ARUNAI PUBLICATIONS

Asian Journal of Applied Research

DOI: http://dx.doi.org/10.20468/ajar.2018.10.04

Research Article

Internet of Things Based Monitoring of Fertilizer and Moisture in Agriculture

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ABSTRACT

Fertilizer is made with synthetic ingredients designed to stimulate plant growth and increase yields of crops around the world, but over fertilization can be injurious to human health mainly skin and respiratory system. Fertilizer contains nitrogen can cause soil acidification when added. This may lead to decreases in nutrient availability, which may be offset by liming. This project based on internet of things (IOT) is to measure the amount of the nitrogen and moisture level presents in the soil using sensors and intimates to the user with the help of Arduino. Considering the requirements of this project, moisture sensor, android mobile, nitrogen sensor, Arduino processing module, and its peripherals implement based on this platform. It shows that the designed system is good enough to run the data stream which flows smoothly between the sensor and the Arduino. IOT enables various applications (fertilizer monitoring and moisture sensing) in digital agriculture domain.

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Key words:
Arduino, Moisture sensor, Nitrogen sensor, Wireless communication

Received: 05th February 2018
Accepted: 20th September 2018
Published: 13th October 2018

INTRODUCTION

Most countries depend on agriculture, and hence, the optimal usage of land and water resources is very critical. Previous agriculture systems were labor dependent. The agriculture systems in developing countries are still labor dependent and do not use any crop management, pest/disease control, or quality management systems. Hence, a technology-based agricultural monitoring system is greatly required for farmers in developing countries. Sensors include low power radio and power management mechanisms to conserve energy for a longer time network operation. Hence, sensors are used as the integral part of machine-to-machine (M2M) communication networks for different monitoring applications, especially agricultural monitoring. Agriculture monitoring systems mainly focus on sense the over fertilization, moisture content. Recently, many sensor-based agriculture monitoring systems have been designed and implemented (mostly for developed countries) nitrogen (N) plays a key role in the plant life cycle. It is the main plant mineral nutrient needed for chlorophyll production and other plant cell components (proteins, nucleic acids, and amino acids). Crop yield is affected by plant N status. Thus, the optimization of nitrogen fertilization has become the object of intense research due to its environmental and economic impact. Hence, here, we measure the amount of nitrogen content in the soil and indicate the user if there was over fertilization of nitrogen. Water contained in the soil is called soil moisture. Moreover, it is very important for plant growth. The moisture is measured using the moisture sensor and then indicate to the user if the soil becomes dry. The advantage of using wireless sensors is to control all related parameters for better irrigation management. This paper gives a review of remote monitoring and control system based on existing technologies.

INTERNET OF THINGS (IOT)

IOT is an emerging technological framework where daily use machines such as refrigerator, microwave oven, cell phone, laptop, tablet, smartphone, and electric meter can communicate with each other and send data to the central server or cloud area networks (e.g., sensor, RFID, and Bluetooth) and core networks (e.g., WLAN, 3G, IP, and WiMAX). Thus, monitoring devices and applications are connected to each other to work as a large-scale framework of IOT. A machine is known as a machine type communication (MTC) device. The MTC devices communicate with each other and send data to the MTC gateway of M2M area networks through multi-hop communications. The MTC gateway again

transmits data to the backhaul core networks through MTC routers having a large communication range. Hundreds of low cost, energy, and computational power wireless sensor nodes are mostly used as MTC devices in the M2M area networks since sensors can be deployed easily, controlled automatically, and monitored remotely.

SYSTEM HARDWARE DESIGN

The whole system is composed by following parts: Arduino to connect sensor with android, nitrogen and moisture sensor are used to detect the nitrogen and moisture content in the soil and give the user indication. The system block diagram is shown in Figure 1.

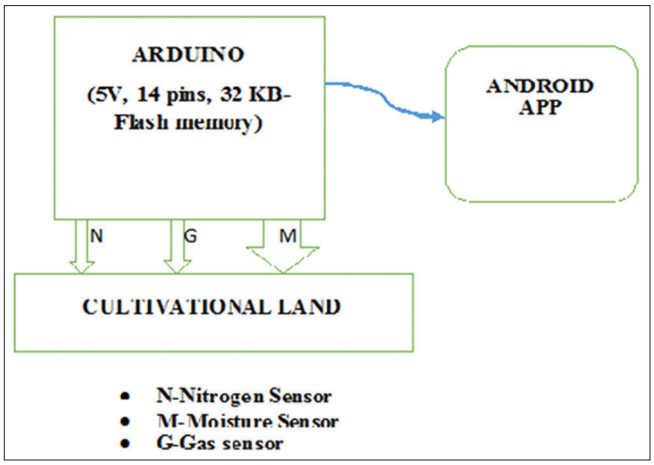

Figure 1: System block diagram

ARDUINO

Arduino is an open-source computer hardware and software company, project, and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on the processing project, which includes support for the C and C++ programming languages. Arduino IDE supplies a software library called "Wiring" from the wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consists of two functions that are compiled and linked with a program stub main() into an executable cyclic executive program:

- Setup (): A function that runs once at the start of a program and that can initialize settings.
- Loop (): A function called repeatedly until the board powers off.

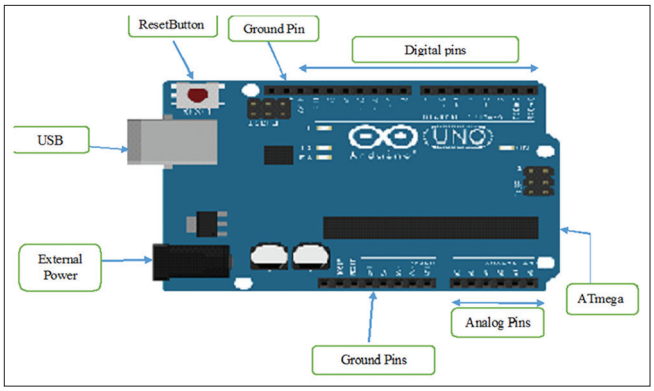

Figure 2: Arduino

MAIN PROCESSING CHIP

The Arduino UNO R3 is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller simply connect it to a computer with a USB cable (not included) or power it with an AC-to-DC adapter or battery to get started. The UNO differs from all preceding boards because it does not use the FTDI USB-to-serial driver chip [Figure 2].

ARDUINO SPECIFICATION TABLE

Interfaces comes under system hardware design.

INTERFACES

Plenty of interfaces are contained on the Arduino board, including library that provides unified interface to all input devices. The interface can sense buttons, rotary encoders, keypads, analog buttons, serial keypads, or even smartphone as your Arduino input. Make local interface on your project and controls it the same on remote interfaces on PC, phones, or internet.

SENSORS

A sensor is an object whose purpose is to detect events or changes in its environment and then provide a corresponding output. A sensor is a type of transducer; sensors may provide various types of output, but typically use electrical or optical signals. Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base, besides innumerable applications of which most people are never aware. With advances in micromachinery and easy-to-use microcontroller platforms.

NITROGEN SENSOR

The amount of nitrogen (N) available to plant roots is the main factor limiting the yield of crops. Depending on the soil type, climate and crops grown during previous years the fertilizer requirements vary within a field and throughout the year. Profitable and efficient agriculture needs to match crop N supply to the demands throughout the season. Soil mineral N is currently measured using costly labor-intensive field sampling methods that require later laboratory analysis. The aim of this

Table 1: Specifications of Arduino

Specifications	Values
Microcontroller	Arduino
Operating voltage	5 V
Input voltage (recommended)	7–12 V
Input voltage (limit)	6–20 V
Digital I/O pins	14 (of which 6 provide PWM output)
PWM digital I/O pins	6
Analog input pins	6
DC current per I/O pin	20 mA
DC current for 3.3 V pin	50 mA
Flash memory	32 KB (ATmega328P, of which 0.5 KB used by bootloader)
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega 328P)
Clock speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

work was to produce nitrogen sensors that can be used to continuously monitor the available soil water N in the field.

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 using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. 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.

CONTROLS THROUGH ANDROID

Control through android mobile using Bluetooth or Wifi no android programming required. Our Arduino code completely specifies what controls are displayed on the user's mobile phone. The user can navigate, execute commands by button presses, choose menu items, select items on lists, input text, input numbers, and view raw data feeds from your Arduino project. Very flexible and very simple to code.

METHODOLOGY OF WORK

Nitrogen sensors, moisture sensor, and gas sensor which are connected with Arduino board which is coded and then give the optimum value of nitrogen amount for the soil. The android app is connected to the Arduino. During the fertilization, the embedded system measures the amount of the nitrogen and moisture level presents in the soil using sensors and intimates to the user with the help of Arduino through android.

FUTURE DEVELOPMENTS

By the method we have mentioned above, we can send messages of content values to mobile phones using the Arduino GSM module. By our future works, we are on progress of creating a mobile application in which we can link our mobile with the Arduino using our mobile number. The app will be containing all the details such as the optimum content of nutrients chart for different types of soil and each and every information about the soil. It will notify you if the value is excess, optimum, or less. The application will be active always so that we can always be sure that our crops are fine.

CONCLUSION

This paper reports that we are going to develop a sensor system using Arduino board which is coded. We may draw a few conclusions from our systematic review. First, there is an availability of a number of helpful smartphone applications for target farmers. Most of these applications are easily accessed by the users. The app for this project must be developed and it must create awareness among the farmers and the people. Second, researchers and smartphone application developers reading our review paper may have an impression of research gap regarding which agricultural applications to develop using smartphone. Third, governments and agricultural agencies can respond to how even the most basic sensors on smartphones can be used in agriculture.

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Cite this article: Seema M, Venkatanarayanan S, Kannan SM. Internet of Things Based Monitoring of Fertilizer and Moisture in Agriculture. Asian J Appl Res 2018;4(2):15-17.

Source of Support: Nil, **Conflict of Interest:** None declared.