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(Autonomous Institution Affiliated to VTU, Belagavi)

IoT BASED SMART AGRICULTURE SYSTEM

Assignment Report

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IoT BASED SMART AGRICULTURE SYSTEM

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Agriculture requires close interaction of farmer with the crop growth cycle taking into account many factors that affect agriculture. Application of technology brings several advantages in efficient use of available resources in optimal manner. Water is the most precious resource and hence needs to be preserved at all costs. Smart farming through IoT can bring in a cost effective and reliable solution. IoT enables automatic interaction over network using sensors, controllers and actuators for efficient resource control. In this work, we realise a prototype working model that enables interaction with a soil moisture sensor over wi-fi network for control and actuation through a NodeMCU microcontroller and relay actuator to operate a pump. We study the moisture sensor in different soil conditions and calibrate the relay response for controlling the irrigation levels

Key works: IoT(internet of things), smart agriculture, automation, sensor, actuator, microcontroller, Blynk application interface

Introduction

Despite a growing population, now predicted to reach 9.6 billion by 2050, the agriculture industry must rise to meet demand, regardless of environmental challenges like unfavourable weather conditions and climate change. To meet the needs of that growing population, the agriculture industry will have to adopt new technologies to gain a much-needed edge. New agricultural applications in smart farming and precision farming through IoT will enable the industry to increase operational efficiency, lower costs, reduce waste, and improve the quality of their yield.

Smart farming is a capital-intensive and hi-tech system of growing food cleanly and sustainable for the masses. It is the application of modern ICT (Information and Communication Technologies) into agriculture. In IoT-based smart farming, a system is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automating the irrigation system. The farmers can monitor the field conditions from anywhere. IoT-based smart farming is highly efficient when compared with the conventional approach.

The applications of IoT-based smart farming not only target conventional, large farming operations, but could also be new levers to uplift other growing or common trends in agricultural like organic farming, family farming (complex or small spaces, particular cattle and/or cultures, preservation of particular or high-quality varieties, etc.), and enhance highly transparent farming.

In terms of environmental issues, IoT-based smart farming can provide great benefits including more efficient water usage, or optimization of inputs and treatments

Thus, the IoT agricultural applications are making it possible for ranchers and farmers to collect meaningful data. Large landowners and small farmers must understand the potential of IoT market for agriculture by installing smart technologies to increase competitiveness and sustainability in their productions. With the population growing rapidly, the demand can be successfully met if the ranchers, as well as small farmers, implement agricultural IoT solutions in a prosperous manner.

Aim and Objectives

Agriculture contributes to 16% of India's GDP. 12 crore farmers are directly engaged in agriculture. India has the second highest amount of land under agriculture in the world. Among all these numbers – there's this other number that had a profound impact – this number is 23. 23 is the number of farmers who kill themselves every single day because they don't have enough scientific and technical knowledge to generate output for the amount of input they put in. Therefore through this project we aim to ease the problems of farmers.

Monitoring the soil and environment conditions manually and subsequently using an irrigation system efficiently is a labour intensive task. Our idea aims to offset this load

by using sensors to relay the data to the farmers through the Blynk app. The next step is the control of the water pump through a single tap on the smartphone. Through this, we aim to ease the burden on the farmers with respect to irrigation.

Objectives:

- To design an automated Irrigation System using IoT
- To monitor the soil moisture content and environment temperature
- To relay the obtained data to the user via NodeMCU and Blynk App
- To automate the process of irrigation based on the obtained data

Literature survey

National papers

1. G. Sushanth and S. Sujatha, "IOT Based Smart Agriculture System," 2018 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), Chennai, India, 2018, pp. 1-4, doi: 10.1109/WiSPNET.2018.8538702
Published in: 2018 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)
Date of Conference: 22-24 March 2018
Date Added to IEEE Xplore: 19 November 2018
ISBN Information:
INSPEC Accession Number: 18269070
DOI: 10.1109/WiSPNET.2018.8538702
Publisher: IEEE
Conference Location: Chennai, India

- Paper proposes a Smart agriculture System that uses technologies such as Arduino, IOT and Wireless Sensor Network
- Includes development of a system which can monitor temperature, humidity, moisture through sensors using Arduino board
- in case of any discrepancy send a SMS notification as well as a notification on the application developed for the same to the farmer's smartphone using Wi-Fi/3G/4G.

2. G. Shanmugasundaram, K. K. Prasanth, G. Magesh and B. Sriram, "Automated Irrigation System," 2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN), Pondicherry, India, 2019, pp. 1-6, doi: 10.1109/ICSCAN.2019.8878737.
Published in: 2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN)
Date of Conference: 29-30 March 2019
Date Added to IEEE Xplore: 24 October 2019
ISBN Information:
INSPEC Accession Number: 19082745
DOI: 10.1109/ICSCAN.2019.8878737
Publisher: IEEE
Conference Location: Pondicherry, India

- In order to overcome issues such as water scarcity, lack of human resource etc an optimized Automatic Irrigation System is developed
- collects Datasets from the field using sensors and analytics is done for deciding the threshold value.
- Live values from the sensors is mapped with the threshold value, if both the values

matches water is either irrigated to or drained from the field

3. Neha K. Nawandar, Vishal R. Satpute, IoT based low cost and intelligent module for smart irrigation system,Computers and Electronics in Agriculture,Volume 162,2019,Pages 979-990, https://doi.org/10.1016/j.compag.2019.05.027.(https://www.sciencedirect.com/science/article/pii/S0168169918318076)

- Agriculture contributes to a major share in the Indian economy and most of its people are dependent on it for their livelihood.
- water is an important resource that needs to be preserved using the latest available technologies.
- Work proposed targets to develop a low cost intelligent system for smart irrigation.
- It uses IoT to make devices used in the system to talk and connect on their own, with capabilities like: admin mode for user interaction, one-time setup for irrigation schedule estimation, neural based decision making for intelligent support and remote data monitoring.

4. S. B. Saraf and D. H. Gawali, "IoT based smart irrigation monitoring and controlling system," 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), Bangalore, India, 2017, pp. 815-819, doi: 10.1109/RTEICT.2017.8256711
Published in: 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT)
Date of Conference: 19-20 May 2017
Date Added to IEEE Xplore: 15 January 2018
ISBN Information:
INSPEC Accession Number: 17504411
DOI: 10.1109/RTEICT.2017.8256711
Publisher: IEEE
Conference Location: Bangalore, India

- Interconnection of number of devices through internet describes the Internet of things (IoT). Every object is connected with each other through unique identifier so that data can be transferred without human to human interaction.
- Allows establishing solutions for better management of natural resources. The smart objects embedded with sensors enables interaction with the physical and logical worlds according to the concept of IoT.
- Paper proposes system is based on IoT that uses real time input data.
- Smart farm irrigation system uses android phone for remote monitoring and controlling of drips through wireless sensor network.

International papers

1.C. Ou, Y. Chen, T. Huang and N. Huang, "Design and Implementation of Anomaly Condition Detection in Agricultural IoT Platform System," 2020 International Conference on Information Networking (ICOIN), Barcelona, Spain, 2020, pp. 184-189, doi: 10.1109/ICOIN48656.2020.9016618.
Published in: 2020 International Conference on Information Networking (ICOIN)
Date of Conference: 7-10 Jan. 2020
Date Added to IEEE Xplore: 02 March 2020
ISBN Information:
Print on Demand(PoD) ISSN: 1976-7684

INSPEC Accession Number: 19430816
DOI: 10.1109/ICOIN48656.2020.9016618
Publisher: IEEE
Conference Location: Barcelona, Spain

In recent years, with the rapid development of the Internet of Things (IoT), individuals, industry, and agriculture have begun to apply this technology to solve the difficulties encountered. IoT makes data collection more convenient, enabling us to monitor environmental information and control from a remote location. We can use the data collected from the farm to do many analysis and application to solve the problems encountered by farmers at work. However, when the sensor data is abnormal, we can't know it instantly. This situation may be an anomaly situation in the farm environment and needs to be dealt with in a timely manner. Therefore, we implement an appropriate anomaly data detection system to find out the sensor that has an anomaly phenomenon. Compared with existing implementation, we consider not only the single data but also all kind of same type data simultaneously. When we find out the anomaly situation, our IoT platform will notify the farmer the information of the time, the situation and the possible anomaly condition to help the farmers find out the problems in the farm. By detecting anomaly data, it can help reduce farm losses due to environmental or human-induced.

2. H. Liang, W. Gao, J. H. Nguyen, M. F. Orpilla and W. Yu, "Internet of Things Data Collection Using Unmanned Aerial Vehicles in Infrastructure Free Environments," in IEEE Access, vol. 8, pp. 3932-3944, 2020, doi: 10.1109/ACCESS.2019.2962323
Published in: IEEE Access (Volume: 8)
Page(s): 3932 - 3944
Date of Publication: 25 December 2019
Electronic ISSN: 2169-3536
INSPEC Accession Number: 19312463
DOI: 10.1109/ACCESS.2019.2962323
Publisher: IEEE
With the immensity of distributed Internet of Things (IoT) devices and the exponential increase in data generated from a variety of IoT-driven smart-world applications, how to effectively provide data driven service supported by IoT has become a critical issue. While the state-of-the-art technologies have been developed and network infrastructures with high capabilities have been designed to deal with the data collection problem, there are still application scenarios, in which network infrastructure is not available or appropriate in large target areas (e.g., farmlands deployed with IoT sensors in operation, providing precise agriculture; emergency responder with IoT sensors, providing public safety service). To address the issue of efficiently collecting data from IoT devices deployed in large areas without pre-deployed network infrastructure, we formalize the problem space in a three-dimensional model that considers task, resource, and methodology.

Methodology

- Components used

Soil moisture sensor

- Operating voltage: 3.3v - 5v

- Sensing probe dimensions: 60x30mm
- Panel pcb dimensions: 30 x 60mm
- On-board lm393 comparator
- On-board power indicator led

- Product Dimensions : 6 x 3 x 1 cm; 10 Grams
- Manufacturer : Kuongshun Electronic Ltd.
- ASIN : B07FM41J4F
- Item model number : RC-A-4079
- Country of Origin : China

Is used to detect the soil moisture content.

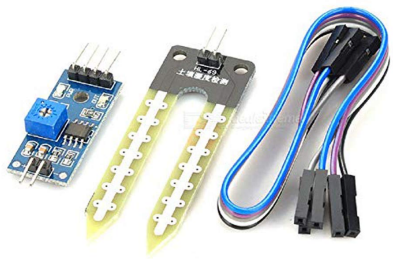
Has two outputs: analog output and digital output.

The digital o/p is permanent and the analog o/p threshold can be changed. The working principle of soil moisture sensor is based on open & short circuit concept. Here the LED gives an indication when the output is high or low.

When the condition of the soil is dried up, current will not flow through it. So it works like an open circuit. Therefore the o/p will be maximized

When the soil condition is soaked, the flow of current pass from one terminal to the other. So it works like a closed circuit. Therefore the o/p will be zero.

Here sensor is coated with platinum, and anti-rust to make higher efficiency as well as long life. The sensing range is also high which will pay for the farmer at a minimum cost



NodeMCU

- Usb-ttl included
- 10 gpio, every gpio can be pwm
- Pcb antenna
- I2c, 1-wire, plug & play
- weight: 60 gms

- Product Dimensions : 4.06 x 5.08 x 5.84 cm; 60 Grams
- Manufacturer : Kudos
- ASIN : B07262H53W
- Item model number : ESP8266
- Country of Origin : China
- Manufacturer : Kudos

NodeMCU is a low-cost open source IoT platform.[4][5] It initially included firmwarewhich runs on the ESP8266Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module.[6][7] Later, support for the ESP32 32-bit MCU was added.

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit) The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits

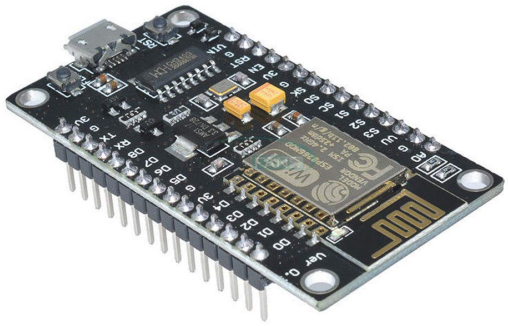
Both the firmware and prototyping board designs are open source.[8]

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson[9] and SPIFFS.[10] Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a TensilicaXtensa LX106 core, widely used in IoT applications (see related projects).

NodeMCU was created shortly after the ESP8266 came out. On December 30, 2013, Espressif Systems[6] began production of the ESP8266.[11] NodeMCU started on 13 Oct 2015, when Hong committed the first file of nodemcu-firmware to GitHub.[12] Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9.[13] Later that month, Tuan PM ported MQTT client library from Contiki to the ESP8266 SoC platform,[14] and committed to NodeMCU project, then NodeMCU was able to support the MQTT IoT protocol, using Lua to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devsaurus ported the u8glib[15] to the NodeMCU project,[16] enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

In the summer of 2015 the original creators abandoned the firmware project and a group of independent contributors took over. By the summer of 2016 the NodeMCU included more than 40 different modules



Relay module

This 4 channel 5 V relay module is a low pull, high release relay module and features energization status indicator light, release status led is off.

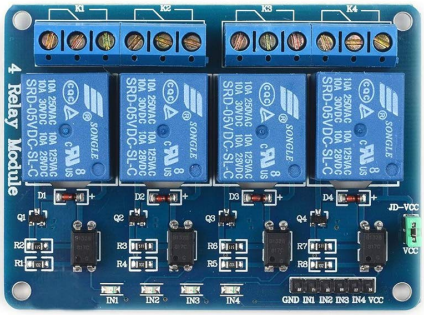
- By default, this is a 5V relay module and uses jd-vcc for the relay power and is compliant with international safety standards, control and load areas isolation trenches.
- The 4 channel relay module can be used to control various various appliances and other types of equipment with large current.

- The maximum output of the relay module is AC250V 10A and DC5V 10A.
- This 5V 4ch relay is ideal for microcontrollers compatible with arduino, AVR, PIC, ARM and so on.
- Package Dimensions : 12.8 x 9.9 x 4.8 cm; 80 Grams
- Date First Available : 25 June 2017
- Manufacturer : Robocraze
- ASIN : B073B7QGRF
- Item part number : RC-A-053

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

A simple relay consists of wire coil wrapped around a soft iron core, or solenoid, an iron yoke that delivers a low reluctance path for magnetic flux, a movable iron armature and one or more sets of contacts. The movable armature is hinged to the yoke and linked to one or more set of the moving contacts. Held in place by a spring, the armature leaves a gap in the magnetic circuit when the relay is de-energized. While in this position, one of the two sets of contacts is closed while the other set remains open.

When electrical current is passed through a coil, it generates a magnetic field that in turn activates the armature. This movement of the movable contacts makes or breaks a connection with the fixed contact. When the relay is de-energized, the sets of contacts that were closed, open and breaks the connection and vice versa if the contacts were open. When switching off the current to the coil, the armature is returned, by force, to its relaxed position. This force is usually provided by a spring, but gravity can also be used in certain applications. Most power relays are manufactured to operate in a quick manner

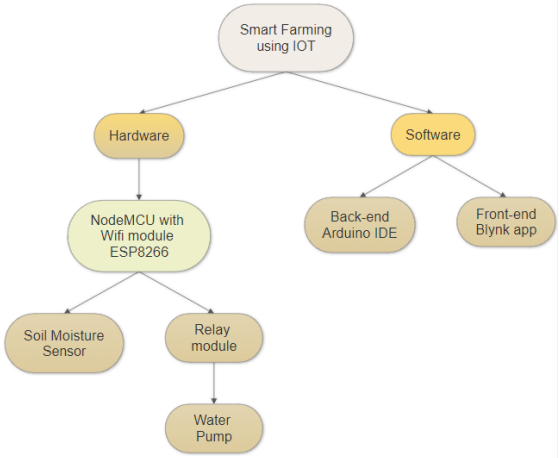


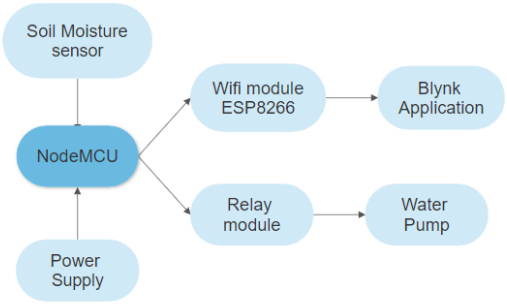
Water pump

- Sold By UG LAND INDIA (Original)
- Flow Rate : 80 ~ 120 L/H,
- Maximum Lift : 40 ~ 110 mm
- Operating Voltage : 6 ~ 9V
- Continuous Working Life : 500 hours
- Package Dimensions : 4 x 3 x 2 cm; 200 Grams
- Manufacturer : UG LAND INDIA
- ASIN : B07FDK6HQQ
- Item part number : UGLI32743

- Centrifugal pumps are used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. The rotational energy typically comes from an engine or electric motor. They are a sub-class of dynamic axisymmetric work-absorbing turbomachinery The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a diffuser or volute chamber (casing), from which it exits.
- Common uses include water, sewage, agriculture, petroleum and petrochemical pumping. Centrifugal pumps are often chosen for their high flow rate capabilities, abrasive solution compatibility, mixing potential, as well as their relatively simple engineering.
  [2] A centrifugal fan is commonly used to implement an air handling unit or vacuum cleaner. The reverse function of the centrifugal pump is a water turbine converting potential energy of water pressure into mechanical rotational energy.

- Execution/Implementation

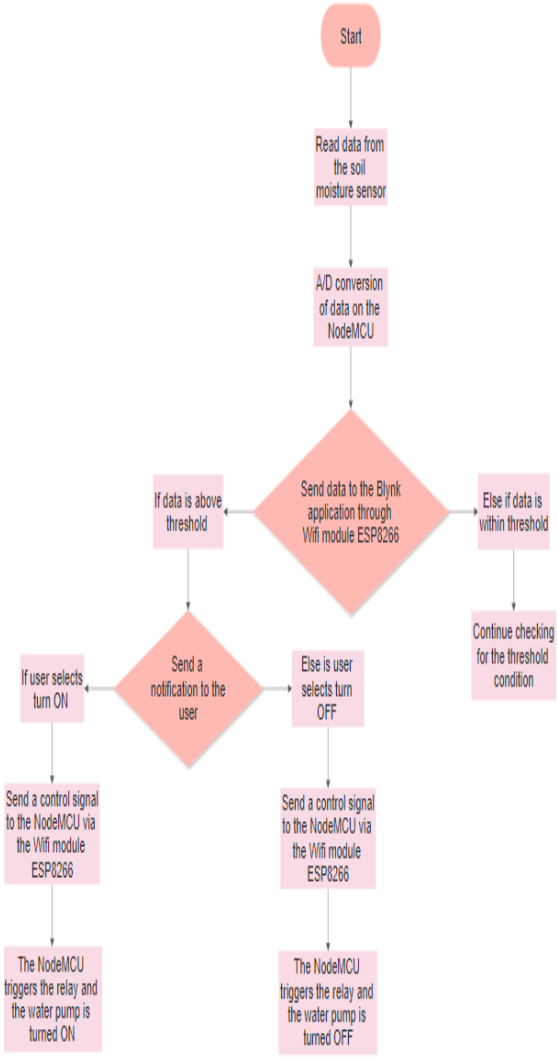


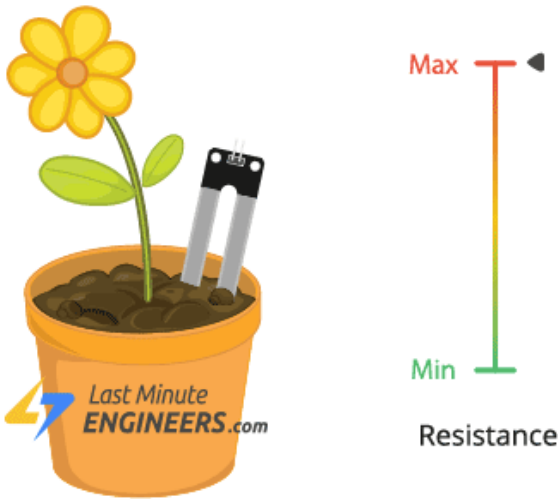


- Physics principles governing the project

Soil Moisture Sensor

The fork-shaped probe with two exposed conductors, acts as a variable resistor (just like a potentiometer) whose resistance varies according to the water content in the soil.





This resistance is inversely proportional to the soil moisture:

- The more water in the soil means better conductivity and will result in a lower resistance.
- The less water in the soil means poor conductivity and will result in a higher resistance.

The sensor produces an output voltage according to the resistance, which by measuring we can determine the moisture level.

Hardware Overview

A typical soil moisture sensor has two components.

The Probe

The sensor contains a fork-shaped probe with two exposed conductors that goes into the soil or anywhere else where the water content is to be measured.

It acts as a variable resistor whose resistance varies according to the soil moisture.

The Module

The sensor also contains an electronic module that connects the probe to the Arduino.

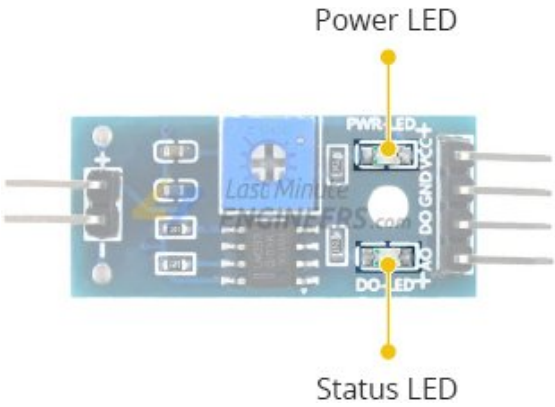
The module produces an output voltage according to the resistance of the probe and is made available at an Analog Output (AO) pin.

The same signal is fed to a LM393 High Precision Comparator to digitize it and is made available at an Digital Output (DO) pin.

The module has a built-in potentiometer for sensitivity adjustment of the digital output (DO).

A threshold can be set by using a potentiometer, so that when the moisture level exceeds the threshold value, the module will output LOW otherwise HIGH.

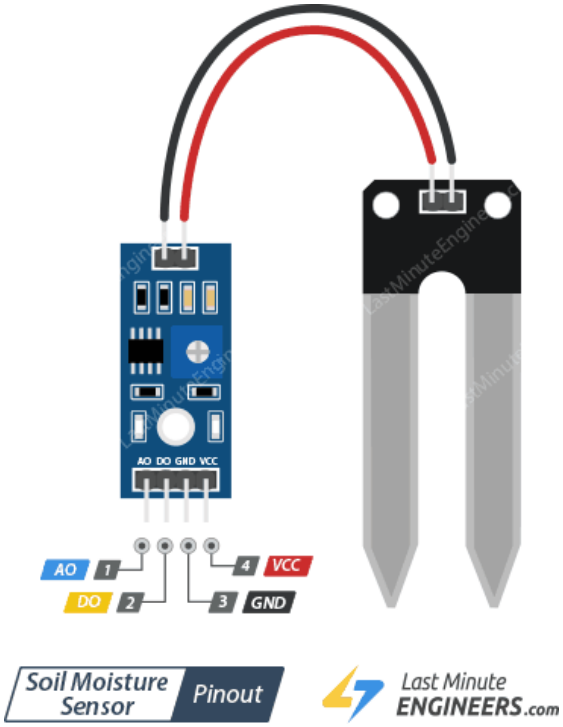
This setup is very useful to trigger an action when certain threshold is reached. For example, when the moisture level in the soil crosses a threshold, you can activate a relay to start pumping water.



Apart from this, the module has two LEDs. The Power LED will light up when the module is powered. The Status LED will light up when the digital output goes LOW.

Soil Moisture Sensor Pinout

The soil moisture sensor is easy to use and only has 4 pins to connect.



AO (Analog Output) pin gives us an analog signal between the supply value to 0V and will be connected to one of the analog inputs on your Arduino.
DO (Digital Output) pin gives Digital output of internal comparator circuit. You can connect it to any digital pin on an Arduino or directly to a 5V relay or similar device.
pin supplies power for the sensor. It is recommended to power the sensor with between 3.3V – 5V. GND is a ground connection.

Centrifugal pump

A centrifugal pump is a mechanical device designed to move a fluid by means of the transfer of rotational energy from one or more driven rotors, called impellers. Fluid enters the rapidly rotating impeller along its axis and is cast out by centrifugal force along its circumference through the impeller's vane tips. The action of the impeller increases the fluid's velocity and pressure and also directs it towards the pump outlet. The pump casing is specially designed to constrict the fluid from the pump inlet, direct it into the impeller and then slow and control the fluid before discharge.

The impeller is the key component of a centrifugal pump. It consists of a series of curved vanes. These are normally sandwiched between two discs (an enclosed impeller). For fluids with entrained solids, an open or semi-open impeller (backed by a single disc) is preferred (Figure 1).

Figure 1. Impeller Types (l to r): Open, Semi-Enclosed (or Semi-Open), Enclosed.

Fluid enters the impeller at its axis (the 'eye') and exits along the circumference between the vanes. The impeller, on the opposite side to the eye, is connected through a drive shaft to a motor and rotated at high speed (typically 500-5000rpm). The rotational motion of the impeller accelerates the fluid out through the impeller vanes into the pump casing.

There are two basic designs of pump casing: volute and diffuser. The purpose in both designs is to translate the fluid flow into a controlled discharge at pressure.

In a volute casing, the impeller is offset, effectively creating a curved funnel with an increasing cross-sectional area towards the pump outlet. This design causes the fluid pressure to increase towards the outlet (Figure 2).

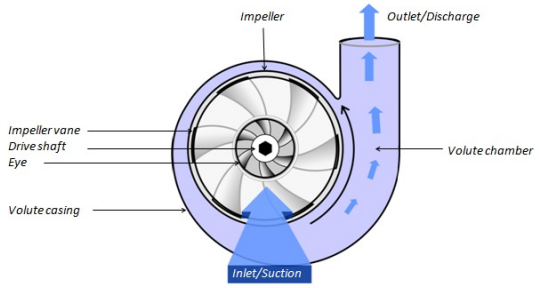


Figure 2. Volute case design

The same basic principle applies to diffuser designs. In this case, the fluid pressure increases as fluid is expelled between a set of stationary vanes surrounding the impeller (Figure 3). Diffuser designs can be tailored for specific applications and can therefore be more efficient. Volute cases are better suited to applications involving entrained solids or high viscosity fluids when it is advantageous to avoid the added constrictions of diffuser vanes. The asymmetry of the volute design can result in greater wear on the impeller and drive shaft.

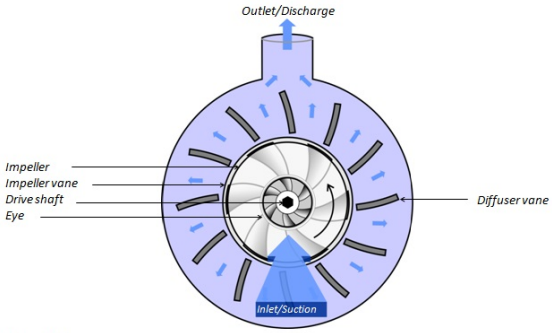


Figure 3. Diffuser case design

What are the main features of a centrifugal pump?

There are two main families of pumps: centrifugal and positive displacement pumps. In comparison to the latter, centrifugal pumps are usually specified for higher flows and for pumping lower viscosity liquids, down to 0.1 cP. In some chemical plants, 90% of the pumps in use will be centrifugal pumps. However, there are a number of applications for which positive displacement pumps are preferred.

Limitation: The efficient operation of a centrifugal pump relies on the constant, high speed rotation of its impeller. With high viscosity feeds, centrifugal pumps become increasingly inefficient: there is greater resistance and a higher pressure is needed to maintain a specific flow rate. In general, centrifugal pumps are therefore suited to low pressure, high capacity, pumping applications of liquids with viscosities between 0.1 and 200 cP.

Slurries such as mud, or high viscosity oils can cause excessive wear and overheating leading to damage and premature failures. Positive displacement pumps often operate at considerably lower speeds and are less prone to these problems.

Any pumped medium that is sensitive to shearing (the separation of emulsions, slurries or biological liquids) can also be damaged by the high speed of a centrifugal pump's impeller. In such cases, the lower speed of a positive displacement pump is preferred.

A further limitation is that, unlike a positive displacement pump, a centrifugal pump cannot provide suction when dry: it must initially be primed with the pumped fluid. Centrifugal pumps are therefore not suited to any application where the supply is intermittent. Additionally, if the feed pressure is variable, a centrifugal pump produces a variable flow; a positive displacement pump is insensitive to changing pressures and will provide a constant output. So, in applications where

accurate dosing is required, a positive displacement pump is preferred.

A centrifugal pump operates through the transfer of rotational energy from one or more driven rotors, called impellers. The action of the impeller increases the fluid's velocity and pressure and directs it towards the pump outlet. With its simple design, the centrifugal pump is well understood and easy to operate and maintain.

Centrifugal pump designs offer simple and low cost solutions to most low pressure, high capacity pumping applications involving low viscosity fluids such as water, solvents, chemicals and light oils. Typical applications involve water supply and circulation, irrigation, and the transfer of chemicals in petrochemical plants. Positive displacement pumps are preferred for applications involving highly viscous fluids such as thick oils and slurries, especially at high pressures, for complex feeds such as emulsions, foodstuffs or biological fluids, and when accurate dosing is required.

- Basic Electrical Concepts

The project makes use of a simple electrical circuit based on the NodeMCU microcontroller.

1) The soil moisture sensor has 4 pins – Vcc, ground, A0 and D0 pins. It is connected to the NodeMCU using female connector wires.
    - The A0 pin of the soil moisture sensor is connected to the A0 pin of the NodeMCU
    - The Vcc pin of the soil moisture sensor is connected to the 3V pin of the NodeMCU
    - The ground pin of the soil moisture sensor is connected to the ground pin of the NodeMCU
2) The relay module is connected to the NodeMCU via female connector wires and to the battery and pump via male connector wires.
    - The VCC pin of the relay module is connected to the 3V pin of the NodeMCU
    - The input Control pin of the relay module is connected to the D0 output pin of the NodeMCU
    - The ground pin of the relay module is connected to the ground pin of the NodeMCU
    - The COM (common) terminal of the relay module is connected to the positive terminal of the pump
    - The NO (normally open) terminal of the relay module is connected to the positive terminal of the battery (It means the positive terminal of the pump is connected to the positive terminal of the battery through relay)
3) The pump and battery are connected using long thin connecting wires

- The negative of the battery is directly connected to the negative of the pump

Working Principle of the circuit and the components

The sensor contains a fork-shaped probe with two exposed conductors that goes into the soil in which the water content needs to be measured. They act as a variable resistor whose resistance varies according to the water content in the soil. This resistance is inversely proportional to the soil moisture:

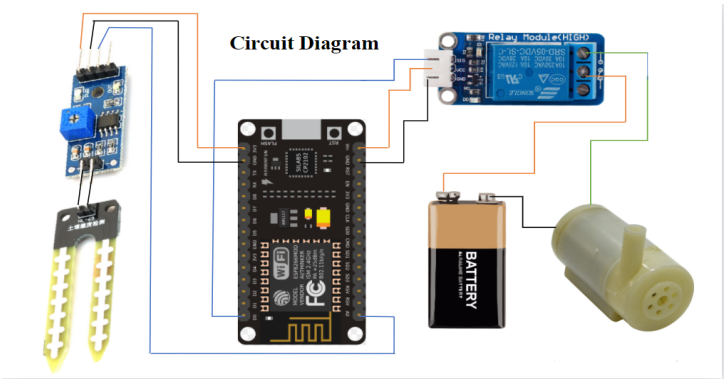
- The more water in the soil means better conductivity and will result in a lower resistance.
- The less water in the soil means poor conductivity and will result in a higher resistance.

The sensor produces a varying output voltage according to the resistance of the soil. By measuring this voltage, the moisture level of the soil can be determined. The information about the soil moisture content is given to the A0 pin of the NodeMCU which uses a Buil-In ADC (analogue to digital converter) to convert the analogue input from the soil moisture sensor to a digital signal, which is then sent to the Blynk app on the smart phone using the wifi module ESP8266.

The user, on knowing the moisture content of the soil, can then decide whether to switch on or switch off a water pump. On pressing the ON button on the smart phone, the required input is passed on to the NodeMCU via the wifi module ESP8266, which produces a low signal(Logic 0) to the control pin of the relay via the D0 pin, thereby activating the relay and connecting the power supply to the pump. On pressing the OFF button on the smart phone, a high (1) input is applied to the relay module via the D0 pin of the Node MCU, thereby cutting OFF the power to the pump.

The relay works on the principle of electromagnetic attraction. The relay consists of a coil whose one end is connected to the supply of the relay. The other end of the coil receives a high (1) or low (0) input through the D0 pin of the NodeMCU. When a low input is given current flows through the coil and produces a magnetic field which attracts the upper arm of the magnet which acts like a switch.

The switch when activated connects the NO pin to the COM terminal of the relay. Since the Positive terminal of the battery is connected to the NO pin of the relay and the positive terminal of the pump is connected to the COM terminal of the relay, the circuit gets completed and the water pump receives the power supply and switches ON. If a high input is given to the relay through D0 pin, no current flows through the coil and hence Com terminal remains connected to NC pin of the relay. In this case circuit remains open and the water pump remains in OFF condition.



Civil Applications Of The Idea

One of the important roles of Civil Engineering is the supply of water to agricultural fields. Water resources and irrigation engineering is a crucial field in civil engineering. This field of engineering is concerned with the management of quantity and quality of water in underground and above ground water resources. Water resource engineering involves the proper conservation and use of water and its associated land resources to obtain optimum development with the most economical expenditure of the funds and resources.

Irrigation is the process through which controlled amount of water can be supplied through artificial means such as pipes, ditches, sprinklers etc. the main objective of irrigation systems is to help agricultural crop growth, landscape maintenance, reduce the effect of inadequate rainfall etc. Therefore, the importance of irrigation systems is very high.

Agriculture is often greatly hampered due to irregular, insufficient or uncertain rain. Proper irrigation systems can secure uninterrupted agriculture. The productivity of irrigated land is more than the un-irrigated land. Crop yields everywhere in the developing world are consistently higher in irrigated areas than in rainfed areas. Irrigation contributes to the economic growth and poverty reduction. As income and employment are closely related to output and irrigation increases production, substantial increase in income is achieved in the countryside.

Since Agriculture is a very important field that demands the adaptation of newer technologies, we can combine principles of Water Resource Engineering with IoT to make the job easier. Through this project we aim to automate the process of irrigation in agricultural fields using concepts of IoT. The farmers can simply use their mobile phones to know the moisture content in soil and use their smart phones to control the water pump used for irrigating the field. This not only helps conserve water but also results in better crop yield as the crops are not flooded with water when the soil already has enough moisture. The same principles can be extended to make the detection of soil nutrients more effective and hence prescribe the required amount of fertilizer to be deployed accordingly.

Since this automation controls only the supply of water and fertilizers, different methods of irrigation required for different types of crops can be applied in order to effectively deliver the water resources. This goes in accordance with newer Irrigation Technologies.

Hence, the automation process also helps to decrease the manual load of farmers

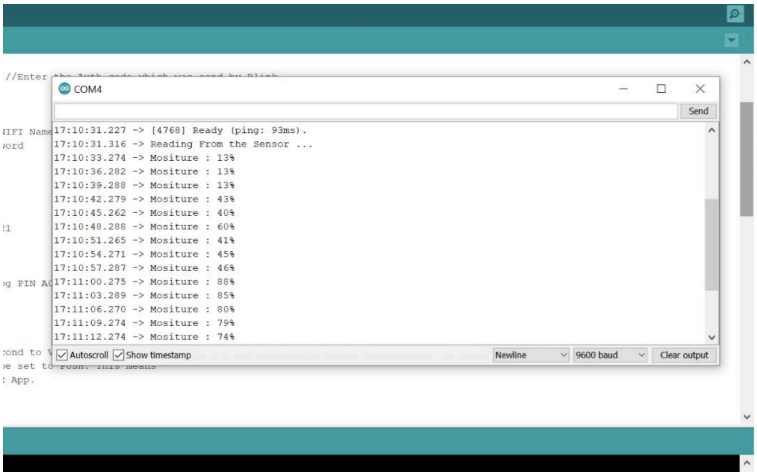
Inferences and Conclusions

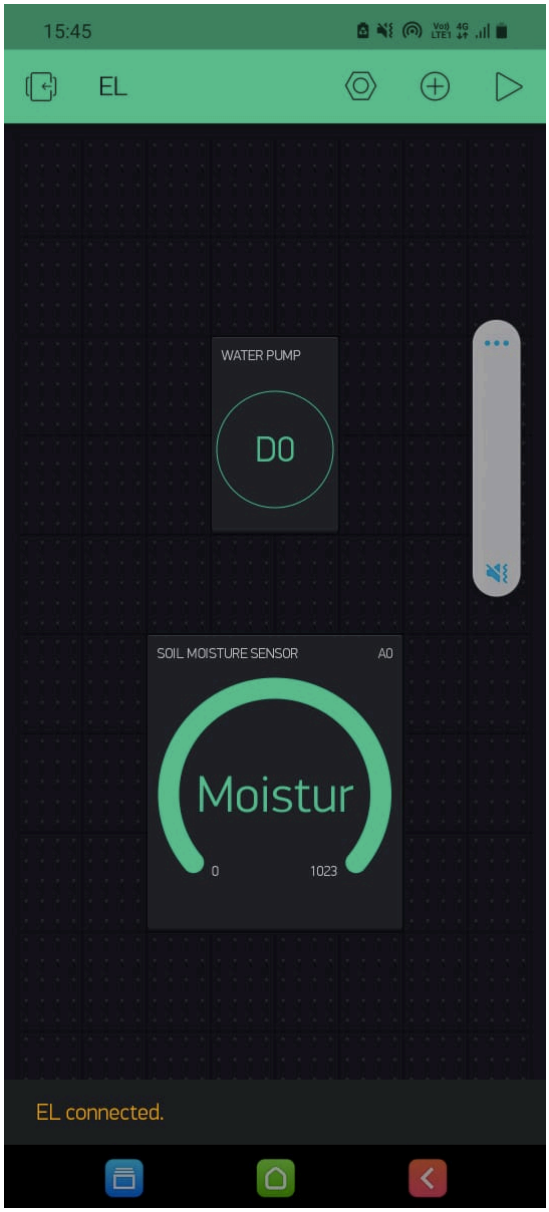
Experiment: Experimentation with NodeMCU and sensors for applications in soil monitoring for enabling controlled watering of crops for smart irrigation

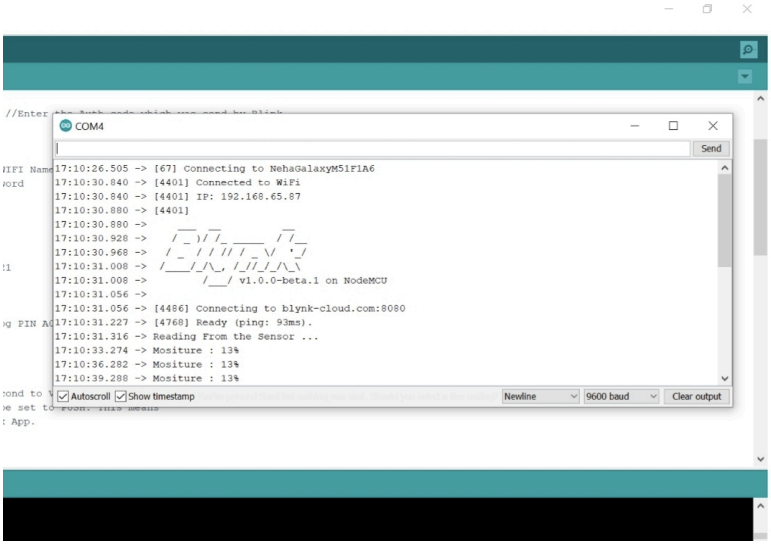
In specific, this involves experimentation with Generic ESP8266 NodeMCU, 5V moisture sensors and 5V relay module with actuation using 9V pump

Testing:

Condition of soil	Blynk application interface	Instruction	Action of pump
Dry	Meter reads low value- 13%	On	Sprays water
Wet	Meter reads high value- 74%	Off	Does not spray water







Future scope of the Project

- Fertilizers and pesticides can also be mixed in water.
- GPS can be used to determine the location of the farmers and then by using the climate data of that region, we can suggest other crops which can be grown on that soil.
- This can also be used in households. People are busy these days and don't have time to water plants. Thus by

automating this process it can save a lot of plants and saves people's time.
- It can be used to water plants in small gardens.
- Alexa/Google Home/Siri can be used to control the pump.

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