IOT BASED AUTOMATIC IRRIGATION SYSTEM AND CROP PREDICTION

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TABLE OF CONTENTS

DECLARATION

I/We hereby declare that this submission is my/our own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that the work titled "**IOT BASED SMART CROP PREDICTION AND IRRIGATION SYSTEM**" submitted by "**Soumy Agrawal, Shivam Rajpoot, Soumy Agrawal**" in partial fulfillment for the award of degree of B.Tech of Jaypee Institute of Information Technology, Noida has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

Name of Supervisor	Ms. Amarjeet Kaur
Designation	ASSISTANT PROFESSOR
Date	12 Dec 2020

ACKNOWLEDGEMENT

We are exceptionally obliged to **Jaypee Institute Of Information Technology** for their direction and consistent supervision and for giving vital data in regards to the undertaking and additionally for their help in finishing the task. We want to offer our thanks towards my folks and individuals from **Jaypee Institute Of Information Technology** for their kind co-task and consolation which help me in consummation of this venture. We also take this opportunity to express our deepest and sincere gratitude to our supervisor Ms. Amarjeet Kaur ma'am, DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY for her insightful advice, motivating suggestions, invaluable guidance, help and support in successful completion of this project.

Signature of the Students

Name of Students	Soumy Agrawal	Bharat Panjwani	Shivam Rajpoot
Enrollment Number	17103331	17103288	17803004
Date	12 Dec 2020		

SUMMARY

This project is to automate the irrigation process for agriculture which amounts for 70% of the income of India. Input for various reading from DHT11(temperature and humidity) and moisture sensor are passed on to the Arduino board which based on set values determines if the pump should be turned on or not. We can change the values for different crops as they need different conditions to grow and hence the field can be irrigated based on a new set of parameters suitable for that crop.

Having a cheap tech like this that can free up the farmer from the constant monitoring the field that he has to do right now would be serve as a boon to the economy as they can now now invest their free time in side business improving their financial conditions not to mention if the crop fails due to some reason the farmer will have something to live on.

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

1.1 General Introduction

This project aims to simplify the most complex question the farmers have ie. should they irrigate their fields or not. This project when it launches will come hardcoded with values set according to crops based on trials and suggestions by various scientists and all the farmer has to do is link it to his irrigations system.

1.2 Problem Statement

Agriculture, for decades, had been associated with the production of basic food crops. Today marketing, processing, distribution of agricultural production etc. are all accepted as a part of modern agriculture. In India, the main occupation of the working population(around 70%) is agriculture but still most of the Indian farmers do not have sufficient technology to address major problems like monitoring of fields which includes irrigation control, soil ecosystem and to invigilate water level. The times as of now are very hard in economic terms and farmers need the tested measures to ensure optimal yield from their crops.

That is where our project comes in which simplifies the whole irrigation problem from monitoring the parameters to discharge correct amount of water such that it is sufficient for the crops to survive and also ensures water conservation.

1.3 Significance of the problem

Any problem that affects 70% of the population of the most populous country in the world is very significant. It is not just about the survival of the crops but also about water conservation and its optimal use to ensure a continuous and optimal supply for the future generations. Though it effects such a large population and there are researches are undergoing the knowledge delivery to people is very slow and using this farmers wont need the knowledge just a 9V battery to get on.

1.4 Brief description of solution approach

We are using a moisture sensor probe and a DHT11 to record soil moisture, humidity and temperature and decide should the water be turned on to maintain idle conditions or are the crops in good enough conditions. The debate here is to use as little water as possible to maintain soil water table as most of the farmers will be using borewells or wells for irrigation and also ensure that implementing water conservation does not effect the idle conditions for the crop.

1.5 Comparison to existing approaches of the problem framed

First of all there aren't many solutions to this in market as whoever has this tech generally uses it for their personal needs. Most of the publicly available ones just use soil moisture as the sole parameter for if the pump should be turned on or not. Though soil moisture is enough in 8-% cases but in the rest 20% it is really needed to have the humidity and temperature sensor to avoid flooding or drying up of the field.

LITERATURE SURVEY

Paper 1

Title	Smart irrigation system using Arduino Uno
Authors	Kavya Monisha K.,Aishwarya D.,Krupaleni K.
Year	2018
Summary	This paper introduces us to a smart irrigation system, using Arduino-Uno,checks the moisture level in the soil. If the moisture level in the soil is low, it automatically sends an alert message and turns on the water motor to flow water to the soil. If the moisture level in the soil is sufficient, it switches off the motor.This system reduces the effect caused by insufficient rainfall. This irrigation system prevents excess water flowing into the soil which causes a wastage of water, electricity and damage to the soil, effectively.

Paper 2

Title	IoT solar energy powered smart farm irrigation system
Authors	A.R. Al-Ali,Ahmad Al Nabulsi,Shayok Mukhopadhyay
Year	2016
Summary	This paper proposes a system which utilizes a single board system-on-a-chip controller,which has built-in WiFi connectivity, and connections to a solar cell to provide the required operating power. The controller reads the field soil moisture, humidity, and temperature sensors, and outputs appropriate actuation command signals to operate irrigation pumps. The controller also monitors the underground water level,which is essential to prevent the pump motors from burning due to the level in the water well.

Paper 3

Title	Smart Irrigation and Tank Monitoring System
Authors	Kumar Kunal,Md. Azhar Hussain,Dr. N Srinivasan,J.Albert Mayan
Year	2017
Summary	The framework peruses the moisture substance of the dirt utilizing soil moisture sensor and switches ON the motor when the moisture is underneath as far as possible. Right when the clamminess level rises above the set point, the system switches off the pump.The tank monitoring system uses ultrasonic sensor to measure the level of water inside the tank which is automated and switches on and off the motor comparing to a threshold level which has been set and it also use DHT sensor which prevent the motor in case of leakage as the temperature will increase which switches off the motor going beyond certain level. The system uses GSM modem to communicate with user by sending and receiving text message as status of the integrated system.

Paper 4

Title	A Study on Smart Irrigation System Using IoT for Surveillance of Crop-Field
Authors	Ashwini B V
Year	2015
Summary	Automated Irrigation system using WSN and GPRS Module having main goal is that optimize use of water for agriculture crops[1]. This system is composed of distributed wireless sensor network with soil moisture and temperature sensor in WSN. Gateway units are used to transfer data from sensor unit to base station, send command to actuator for irrigation control and manage data of sensor unit. Algorithm used in system for controlling water quantity as per requirement and condition of filed. It is programmed in microcontroller and it sends command through actuator to control water quantity through valve unit.It can be done through web pages.

Paper 5

Title	A Low Cost Smart Irrigation Control System
Authors	Chandan kumar sahu
Year	2015
Summary	This paper focus on a smart irrigation system which is cost effective and a middle class farmer use it in farm field. Today we are living in 21st century where automation is playing important role in human life. Automation allows us to control appliances automatic control. It not only provide comfort but also reduce energy, efficiency and time saving. Today industries are use automation and control machine which is high in cost and not suitable for using in a farm field. So here we also design a smart irrigation technology in low cost which is usable by Indian farmers. The objectives of this paper were to control the water motor automatically and select the direction of the flow of water in pipe with the help of soil moisture sensor. Finally send the information(operation of the motor and direction of water) of the farm field to the mobile message and g-mail account of the user.

Paper 6

Title	GSM Based Automated Irrigation Control using Rain gun Irrigation System.
Authors	R.suresh , S.Gopinath , K.Govindaraju , T.Devika , N.SuthanthiraVanitha
Year	2015
Summary	The main objective of this paper is to provide an automatic irrigation system thereby saving time, money & power of the farmer. With the automated technology of irrigation the human intervention can be minimized. Whenever there is a change in temperature and humidity of the surroundings these sensors senses the change in temperature and humidity and gives an interrupt signal to the micro-controller. In India most of the irrigation systems are operated manually.These outmoded techniques are replaced with semi-automated and automated techniques.

Paper 7

Title	IOT BASED SMART CROP-FIELD MONITORING AND AUTOMATION IRRIGATION SYSTEM
Authors	R. Nageswara Rao, B.Sridhar
Year	2014
Summary	The proposed method aims at making agriculture smart using automation and IoT technologies. Internet of Things (IoT) enables various applications crop growth monitoring and selection, irrigation decision support, etc. A Raspberry Pi based automatic irrigation IOT system is proposed to modernization and improves productivity of the crop. main aim of this work to crop development at low quantity water consumption, In order to focus on water available to the plants at the required time, for that purpose most of the farmers waste lot time in the fields. An efficient management of water should be developed and the system circuit complexity to be reduced.

Paper 8

Title	Automated Irrigation System Using Solar Power
Authors	Jia Uddin, S.M. Taslim Reza, Qader Newaz, Jamal Uddin, Touhidul Islam, and Jong-Myon Kim
Year	2015
Summary	This paper proposes a model of variable rate automatic microcontroller based irrigation system. Solar power is used as only the source of power to control the overall system. Sensors are placed on the paddy field and these sensors continuously sense the water level and give the message to the farmer informing the water level. Without visiting the paddy fields, farmers can get the information about the water level. Based on the water level, a farmer can control the motor by sending a message from his cellular phone even from a remote place. However, if the water level reaches to the danger level; the motor will automatically start without confirmation of farmer to ensure the proper water level in the site. This paper proposes a solar power controlled automated irrigation system

Paper 9

Title	Solar Powered Smart Irrigation System
Authors	S. Harishankar , R. Sathish Kumar , Sudharsan K.P, U. Vignesh
Year	2016
Summary	This paper introduces us the way by which we can develop a system of irrigation with the use of solar energy as source. According to this paper we utilize the solar energy from solar panels to automatically pump water depending on the intensity of sunlight.This will save substantial amount of energy and also efficient use of renewable energy.

Paper 10

Title	Smart Irrigation Using Low-Cost Moisture Sensors and XBee-based Communication
Authors	A. Kumar,K. Kamal,M. O. Arshad,T. Vadamala
Year	2018
Summary	This paper presents a smart system that uses a bespoke, low cost soil moisture sensor to control water supply in water deficient areas. The sensor, which works on the principle of moisture dependent resistance change between two points in the soil, is fabricated using affordable materials and methods. Moisture data acquired from a sensor node is sent through XBEE wireless communication modules to a centralized server that controls water supply. A user-friendly interface is developed to visualize the daily moisture data.

Paper 11

Title	Smart Irrigation System using IOT and Raspberry Pi
Authors	Ms. Swapnali B. Pawar, Prof Priti Rajput, Prof. Asif Shaikh
Year	2019
Summary	In this project we use raspberry Pi to implement IOT based smart system which monitors soil moisture, humidity and temperature and the sensors send an alert to the Pi if there is any change in the values. We are using "ATMEGA318" microcontroller which is on Arduino UNO. Raspberry Pi is used to send data to microcontroller through internet. Raspberry Pi used here is basically a mini modern day computer that has 1 gb ram, 2 usb ports, display port, ARM V8 and other connectivity options as needed and is capable of doing the any job needed. Relays are optically operated switches.

Paper 12

Title	Arduino based Irrigation System using IOT
Authors	R. Nandhini, S. Poovizhi, Priyanka Jose, R. Ranjitha, Dr. S. Anila.
Year	2016
Summary	In the following research paper, an IOT based automated system is proposed that uses sensors to measure soil moisture, pH, humility and pressure and use it to decide the ideal conditions for irrigation. There is also an intruder detection system which is implemented with the help of PIR sensor where the birds are repelled from entering into the field. It improves the management of water and reduces the chances of under or over irrigation.

Paper 13

Title	Network in Internet Of Things And Smart Grid
Authors	Li Li, Hu Xiaoguang, Chen Ke, He Ketai.
Year	2017
Summary	The smart grid system in various developed countries or groups of countries (United States, Japan , the European Smart Grid and how China has been working on one) has been referred to to show its effectiveness and uses. The next part is the recommended use of WiFi WSNs(Wireless Sensor Networks) over ZigBee as WiFi ones have much better bandwidths, form mesh patterns that allow multiple simultaneous signals to travel which are the two major issues in ZigBee. Also the fact that WiFi has better range, backwards compatibility, will be cheaper considering the amount of research going into it, has been around way longer, has better intelligence when dealing with nodes failure as each node can have upto 100 connections so alternate routes are easy to find and can travel through 1 load bearing wall compared to 0 of ZigBee are major factors in play.

Paper 14

Title	Design and Implementation of solar powered smart Irrigation System
Authors	Dr. Esther T. Ososanya,Dr. Sasan Haghani,Dr. Wagdy H Mahmoud, Dr. Samuel Lakeou
Year	2018
Summary	This paper focus on a smart irrigation system which is cost effective and a middle class farmer use it in farm field. Today we are living in 21st century where automation is playing important role in human life. Automation allows us to control appliances automatic control. It not only provide comfort but also reduce energy, efficiency and time saving. Today industries are use automation and control machine which is high in cost and not suitable for using in a farm field. So here we also design a smart irrigation technology in low cost which is usable by Indian farmers. The objectives of this paper were to control the water motor automatically and select the direction of the flow of water in pipe with the help of soil moisture sensor.

Paper 15

Title	A Low Cost Smart Irrigation Control System
Authors	Andre Esteva, Brett Kuprel, Roberto A. Novoa, Justin Ko, Susan M. Swetter, Helen M. Blau & Sebastian Thrun
Year	2019
Summary	This paper focus on a smart irrigation system which is cost effective and a middle class farmer use it in farm field. Today we are living in 21st century where automation is playing important role in human life. Automation allows us to control appliances automatic control. It not only provide comfort but also reduce energy, efficiency and time saving. Today industries are use automation and control machine which is high in cost and not suitable for using in a farm field. So here we also design a smart irrigation technology in low cost which is usable by Indian farmers. The objectives of this paper were to control the water motor automatically and select the direction of the flow of water in pipe with the help of soil moisture sensor.

Paper 16

Title	Automatic Plant Watering and Monitoring System using NodeMCU
Authors	Jayendra Kumar,Alisha Kumari
Year	2017
Summary	This paper aims at achieving automation for the purpose of plant monitoring and irrigation system, using Node MCU. Sensors are used for monitoring the environmental conditions surrounding the crop, whose outputs are obtained on an Android based mobile application as well as uploaded on the cloud. The updates of the atmospheric conditions such as temperature, humidity and soil moisture can be fetched from anywhere in the world as the data is shared on the cloud platform (Thingspeak). A record of this data can be maintained which could be used for the future reference, i.e., in the next cropping season, thereby, enhancing the planning and development of crop production.

Paper 17

Title	Automatic Water Supply Control System of Graded Constant Pressure by Variable Frequency Speed and Its Application to Pipeline Irrigation
Authors	H Kittler, H Pehamberger, K Wolff, M Binder
Year	2019
Summary	In pipeline irrigation system using pressurizing electromechanical pumps, the pumps usually work in constant speed under fundamental frequency power supply (50Hz) and the operation characteristics of pumps could not adapt to the practical changes of pipe network.Automatic water supply control system of graded constant pressure by variable frequency speed combines the frequency conversion and automation technologies, and is an electromechanical integrated intelligent device with functions of variable frequency speed control and automatic closed-loop control. This system switches pressure graded automatically according to required irrigation sub areas to realize graded and constant-pressure irrigation which could not only greatly enhance irrigation uniformity, but also has functions of saving water and energy as well as protecting the water pumps and the pipe network.

Paper 18

Title	Study on precision water-saving irrigation automatic control system by plant physiology
Authors	Yandong Zhao; Junfu Zhang; Jinfeng Guan
Year	2014
Summary	Precision water-saving irrigation automatic control system by plant physiology this paper described is one of the Olympic games facilities projects, which takes standards of water plant physiologically need and soil water content as the basis. Through the combination of independent research and development of irrigation monitoring controller and wireless data transmission, implement a drip irrigation, sprinkler irrigation, micro-irrigation, and low-pressure pipelines, such as different modes of irrigation automatic control. On this basis, the system monitors by GSM remote wireless communication make all irrigation incidents automatically enter into the database, and generate a variety of reports to the irrigation data for statistical analysis.

Paper 19

Title	Design of Solar Powered Automatic Irrigation System
Authors	Piyali Das; Chichanben Patton; S Farishta Devi; Wanmedemora Ch Marak; Taba Yake
Year	2019
Summary	This study was conducted with few objectives of design a microcontroller based solar powered automatic irrigation system (AIS) model. To quantify the paddy field water content of and as well to provide adequate water supply in the right paddy- field areas. In agricultural areas this may help for the production of crops as well can prevent the wastage of energy. To provide an efficient design to the farmers is the main objective of this paper.

Paper 20

Title	Automatic Agricultural Land Irrigation System by Fuzzy Logic
Authors	Zohaib Mushtaq; Syeda Shaima Sani; Khizar Hamed; Amjad Ali; Aitizaz Ali; Syed Muhammad Belal; Abid A. Naqvi
Year	2018
Summary	Water is an important component for agriculture. Conventional methods for irrigation system like canal, wells and rainfall are time consuming and seasonal. By using automated land irrigation system with hybrid power (Solar & Grid), water, time and energy. Therefore, maximum area can be irrigated in less time. The crux of this research is to design and simulate a fuzzy controller using MATLAB for automatic land irrigation. This controller is mathematically designed and simulated in MATLAB. It consist of inputs/outputs values with membership functions. Input involve agricultural land water level categorization and time. Output of designed controller consist of tube well operation and power source.

Paper 21

Title	A Study On Smart Irrigation Systems For Agriculture Using Iot
Authors	Dr. J. Jegathesh Amalraj, S. Banumathi, J. Jereena John
Year	2019
Summary	The proper utilization of water needs to be considered as most urgent issue in the current scenario of water decreasing and drying up of rivers and tanks. To come across from this issue the use of sensors such as temperature and moisture at appropriate locations for monitoring the crops implemented. An algorithm developed and implemented with threshold values. The threshold values are applied in the temperature and soil moisture by using micro controller based gateway to monitor water quantity. The system can be powered and have communication link on cellular interface that allows data monitoring and irrigation scheduling through a web page. The innovative system with new technologies in agriculture helps to provide betterment for farmers in increasing the agricultural yield. A remote sensing and control irrigation system using distributed wireless sensor network was developed. The irrigation rate was measured in the field and linear moving of irrigation system used to maximize the productivity with minimal use of water was developed by author. Wireless sensor networks and its development make possible to monitoring and control parameters in precision agriculture.

Paper 22

Title	STUDY PAPER ON SMART IRRIGATION SYSTEM
Authors	Mr. Dhanaji Baravade, Miss. Mayuri Mali, Miss. Simran Mulla
Year	2015
Summary	The proposed system is designed by keeping in mind the low cost devices readily available in the local market.The experimental setup is deployed in the good quality farm land admeasuring 1 acre which is planted with 5000 sugarcane plants of good quality. The experimental setup .The full term of sugarcane crop is assumed to be of 15 months (450 days) as an average case. It is also assumed that the raining period is of 150 days during which watering by means of traditional or drip irrigation system is avoided.

Paper 23

Title	SMART IRRIGATION SYSTEM
Authors	G.Ravi kumar, T.Venu Gopal, V.Sridhar, G.Nagendra
Year	2017
Summary	The key objective of the paper is to monitor the soil's moisture content during its dry and wet conditions with the aid of a moisture sensor circuit, calculate the corresponding relative humidity and irrigate it based on its nature using a PC based LabVIEW system, NI myRIO, IOT, GSM and an automatic water inlet setup which can also monitor and record temperature, humidity and sunlight, which is constantly modified and can be controlled in future to optimize these resources so that the plant growth and yield is maximized.

Paper 24

Title	Internet of Things and Nodemcu
Authors	Yogendra Singh Parihar
Year	2018
Summary	NodeMCU is open source platform, it's hardware design is open for edit/modify/build. NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip.The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol.[12] More details can be found on ESP8266 Documentation. NodeMCU uses an on-module flash-based SPIFFS(Serial Peripheral Interface Flash File System) file system. NodeMCU is implemented in C and is layered on the Espressif NON-OS SDK. The firmware was initially developed as is a companion project to the popular ESP8266-based NodeMCU development modules, but the project is now community-supported, and the firmware can now be run on any ESP module.[13] Generally, we can find NodeMCU Dev boards of make Amica,DOIT,Lolin & D1 mini /Wemos etc. in market. Amica produces NodeMCU ESP8266 Development Boards v1.0(Version2) with designed hardware specifications.

Paper 25

Title	Measurement of Temperature and Humidity by using Arduino Tool and DHT11
Authors	Deeksha Srivastava, Awanish Kesarwani, Shivani Dubey
Year	2018
Summary	Temperature and humidity are very important parameters of the environment in various industries like medicine, food, paper mills, textile, metrological, semiconductors, services etc. In recent years, optical fiber sensors have attracted more attentions in sensing and measurement areas due to their many advantages over their conventional electronic counterparts. Similar works in this particular area make use of the Short Message Service (SMS) facility so as to alert the user as seen in the paper [1].The temperature-humidity sensor could be also used in tissue culture lab use this particular mechanism and use a GSM module to send a message which displays the present status of the temperature and humidity and displays the message “Tissue Culture lab parameters exceeded”

Paper 26

Title	AUTOMATION OF IRRIGATION SYSTEM USING IoT
Authors	Pavankumar Naik,Arun Kumbi
Year	2019
Summary	This paper on "Automatic Irrigation System on Sensing Soil Moisture Content" is intended to create an automated irrigation mechanism which turns the pumping motor ON and OFF on detecting the dampness content of the earth. In this paper only soil moisture value is considered but proposed project provided extension to this existed project by adding temperature and humidity values.

Paper 27

Title	An IOT based Smart Irrigation System using Soil Moisture and Weather Prediction
Authors	Dr. S. Velmurugan , V. Balaji , T. Manoj Bharathi, K. Saravanan
Year	2017
Summary	In the system uses arduino technology to control watering and roofing of the green house. It uses statistical data acquired from sensors (like temperature, humidity, moisture and light intensity sensors) compared with the weather forecast for decision making. Kalman filter is used to eliminate noise from the sensors. Agriculture System (AgriSys) uses temperature, pH, humidity sensors and the hybrid inference to input the data from sensors. The system monitors the sensors information on LCD and PC. Muhammad (2010),Proposed a simple approach to "Automatic Irrigation control problem using Artificial Neural Network Controller". The proposed system is compared with ON/OFF controller and it is shown that ON/OFF Controller based System fails miserably because of its limitations.

Paper 28

Title	AN IoT BASED SMART IRRIGATION SYSTEM
Authors	Priyadharsnee K, Dr.S.Rathi
Year	2016
Summary	An IoT based irrigation system is for efficient agricultural management system which enables farmers to contend with challenges they face. There are many applications in IoT, which addresses the major problems like soil moisture detection, water conservation management, crop growth monitoring, etc., This project enables better and smarter irrigation through temperature, humidity and other sensors networked to communicate with the user. For farmers and growers, Internet of Things has provided extremely productive ways to cultivate soil with the use of cheap, easyto-install sensors and an abundance of insightful data they offer.

Paper 29

Title	Smart Irrigation System using IOT
Authors	Arif Gori, Manglesh Singh , Ojas Thanawala, Anupam Vishwakarma, Prof. Ashfaque Shaikh
Year	2018
Summary	This paper aims at reducing the wastage of water and the labor that is used to carry out irrigation manually. The proposed system aims at detecting the moisture content of the soil using sensors that are placed directly into the soil. This sensors sense the water level of the soil and if the water level is not adequate then the user will be notified through a message that will be sent to the application which would be installed on the user's mobile phone. The Arduino board, a microcontroller, controls the digital connection and interaction between objects in the proposed system, enabling the objects to sense and act . Also, with its powerful on-board processing, various sensors and other application specific devices can be integrated to it.

Paper 30

Title	SMART IRRIGATION SYSTEM BASED ON SOIL MOISTURE USING IoT
Authors	S Nalini Durga, M Ramakrishna
Year	2015
Summary	The system has three major parts; humidity sensing part, control section and the output section. The soil humidity was detected using YL-69 soil sensor (a resistance type sensor). The control unit was achieved using ATMega328 microcontroller based on arduino platform. The output is irrigation system which is controlled by the control unit by switching it on and off depending on the soil moisture contents. Two stages of design were undertaken; hardware and software.

REQUIREMENT ANALYSIS AND PROPOSED APPROACH

3.1 Overall Description

Our primary objective is to create a tech that monitors the irrigation process for the farmers as most of the time of the farmers is spent on the field monitoring the crop conditions and debating if to irrigate or not. Also as we know in India we generally have small farmers that are not really strong financially so we wanted the solution to be cheap(should be under Rs. 2000) and reusable(we know crop rotation is a thing but different farmers in the village should have different crops at different times, so they can swap device among themselves if they want to have a different crop or they can visit us where with a software update which basically is changing the activation values, we can make the device work for a different crop). The design needed to be easily replicable so we only used generic components as the objective would to be get it to anyone who can afford it.

Secondary objective was to ensure proper use of resources available and conservation of environment. We are ensuring this by only using the correct amount of water not a drop more. Also as a lot of rural areas in India have a very irregular supply of water so what it does is it only operates the generators when the water needs to be drawn too for a minimal period; that saves fuel as well as monitors air pollution.

3.2 Requirement analysis

We need a DHT11, moisture sensor probe, an arduino or raspberry pi(whichever is cheaper), a pump and a motor starter. The pump outlet and inlet can be linked to the existing irrigation system. For power we can either use a 9V battery or have an adapter that converts power grid AC to 9V DC.

3.3 Proposed approach

DHT

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

Code snippet for DHT

```
  float h = dht.readHumidity();
  float t = dht.readTemperature();

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }

  Blynk.virtualWrite(V5, h);  //V5 is for Humidity
  Blynk.virtualWrite(V6, t);  //V6 is for Temperature
}
```

Fig. 1 Code snippet for DHT11

This part of code checks for the values received by the DHT11 sensor of humidity and temperature whether they are numerical of not, and shows the error in case of any non numerical value given.

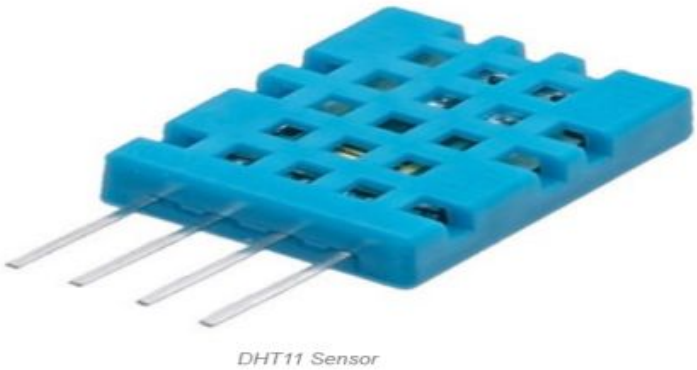


Fig. 2 DHT11 sensor

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. For high sensitivity of the resistance, to get reading even for minor change in temperature, sensor is made up of semiconductor ceramics or polymers.

Soil Moisture Sensor

A soil moisture sensor generally has two components :-

The Probe

The sensor contains a fork-shaped probe with two exposed conductors that goes into the soil or anywhere else where the water content is to be measured. It acts as a variable resistor whose resistance varies according to the soil moisture.

Fig. 3 Soil Moisture sensor

The Module

The sensor also contains an electronic module that connects the probe to the Arduino.The module produces an output voltage according to the resistance of the probe and is made available at an Analog Output (AO) pin.The same signal is fed to a LM393 High Precision Comparator to digitize it and is made available at an Digital Output (DO) pin.

Fig. 4 The module of Soil moisture sensor

The knob is rotated clockwise for increasing the sensitivity and anticlockwise for decreasing the sensitivity.

Node MCU

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language.

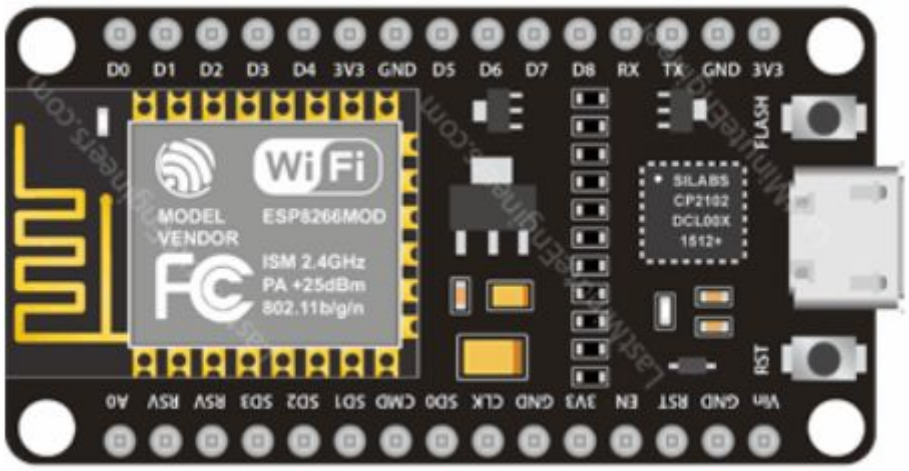


Fig. 5 Node MCU

Sensors' values range and used in the program

Sensors	Range of Values	Values used in Program
DHT11	Humidity - 20 to 80 % with 5% accuracy Temperature - 0 to 50 degree Celsius with 2 degree accuracy	Humidity and temperature value on the day of testing
Soil Moisture	Target Range 500-700	<500 - Soil is dry, turn motor on >700 - Soil is wet, stop the motor

Screenshots of the values as displayed in the Blynk Application

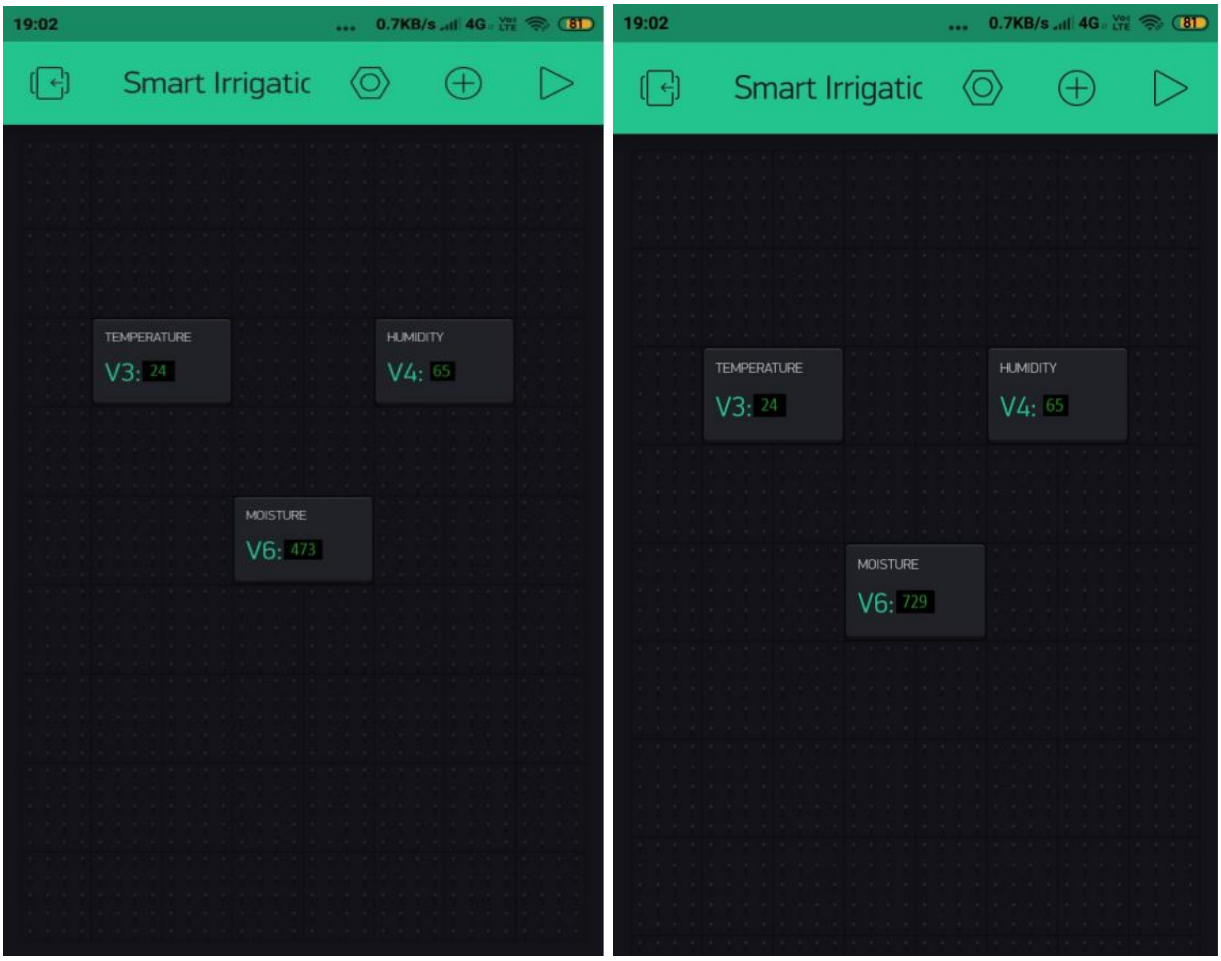


Fig. 6 Blynk App Screenshot for the readings of Dry Soil and Wet Soil

MODELLING AND IMPLEMENTATION DETAILS

4.1 Modular diagram

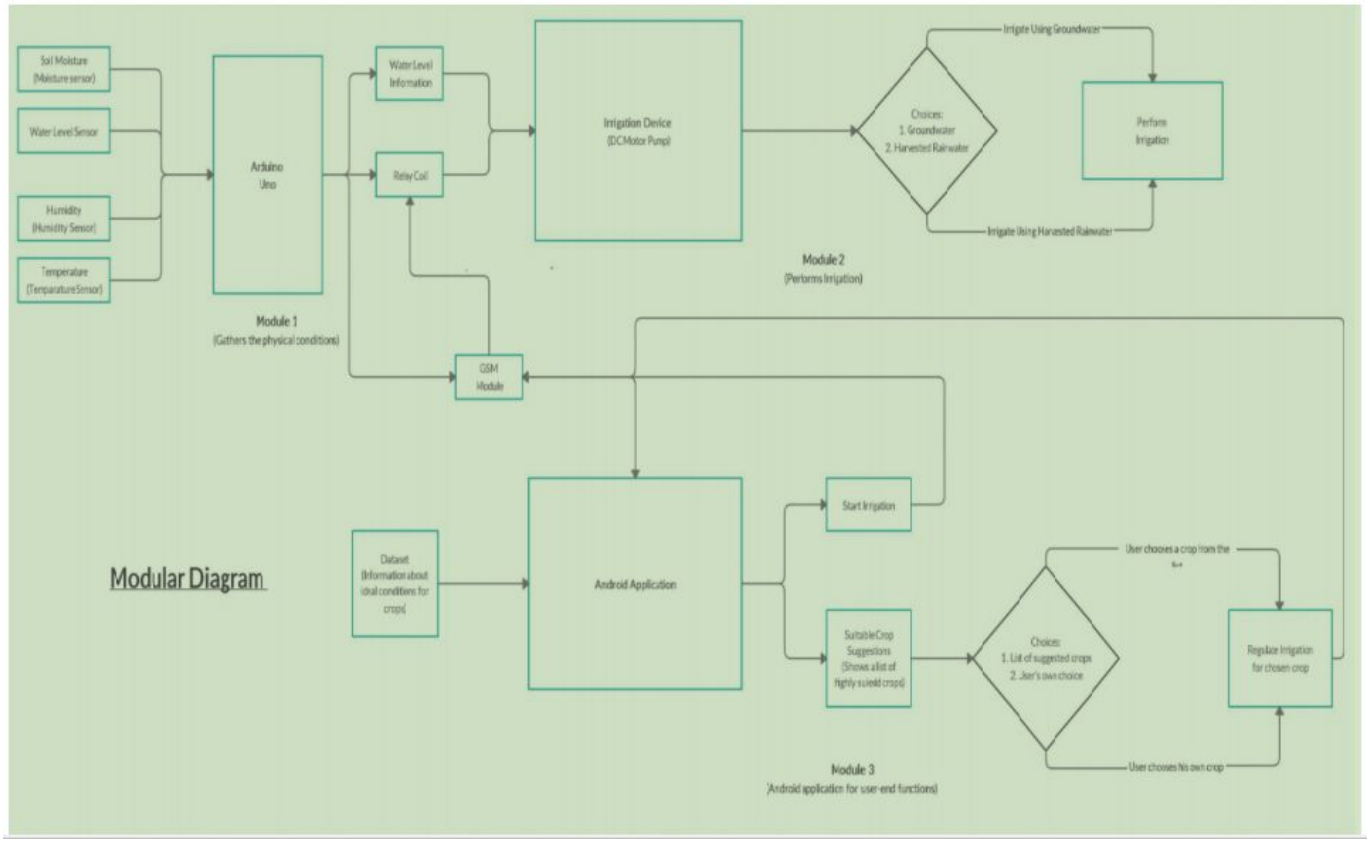


Fig. 7 Modular diagram of complete circuit

4.1.1 Module 1 (input)

This module focuses on gathering information from the environment via use of sensors. The information gathered includes soil moisture, humidity and temperature of the air.

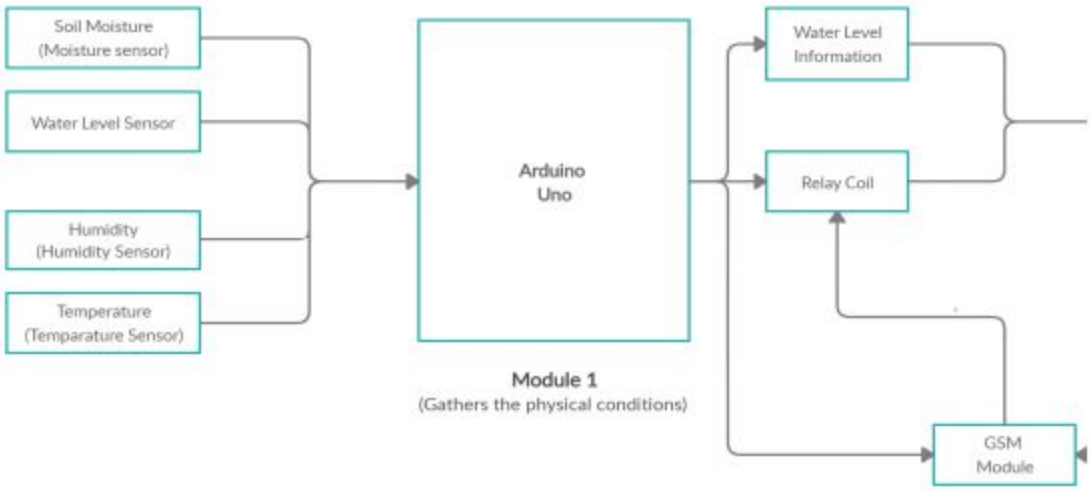


Fig. 8 Module 1

4.1.2 Module 2 (output)

This module controls irrigation based on current ground water and harvested water level.

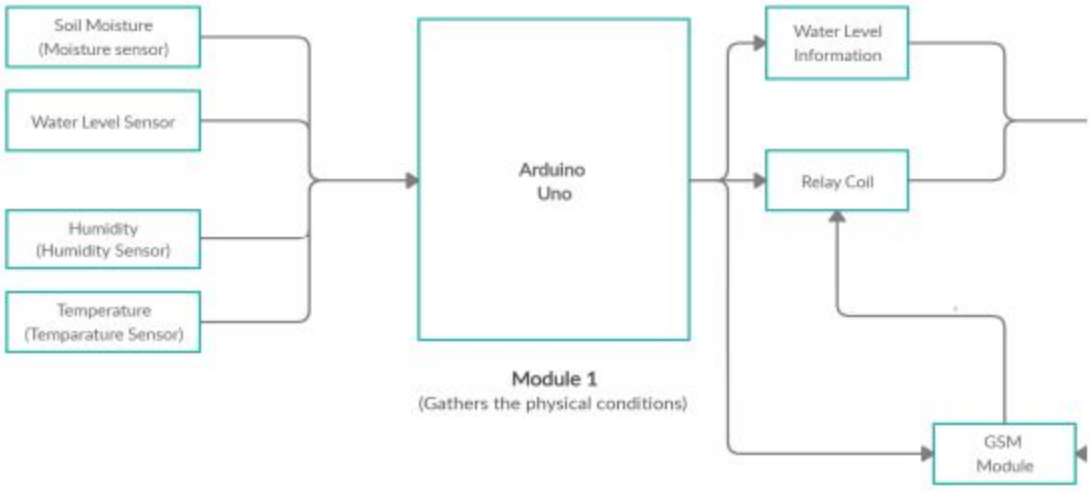
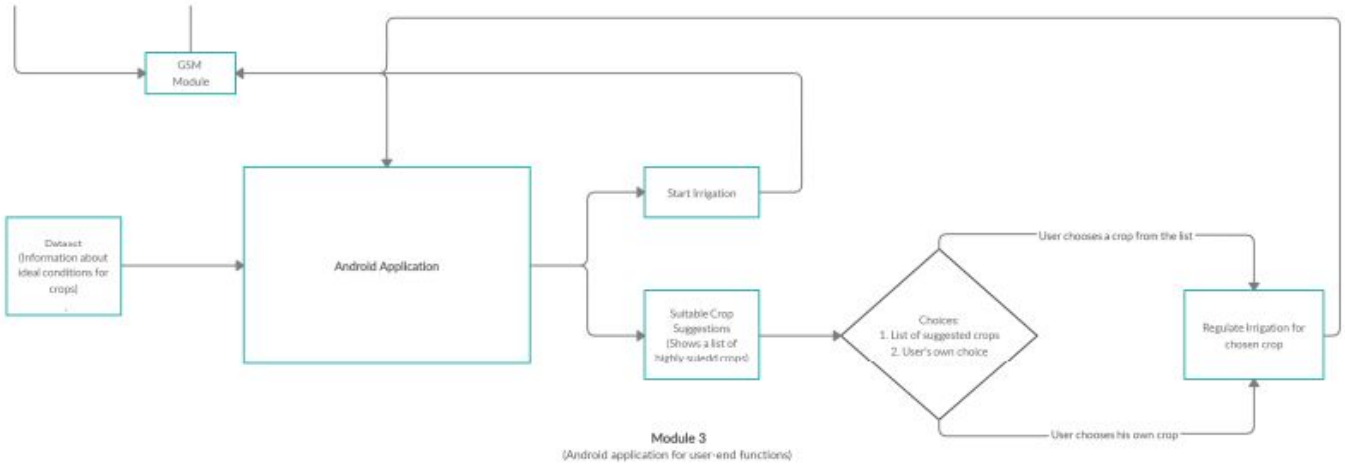


Fig. 9 Module 2

4.1.3 Module 3(output)

This module controls the irrigation process based on the choice of crop selected (ie. the hard coded value for the crop).



4.2 Implementation details and issues

This product as such does not have many issues other than the fact that the wiring needs to be very accurate as the pin layout on any micro-processor board is very close and any short circuit or mismatch can spell the end of a Rs. 800 board in an instant. Also if a sensor fails, the project crashes and without a proper predefined error code so detection can be a bit hard. Same goes for motor starter failure. These are the two major issues that we will work on.

This project can be implemented in any atmosphere as long as some environmental constraint is not applied on the functionality of the sensors. So in terms of implementation it is practically applicable everywhere we need to monitor and irrigate crops as long as we can set the parameters correctly.

4.3 Risk analysis

The only risk involved is if the project fails because of one of the above mentioned reasons and it is not detected timely, this could mean that the farmer loses the whole crop this season. I know this is a big risk but the probability of failure is pretty low as well.

FINDINGS, CONCLUSION AND FUTURE WORK

5.1 Findings

The Soil Moisture sensor used has a more significant role in the project compared to the DHT11 humidity and temperature sensor because there are not any changes in the readings of DHT11 sensor.

5.2 Conclusion

A system to monitor moisture levels in the soil, temperature and humidity of soil was designed and the project provided an opportunity to study the existing systems, along with their features and drawbacks. The proposed system can be used to monitor soil moisture levels thereby automating the process of irrigation which is one of the most time consuming activities in farming. Agriculture is one of the most water-consuming activities. The system uses information from soil moisture sensors to irrigate soil which helps to prevent over irrigation or under irrigation of soil thereby avoiding crop damage. The farm owner can monitor the process online through the application BLYNK. Through this project it can be concluded that there can be considerable development in farming with the use of IOT and automation. Thus, the system is a potential solution to the problems faced in the existing manual and cumbersome process of irrigation by enabling efficient utilization of water resources.

5.3 Future work

The future of this project is practically limitless though what we have planned to add were according to us the most sensible upgrades. First of all we would like to provide a solar power based alternative with a solar panel, battery and all the necessary components for the backward areas where the power supply is unreliable or in some cases practically non-existent.

Also the fact that we have environmental conditions, we have the groundwork for a crop predictor laid. All we need is to link it to a database and find a list of crops that is suitable for the given conditions. The list would be sorted according to the most preferred crop that would be based on how close the conditions are to the idle conditions for a given crop.

We are also working on storing multiple profiles on the same circuit that can be switched by the press of a button; so that when a farmer needs to grow a different crop, he doesn't need a new device or to visit a centre but only a press of a button to switch. We would have a multi-color LED to indicate which of the 3 profiles is currently active.

REFERENCES

[1] Advance in Electronic and Electric Engineering.ISSN 2231-1297, Volume 4, Number 4 (2014), pp. 341-346Solar Powered Smart Irrigation System S. Harishankar1, R. Sathish Kumar2.

[2] Soil moisture estimation using remote sensing (Jeffrey Walker11 and Paul Houser2)

[3] International Journal of Environmental Research and Development. ISSN 2249-3131 Volume 4, Number 4 (2014), pp. 371-374 Smart Irrigation Control System Mr. Deepak Kumar Roy and Mr.Murtaza Hassan Ansari.)

[4] An introduction to the Linux Command Shell for Beginners, Presented by: (Victor Gedris)

[5] Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra NietoGaribay, and Miguel Ángel Porta-Gándara" Automated Irrigation System Using a Wireless Sensor Network and GPRS module" , Ieee Transactions OnInstrumentation And Measurement, Vol. 63, No. 1, January 2014.

[6] Journal of Advancements in Research & Technology, Volume 2, Issue-4, April-2013

[7] J. Kawahara et al., "Deep features to classify skin lesions," in ISBI, 2016, pp. 1397–1400.

[8]S. Li, J. Cui, Z. Li, "Wireless Sensor Network for Precise Agriculture Monitoring," Fourth International Conference on Intelligent Computation Technology and Automation, Shenzhen,China, March 28-29, 2011.

[9] J G. Yuan, Y. Luo, X. Sun, and D. Tang, "Evaluation of a crop water stress index for detecting water stress in winter wheat in the North China Plain," Agricult. Water Manag., vol. 64, no. 1, pp. 29–40, Jan. 2004.

[10] Water conservation potential of landscape irrigation smart controllers (M.D. dukes)

[11] Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 4, Number 4 (2014), pp. 341346Solar Powered Smart Irrigation System S. Harishankar1, R. Sathish Kumar2

[12] Wernick MN, Yang Y, Brankov JG, Yourganov G, Strother SC. Machine Learning in Medical Imaging. IEEE Signal Process Mag. 2010;27(4):25-38.
doi:10.1109/MSP.2010.936730

[13] X. Wang, W. Yang, A. Wheaton, N. Cooley, and B. Moran, “E_cient registration of optical and IR images for automatic plant water stress assessment", Comput. Electron. Agricult., vol. 74, no. 2, pp.

[14]Albert Mayan .J , Dr. T. Ravi, “Optimized Regression Testing using Genetic Algorithm and Dependency Structure Matrix”, International Journal of Applied Engineering Research , Vol:9, Issue:20, pp: 7679-7690,Nov 2014 , ISSN: 1087-1090

[15] S. V. Devika, Sk.Khamuruddeen, Sk.Khamurunnisa, Jayanth Thota, KhaleshaShaik,“Arduino Based Automatic Plant Watering System”, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 10,pp. 2-3,October 2014.

[16]]G. Merlin Suba, Y M Jagadeesh, S Karthik and E Raj Sampath, “Smart Irrigation System Through Wireless Sensor Networks”, ARPN Journal of Engineering and Applied Sciences, vol. 10, pp. 1,no. 17, september 2015.

[17] Argenziano G, Puig S, Zalaudek I, Sera F, Corona R, Alsina M, Barbato F, Carrera C, Ferrara G, Guilabert A, Massi D, Moreno-Romero JA, Muñoz-Santos C, Petrillo G, Segura S, Soyer HP, Zanchini R, Malvehy J. Dermoscopy improves accuracy of primary care physicians to triage lesions suggestive of skin cancer. J Clin Oncol. 2006 Apr 20;24(12):1877-82. doi: 10.1200/JCO.2005.05.0864. PMID: 16622262.

[18]L. Prisilla, P.S.V. Rooban and L. Arockiam, “A novel method for water irrigation system for paddy fields using ANN,” International Journal of Computer Science and Network, Vol.1, No. 2, April 2012

[19] L. Longchang and W. Yanjun, “Pipeline Water Delivery Technology,” China Water Power Press, pp. 33-35, March 1998.

[20] M. Dursun and S. Ozden, “A Prototype of PC Based Remote Control of Irrigation,” International Conference on Environmental Engineering and Applications, Singapore, pp. 255-258, Sept. 2010.

[21] G. Yang, Y. Liu, L. Zhao, S. Cui, Q. Meng and H. Chen, “Automatic Irrigation System Based on Wireless Network,” 8th IEEE International Conference on Control and Automation, pp. 2120-2125, June 2010

[22]C. Yi, “Technology and Application of Water Saving Irrigation,” Chemical Industry Press, Beijing, China, pp. 345-349, 2005

[23] S. Zeng, G. Qi, Q. Liu and Z. Wang, “Mobile irrigation systems for arid areas of Northeast China,” International Conference on WaterSaving Agriculture and Sustainable Use of Water and Land Resources, Shaanxi, China, Oct. 2003.

[24] Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra NietoGaribay, and Miguel Ángel Porta-Gándara” Automated Irrigation System Using a Wireless Sensor Network and GPRS module” , Ieee Transactions OnInstrumentation And Measurement, Vol. 63, No. 1, January 2014

[25] Venkata Naga Rohit Gunturi, “Micro Controller Based Automatic Plant Irrigation System” International.

[26] K. Honda, A. Shrestha, A. Witayangkurn, et. al., "Fieldservers and Sensor Service Grid as Real-time Monitoring Infrastructure for Ubiquitous Sensor Networks", Sensors, vol. 9, pp. 2363-2370, 2009.

[27]Kshitij Shinghal, Arti Noor, Neelam Srivastava, Raghuvir Singh; "intelligent humidity sensor for wireless sensor network agricultural application";International Journal of Wireless & Mobile Networks (IJWMN) Vol. 3, No. 1, February 2011.

[28]S. Gangopadhyay and M. K. Mondal, “A wireless framework for environmental monitoring and instant response alert,” in 2016 International Conference on Microelectronics, Computing and Communications (MicroCom), Jan 2016, pp. 1–6.

[29]Y. Zhou, Q. Zhou, Q. Kong, and W. Cai, “Wireless temperature amp; humidity monitor and control system,” in 2012 2nd International Conference on Consumer Electronics, Communications and Networks (CECNet), April 2012, pp. 2246–2250.

[30]A.V. Bosisio and M. P. Cadeddu, “Rain detection from groundbased radiometric measurements: Validation against rain sensor observations,” in 2015 IEEE International Geo-science and Remote Sensing Symposium (IGARSS), July 2015, pp. 2323–2326.