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Smart Irrigation and Intrusions Detection in Agricultural Fields Using I.o.T.

Divyansh Thakur[a,*], Yugal Kumar,[b] Singh Vijendra[c]

[a]*Dept. of Computer Science and Engineering, Indian Institute of Information Technology,* Una 177209, India
[b]*Dept. of Computer Science and Engineering, Jaypee University of Information Technology,* Solan 173234, India
[c]*Dept. of Informatics, School of Computer Science, University of Petroleum and Energy Studies, Dehradun, India*

Abstract

Agriculture plays an important role in the life span of human being not only for their survival but for the better economic growth of the country too. Precision agriculture is the new trending term in the field of technology whose main motive is to reduce the workload of the farmers and increase the productivity of the farms by using technologies like I.O.T, WSNs, Remote Sensing, Drone surveillance and many more. In this paper, we show the work done by our cost effective and reliable device whose aim is to irrigate fields only when there is a need of water and to provide information about detection of any intrusion in agricultural fields. The information is sent to the farmers by using cloud application. The performance of our system is measured in terms of intrusion detection and moisture of soil for irrigation.

Keywords: IoT; wireless sensor networks; soil moisture sensor; PIR sensor; smart irrigation; cloud application

1. Introduction

Internet of Things (IoT) is a new hot topic in the field of technology. The IoT is a network of material devices which is composed of embedded system like sensors, actuators, receivers, transmitters and many more hardware devices. The main aim of IoT devices is to reduce the load on human bodies. Many sub domains like wireless sensor network, remote sensing, automation and many more come under the umbrella of IoT.

Agriculture plays a very vital role in the life span of human being not only for their survival but also in economic perspective. To increase the quality and quantity of the crop IoT contributes a huge role by using various IoT related

* Corresponding author. Tel.: +91-7018503033;
E-mail address: divyanshthakur8@gmail.com

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devices the protection and production of crop can be easily done. Smart agriculture term refers to precise agriculture by the aid of technology like sensor devices, drone surveillance of field, remote sensing and many more.

Nowadays there is huge shortage of water. Many places in our country are facing this problem. According to a survey mostly crops were not able to grow well because of water. For getting off by this problem smart irrigation contributes huge role. Smart irrigation is conduct by using various sensor devices.

In this paper we proposed a prototype model for better irrigation and for detecting intrusion in an agriculture field. The proposed model is composed of various sensors which help in providing precise irrigation and information to the farmers regarding any detection of intrusion in their fields.

2. Related Work

For real time monitoring of the plant for growth analysis, Thakur et al., [1] proposed a device which can measure the temperature, soil moisture and automatic irrigation. The proposed device is tested for a growth analysis of valeriana jatamani plant. To surveillance the farms through camera sensors and monitoring of data transmission, Sanchez et al., [2] designed a system for distributed crops to do so. The sensors used for this system are HTDRA-PROBE II, IMOTE2 main board, Camera sensor. The whole system is tested for broccoli crop fields. For protecting crops from animal attack, Bapat et al., [3] developed a device. The developed device is designed by using PIR sensors, Arduino Board. The Graphical User Interface (GUI) is used for indication of status in fields. For measuring quality of soil, Georgieva et al., [4] designed a system using Zigbee, LabVIEW software and arduino. The ZigBee in the proposed system used for transmission of data whereas LabVIEW software is used for graphical user interface. By using LM-35, Arduino, Humidity Sensor, Carrascosa et al., [5] developed a system. The developed system is deployed in an agriculture field where cotton is cultivated. The main working of the designed system is to measure the environmental parameters. To monitor and control irrigation in an agricultural field, Chavez et al., [6] proposed a system by using Solenoid valve, Relay board, Wireless ethernet bridge. For controlling the irrigation through valve, Coates et al., [7] developed a system. The sensor used in the proposed system is soil moisture sensor whose functioning is to measure the moisture of soil so based on this irrigation will be done. To measure the organic carbon present in the soil, Knadel et al., [8] developed a system whose working is rely on visible near infrares spectroscopy which is a rapid and cost-effective method useful for soil analysis. For measuring the water content in the soil, Ristema et al., [9] designed a system. The designed system is composed of EC- 5 sensor useful for measuring the properties of the soil and Ambient studio software for graphical user interface. By integrating CC2530 chip, ZigBee, SY-HS-220 sensor and temperature sensor, Jahnavi et al., [10] proposed a smart wireless sensor network system for greenhouse. Thakur et al., [11] done a survey for getting precise information about various sensors and crops in which wireless sensor networks and internet of things are compatible.

3. Material and Method

To make the designed system working the requirement of software and hardware tools were needed. Software required for implantations are:

3.1. Arduino

The Arduino IDE is an open source software which is used for uploading the code into Arduino board. The working of all the sensor are rely on the given code which is written in Arduino IDE. The IDE software is compatible with

windows, Mac operating system, Linux and can be easily installed in any computer system. The programming language used in Arduino IDE is C++.

3.2. Python

The data from all the devices integrated with Arduino board is stored in Arduino IDE. Python language is used for storing that data in excel spreadsheet which helps in accessing the data from remote location easily. For this we used a port number 9600 in which Arduino board is connected and convert the data into spreadsheet.

3.3. Cloud Application

The cloud application which is used in proposed system for accessing the data remotely is dropbox. With the help of dropbox application farmer can check the status of the fields any time.

Hardware tools required for design of the system are:

3.4. Soil Moisture Sensor

The soil moisture sensor is used for calculating the volumetric content of the soil. The working of soil moisture sensor is relying on the working procedure of resistance. If the resistance between two dissimilar points of soil is diminution than there is increase in volumetric content of water in soil. If the resistance between two different points of soil is augmented than there is decrease in volumetric content of water in soil. The soil moisture sensor is composed of probe and circuit. The probes are injected under the soil surface which is used for measuring the volumetric content of the water. The second component of the soil moisture sensor is a circuit in which LED, Comparator, Potentiometer, LM293 and 4 Pins are integrated. Fig. 1. demonstrations the pin diagram of this sensor. Pin VCC is for volatrge supply soil moisture sensor supports the voltage supply of 5V. For ground this sensor GND pin is used. A_0 and D_0 are used for analog and digital signals respectively.

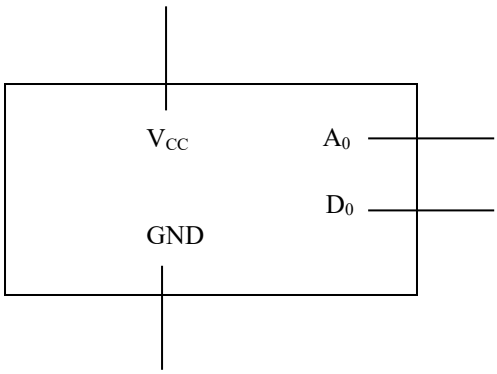

Fig. 1. Pin Diagram of Soil Moisture Sensor

3.5. PIR Sesnsor

The Passive Infrared sensor (PIR) sensor is used for measuring the detection of intrusion in the fields. The PIR sensor used in a proposed system is HC-SR501. The minimum voltage requires for working of this sensor is 5v

and maximum voltage is of 20v. It has three pins in it which relates to Arduino board. The pin V_{CC} is for voltage regulation. GND PIN and OUT pin is for ground the sensor and for getting output through the sensor respectively.

3.6. Water Pump

The water pump is useful for the irrigation of the fields. The working of the water pump is relying on the moisture of soil. If the moisture of soil goes below the specific value of soil moisture which was assigned in Arduino IDE software than water pump will start working till the desired value of soil moisture is achieved.

3.7. Arduino Board

The Arduino board is a hardware device having various variants. Arduino Uno Board is used in our system in which all the sensors are integrated. The Fig. 2. Shows an arduino board.

- USB Slot (1): Use for connecting Arduino board with the system
- Microcontroller (2): Use for transmitting and receiving of data. The microcontroller used in Arduino is ATMEGA 328.
- Barrel Slot (3): Use for power supply
- Reset (4): Use for clearing up all the code.
- Voltage regulator (5): Use for handling the voltage supply.
- Power pins (6,7): Use for providing 3v and 5v power supply
- GND PIN (8): For ground the Arduino.
- Analog pins (9): Ranging from A_0-A_5 helps in reading analog data
- Digital pins (10): Ranging from 0 to 13 useful for digital data information.

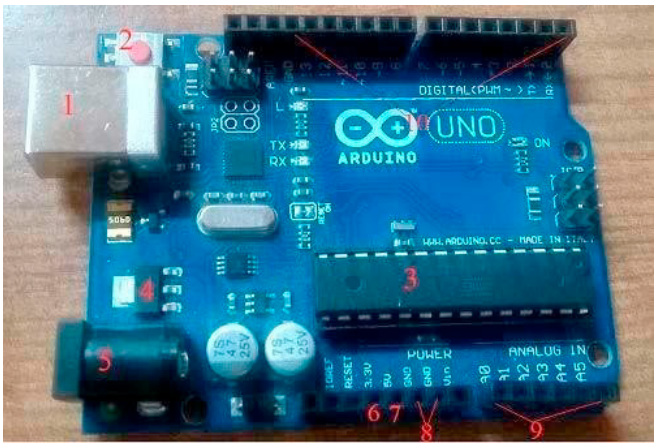

Fig. 2. Arduino Board

4. Block Diagram

The block diagram of the proposed system is shown in Fig. 3. Working of system is done by integrating soil moisture sensor, PIR sensor and Water pump together with arduino board. The role of soil moisture sensor is to sense the moisture of the soil and give its respective outputs to the user. Water pump will irrigate the field

only whenever the moisture of soil goes below the desired threshold value and it stop working till the desired threshold value of moisture is achieved which is clearly explain in result section. The detection of intrusion is measured by the help of passive infrared sensor (PIR) whenever there is any detection of intrusion in the field the users will get to know about it in the form of assigned values.

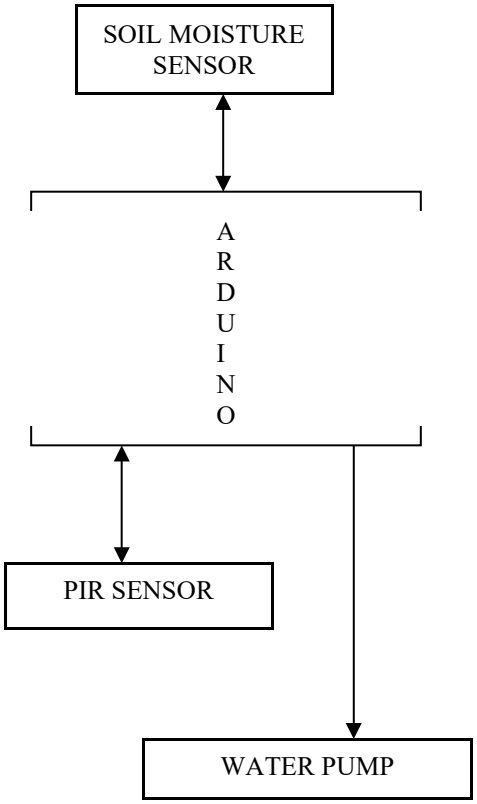

Fig. 3. Block Diagram

5. Experimental Setup

The designed prototype model was tested in a greenhouse at national institute of technology hamirpur himachal Pradesh. The setup was tested for one month and data of intrusion detection was easily collected through PIR sensor and the working of water pump is easily done without ant problem.

The water pump shown in Fig. 4. Helps in irrigating the greenhouse area where the device is deployed. The working of this water pump is totally relying on the moisture of soil. Whenever the soil moisture goes below to the assigned value the water pump start working till the peak value of soil moisture is achieved.

Fig. 4. Water Pump

The Passive infrared sensor is used for the detection of intrusion. The detection of intrusion is based on the motion this sensor give response based on motions. The Fig. 5. Shows the P IR Sensor.

Fig. 5. PIR Sensor.

The data is transferred to the user system with the help of cloud application. The output of data is shown in Fig. 6. arduino IDE, the drawback of arduino IDE is that we can not access data remotely in our cell phones. For solving this problem we use python script which stores the data in the excel sheet that can be easily assessable as shown in Fig. 7.

Fig. 6. Data in Arduino IDE.

```
import csv
import time

from time import sleep
import serial

ser = serial.Serial('COM3', 9600)
while True:
localtime=time.localtime(time.time())

k=','+str(localtime[2])+'-'+str(localtime[1])+'-

'+str(localtime[0])+','+str(localtime[3])+':'+str(localtime[4])
inp=ser.readline()

inp=str(inp) + str(k)
i=inp.split(',')

i[3]=i[3][0] s=i[0].split("b'") i[0]=s[1]
print (i)

writer = csv.writer(open("data.csv", 'a'))     writer.writerow(i)
Sleep(9.5)
```

Fig. 7. Python Script

The proposed system is tested for seven days in the greenhouse. The main motive of our work is to provide smart irrigation and detection of intrusion in the field which is easily done through the proposed model.

Whenever the soil moisture goes below 20 the water pump started automatically and irrigate the field till the moisture of the soil reaches to 90. As show in Fig. 8. x axis represent the time in seconds and y axis represents the water content present in the soil the variation in the graph depict about the enhancement of the water content.

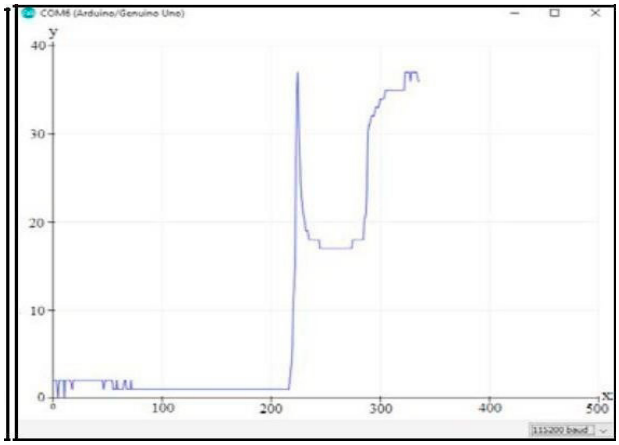

Fig. 8. Soil Moisture of Field

At certain point the water content of the soil will remain at constant point and there will be no variation in the graph as shown in the Fig. 9. this because the water pump stop irrigating the field because the particular assigned threshold value on which the water pump will stop irrigating the field is achieved.

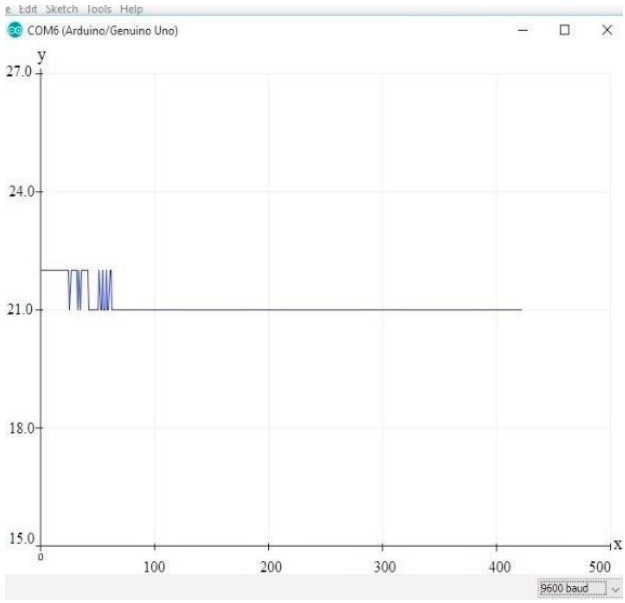

Fig. 9 Soil Moisture after Irrigation

At value 21 the water pump will stop irrigating the field. If there is any detection in the field then it will be caught by PIR sensor, as it was done by PIR sensor during the testing of proposed model. As show in Fig. 9.

The detection of the motion is for particular time period as shown in the Fig. 10. The first motion is detected for 16 seconds after that the motion is ended, here motion shows about the detection of the intrusion in the field. The whole data through the proposed model in stored in the system which can be also assessable from the remotely location. The whole data is stored in the form of excel sheet with the help of python script. The Fig. 11. shows the data in the excel she

```
Motion detected.
16sec
Motion ended.
Motion detected.
43sec
Motion ended.
Motion detected.
59sec
Motion ended.
```

Fig. 10. Detection of Intrusion

Moisture	Temp	Motion	Date	Time
72.71	12.53	1	15-11-2018	09:15
72.12	15.48	0	15-11-2018	09:15
71.6	14.86	1	15-11-2018	09:15
65.46	15.18	1	15-11-2018	09:15
66.26	15.56	0	15-11-2018	09:15
63.72	13.79	0	15-11-2018	09:15
63.12	13.93	1	15-11-2018	09:15
66.97	13.15	0	15-11-2018	09:16

Fig. 11. Data Shown in Excel Sheet Remotely

6. Conclusion

By implementing the designed prototype in a greenhouse, the water wastage problem is reduced. Device start automatically irrigating the field when there is need of water. Even though with the help of designed prototype the occurrence of any intrusion the field can be easily identified. In future we will work over soil moisture, pH value of Soil for getting better production of the crops.

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