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Paper Authors
N. Sai Sushmitha, Sk. Anjuman ,G. Reshma ,G. Meghana Reddy ,K. Vijaya Vani
A. Swetha Kathyayani ,Mr. P. RAVI KUMAR,Mr. Rajesh Pasupuleti

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REAL-TIME AUTOMATION AND MONITORING SYSTEM FOR MODERNIZED AGRICULTURE USING NODE MCU

First Author:

N. Sai Sushmitha B.Tech (Ece) From Sree Venkateswara College Of Engineering, Nellore.
Sk. Anjuman B.Tech (Ece) From Sree Venkateswara College Of Engineering, Nellore.
G. Reshma B.Tech (Ece) From Sree Venkateswara College Of Engineering, Nellore.
G. Meghana Reddy B.Tech (Ece) From Sree Venkateswara College Of Engineering, Nellore.
K. Vijaya Vani B.Tech (Ece) From Sree Venkateswara College Of Engineering, Nellore.
A. Swetha Kathyayani B.Tech (Ece) From Sree Venkateswara College Of Engineering, Nellore.

Second Author:

Mr. P. RAVI KUMAR, M. Tech, Associate Professor, Department Of ECE, Sree Venkateswara College of Engineering, Nellore

Third Author:

Mr. Rajesh Pasupuleti (Ph.D), HOD & Associate Professor, Department Of ECE, Sree Venkateswara College Of Engineering, Nellore

ABSTRACT

Presently conventional pump switches located in different parts of the agricultural lands makes it difficult for the user to go near them to operate and physically present on those areas. Even more it becomes more difficult for the elderly or physically handicapped People to do. So remote control irrigation automation system provides a modern situation with smart phones for those persons who want to agriculture without physically present on that place. In order to achieve this an IOT (INTERNET OF THINGS) module is interfaced to NODEMCU board. The loads are operated by IOT board through relay module along with this we use a soil sensor which detects whether soil is dry or wet. When soil condition is dry soil sensor gives command to IOT module to start the pump. When soil becomes wet it gives command to stop the water pump.

1. INTRODUCTION

India being the largest freshwater user in the world, and the country's total water use being greater than any other continent, the agricultural sector is the biggest user of water, followed by the domestic sector and the industrial sector. This project presents smart irrigation system for an agricultural farm with the use of devices like Arduino, Node MCU is used for automation purpose. Focus area will be parameters such as temperature and soil moisture. The system may prove to be a substitute to traditional farming method and adapting to an optimized irrigation is necessary nowadays due to the lack of world water resource. The system has a distributed wireless network of temperature and soil moisture sensor.

The objectives of this project were to control the water supply to each plant automatically depending on values of temperature and soil moisture sensors. The commands from the user are processed at Arduino using Node MCU. Internet or Wi-Fi module is interfaced with the system to provide data inspection. Agriculture is the spine of world's economy as well as the economy of a developing country like India. In existing system, a farmer has to work physically to control the irrigation system and

traditional instrumentation based on discrete and wired solutions presents difficulties in large geographical areas such as our country.

So It can be concluded that, a matter of serious concern and to overcome this major problem, there have been a lot of works to automate the agricultural sector or to make irrigation smart, like uses of wireless networks, uses of WI-FI module and using Arduino to process the conventional irrigation into an Automated smart one. India is the largest freshwater user in the world, and the country's total water use is greater than any other continent. The agricultural sector is the biggest user of water, followed by the domestic sector and the industrial sector. This project present smart irrigation system for an agriculture farm with the use of devices like Arduino. WI-FI Module is used for automation purpose. Focus area will be parameters such as temperature and soil moisture.

The system may prove to be a substitute to traditional farming method. And adopting an optimized irrigation is a necessity nowadays due to the lack of world water resource. The system has a distributed wireless network of temperature and soil moisture sensor. The objectives of this paper were to control the water supply to each plant automatically depending on values of temperature and soil moisture sensors. The commands from the user are processed at Arduino using WI-FI Module. So an open source microcontroller, Arduino Uno is used. Resistive soil moisture sensor is connected to raspberry pi board through a node along with temperature and humidity sensor. The Arduino board is connected to a power supply that directs the water pump to work along with the change in temperature, humidity, moisture and such environmental parameters. The use of resistive soil moisture sensor (FC-28), temperature and Humidity sensor (DHT11) provide us with a smart automated irrigation system.

2. LITERATURE SURVEY

In the existing system of agriculture, the crops are being monitored with the help of Arduino boards and GSM technology where in Arduino boards acts as a microcontroller but not as a server. Hence in order to overcome all these features Arduino Nano boards or renesas microcontrollers are being included with the Node MCU which a latest version is and also acts both as a microcontroller as well as server. Main feature of this methodology is its cheap cost for installation and multiple advantages. Here one can access as well as control the agriculture system in laptop, cell phone or a computer.

EMBEDDED SYSTEM

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. An embedded system is a microcontroller-based, software driven, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost-conscious market.

An embedded system is not a computer system that is used primarily for processing, not a software system on PC or UNIX, not a traditional business or scientific application. High-end embedded & lower end embedded systems.

•HIGH-END EMBEDDED SYSTEM - Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc.

•LOWER-END EMBEDDED SYSTEMS - Generally 8,16 Bit Controllers used with a minimal operating systems and hardware layout designed for the specific purpose.

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Example: Washing machine, Microwave ovens.

INTERNET OF THINGS(IoT)

The digital space has witnessed major transformations in the last couple of years and as per industry experts would continue to evolve itself. The latest entrant to the digital space is the Internet of Things (IoT), IoT can also be defined as interplay for software, telecom and electronic hardware industry and promises to offer tremendous opportunities for many industries

The various initiatives proposed to be taken under the Smart City concept and the Digital India Program to setup Digital Infrastructure in the country would help boost the IoT industry, IoT will be critical in making these cities smarter. Some of the key aspects of a smart city will be

•Smart parking
•Intelligent transport system.
•Tele-care.
•Woman Safety Smart grids.
•Waste management.
•Smart city maintenance.
•Digital-signage
•Water Management

Among other things, IoT can help automate solutions to problems faced by various industries like agriculture, health services, energy, security, disaster management etc. through remotely connected devices. IoT offers avenues for telecom operators & system integrators to significantly boost their revenues and this has resulted in their taking lead in adoption of IoT applications and services being offered by the technology. Apart from direct IoT applications, the IT industry also has an opportunity to provide services, analytics and applications related to IoT.

3. PROPOSED SYSTEM

The smart agriculture model main aim to avoid water wastage in the irrigation process. It is low cost and efficient system is shown below. It includes Node MCU, Arduino Nano, sensors like soil moisture and Dht11, Solenoid valves, relays.

Monitoring of the land is done by using Blynk app. The Blynk app is directly connect to the node MCU of the system.

The App provides the information about the humidity, temperature, Soil moisture and status of the fire.

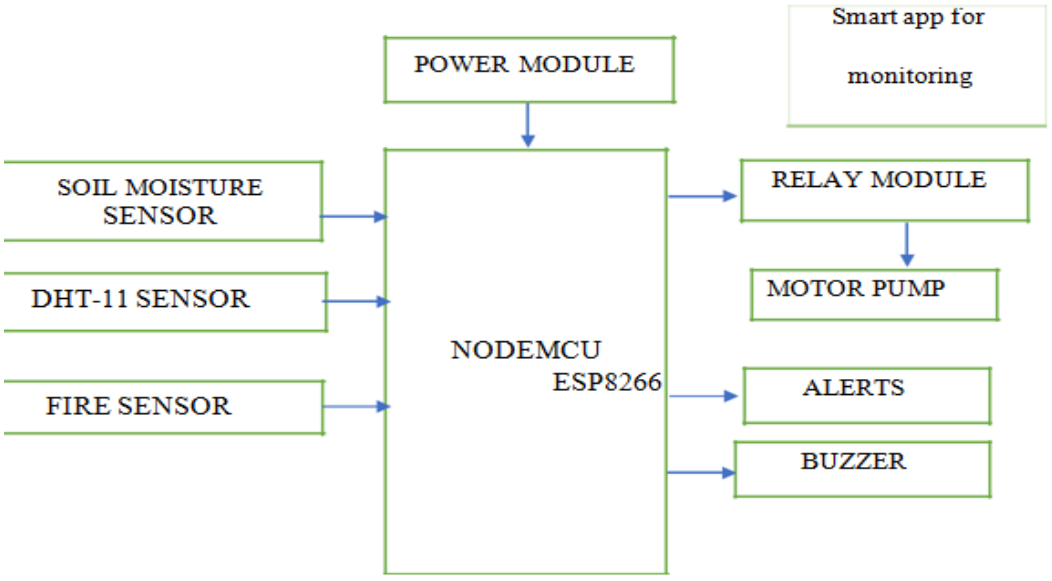

Fig 1: Block diagram of Proposed System

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HARDWARE REQURIEMENTS:

•Node MCU
•SOIL MOISTURE SENSOR
•FIRE SENSOR
•DHT-11 sensor
•Relay Module
•Motor Pump
•BUZZER
•Power Module

SOFTWARE REQURIMENTS:

•Arduino IDE
•Blynk Cloud
•Customized APP

Hardware's description and functionalities:

NODE MCU

The Node MCU is an open-source firmware and development kit that helps you to Prototype your IOT product within a few Lua script lines. It includes firmware which runs on the ESP8266 Wi-Fi SOC from Espress if Systems, and hardware which is based on the ESP-12 module.

FEATURES

- Open-source
- Interactive
- Programmable
- Low cost
- Simple
- Smart
- WI-FI enabled

ARDUINO-LIKE HARDWARE IO

Advanced API for hardware IO, which can dramatically reduce the redundant work for configuring and manipulating hardware. Code like Arduino, but interactively in Lua script.

Fig 2: NODE MCU

ESP-12E WI-FI MODULE (ESP8266):

ESP-12E Wi-Fi module is developed by Ai-thinker Team. core processor ESP8266 in smaller sizes of the module encapsulates Ten silica L106 integrates industry-leading ultra-low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller. ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers.

ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. ESP8266EX is among the most integrated Wi-Fi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest

cost, and minimal space requirement.

The ESP8266 has seen a wide adoption as a cost-effective solution for IOT and Wi-Fi-capable devices. The ESP8266 was developed by Shangai-based Espressif systems, as a Serial (UART) to Wi-Fi SoC (System on a Chip) based around a Ten silica X tensa LX3DPU. This tiny IC includes an RF front end, RAM, and (usually) an onboard TCP/IP stack that allows it ready to connect to a nearby Access Point, to act as an Access Point itself, or both.

FIRE SENSOR

A sensor which is most sensitive to a normal light is known as a flame sensor. That's why this sensor module is used in flame alarms. This sensor detects flame otherwise wavelength within the range of 760 nm – 1100 nm from the light source. This sensor can be easily damaged to high temperature. So this sensor can be placed at a certain distance from the flame. The flame detection can be done from a 100cm distance and the detection angle will be 600. The output of this sensor is an Analog signal or digital signal. These sensors are used in firefighting robots like as a flame alarm

WORKING PRINCIPLE

This sensor/detector can be built with an electronic circuit using a receiver like electromagnetic radiation. This sensor uses the infrared flame flash method, which allows the sensor to work through a coating of oil, dust, water vapor, otherwise ice.

SOIL MOISTURE SENSOR

This sensor can be used to test the moisture of soil, when the soil is having water shortage, the module output is at high level, else the output is at low level. By using this sensor one can automatically water the flower plant, or any other plants requiring automatic watering technique. Module triple output mode, digital output is simple, analog output more accurate, serial output with exact readings.

Soil Moisture Sensor is a simple breakout for measuring the moisture in soil and similar materials. The soil moisture sensor is pretty straight forward to use. The two large exposed pads function as probes for the sensor, together acting as a variable resistor. The more water that is in the soil means the better the conductivity between the pads will be and will result in a lower resistance, and a higher SIG out. Soil Moisture Sensor functioning all you will need is to connect the VCC and GND pins to your Arduino-based device (or compatible development board) and you will receive a SIG out which will depend on the amount of water in the soil. One commonly known issue with soil moisture sensors is their short lifespan when exposed to a moist environment. To combat this, we've had the PCB coated in Gold Finishing (ENIG or Electro Less Nickel Immersion Gold). We recommend either a simple 3-pin screw pin terminal or a 3-pin jumper wire assembly (both can be found in the Recommended Products section below) to be soldered onto the sensor for easy wiring.

TEMPERATURE AND HUMIDITY MODULE - DHT11

DHT11 digital temperature and humidity sensor is a calibrated digital signal output of the temperature and humidity combined sensor. It uses a dedicated digital modules capture technology and the temperature and humidity sensor technology to ensure that products with high reliability and excellent long-term stability. Sensor includes a resistive element and a sense of wet NTC temperature measurement devices and with a high-performance 8-bit microcontroller connected.

DHT11 output calibrated digital signal. It utilizes exclusive digital-signal-collecting-technique and humidity sensing technology, assuring its reliability and stability. Its sensing

elements are connected with 8-bit single-chip computer. Every sensor of this model is temperature compensated and calibrated in accurate calibration chamber and the calibration-coefficient is saved in OTP memory. Small size & low consumption & long transmission distance (20m) enable DHT11 to be suited in all kinds of harsh application occasions. Single-row packaged with four pins, making the connection very convenient.

RELAY MODULE

A relay is an electrically operated switch Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

WATER PUMP

It is used in this project to pump the water needed for irrigation from the main water tank through pipes. This pump can be used for different applications, in household include cleaning, bathing, space heating and flower of water. This pump is selected for this project because it has good advantages. Such as, it has a lightweight. Also, it has a small size, so it is easy to install and replace it. Furthermore, it has an enough efficiency to pump water for irrigation. Since it operates in 6 volts, so it consumes lower power.

BUZZER

The electric buzzer was invented in 1831 by Joseph Henry. They were mainly used in early doorbells until they were phased out in the early 1930s in favor of musical chimes, which had a softer tone. Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

4. RESULT

In this project we can control the motor in the field based on humidity, temperature and moisture level. The Moisture level of soil is measure or sensed by the sensors. These values are converted into digital form and applied to Arduino Nano. If the moisture levels of soil are dropped to a certain level the motor is turned on automatically without human interaction.

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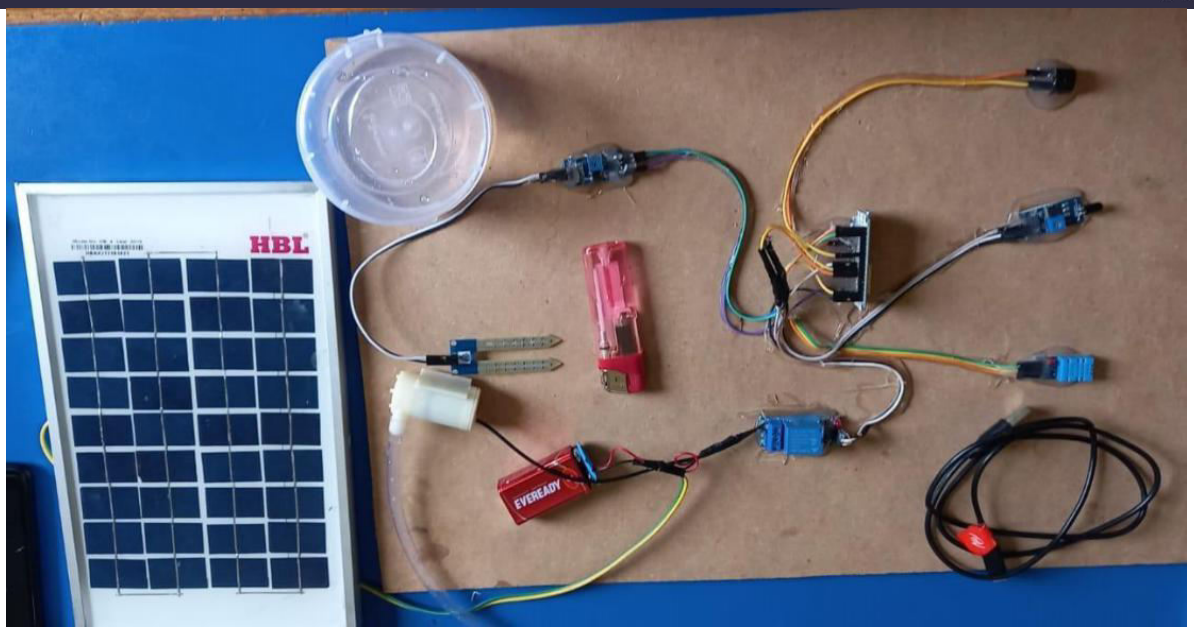

Fig 3: Experimental Setup

Fig 4: Screen Shot of blynk mobile app

CASE 1: When Soil Moisture sensor value is >750, Motor will be “ON”

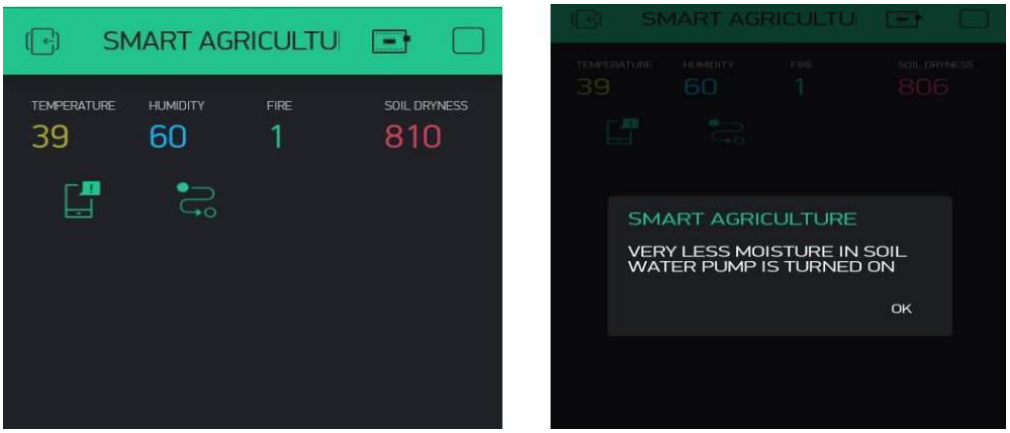

Fig 5: Screenshot when value of Soil moisture sensor is >750

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CASE 2: When Soil Moisture sensor value is <750, Motor will be “OFF”

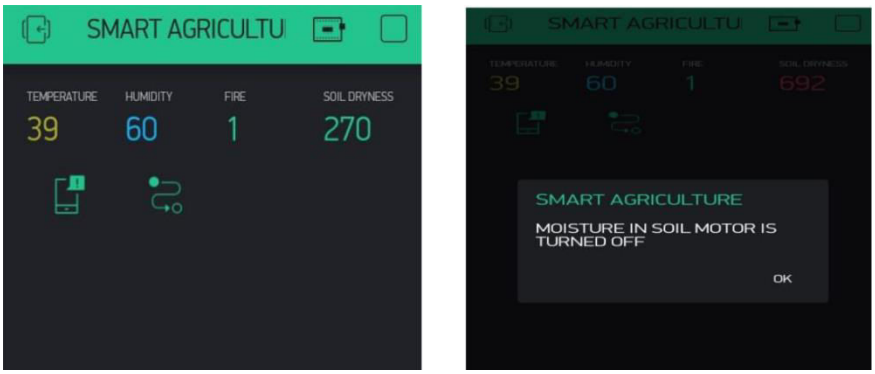

Fig 6: Screenshot when value of Soil moisture sensor is <750

CASE 3: When Fire sensor value is 1, Motor will be “OFF”

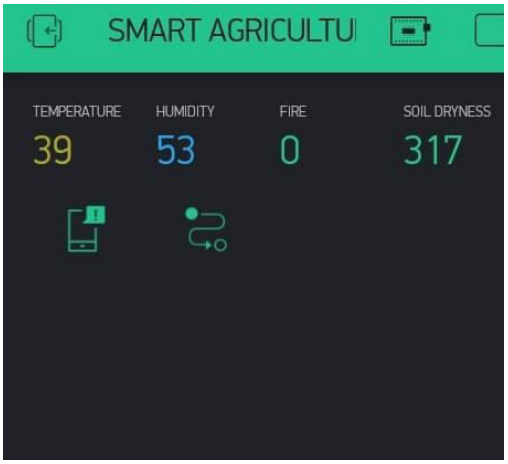

Fig 7 Screenshot when value of Fire sensor is “1”

CASE 4: When Fire sensor value is 0, Motor will be “ON”

Fig 8: Screenshot when value of Fire sensor is “0”

5. CONCLUSION

The implemented system is integrated with multi-sensors such as soil moisture sensors, humidity and temperature sensors. This proposed system managed to reduce cost, minimize waste water, and reduce physical human interface. The entire system is monitored and controlled by the Node MCU. The system is capable of automatic watering of plants depending upon certain parameters collected by the sensors. The system will have connected to BLYNK cloud and operates from remote areas.

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