil Moisture Sensor

Deciding how to measure soil moisture can be complicated, but METER's easy, plug and play soil sensors simplify the process. When choosing a METER soil moisture sensor, the first thing to know is that all METER soil sensors have the same research grade accuracy with minimum sensitivity to salts

2. VOLUMETRIC WATER CONTENT

If you want to measure the rise and fall of the amount (or percentage) of water in the soil, you will need a water content sensor (soil moisture sensor). Soil is made up of P a g e 15 water, air, minerals, organic matter, and sometimes ice (Figure 1). As a component, water makes up a percentage of the total. To directly measure soil water content, you can calculate the percentage on a mass basis (gravimetric water content) by comparing the amount of water, as a mass, to the total mass of everything else. However, since this method is labor intensive, most researchers use soil moisture sensors to make an automated volume-based measurement called volumetric water content (VWC).

Table: Performance Parameters Of Soil Moisture Sensor

Parameter	Specifications
Model name YL-38	Model name YL-38
Operating Temperature	-40 to +60 deg C
Sensing Range	0-45%volumetric water content of soil
Operating Voltage	5V DC
Power Consumption	3mA

Relay:

It is a switching device. To mechanically control a switch many of the relays use electromagnet but some other fundamentals can also be used like relays that are solid state. P a g e 16 When it is important to operate a circuit by a way of independent low power signal or if different circuits are managed by means of a single signal, then relays are used. So relay acts as an automated switch that operates on circuit having high current using low current signal.

Features

• Great in safety. In high voltage and power system, the higher current is controlled by the lower one. Wide scope of controllable Voltage.

• Have the capacity to manage high load current, that could attain 240V, 10A with Normally-open (NO) and Normally-closed (NC) contacts.

• Board has a power indicator(Red LED) and relay status(Green LED) for debugging.

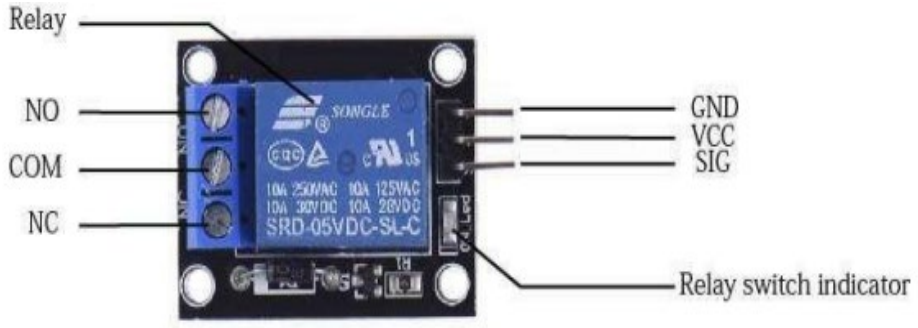

Figure: Pins of Relay

A relay is an electrically controllable switch widely used in industrial controls, automobiles and appliances.

The relay allows the isolation of two separate sections of a system with two different voltage sources i.e., a small amount of voltage/current on one side can handle a large amount of voltage/current on theother side but there is no chance that these two voltages mix up.

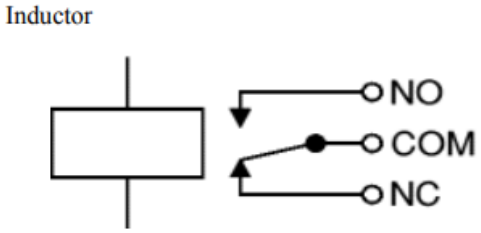

Fig: Circuit symbol of a relay

Operation:

When current flows through the coil, a magnetic field is created around the coil i.e., the coil is energized. This causes the armature to be attracted to the coil. The armature's contact acts like a switch and closes or opens the circuit. When the coil is not energized, a spring pulls the armature to its normal state of open or closed. There are all types of relays for all kinds of applications.

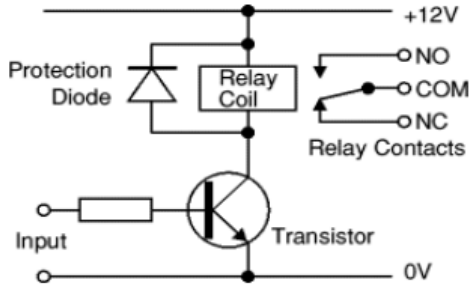

Fig: Relay Operation and use of protection diodes

Transistors and ICs must be protected from the brief high voltage 'spike' produced when the relay coil is switched off. The above diagram shows how a signal diode (eg 1N4148) is connected across the relay coil to provide this protection. The diode is connected 'backwards' so that it will normally not conduct. Conduction occurs only when the relay coil is switched off, at this moment the current tries to flow continuously through the coil and it is safely diverted through the diode. Without the diode no current could flow and the coil would produce a damaging high voltage 'spike' in its attempt to keep the current flowing.

In choosing a relay, the following characteristics need to be considered:

The contacts can be normally open (NO) or normally closed (NC). In the NC type, the contacts are closed when the coil is not energized. In the NO type, the contacts are closed when the coil is energized.

There can be one or more contacts. i.e., different types like SPST (single pole single throw), SPDT (single pole double throw) and DPDT (double pole double throw) relays.

The voltage and current required to energize the coil. The voltage can vary from a few volts to 50 volts, while the current can be from a few milliamps to 20milliamps. The relay has a minimum voltage, below which the coil will not be energized. This minimum voltage is called the "pull-in" voltage.

The minimum DC/AC voltage and current that can be handled by the contacts. This is in the range of a few volts to hundreds of volts, while the current can be from a few amps to 40A or more, depending on the relay.

ARDUINO UNO BOARD:

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP

header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

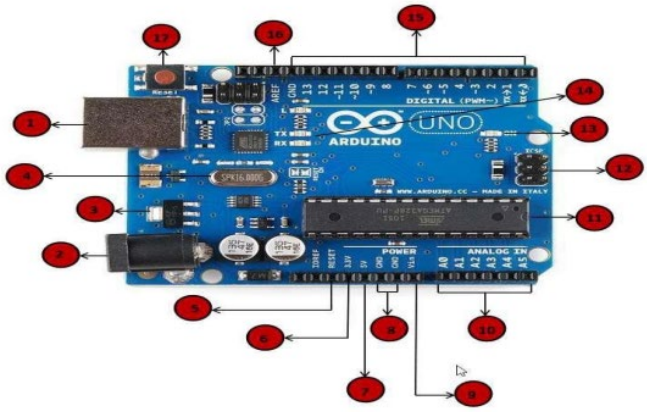

Figure: Arduino uno board

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converters.

Technical Specifications:

Table: Arduino uno specifications

FEATURE	SPECIFICATION
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Submersible Pump:

It is a micro submersible pump which works on dc 3-6v with cost efficient and portable. It is able to take around 120 litres for every hour with extremely low current utilization. Water level should be higher as if the motor is used without water it can harm the parts of this device due to overheating. There are many applications such as controlled fountain water flow, hydroponic systems, controlled garden watering system.

Figure: Submersible Pump

3. RESULTS

The Model of Hydraulic Pump Control is tested in water sump to pump the water to field. Tested field is two different soils dry and wet. Both soils moisture content is measured by the soil moisture sensor and it is compared to the threshold value which are set by the user in the code.

Test 1: Moisture level sensed by the sensor in the first soil is lower than the threshold value so the pump automatically feed water to field.

Test 2: Moisture level sensed by the sensor in the second soil is lower than the threshold value sot the pump automatically water feeding stop.

Status: The status of pump (ON/OFF) and field (DRY/WET). We can get the updates in internet through things cloud software.

4. CONCLUSION

The proposed model explores the use of IoT (Internet of things) in the pump control (or) any Mechanical Devices. This model aims in efficient use of pump with particular soil. Thingspeak helps in real time sampling of the soil and hence the data acquired can be further used for analyzing the crop. We have also taken many readings of the soil moisture, of the environment for various days at different times of the day. Data on the cloud also helps the agriculturists in improving the yield, evaluating the manures, illness in the fields. This system is cost effective and feasible. It also focuses on optimizing the use of water resources which combats issues like water scarcity and ensures sustainability. This model focuses on the utilization of IoT in controlling of Mechanical devices through Iot and the solutions proposed in this paper will improve controlling methods, increase productivity and lead to effective use of limited resources.

5. FUTURE SCOPE

The future scope of this project could be including variety of soil sensors like pH sensor, Rain sensor and then collecting and storing the data on cloud server. This would make the predicting and analyzing processes more accurate. It also includes making different data mining algorithms suitable for data analysis in agriculture.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

S. Sivachandran, K.Balakrishnan, K.Navin, "Real Time Embedded Based Soil Analyser", International Research Journal of Engineering and Technology (IRJET). Volume: 3 Issue 3 | March 2014

Anand Nayyar, Er. Vikram Puri, "IoT Based Smart Sensors Agriculture Stick for Live Temperature and Moisture Monitoring using Arduino, Cloud Computing & Solar Technology" May 2015

Chandan kumar sahu, Pramitee Behera, "A Low Cost Smart Irrigation Control System", IEEE sponsored 2nd International conference on electronics and communication system (ICECS2015)

Apurva C. Pusatkar, Vijay S. Gulhane, "Implementation of Wireless Sensor Network for Real Time Monitoring of Agriculture", International research journal of engineering and technology (IRJET). Volume: 03 issue: 05 | May-2016

Laxmi C. Gavade, A.D Bhoi , "N, P, K Detection and Control for Agriculture Applications using PIC Controller", International Research Journal of Engineering and Technology (IRJET). Volume: 6 Issue: 4 | April 2017

Mrs.T.Vineela, J. NagaHarini, Ch.Kiranma, G.Harshitha, B.AdiLaksh, "IoT Based Agriculture Monitoring and Smart Irrigation System Using Raspberry Pi", International Research Journal of Engineering and Technology (IRJET). Volume: 5 Issue: 1 | Jan 2018