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Application of Internet of Things for Smart Gardening System

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Abstract: ***In this paper we have presented an IOT based Smart Gardening system to control the moisture of soil. This technique actually measure the moisture of soil and if the moister level is below the user defined threshold value then the motor starts automatically and power on the water pump. If it reaches or crosses the threshold value it stops the motor. This is done with wireless moisture sensors that communicate with the smart gardening controls and also give the information about the water requirement for gardening. It uses ARDUINO-Mini as the microcontroller which is the core part of the system. The main components of the systems are Node MCU, L293D Motor Driver, 9V battery, Jumper Wires, Soil Moisturizer Sensor, DC Motor and software components. With smart gardening systems we can be better stewards of our resources.***
Keywords: Smart gardening system, microcontroller, MCU

I. INTRODUCTION

IOT systems allow users to achieve deeper automation, analysis, and integration within a system. They improve the reach of these areas and their accuracy. IOT utilizes existing and emerging technology for sensing, networking, and robotics. IOT exploits recent advances in software, falling hardware prices, and modern attitudes towards technology. Its new and advanced elements bring major changes in the delivery of products, goods, and services; and the social, economic, and political impact of those changes.

The advantages of IOT span across every area of lifestyle and business. List of some of the advantages that IOT can offer:

1) Improved Customer Engagement – Current analytics suffer from blind-spots and significant flaws in accuracy; and as noted, engagement remains passive. IOT completely transforms this to achieve richer and more effective engagement with audiences.
2) Technology Optimization – The same technologies and data which improve the customer experience also improve device use, and aid in more potent improvements to technology. IOT unlocks a world of critical functional and field data.
3) Enhanced Data Collection – Modern data collection suffers from its limitations and its design for passive use. IOT breaks it out of those spaces, and places it exactly where humans really want to go to analyze our world. It allows an accurate picture of everything.

IOT has applications across all industries and markets. It spans user groups from those who want to reduce energy use in their home to large organizations who want to streamline their operations. It proves not just useful, but nearly critical in many industries as technology advances and we move towards the advanced automation imagined in the distant future. Engineering, Industry, and Infrastructure Applications of IOT in these areas include improving production, marketing, service delivery, and safety. IOT provides a strong means of monitoring various processes; and real transparency creates greater visibility for improvement opportunities. The deep level of control afforded by IOT allows rapid and more action on those opportunities, which include events like obvious customer needs, nonconforming product, malfunctions in equipment, problems in the distribution network, and more. In this paper we have presented a IOT based smart gardening system. The main objective of this work is to measure the moisture level of soil.

II. COMPONENT USED

Required components to implement the circuit are
Node MCU, L293D Motor Driver, DC Motor,Soil Moisturizer Sensor, Plastic pipe, 9V Battery Jumper Wires, Arduino IDE, Blynk App. The descriptions of these components are given below:

A. Node MCU

NodeMCU is an open source IOT platform. It includes firmware which runs on the ESP8266 Wi-FiSoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language.

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Node MCU was created shortly after the ESP8266 came out. On December 30, 2013, Espress if Systems began production of the ESP8266. The ESP8266 is a Wi-Fi SoC integrated with a TensilicaXtensa LX106 core, widely used in IOT applications (see related projects).

NodeMCU is an open source LUA based firmware developed for ESP8266 wifi chip. By exploring functionality with ESP8266 chip, NodeMCUfirmware comes with ESP8266 Development board/kit i.e. NodeMCU Development board.

NodeMCU Dev Kit/board consists of ESP8266 wifi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. For more information about ESP8266, you can refer ESP8266 WiFi Module. There is Version2 (V2) available for NodeMCU Dev Kit i.e. NodeMCU Development Board v1.0 (Version2)**,** which usually comes in black colored PCB.

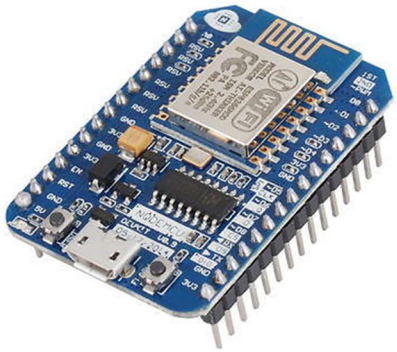

Figure1.NodeMCU Development Board/kit v0.9 (Version1)

B. L293d Motor Driver

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit* (*IC*).The l293d can drive small and quiet big motors as well, check the Voltage Specification at the end of this page for more info. You can Buy L293D IC in any electronic shop very easily and it costs around 70 Rupees (INR) or around 1 $ Dollar (approx Cost) or even lesser cost. You can find the necessary pin diagram, working, a circuit diagram, Logic description and Project as you read through. It works on the concept of H-bridge.

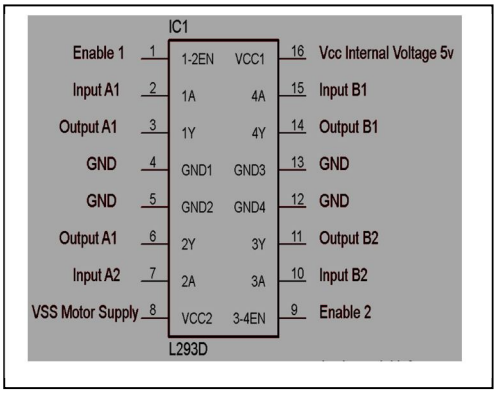

Figure 2. L293D is a typical Motor driver

H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltageneed to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, hence H-bridge IC areideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller. There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high. And for right H-Bridge you need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch.

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C. Soil Moisture Sensor

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant.The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners. Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential; these sensors are usually referred to as soil water potential sensors.

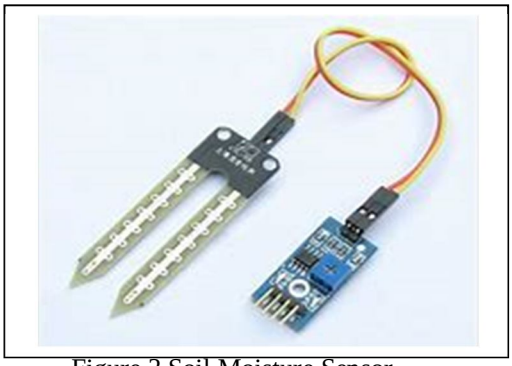


Figure 3.Soil Moisture Sensor

D. Jumper Wire

A jumper wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

There are different types of jumper wires. Some have the same type of electrical connector at both ends, while others have different connectors. Some common connectors are:

Solid tips – are used to connect on/with a breadboard or female header connector. The arrangement of the elements and ease of insertion on a breadboard allows increasing the mounting density of both components and jump wires without fear of short-circuits. The jump wires vary in size and colour to distinguish the different working signals.

Crocodile clips – are used, among other applications, to temporarily bridge sensors, buttons and other elements of prototypes with components or equipment that have arbitrary connectors, wires, screw terminals, etc.

Banana connectors – are commonly used on test equipment for DC and low-frequency AC signals.

Registered jack (RJnn) – are commonly used in telephone (RJ11) and computer networking (RJ45).

RCA connectors – are often used for audio, low-resolution composite video signals, or other low-frequency applications requiring a shielded cable.

RF connectors – are used to carry radio frequency signals between circuits, test equipment, and antennas.

E. DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. DC motors were

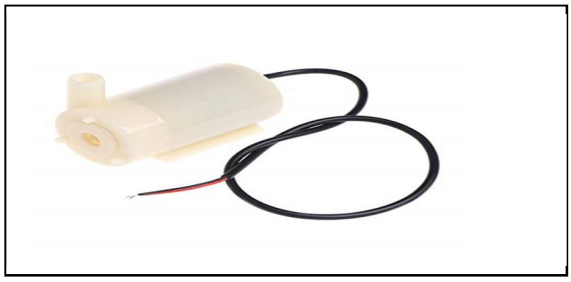


Figure 4.DC Motor

The first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills.

F. 9V Battery

9-volt battery is a common size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in walkie-talkies, clocks and smoke detectors.

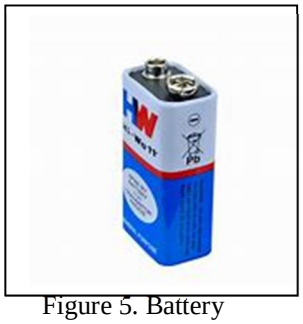


Figure 5. Battery

G. Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, mac, OS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.The Arduino is a fantastic single-board microcontroller solution for many DIY projects, and, in this blog, we will look at the Integrated Development Environment, or IDE, that is used to program it. Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment. Different Arduino modules available including Arduino Uno,Arduino Mega, Arduino Leonardo and many more.Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.

The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.This environment supports both C and C++ languages.The IDE environment is mainly distributed into three sections

1. Menu Bar
2. Text Editor
3. Output Pane

As you download and open the IDE software, it will appear like an image below:

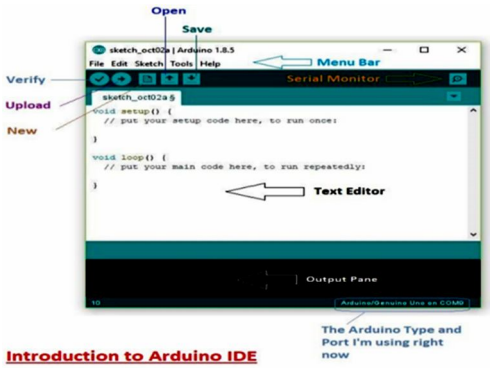


Figure 6. ARDUINO IDE platform

H. BLYNK APP

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other cool things.

There are three major components in the platform:

- Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.
- Blynk Server - responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming command.

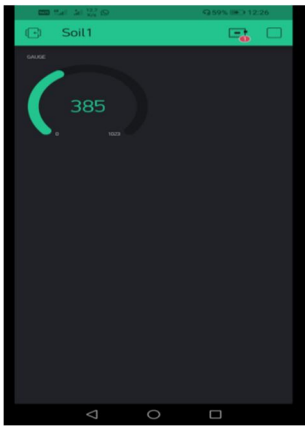


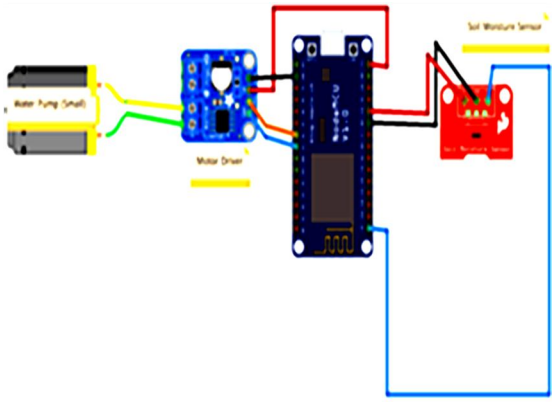
Figure 7. Image of BLYNK APP

Blynk works over the Internet. This means that the hardware we choose should be able to connect to the internet. Some of the boards, like Arduino Uno will need an Ethernet or Wi-Fi Shield to communicate, others are already Internet-enabled: like the ESP8266, Raspberri Pi with WiFi dongle, Particle Photon or SparkFunBlynk Board. But even if we don't have a shield, we can connect it over USB to our laptop or desktop.

In this project we use BlynkApp to check the soil moisture level. When we put the soil moisturizer sensor in the soil,if the soil is deficient of moisture and could not meet the threshold value given by the user in the code then the level of moisturizer will increase and the motor will automatically ON. When the soil is enough moisturized and meet the threshold value, so the level of moisturizer will decrease will be shown in blynk append the motor will automatically stop.

III. CIRCUIT DIAGRAM and WORKING PRINCIPLE:

The complete circuit diagram of this work shown in Figure.8 and implemented figure shown in Figure 9. If the moisture level in soil is less than the desired level then the motor starts automatically and fetches water through the pipe and when the moisture reached at desired level the motor stops. The moisture is measured by a threshold value(desired level) which is provided by user itself.



igure8. Circuit of Smart Gardening System

Figure 9. Implementation of smart gardening system

Smart gardening systems offer a variety of advantages over traditional gardening systems. Smart gardening systems can optimize water levels based on things such as soil moisture and weather predictions. This is done with wireless moisture sensors that communicate with the smart gardening controls and help inform the system whether or not the landscape is in need of water.
The advantages of these smart gardening systems are wide reaching. The smart gardening system will help you have better control of your landscape and gardening needs as well as peace of mind that the smart system can make decisions independently if you are away. You will save a significant amount of money on your water bills because through intelligent control and automation, your smart gardening system will optimize resources so that everything gets what it needs without needless waste. Additionally, we have all seen many places in the country that have experienced droughts and we know that our water resources are precious. With smart gardening systems we can be better stewards of our resources which is better for the environment. The opportunity to save dramatically, have better control and be eco-friendlier while maintaining a lush and beautiful landscape are just a few of the advantages a smart gardening system provides and would make a wonderful addition to any home.

IV. CONCLUSION AND FUTURE SCOPE

This IOT based gardening system save our time and cost. Improvements in agriculture for rural and urban areas arerisingin recent decades with the help of digital technology. Presently available sensors are used to get possible outcome. The Blynk app is developed which is free anytime and anywhere when system has connection with internet. This system will optimize the resources in plant area. The installation cost is tolerable as compared to large instruments. Totally this proposed system solves major issues of the agriculture field. In future work, improvement in various agricultural applications will be done and

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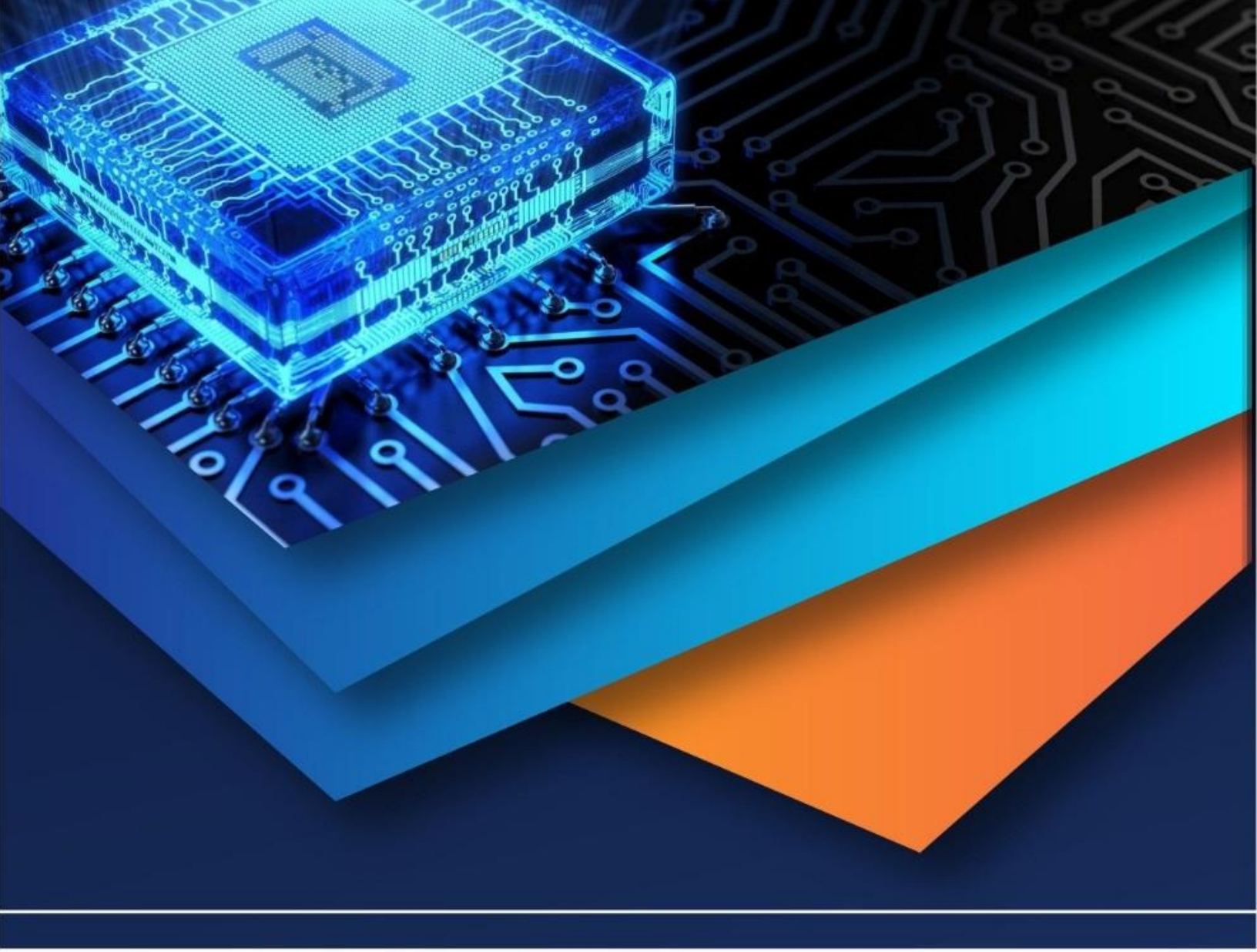

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