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Design and Development of IoT and Cloud Based Smart Farming System for Optimum Water Utilization for Better Yield

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ABSTRACT

India is a land of farmers Agriculture plays major role in the economical development and growth of our country, it contributes nearly 17-18 % of total GDP according to 2017-18 economic survey .It acts as the main source of employment for 60% of the population. Nearly 70% of rural households and farmers depends upon the agriculture .Indian farming relies on either rain fed farming or irrigation system for the water usages in agriculture , very less states and places of our country falls under rain –fed farming where as maximum farming is dependent on Irrigation system but the availability of water resources in our country for agriculture is very less hence there is a need of water conservation for better yield and maximise the cost of production . Most of the framers are using old irrigation systems like Drip irrigation, micro-irrigation, sprinklers, pivot etc to reduce the utilisation of water .They still follow the traditional methods of watering the crops thereby watering the crops unevenly, sometimes they may water the crops less or more or sometimes unnecessarily this may lead to wastage of water and soil moisture level may decrease.

In the proposed smart agricultural system the researcher focuses to overcome the problems in this traditional irrigation systems used for agriculture by implementing the IoT and cloud is .In this system various vegetable crops and soil samples with different moisture level are considered and sensors are placed in the fields that provides soil moisture levels as input to the aurduino uno and this uploads the soil moisture levels frequently to the cloud through internet and WIFI module and depending upon these soil moisture levels the motor switches to ON/OFF state there by watering the crops only when the soil becomes dry at certain level according to threshold values programmed in the Microcontroller. This system works with very less human involvements .The farm statistical report can be viewed by the farmer anytime on the App , thereby making optimal utilization of water for better crop yield

KEYWORDS: *Water conservation, Agriculture, Retaining Soil moisture levels, IoT based smart APP*

1. INTRODUCTION

The term agriculture is derived from Latin word. It means soil and cultivation which is the basic source of livelihood for all the farmers .farmers do substantial farming to meet the needs of their family and commercial farming for commercial purpose hence it also affects the economy of our country but considering the resources available for farming it is observed that few parts of country can rely on rain where are most of the areas depends on Irrigation systems like Drip, Sprinkler and so many. Farmer is prone to old traditional approaches of watering the crops he may water the crops as a daily routine but this uneven watering may lead to the wastage of water and even loss of soil moisture level and fertility. India has annual average precipitation of 1,1700mm and 80%of total area of country experiences

rainfall of 750mm. Nearly 90% of population comes under water stress .Hence there is an intense need of water conservation and increase the production cost also and maximise the yields by optimal water usages. There is a need of adopting latest technologies so that the farming can be carried out efficiently with less human intervention and by making usage of optimal resources for farming .In this paper the researcher focuses on latest technologies like IoT and Cloud with the implementation of this system various soil moisture sensors cab be placed in the farm that frequently monitors the soil moisture levels and depending upon the moisture level the watering is done to the crops in the farm automatically.

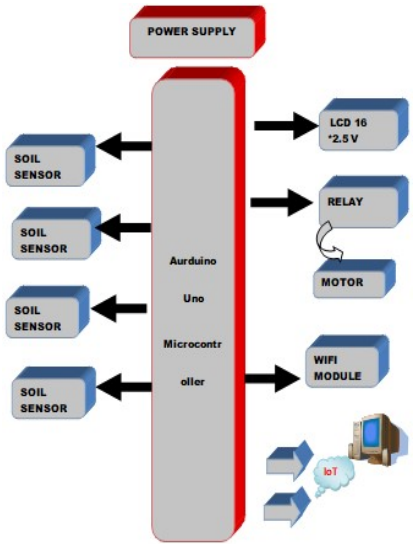
1.1. Literature Review

As our agriculture plays vital role for our country as well as for farmers .Considering the current scenarios water availability for agriculture is very less. Water resources available for irrigation are also very less which is threatening the biodiversity and food production .there is also need to preserve the arable land and soil fertility. Hence to utilize all the resources efficiently and to conserve them smart farming is needed this can be implemented using 1. IOT (Internet Of things)It is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human/human-to-computer interaction." .

The other one is Cloud Services: Cloud computing is availability of open space to store the data and utilize the data for analysing purposes. Different smart farming systems are developed using various devices like Zigbee, Bluetooth Module, Wi-Fi Modules ,GSM Modules ,GPRS Modules, RFID all these are built on different IoT nodes like Arduino Uno, Node Mcu, Raspberry Pi and so many Different nodes can be used on the requirements of the system. some of the devices has advantages and disadvantages over each other and some are cost variant. Different systems are designed for automated irrigation system which senses the different attributes of soil and water the farm accordingly. Hence the researcher focused on developing a system which will overcome all the constraints like cost the researcher implemented this system which works on wireless communication and farmer can get the reporting of farm in any part of world and entire farm will be automated and optimal water is used to get better yield.

System Overview

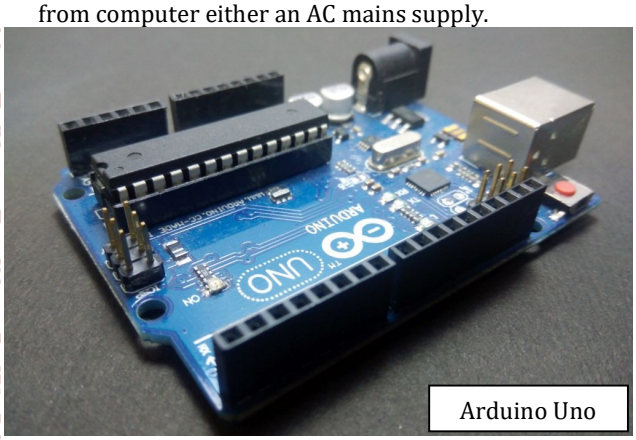
The proposed system is implemented using four major components Microcontroller Aurduino Uno, Soil Moisture level Sensors, Wi-Fi Module, Relay. LCD display and Motor. The block diagram is as shown below



Block Diagram of the System

Hardware Used:

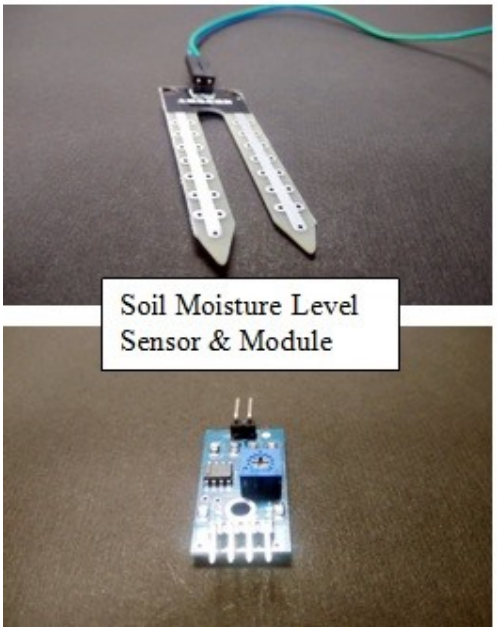
A. Aurduino Uno Microcontroller: It is an open source with both hardware and software drive with 8 bit ATmega328 a low power CMOS controller based on RISC architecture .It has highest performance with variety of choices fully static operation and self programmable flash program memory in the system. It can be powered using USB cable from computer either an AC mains supply.



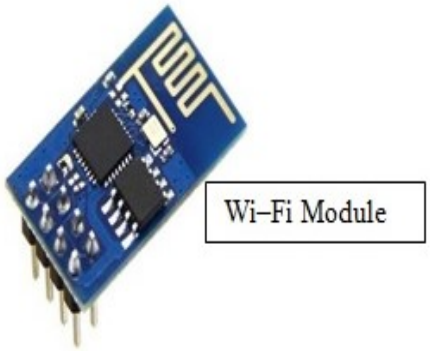
Arduino Uno

B. Soil sensor: This soil sensor detects the moisture level of soil on field from 20%(wet) - 200 % (dry). It is a circuit board having two probes which senses the soil status. This sensor will show the volumetric content of soil and loss of water content due to evaporation. This sensor is merged with the controller and coded.

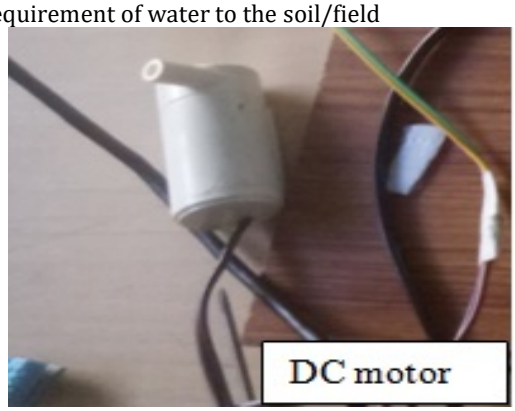
The sensor contains two fingers through those current is passed to soil when sensor is placed in the soil. The sensor finger passes more current to soil with less resistance indicates the soil is wet where as the probes pass less current with high resistance indicates that soil is dry. This values of resistance helps us to detect the soil moisture status



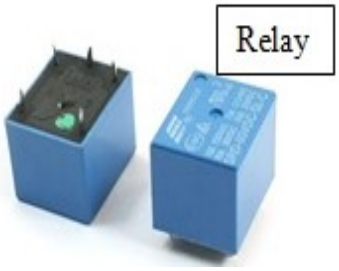
C. Wi-Fi ESP8266 MODULE
This module is a self contained socket which is capable of hosting an application .It contains the TCP/IP stack and microcontroller capability, this module allows microcontrollers to connect to Wi-Fi networks. It has 16 GPIO pins



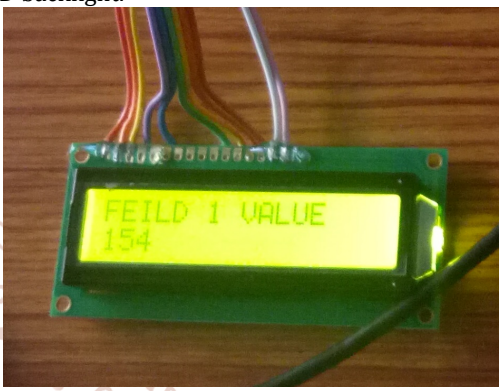
D. Water motor: The motor is connected to the relay for managing the flow of current. Motor pump is used to pump the water from water storage during the requirement of water to the soil/field



E. Relay: It is used to connect the valves to the microcontroller, the ignition key when turned ON; the electricity flows through the relay and then connects the battery to the motor to start. They allow low power circuits with small switch

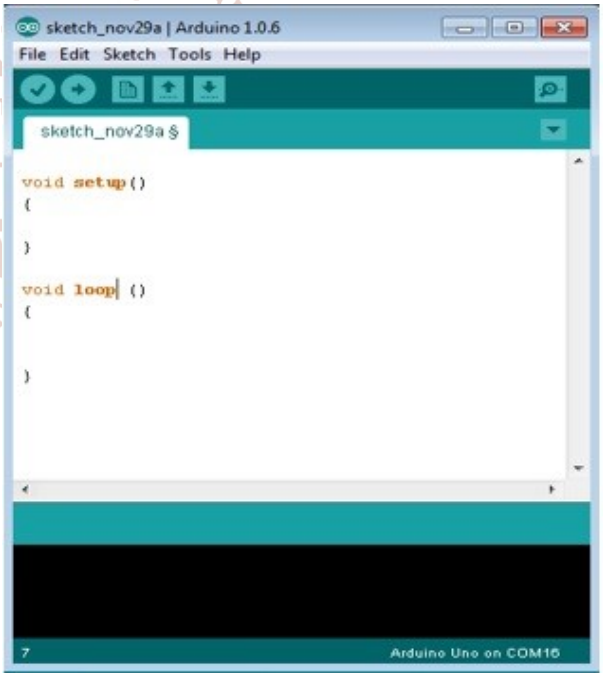


F. LCD Display: This is a basic 16 character by 2 line display. Black text on Green background Utilizes the extremely common HD44780 parallel interface chipset (datasheet). Interface code is freely available. You will need ~11 general I/O pins to interface to this LCD screen. Includes LED backlight.



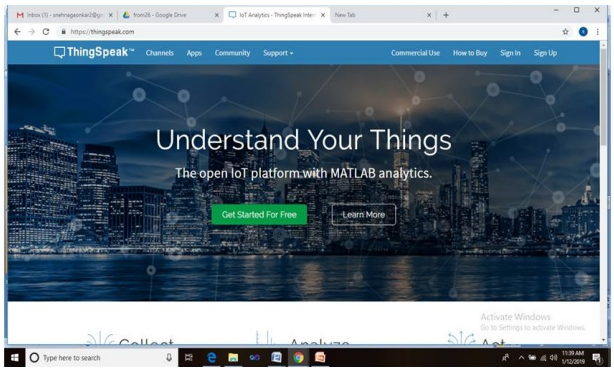
Software Used

A. Arduino IDE

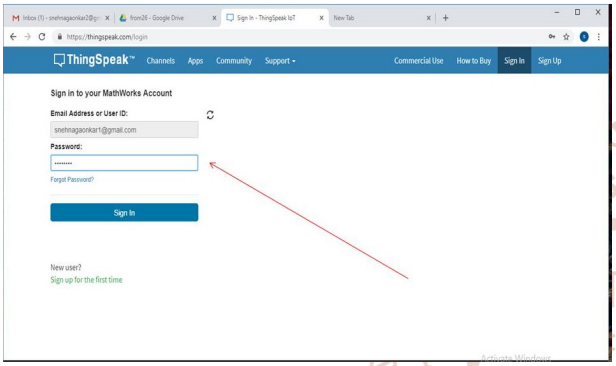


Arduino can be programmed using this IDE, it is very simple and easy to use. A sketch is the file where the code is saved. It uses language similar to C++ and later it translates to MLL to execute the code this is called compilation .Here the researchers is using Arduino Uno board .After the code is ready it is dumped on to the board and it is ready to run.

B. Thing speak



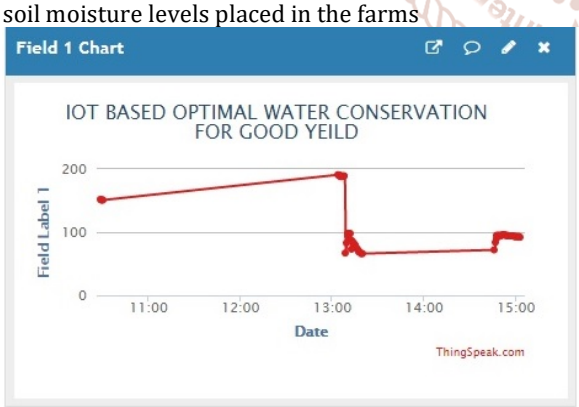
Thing speak is free web service to store the sensors data to the cloud and use the same data for data analytics .It contains apps that provide data analytics and data visualizations. Any of the sensor data can be sent to this web service using Arduino, Node Mcu and Raspberry Pi and other hardware..



We need to register to the site and start using the service by using the API keys generated .it access the data from sensors using HTTP protocol and picks the data from things using network

2. Output of field and Graph Reports.

These are the sample outputs of different days. of soil moisture levels placed in the farms

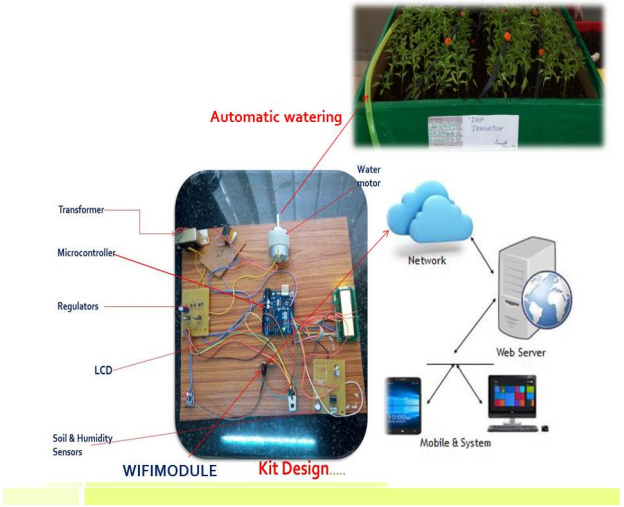


Readings uploaded to Cloud web service (Registered IoT Account)

	A	B	C	D
1	created_at	entry_	field1	field2
2	2018-12-28 03:59:40 UTC	583	157	141
3	2018-12-28 04:00:15 UTC	584	157	142
90	2018-12-28 05:00:02 UTC	671	151	165
92	2018-12-28 07:34:05 UTC	673	191	142
119	2018-12-28 09:16:15 UTC	700	72	89
157				

	created_at	entry_	field1	field2
2	2018-12-28 03:59:40 UTC	583	157	141
3	2018-12-28 04:00:15 UTC	584	157	142
4	2018-12-28 04:00:53 UTC	585	157	146
5	2018-12-28 04:01:27 UTC	586	157	147
6	2018-12-28 04:09:31 UTC	587	133	136
7	2018-12-28 04:10:08 UTC	588	146	141
8	2018-12-28 04:10:44 UTC	589	148	143
9	2018-12-28 04:11:20 UTC	590	149	144
10	2018-12-28 04:11:56 UTC	591	150	145
11	2018-12-28 04:12:32 UTC	592	150	147
12	2018-12-28 04:13:08 UTC	593	150	148
13	2018-12-28 04:13:44 UTC	594	151	149
14	2018-12-28 04:14:21 UTC	595	151	150
15	2018-12-28 04:14:57 UTC	596	151	151
16	2018-12-28 04:15:33 UTC	597	151	152
17	2018-12-28 04:16:09 UTC	598	151	152

Working of the system



The system is built by using Arduino Uno and Wi-Fi Module, two soil moisture level sensors, Relay and LCD. The soil

moisture level sensors senses the moisture level frequently and the microcontroller processes the data and sends through the registered Wi-Fi module which can access the internet and upload the data to the cloud in the web service.

Depending upon the soil moisture levels the motor is turned ON/OFF automatically. In this system the motor turns ON when the dry level is detected (>170) and watering is made until required moist level and later turned OFF meanwhile all the values are uploaded to the cloud later they can be utilised for data analysis. In this system optimal watering is done in the farm which is done automatically.

Conclusion

As The earth is left out with limited resources for agriculture there is an utmost need to preserve our resources such as arable land ,water and fertile soil which can also help the farmer to produce more quality yield and increase the cost of production .Hence there is a need of adoption of Modernisation in Agriculture such as smart farming which will reduce human intervention and by using optimal resources like water the framer can grow more yield which will also help in the economical growth of the country

Future Scope

This system helps us to identify the soil moisture levels in the field and water accordingly. We can enhance this system using water flow sensors and analyse the water content utilised for the entire farm to obtain the yield.

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