Design and Implementation of Smart IoT Farm

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Abstract - *Smart IOT Farm is a proposed system to increase the yield considerably by allowing the farmers to monitor farm parameters such as temperature using temperature sensor, humidity using humidity sensor, rainfall using arrangement of wires, light intensity using LDR (light dependant resistance) sensor and plant height using ultrasonic sensor. The farmer will be able to easily monitor the readings of these sensors remotely on his mobile on an app that I have made in a graphical GUI format. The system will also compare data of sensors and control the irrigation and ventilation (in greenhouse) system accordingly. I have also used some AI algorithms to make future predictions of all the mentioned parameters and yield. This will increase the yield drastically.*

Key Words: IoT, LDR, Soil Moisture, Humidity, Node MCU, Ultrasonic sensor, DHT

4. BLOCK DIAGRAM

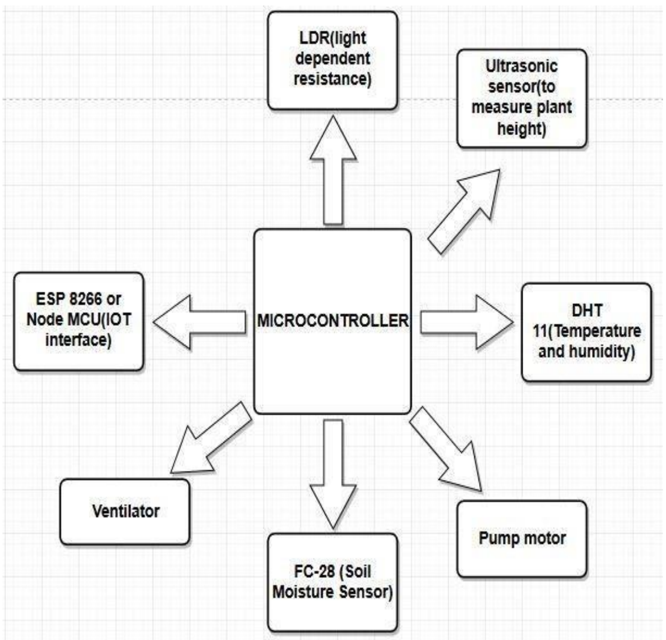
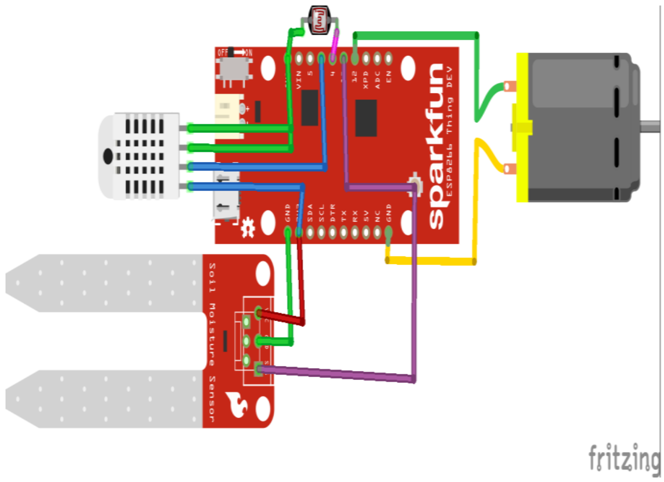


Fig 1 - Block Diagram

2. CIRCUIT DIAGRAM



3. INTRODUCTION

Farmers are backbone of any civilization. A society where farmers are in miserable state today, is on path to starvation tomorrow. Nowadays many farmers are committing suicide because of unfavourable conditions, lack of knowledge. This device aims to help farmers, they can post their queries on the online platform or by the app and they can also view their live farm data just by a click. The farm data is sent to the farmer in a excel spreadsheet and the farmer can easily view the data in a tabular form. The online interface by a web site or the Smart Farming app one can easily send his queries in public. These will be answered by farming experts, herbalists, botanists, other farmers etc.

4. PROBLEMS IN FOCUS

4.1 Problem

- Maintaining track of different farm parameters such as humidity, soil moisture, temperature, electrical conductivity, plant height, light intensity.

Proposed Solution

- Sensors like DHT 11 or DHT 22 sensor for temperature and humidity, rainfall using arrangement of wires, LDR (light dependant resistance) sensor for light intensity, electrical conductivity by keeping two bare wires in soil at appropriate distance, pass some voltage (3.3-5 V) and measure potential at other wire and ultrasonic sensor for plant height.
- This will also increase the yield considerably.

4.2 Problem

- Viewing all the parameters data in a graphical format.
- Viewing past data.
- Storing data in a secure place and in tabular format.
- View the live and past data remotely.

Proposed Solution

- The Smart Farming app can be used which will plot the data using line, bar or area graphs and gauges.
- It will also allow the farmer to view his past data (till past one year) on the app.
- All the data will be stored in the farmers Google Drive account in form of an excel spreadsheet.
- The farmer will be able to view his live farm data remotely on his app or on the adafruit.io website. The data will be transferred by means of IOT (internet of things).

4.3 Problem

- To predict future above-mentioned farm parameters and accordingly predict the yield.

Proposed Solution

- Some AI algorithms like linear and nonlinear regression (if past data is available) and grouping algorithms (if past data is not available) can predict the yield and future farm parameters so the farmer is ready with the measures.

4.4 Problem

- To control the temperature automatically inside a greenhouse.

Proposed Solution

- The temperature data will be compared to the expected temperature readings and the ventilator will be switched on and off from this data and the farmer will also be able to control the ventilator manually.

4.5 Problem

- To control the irrigation by soil moisture and humidity data.

Proposed Solution

- The humidity and soil moisture data will be compared to the expected readings and the pump motor to control amount of water flown will be switched on and off from this data and the farmer will also be able to control the pump manually.

4.6 Problem

- Many farmers have queries and need some advice from others or expert help.
- Proposed Solution
- I have made the Smart Farming website on which queries can be posted and one can reply to them too. These queries will be answered by farming experts, herbalists, botanists, other farmers etc. The URL is - https://daglialpa.wixsite.com/mysi te

5. METHOD OF FUNCTION

On the farm the device will get all the live sensor readings and stream them on the app that I have made. The user does not necessarily need to be connected the same network to which smart farming device has been connected. These data readings will also be sent to adafruit.io website. The farmer will be able to see the live and past data on the app and the website. I have used IFTTT (if this then that) to save a copy of all the data into an excel spreadsheet in an organised tabular format on the google drive account of the farmer. From the app and website farmer will also be able to compare the soil moisture and temperature readings with the expected readings and accordingly can remotely switch on and off the irrigation system and ventilator. One will easily be able to read the data and interpret it as the data will be plotted and displayed in a graphical GUI (graphical user interface) format. The smart farming device will also compare the soil moisture and temperature readings with the expected readings and accordingly switch on and off the irrigation system and ventilator without the farmer having to do it manually. I have also included the snippets of the app and adafruit.io website output. I have also used some AI algorithms like linear regression and non-linear regression to make predictions of future parameters and future yield in results section. These algorithms will analyse the previous data and try to find a best fit line in case of linear regression and some pattern in case of non- linear regression. I have also included snippets of output of the algorithms where it was provided with data of first 20 days and it had to find a forecast of the parameters for next 10 days in results section. I have also included the graphs made by the algorithm which depict a particular pattern in results section.

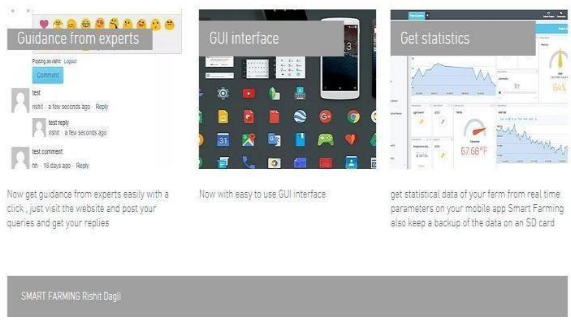
6. IMPLEMENTATION

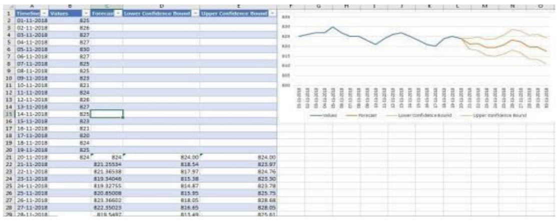
- The prototype which I made depicts the working of the proposed system on a greenhouse however we can also use this on an open farm by putting all the mentioned sensors in a small box which can be placed on the four corners of the field. For prototyping purposes, I have used Node MCU (ESP 8266) but while implementing this on a large scale we can use some other custom-made microcontroller which is water resistant and small in size too or ARM microcontrollers.
- To make this box as small as possible we can use VLSI (very large- scale integration) that is making parts dedicated for the Smart Farm and integrate all the sensors and actuators on a single PCB (printed circuit board).
- Some crops' yield is independent of some parameters change for example light intensity in some particular crop so the LDR sensor which measures the light intensity can be removed from the system but however a very large change in light intensity would affect the plant so in that case we can obtain the data from some web API's such as wunderground, open weather map, wetter online, Accu weather , wetherbit.io etc. and can be displayed. However, this data will not be very accurate. This will also improve the cost effectiveness of the system.

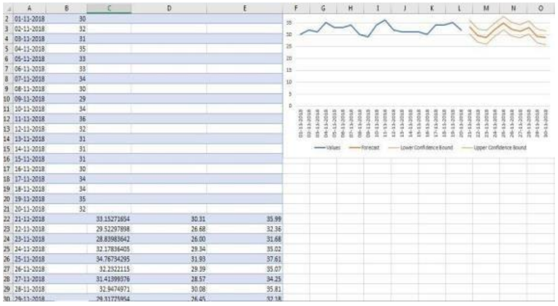
7. POWER MANAGEMENT

- Power management means powering the device.
- Lithium Ion which is used in mobiles can be used in suggested gear.
- Most devices work on 3.3V, so we can have a battery of 4.3V or maximum 5V.
- All devices have to be managed for efficient power utilisation.
- A lithium-ion battery or Li-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging.
- Because of the inherent instability of lithium metal, especially during charging, research shifted to a non-metallic lithium battery using lithium ions. Although slightly lower in energy density than lithium metal, lithium-ion is safe

8. RESULTS







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