INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 05 ISSUE: 05 | MAY - 2021 ISSN: 2582-3930

SMART AUTOMATION FOR AGRICULTURE

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Abstract—

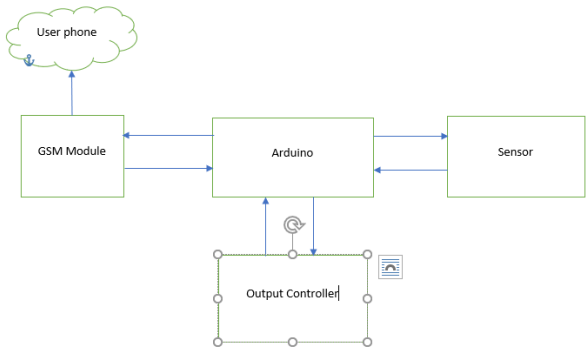
In this study, we made a device SMART AUTOMATION FOR AGRICULTURE, which is an automated monitoring device. It monitors the surroundings and acts accordingly. We are using sensors, modules and kit(Arduino) It is to solve problem faced by farmers these days. From ancient days, farming plays an important role in our day-to-day life, so being an engineer, it's our responsibility to use techniques to help our society.The highlighting features of this project includes smart GSM based remote monitoring and controlling to perform tasks like soil PH sensing moisture sensing, temperature and humidity monitoring. Secondly it includes smart irrigation with automatic (without human interfacing) and intelligent decision making based on accurate real time field data. Thirdly, smart warehouse management which includes temperature maintenance, humidity maintenance. Controlling of all these operations will be through any remote smart device or computer connected to Internet and the operations will be performed by interfacing sensors, GSM module, relay, actuators

Keywords— Arduino IDE, Fritzing, Arduino UNO, sensors, modules

I. INTRODUCTION

Agriculture is considered as the basis of life for the human species as it is the main source of food grains and other raw materials. It plays vital role in the growth of country's economy. It also provides large ample employment opportunities to the people. Growth in agricultural sector is necessary for the development of economic condition of the country. Unfortunately, many farmers still use the traditional methods of farming which results in low yielding of crops and fruits. But wherever automation had been implemented and human beings had been replaced by automatic machineries, the yield has been improved. Hence there is need to implement modern science and technology in the agriculture sector for increasing the yield.[1] Most of the papers signifies the use of wireless sensor network which collects the data from different types of sensors and then send it to your mobile phone by GSM module. The collected data provides the information about different environmental factors which in turns helps to monitor the system manually and automatically also. Monitoring environmental factors is not enough and complete solution to improve the yield of the crops. There are number of other factors that affect the productivity to great extent. These factors include PH of soil .The pH is important because it influences the availability of essential nutrients. Most horticultural crops will grow satisfactorily in soils having a pH between 6 (slightly acid) and 7.5 (slightly alkaline). Since most garden soils in Iowa are in this range, most gardeners experience few problems with soil PH[2]. Secondly,Humidity can be the most difficult environment factor to control in greenhouses. Humid air directly contributes to problems such as foliar and root diseases, slow drying of the growing medium, plant stress, loss of quality, loss in yields, etc. Therefore, more pesticides are needed for disease control and plants tend to have weak, stretched growth making the plant less desirable. This paper therefore proposes a system which is useful in monitoring the field data as well as controlling the field operations which provides the flexibility. The paper aims at making agriculture smart using automation and IoT technologies.[6] The highlighting features of this paper includes smart GMS based remote controlled tasks like;[3] spraying, moisture sensing tasks like soil PH sensing moisture sensing, temperature and humidity monitoring etc. Secondly, it includes smart irrigation with smart control based on real time field data. Thirdly, smart warehouse management which includes; temperature maintenance, humidity maintenance in the warehouse. Controlling of all these operations will be through any remote smart device and the operations will be performed by interfacing sensors, GSM module , motors ,actuators with Arduino.

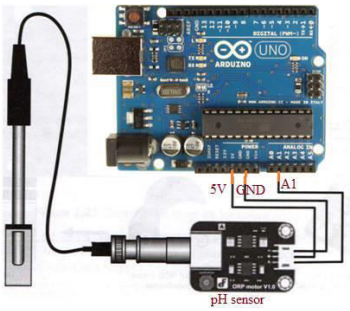
II. SYSTEM OVERVIEW: BLOCK DIAGRAM



The paper consist of four sections; node1, node2, node3 and mobile to control system. In the present system, every node is integration with different sensors and devices and they are interconnected to one central server via wireless communication modules. The server sends and receives information from user end using SMS connectivity. There are

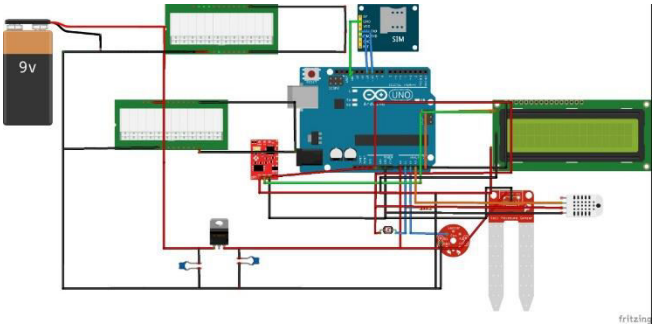
two modes of operation of the system; auto mode and manual mode. In auto mode system takes its own decisions and controls the irrigation system and maintain humidity and temperature on certain level whereas in manual mode user can control the operations of system using mobile phone by SMS.[4]

III. IMPORTANCE OF Ph



- pH is an important quantity that reflects the chemical conditions of a solution. The pH can control the availability of nutrients, biological functions, microbial activity, and the behavior of chemicals. Because of this, monitoring or controlling the pH of soil, water, and food or beverage products is important for a wide variety of applications.
- Under acidic conditions, many minerals in soil become soluble, releasing toxic metals such as aluminum. Some nutrients, such as phosphorus and molybdenum, become less available at lower pH values. Under alkaline (basic) conditions, the soil can become deficient in nutrients such as zinc, copper, iron, manganese, boron and phosphorus.

IV. ARCHITECTURE OF THE SYSTEM



- Node1 is GSM module, which can send all real time on field agriculture data and it can controlled by user through Arduino. The all temperature, humidity and PH sensor, soil moisture and light intensity sensor send data and using them it will perform tasks like Spraying, motor on and off , PH maintaining and controlling ventilation system.
- Node2 will be the warehouse. It consists of light sensor, humidity sensor, temperature sensor, room heater, cooling fan altogether interfaced. Motion detector will detect the motion in the room when security mode will be ON and on detection of motion, it will send the alert signal to phone and thus providing theft detection.
- Node3 is a smart irrigation node with features like; Smart control of water pump based on real time field data i.e. automatically turning on/off the pump after attaining the required soil moisture level in auto mode, Switching water pump on/off remotely via mobile or computer in manual mode, and continuous monitoring of soil moisture.
- In node3, moisture sensor transmits the data using GSM module. The transmitted data is received by node2 and there it is processed by microcontroller in order to control the operation of water pump.

V. WORKING PRINCIPLE

- The amount of moisture is measured using soil moisture sensor. If moisture is sufficient, then it will be neutral, if not then it will give signal user's device(mobile phone) through GSM module.
- User can operate both manually and automatically.

- In manual, user need to choose options among them. But in automation, device will be operated as programmed.
- As we can see in above flowchart, the conditions are shown step wise.

VI. HARDWARE

The list of Hardware components in shown in below table:

Sr. No	Hardware	Types and Values
1	Arduino	Arduino UNO
2	Sensors	1. DHT 11 Humidity and Temperature sensor 2. pH sensor 3. Soil moisture sensor
3	Module	1. GSM Module 2. LDR Module 3. DC Relay Module
4	Pump	DC pump

VII. SPECIFICATION AND WORKING [6] [7]

1. ARDUINO –

Specifications –

Microcontroller - ATmega328P.
Operating Voltage - 5V.
Input Voltage- 7-12V.
Digital I/O Pins - 14 (of which 6 provide PWM output).
Analog Input Pins - 6.
DC Current - 40mA.
Flash Memory -32 KB.
SRAM -2 KB.
EEPROM - 1 KB.
Clock Speed - 16 MHz.

Working –

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. we are using it as main controller for SMART AUTOMATION FOR AGRICULTURE and irrigation system. It will collect data from sensors and by analyzing it gives order to specific sensor or system to work or stop.

2. SENSORS-

1. DHT 11 Humidity and temperature sensor :

Specifications –

Operating Voltage - 3.5V to 5.5V
Operating current - 0.3mA (measuring) 60uA (standby)
Output - Serial data
Temperature Range - 0°C to 50°C
Humidity Range -b20% to 90%
Accuracy - ±1°C and ±1%

Working -

The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. In agriculture we need to temperature and humidity for growth of cropsboth factors can affect crops hard if they were not in their requirementi.e. why DHT 11 used.it will sense the accurate data n according to that we can take the action .

2. PH sensor :

Specification -

Heating voltage – 5 ± 0.2V (AC DC)
Working current – 5-10mA
Detectable concentration range – PH0-14
Detection Temperature range - 0-80 °C
Response time - ≤5S
Settling Time - ≤60S
Working temperature – 10-50 °C
Humidity - 95% RH (nominal humidity 65% RH)
Module Size - 42mm×32mm×20mm
Output – Analog voltage signal output

Working –

A pH of 7 indicates a neutral soil. The pH is important because it influences the availability of essential nutrients. Most horticultural crops will grow satisfactorily in soils having a pH between 6 (slightly acid) and 7.5 (slightly alkaline).

3. Soil moisture sensor :

Specifications –

Chip-LM393 (stable operation)
Operating voltage – 3.3V-5V
Power Indicator (RED)
DO LED(GREEN)
Mode – Dual output mode (accurate output)

Working –

Soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.when it find out soil too dry then it will send signal to controller to start irrigation system.

3. MODULE-

1. GSM MODULE :

Specifications –

Bands – GSM 850MHz, EGSM 900MHz, DCS 1800MHz, PCS 1900MHz
Coding schemes – CS-1, CS-2, CS-3, CS-4 Tx power -Class 4 (2W), Class 1 (1W)
GPRS class 2/10.

Control via AT commands (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT command set).
Voltage Supply Required- 9VDC to 12VDC with atleast 2A Peak Current Capability
High-Quality Product (Not hobby grade).
5V interface for direct communication with MCU kit.
TTL Rx and TTL Tx and DB9 Connector Based RS232 Outputs
Configurable baud rate.
Built-in SIM Card holder.
Built-in Network Status LED.
Inbuilt Powerful TCP/IP protocol stack for internet data transfer over GPRS.
Low power.
Operating temperature - -40C to +85C
External Finger type antenna
Weight – 40gm

Working –
A GSM modem or GSM module is a hardware device that uses GSM mobile telephone technology to provide a data link to a remote network. From the view of the mobile phone network, they are essentially identical to an ordinary mobile phone, including the need for a SIM to identify themselves to the network. It will help to connect mobile phone to wireless network.

2. LDR module :
Specifications -
Operating voltage 3.3V-5V
Output Type - Analog voltage output -A0
Digital switching outputs (0 and 1) -D0
With fixed bolt hole for easy installation
Small board PCB size - 3cm * 1.6cm
Power indicator (red) and the digital switch output indicator (green)
Using LM393 comparator chip, stable

Working –
The LDR Sensor Module is used to detect the presence of light / measuring the intensity of light. The output of the module goes high in the presence of light and it becomes low in the absence of light. The sensitivity of the signal detection can be adjusted using potentiometer.

3. DC Relay module :
Specifications -
Operating Voltage 5V
Max Current : 20mA
Relay Contact Current Capacity at AC250V: 10A
Relay Contact Current Capacity at DC5V: 10A
One normally closed contact and one normally open contact

Working –
It is frequently used in an automatic control circuit. To put it simply, it is an automatic switch to control a high-current circuit with a low-current signal. 5V relay signal input voltage range upto 5 V. It will start irrigation system and motor.

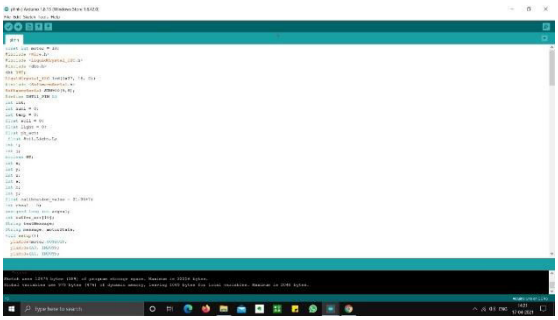
4. PUMP-
Specifications -
Operating Voltage - 3 ~ 6V
Operating Current - 130 ~ 220mA
Flow Rate - 80 ~ 120 L/H
Maximum Lift - 40 ~ 110 mm
Continuous Working Life - 500 hours
Driving Mode - DC, Magnetic Driving

Working –
This is the part of irrigation systemonce the moisture condition detected irrigation system will start by the controller.

VIII. SOFTWARE

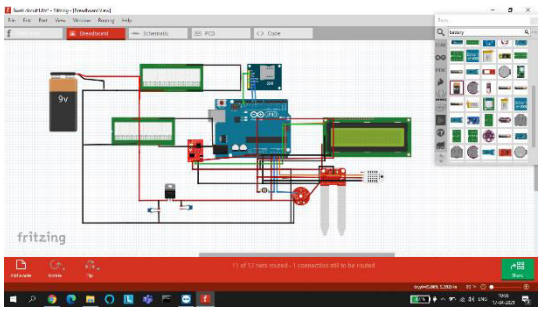
We are using 2 software:

1. Arduino IDE:



The Arduino IDE (Integrated Development Environment) is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

2. Fritzing:



Fritzing is an open-source initiative to develop amateur or hobby CAD software for the design of electronics hardware, to support designers and artists ready to move from experimenting with a prototype to building a more permanent circuits.

IX. RESULT AND CONCLUSION

We can see that sensors and modules are acting precisely. We are getting desired output. But we can improve our model by adding industrial sensors and many modifications.
The sensors and microcontrollers of all three Nodes are successfully interfaced with GSM module, Arduino and wireless communication is achieved between various Nodes. All observations and experimental tests proves that project is a complete solution to field activities, irrigation problems, and smart irrigation system and a smart warehouse management system respectively. Implementation of such a system in the field can definitely help to improve the yield of the crops and overall production.

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