Polyculture Using Precision Farming

Sunanda Dixit, Tejesh P, Varuna M M, Santhosh V, Thulisi Kumar M

Abstract— **Devise an autonomous system where crop rotation can be simplified and facilitate cultivation multiple types of crops within the same field and during the same cycle. Those crops required a similar fertility of soil can grow at once so that it improves yield and also it is better source of soil fertilization. Crops like ragi, mirchi, tomato can be grown at once in the given land as soil required to grow are nearly equal. These crops cultivation can be automated, protected, also can be kept record and can manually control all the sensors with the given farmers ID. A simulated field with micro controlled sensors and actuators which monitor and control the environment. Recorded data is sent to a secure database. A server system which records and performs complex calculations which triggers the actuators at the precise conditions. A security system which monitors illegal entry of foreign entities like animals or unauthorized people. A reporting system which reports events to the respective personnel. System should work remotely. A remote web interface with secure login feature which can monitor and control events remotely. Fall-back system which works for prolonged duration even when the source power supply is cut-off.**

Index Terms— **Polyculture, Precision Farming, Multiplexer, Agricuture, HTML.**

I. INTRODUCTION

Precision agriculture is a sophisticated technique of cultivating crops during which farmer keenly observers each crop and setting that would calculable for maximum profit. Precision Farming is outlined as Info Technology Based mostly, comparatively higher Management System that identifies, procures, analyzes and manages, natural variability amongst the fields and optimizes productivity, profit, property that protects the agricultural natural resources. It is a empiric management technique that's characterized by the gathering and use of land-specific knowledge. This will then be used to regulate the appliance of inputs to specific characteristics of little units of cropland and tract to completely utilize crop necessities like manure, water and input use like adding chemicals throughout right time of crop growth[5]. It is supported technological implementation from various sectors and depends abundant on multiple technologies and infrastructures, like knowledge grouping collecting and management systems, global positioning systems (GPS), microelectronics, [1] wireless sensor networks (WSNs), and identification of intruder with the assistance of microwave device technologies. Precision agriculture is regarding sanctionative farming to require right choices with a goal to exploitation solely the desired quantity of inputs in the right place at the proper time.

Digitization is currently major contribution within the field of agriculture food production, that helps farmers life abundant easier by providing agriculture with a lot of tools for straightforward running i.e., creating them work each manually and mechanically, decision-making. The most objective of precision agriculture is sanctionate improvement that means serving to precise usage of necessities of crops, like fertilizers, pesticides and irrigation water that contain a huge impact on environment by effective and solely with needed necessities like water or air. Generally, acceptable agricultural knowledge management makes it doable to gather and collect data on, among other essentials like soils, climate, crop varieties and farm management. Also, by exploiting common knowledge standards that enable change ability between precision agriculture technologies, there is additionally potential for reducing body burden and exploitation agricultural knowledge for numerous functions.

Precision agriculture become how to assist live a part of the environmental impact of farming, which can facilitate farmers compliance with sensible agricultural management standards and will enhance farmer's role as public merchandise suppliers and support guaranteeing a good money attained for his or her efforts. Agricultural data management and precision agriculture also make farming more transparent by improving the process of tracking, tracing and documenting. The use of digitalization is not exclusive only to industrial agriculture, but also for organic farming or any other agro-ecological approach in order to improve farm management. Appropriate agricultural data management and precision agriculture has additionally been planned to reinforce multiple crops growth in same field thus on come through positive environment and food traceability.
Image segmentation techniques proposed by Sunanda Dixit et al[6-8] and Image registration techniques[9].Heart Disease prediction using machine learning is proposed by [10-11]
The keen impact of precision agriculture lies in its potential effects upon social values, the freedom of the farmer and therefore the comfort ability of native farming structures. These impacts are related to the affordability of precision agriculture technologies, the sweetening of the possible digital divide among these exploitation precision agriculture, the transparency of the algorithms used and therefore the sensible governance of knowledge sharing and possession, informational asymmetries and dependence an advanced suppliers doubtless resulting in monopolies that successively might have an effect on food security, regional cohesion, native genetic and mental object as a result of size, technical complexness, and infrastructural necessities of precision

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farming, usage of precision agriculture would possibly result in a reliance of the overwhelming majority of farmers on off-farm service support, to a chop-chop growing digital division between little and massive farmers, and important power shifts. This will successively result in potential misuse of data by agricultural trade goods markets or operation by major multinationals as a result of little farmers lack the investment capital or knowledge to accumulate precision agriculture technologies, that in impact might signal an unmatched power shift within the industrial farming process.

The objective of the Polyculture project is to create information offered on polyculture systems style that is presently alive however not wide offered, through grouping, analyzing and distributing the principles of successful organic polyculture farming. The organization of paper is Methodlogy is explained in section II.Part III explain Implementation, Part IV Results. Testing explained in V and Conclusion is at Part VI.

II. METHODOLOGY

The system consists of 6 separate modules. Each module performing a crucial role which make the system complete. The 'System Design' consists the relation amongst these modules. The main module on which the complete system depends on is the 'Server System', which holds all data transactions and is responsible for all major computations.
NodeMCU Main System connects with the server to send field sensor data (temperature, soil moisture, light intensity) and it also retrieves pump action status to switch pump state.
NodeMCU Security System connects with the server to send ultrasonic sensor data. This module does not perform any other operation.
Raspberry Pi Security System connects with the server and verifies the state of the security alert. When the alert is true, it captures a video stream and sends this stream to the telegram bot.
Web Interface System provides a user-friendly interactive platform to view latest sensor data and manually operate actuators present in the NodeMCU Main System. The Web Interface System retrieves necessary data from the server[2].
Remote Access & Control System provides Web Interface System access the internet through IPV4. A service provided by 'remote.it' is utilized to provide this feature.

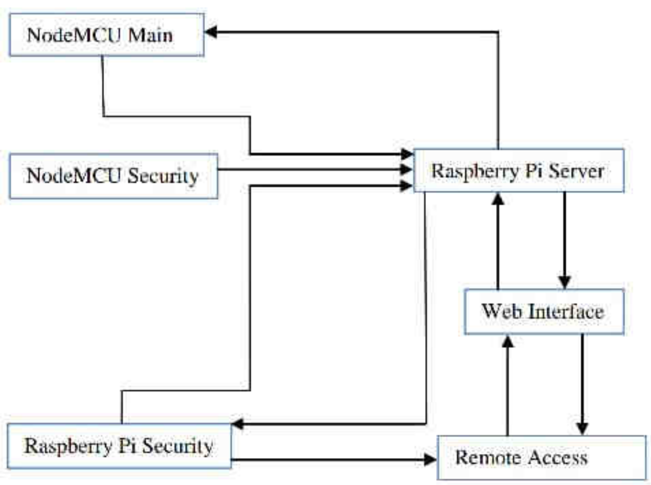


Figure 1. System Architecture

III. IMPLEMENTATION

Raspberry Pi Server Design:
The server is hosted using Apache2, MySQL and phpMyAdmin. MySQL database performs all the major operations such as inserting records, updating records and triggering procedures. The Apache server hosts the connection over the WEB port 80. phpMyAdmin serves as a web interfaced administrative platform for MySQL.

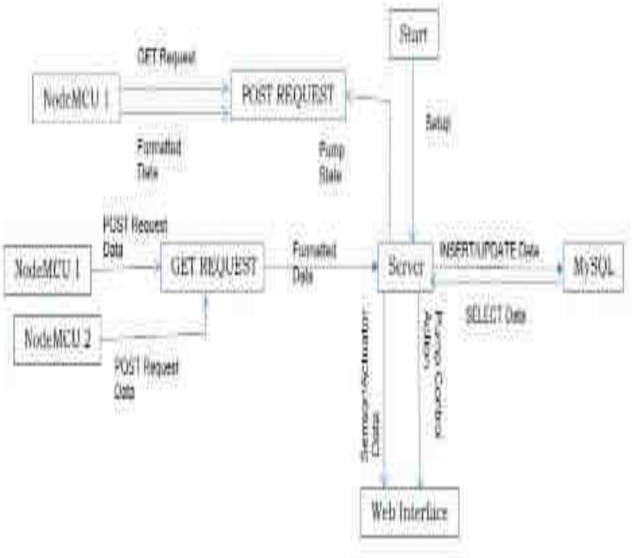
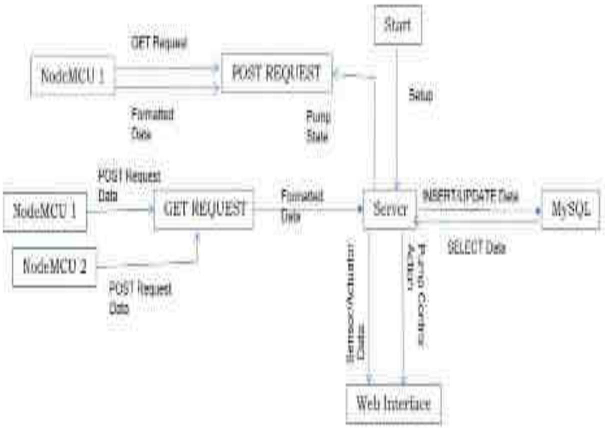


Figure 2.Raspberry Pi Server Design

The server consists of 2 main php scripts which handle POST & GET requests from NodeMCU Systems. The POST request handles all INSERT and UPDATE commands while the GET request handles all the SELECT commands.
The server contains number of scripts written in html, php, java script and css which handle the Web Interface System.
MySQL[3] also triggers procedures when conditions of low moisture have been detected. This procedure updates the values of pumps based on the conditions. These values are sent through the GET request to the NodeMCU Main System.

NodeMCU Main System Design
This system consists of 6 soil moisture sensors, 4 light intensity sensors and 3 temperature sensors. These sensors are read using an analog mux/demux. A control sequence is written by the nodemcu into the mux/demux which change the control bits within mux/demux. This gives a very precise control in reading the sensors and also removes junk reading. The read data is stored in a two dimensional array along with each sensor id. Once all the sensors are read, the values are displayed in the serial monitor.[12]
In the next step, the nodemcu checks the connection with the server. If a connection exists, a POST request string is generated before making the HTTP request. The response code is recorded and displayed in the serial monitor. For a successful POST, response code must be 200.
The final step is a GET request which enquires the state of pumps. If the new state is same as old state, then no changes are performed but if they are different, then respective actions are performed.

The nodemcu loops back to recording sensor data.



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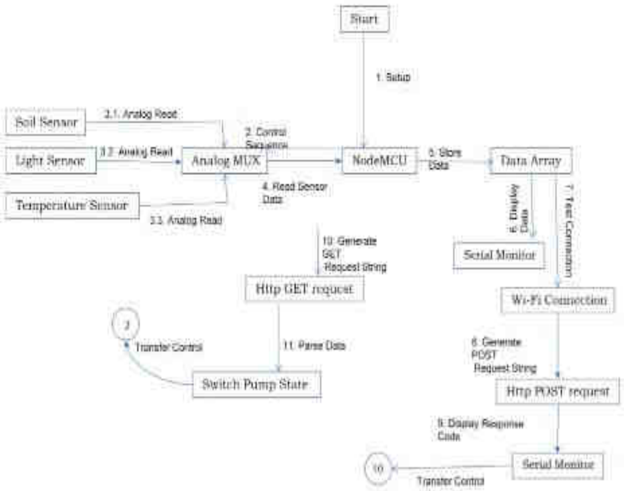


Figure 4.NodeMCU Main System Design

NodeMCU Security System Design
This system consists of 4 ultrasonic sensors which check the interference or entries into the field. They send the data to the server using a POST request as proposed in paper [13][14].

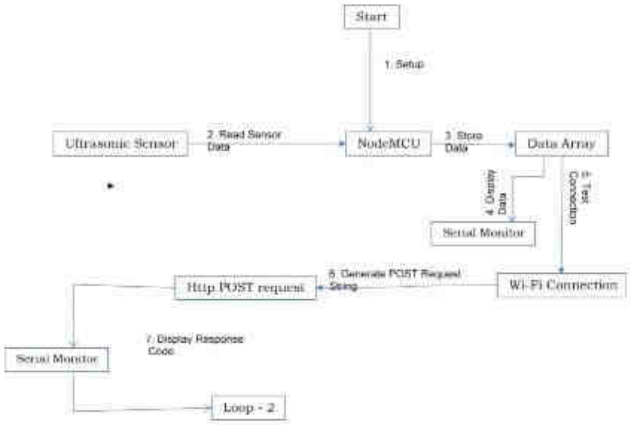


Fig 5.NodeMCU Security System Design

IV. TESTING

It is important to test an ESP8266 WiFi module to see that it is working. An ESP-05 module is used in this basic test, but the test should work with any ESP8266 module (ESP-01, ESP-02, ESP-03, ESP-04, ESP-05, ESP-06, ESP-07, ESP-08, etc.).

The new ESP8266 module could be tested with basic test detailed below. This is considered to be the "run test" to verify the model is in stable, working condition.

Testing is initiated by sending AT commands to the ESP8266 and checking that it responds as expected. AT commands are sent from a terminal window on a PC to the module. An Arduino Due is used to connect the ESP8266 WiFi module to a PC. The Arduino IDE Serial Monitor window is used to send AT commands to the ESP8266 and to see the response from the module.

It is also possible to do the same test using a USB to serial TTL cable such as those offered by FTDI. The commands can then be sent from any serial terminal program.

ESP8266 Test Hardware Setup
An Arduino Due is used in this test because it can deliver enough current from the 3.3V pin to power the ESP8266 module. The Due also has 3.3V I/O pins which make it compatible with the logic levels on the ESP8266 pins.

Connect the ESP8266 module to the Arduino Due as shown in the block diagram below.

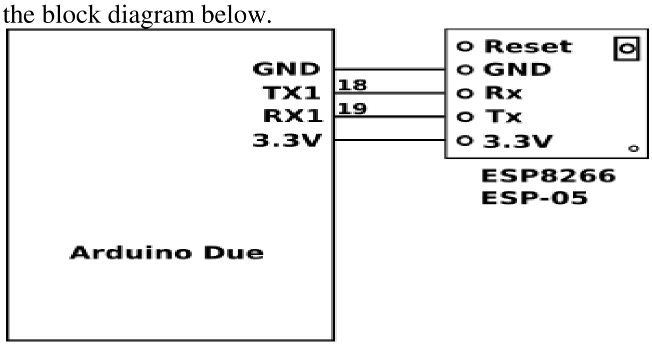


Figure 6. Arduino Board

It is very easy to connect the ESP8266 module to the Arduino Due as shown in the block diagram. Two wires are used for power (3.3V and GND). The transmit and receive signals of the UART on the Arduino and UART on the ESP-05 cross over i.e. transmit from one UART connects to receive on the other and vice versa. The Figure 7 below shows the ESP8266 module connected to an Arduino Due using an electronic breadboard.

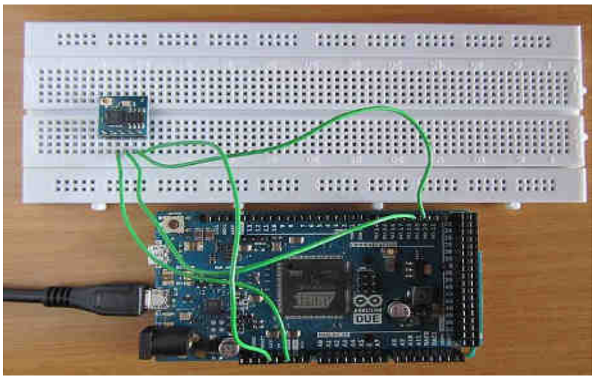


Figure 7: ESP8266 module connected to an Arduino

Arduino Due Test Code Sketch

```
void setup() {
 Serial.begin(115200);    // USB serial port of Due
(PROGRAMMING)
 Serial1.begin(115200);  // ESP8266 on Serial Port 1 of Due
(UART 1)
}

charrx_byte = 0;

void loop() {
  // send terminal byte to ESP8266
  if (Serial.available() > 0) {
    rx_byte = Serial.read();
    Serial1.print(rx_byte);
  }
  // send ESP8266 byte to terminal
  if (Serial1.available() > 0) {
    rx_byte = Serial1.read();
    Serial.print(rx_byte);
  }
}
```

Testing the ESP8266 WiFi Module

With the above code loaded to the Arduino Due and the hardware connected as shown, power is generated to the Arduino from the USB port of a PC. Open the Serial Monitor window from the Arduino IDE and change the following settings at the bottom of the Serial Monitor window:

I. Both NL & CR – send both a newline and carriage return character at the end of a command.
II. 115200 baud – baud rate of communication set to 115200

If different module are used, the baud rate settings may be vary. If the module returns unreadable characters, the baud rate has to be changed frequently. This will need to be changed in the sketch as well and then the sketch reloaded – i.e. change the baud rate in both the sketch and the serial monitor window.

Soil Moisture Sensor Interfacing with NodeMCU

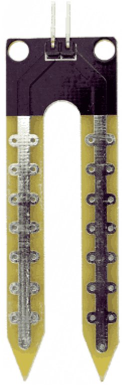
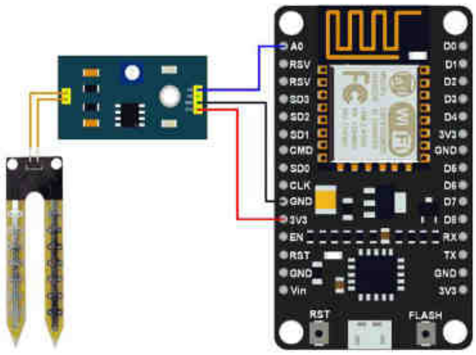


Figure 8: Mositure sensor with Node MCU

Soil moisture is basically the content of water present in soil. This can be measured using a soil moisture sensor which consists of two conducting probes that act as a probe. It can measure the moisture content in the soil based on the change in resistance between the two conducting plates.

The resistance between the two conducting plates varies in an inverse manner with the amount of moisture present in the soil.



Testing an HTML login page

1. Verify if new user can register their account by providng the required details and can create their own password.
2. Verify if a user will be able to login with a valid username and valid password.
3. Verify the “Forgot Password” functionality
4. Verify if the ‘Enter’ key is working correctly on login page

Interfacing water pump with NodeMCU using relay

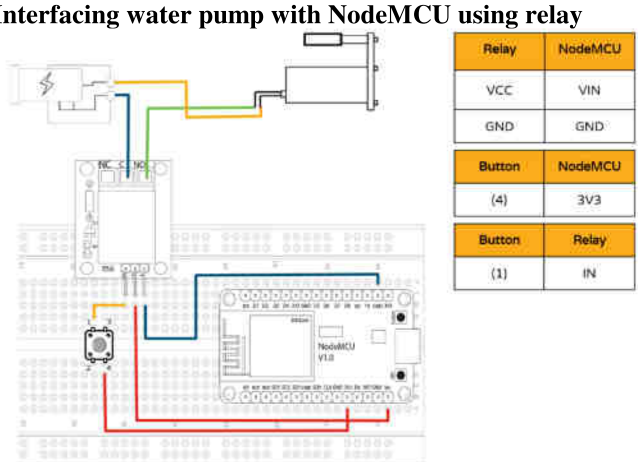


Figure 9: Water pump interfacing with Node MCU.

A relay is a device that allows a low current device, NodeMCU to control a device with a high current requirement like a water pump. The relay acts as a switch. One must build a complete circuit to run the water pump (using a 12V DC power jack) and then use the relay as a way to make or break the circuit.

The relay has three terminals on the low current side- VCC, GND, and IN. The IN pin is how the NodeMCU controls the relay.

The relay also has three terminals on the high current side – NO, C, and NC – which stand for Normally Open, Common, and Normally Closed, respectively.

If the pump circuit is connected between NO and C, then the pump is initially OFF. Giving a LOW signal to the IN pin will cause the relay to close the circuit, and the pump will run.
If the pump circuit is connected between NC and C, then the pump is initially running. Giving a LOW signal to the IN pin will cause the relay to open the circuit, and the pump will switch OFF.

There is button connected as an input to decide whether to send LOW to the relay or not.

V. RESULTS

ESPlorer Serial monitor output window for Soil Moisture

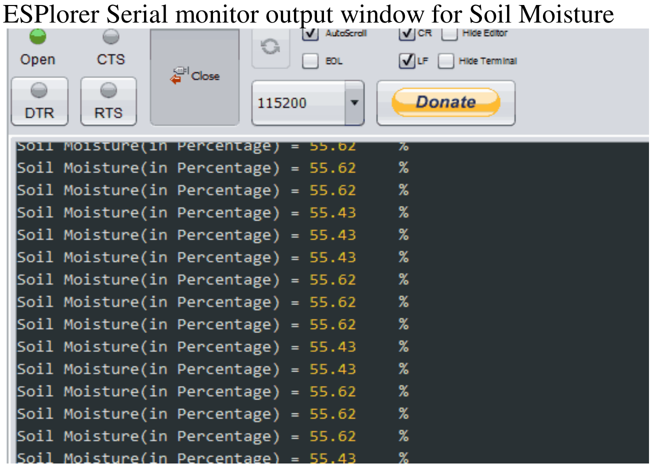
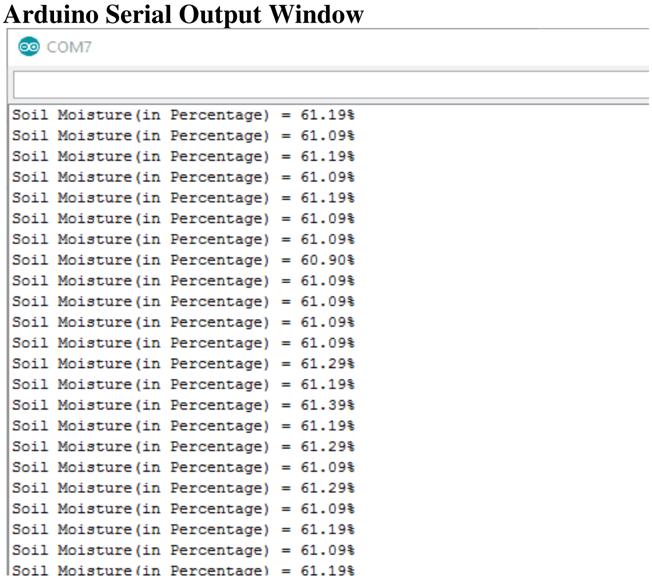


Figure 10: Screen shot of moisture content result

Arduino Serial Output Window



Connecting water pump motor to ESP8266

Figure 11 : Water pump assembly

CONCLUSION

Digitization permits numerous benefits to farmers however will generally be troublesome for who needs to embrace new technologies. There are square number of the challenges the agricultural sector must overcome these days in India- costly machinery, the absence of infrastructure and lack of data. Precision agriculture and agricultural knowledge management are anticipated to lift abundant of makeshift socio-ethical and legal challenges; additionally the agricultural food price chain has characteristics that build it completely different from price chains in several of different industries. The legal analysis points primarily to the challenges which may arisen just in case precision agriculture becomes standard particularly across medium and small size farms.

There were multiple limitations that seems to be excluding some brightness of agriculture or its land management. As any mixed crops is termed a ‘polyculture’, and due to the fact that the pasture crop itself isn’t a solid product, the study, and most of the literature, failed to address ruminating systems in an exceedingly substantial method. Similarly, several helpful, organic practices like inexperienced manures, under seeded following cowl crops, crop rotations, reveling things weren’t Added as the criteria for the study was polyculture production of business crops for purchasable. The analysis study and therefore the literature attended to be dominated by vegetable, fruit and grain cropping with a lesser however important contribution covering agroforestry, animal interaction and pulse production.

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