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Web Based Automatic Irrigation System using Wireless Sensor Network and Arduino

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ABSTRACT: This paper presents an automation of farm irrigation using a wireless sensor network (WSN) and Arduino. Here we are building a web-based irrigation system using wireless sensor network and Arduino UNO. The system provides a web interface to the user so that the user can control and monitor the system remotely. It will not only automatically irrigate water based on the moisture level of soil but also detect the NPK present in the soil, and sends the data to a web page using IoT to keep track on the land condition. The system consists of a pumping motor and sprinkling motor which will be used to pump water or sprinkle water depending on the moisture content of the soil. The system will reduce the water consumption, thus giving uniform water to the crop resulting in increased yield.

KEYWORDS: WSN, Irrigation, Arduino, NPK.

I. INTRODUCTION

Agriculture is the worldwide prime occupation of human being, 64% of total available land is occupied by the agriculture, and it consumes 85 % of available fresh water. This figure of water consumption increases every year due to globalization and population growth. There is a challenge in front of every country to sustain the fresh food requirement and reducing the farm water consumption. Irrigation is the process of watering the soil.

The requirement of water to the soil depends on soil properties like soil moisture and soil temperature. It also depends upon the crop which grows in the soil. Few existing systems working for reducing the agriculture water consumption, have some limitation. In these systems, watering is done without analysing the soil properties, due to which non uniform water is applied to the soil. Also, systems require more human intervention and is time consuming.

So, we require modern technology to resolve this problem for better irrigation management. For this we have proposed a system which is a web based automatic irrigation system using wireless sensor network and Arduino. The wireless sensor network creates a network of multiple devices capable of computation, communication and sensing. It provides a bridge between the real physical world and the virtual world and have a wide range of potential applications in agriculture, home automation, science, civil infrastructure and security.



II. AUTOMATED IRRIGATION SYSTEM

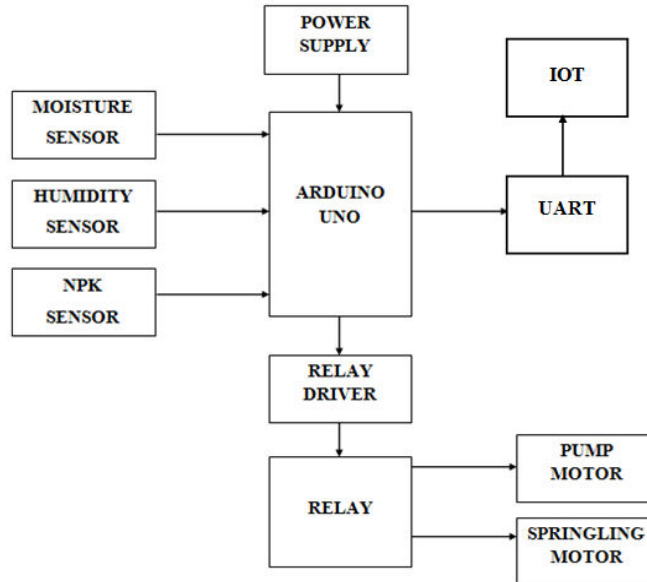


Fig. 1 Block diagram of automated irrigation system

1) ARDUINO UNO

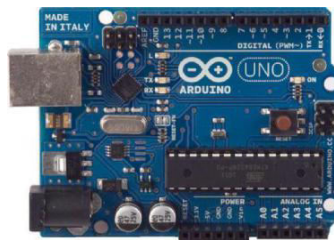


Fig. 2 Arduino Uno

The Arduino UNO is the microcontroller board based on ATmega328. It has 14 digital input/output pins, 6 analog inputs, 16 MHz ceramic resonator, USB connection, a power jack. Arduino consists of a microcontroller and Integrated Development Environment (IDE). IDE is used to write and upload computer code to the microcontroller. It can be powered by USB cable or power jack of 5v. It contains everything needed to support the microcontroller.

Features of Arduino UNO

- Microcontroller ATmega328
- Operating voltage 5V
- Input voltage 7-12V
- Input voltage (limits) 6-20V
- Digital I/O Pins 14
- Analog input pins 6
- DC Current per I/O pin 40mA
- DC Current for 3.3V pin 50mA
- Flash memory 32KB (ATmega328)

- SRAM 2KB(ATmega328)
- EEPROM 1KB (ATmega328)
- Clock speed 16MHz

2) SENSORS

a. SOIL MOISTURE SENSOR

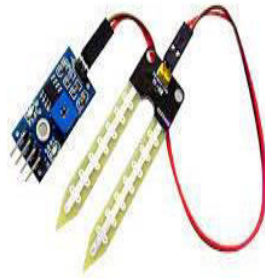


Fig.3 Soil moisture sensor

Soil Moisture 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. This moisture sensor has two probes which are used to pass the current into the soil, and then it reads the resistance between two probes to get the moisture level. When more water is present in the soil, it conducts electricity more easily indicating less resistance, while dry soil having less water conducts electricity poorly indicating more resistance.

b. HUMIDITY SENSOR

A humidity sensor is an electronic device that measures the humidity in the atmosphere and converts its findings into a corresponding electrical signal. Humidity sensors vary in size and functionality.

Humidity sensors can be divided into two groups: relative humidity (RH) sensors and absolute humidity (AH) sensors. Relative humidity is calculated by comparing the live humidity reading at a given temperature to the maximum amount of humidity for air at the same temperature. In contrast, absolute humidity is measured without reference to temperature. The most common RH sensors are the capacitive and resistive humidity sensors.

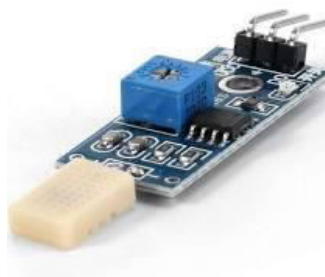


Fig. 4 Humidity sensor

c. NPK SENSOR

Measurement of N (nitrogen), P (phosphorus) and K (potassium) of soil is necessary to decide how much extra content of these nutrients are to be added in the soil to increase crop fertility. In the present work fiber optic-based colour sensor has been developed to determine N, P, and K values in the soil sample. Here colorimetric measurement of aqueous solution of soil has been carried out. The colour sensor is based on the principle of absorption of colour by solution. It helps in determining the N, P, K amounts as high, medium, low, or none.

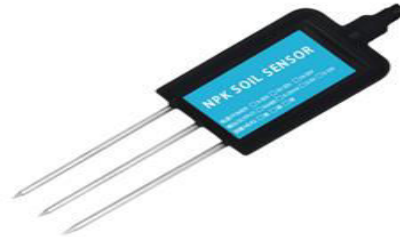


Fig. 5 NPK sensor

3) RELAY

Relay is an electrically operated switch that uses electromagnetism to convert small electrical stimuli into larger currents. These conversions occur when electrical inputs activate electromagnets to either form or break existing circuits. Several relays use a magnet to operate as a switch, however those which use semiconductor transistors, thyristors, triacs, etc, as their switching device are called “Solid State Relays”. Relays are used wherever it's necessary to regulate a circuit by a separate low-power signal, or wherever many circuits should be controlled by one signal.



Fig. 6 Relay

4) MOTORS

a. PUMPING MOTOR

The water pump can be defined as a pump which uses the principles like mechanical and hydraulic throughout a piping system. These pumps are applied within a wide range of farming, housing and manufacturing applications. The working principle of a water pump depends on the positive displacement principle as well as the kinetic energy to push water. These pumps use AC power otherwise DC power for energizing the motor of the water pump. These pumps are used for pumping huge amount of water from one place to another. The common types of pumps used are positive displacement pumps and centrifugal pumps. To represent the pump, DC motor is used, which is the most common type of motor. DC motors normally have two leads, one positive and one negative.

b. SPRINKLING MOTOR

An irrigation sprinkler (also known as a water sprinkler or simply a sprinkler) is a device used to irrigate agricultural crops, lawns, landscapes, golf courses and other areas. Sprinkler irrigation is the method of applying water in a controlled manner in a way similar to rainfall. The water is distributed through a network that may consist of pumps, valves, pipes, and sprinklers. It is useful on uneven land where sufficient water is not available as well as on sandy soil. Similar to the pumping motor, another DC motor is used to represent the sprinkling motor.



Fig. 7 DC motor

5. IoT

Internet of Things (IoT) is a network of physical objects/things - devices, vehicles, buildings embedded with electronics, sensors, micro-controller, and network connectivity that enables these objects to collect and exchange data. These interconnected objects have data regularly collected, analysed and used to initiate action, providing a wealth of intelligence for planning, management and decision making. Thus, it can be described as a huge web of embedded objects designed with wireless technologies such that they can be monitored, controlled and linked within the existing Internet infrastructure. Basic building blocks of IoT consist of sensors, processors, gateways, and applications. The cloud services collect, store and analyse the data collected by the sensors and allow people to take decision accordingly.

III. SOFTWARE ANALYSIS

ARDUINO IDE

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

Key Features

- Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.
- One can control the board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).
- Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. Only a USB cable is enough.
- Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.
- Finally, Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

IV. WORKING

In this paper, we are designing a web based automatic irrigation system using Arduino Uno and Wireless Sensor Network. The environmental changes of the soil are monitored by moisture sensor, humidity sensor, NPK sensor. First, the soil moisture content is determined with the moisture sensor implanted in the soil. The humidity sensor works by detecting changes in the temperature or electrical currents of air. The NPK content of the soil is detected when the NPK sensor comes in contact with the soil. The information from the sensors is collected by the Arduino Uno board. The information is then passed to relay and IoT. The IoT system is programmed to collect and store data on the moisture,



humidity and NPK content of the soil which is then viewed in a webpage. The sprinkling motor and the pumping motor will automatically start operating depending on the moisture and humidity level of the soil.

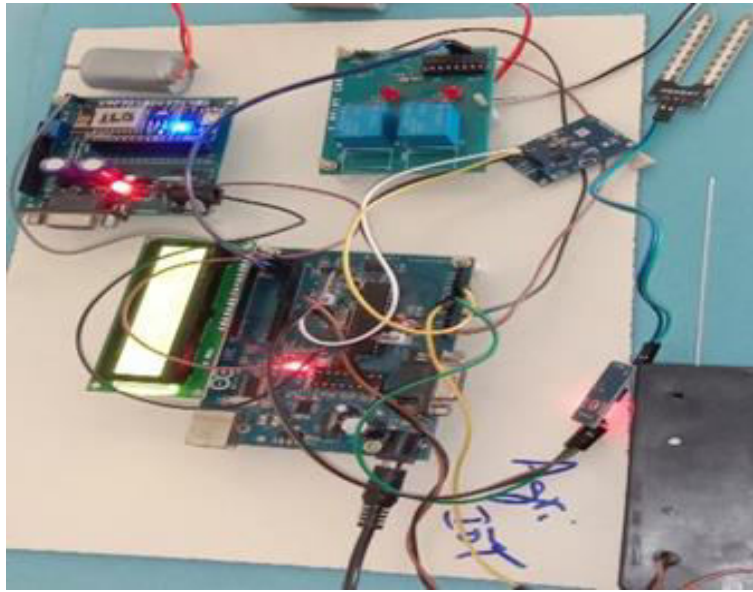


Fig. 8 Hardware implementation of the irrigation system

CIRCUIT DIAGRAM

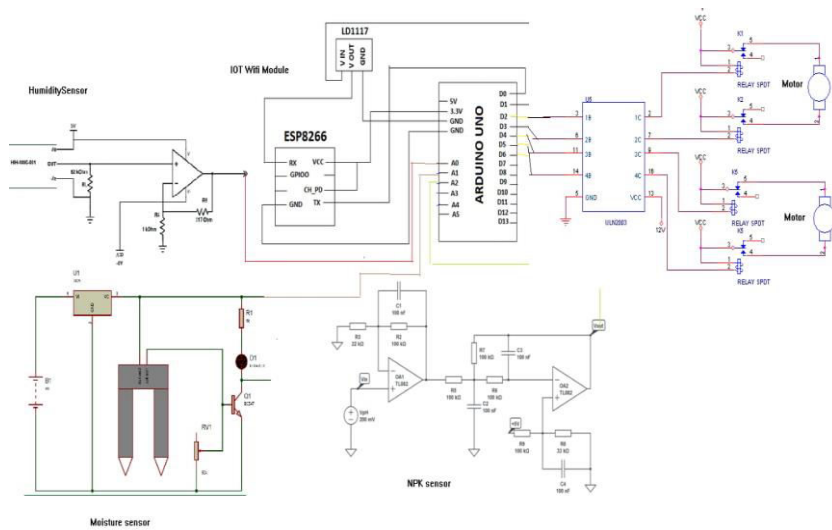
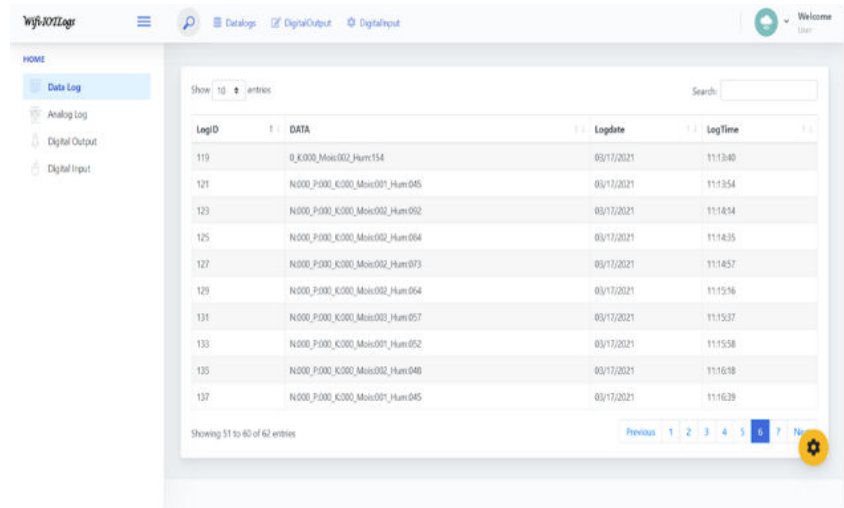


Fig. 9 Circuit diagram of the irrigation system

RESULT


The screenshot shows a web application interface for a wireless sensor network. The main content is a table titled 'Data Log' with columns for LogID, DATA, LogDate, and LogTime. The table contains 10 rows of data, showing sensor readings for moisture and humidity at various times on 03/17/2021. The interface also includes a search bar, a 'Show' dropdown set to 10 entries, and a pagination control at the bottom right.

LogID	DATA	LogDate	LogTime
119	0_K000_Moist002_Hum154	03/17/2021	11:13:40
121	N000_P000_K000_Moist001_Hum045	03/17/2021	11:13:54
123	N000_P000_K000_Moist002_Hum092	03/17/2021	11:14:14
125	N000_P000_K000_Moist002_Hum064	03/17/2021	11:14:35
127	N000_P000_K000_Moist002_Hum073	03/17/2021	11:14:57
129	N000_P000_K000_Moist002_Hum064	03/17/2021	11:15:16
131	N000_P000_K000_Moist002_Hum057	03/17/2021	11:15:37
133	N000_P000_K000_Moist001_Hum052	03/17/2021	11:15:58
135	N000_P000_K000_Moist002_Hum048	03/17/2021	11:16:18
137	N000_P000_K000_Moist001_Hum045	03/17/2021	11:16:39

Fig. 10 Output displayed in web page**V. CONCLUSION**

Thus the “Web based automatic irrigation system using wireless sensor network and Arduino” has been designed and tested successfully. It has been developed by integrating the features of all the hardware components used. The moisture sensors measure the moisture level (water content) of the soil and humidity is measured with the humidity sensor. Depending on the moisture level and humidity, the sensors send the signal to the Arduino board which in turn triggers the sprinkling/pumping motor. The moisture level, humidity and NPK content of the soil can also be accessed in the webpage. Thus, the functionality of the entire system has been tested and it is said to function successfully.

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