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Development of IOT Based Smart Irrigation System

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ABSTRACT-
Currentirrigationsystemwhichweusehaveproblemss uchasoveruseofwaterandsometimesunderuseof water.Thisresultsinpoorqualityofcropandaffectsover allproductivity. Therefore, by automating irrigation system we can save water and increaseproductivity. The biggest problem is to supply exact amount of water for irrigation. Thissystemhelps ustousewaterefficientlyand reduces human efforts.

I. INTRODUCTION

Water is the source of life on our planet and an essential resource for agriculture. Agricultureaccounts for 70 percent of the consumption of this resource. At the same time, water is notendless and manyregionstodaysuffer fromanacuteshortage.

One-fifth of the world's population lives under constraints, and this trend is not declining.According to UN forecasts, by 2025, there will be about 1.8 billion people in conditions ofwater shortages due to climate change. For agriculture, the lack of this precious resource is athreat. The productivity of this sector is directly dependent on water. Therefore, it is vital topreservingthisresource,preventwatererosion,andre duceconsumption.

In 2010, the irrigation sector was the highest water consuming sector with a volume of 688billion cubic meters and was expected to remain the highest water consuming sector even in2025 and in 2050, with a volume of water consumption rising to 910 billion cubic meters and1,072billioncubicmeters respectively.

Over the coming years, the water requirement across all the sectors will likely increase due tothe growing population. There was a significant imbalance between the water demand andwater resource availability, thereby causing water scarcity. With the rising population andindustrialization, it was expected that there would be an increase in the amount of sewage andindustrialwastebeinggenerated.However,thecou ntrylackedthecapacitytotreatthecurrentwaste

IOT:InternetofThings:

InternetofThings(IoT)istheinterconnection ornetworkofphysicaldevicesthatisinterrelated computing devices, digital and mechanical machines, people or animals, objectsthat can sense, accumulate and transfer data over web without any humaninvolvement.Everything is provided with unique identifier. It is a progressed examination and mechanizedframeworkswhichusesdetecting,organiz ing,enormousinformationandman-madeconsciousness innovation to convey total framework for anadministration. Basically IoT isaboutextending thepowerof internetbeyondsmartphonesand computers.

A thing in the internet of things can be a person with a heart monitor implant, a farm animalwith a biochip transponder, an automobile that has built-in sensor to alert thedriver whentirepressure is low or any other natural or man-made object that can be assigned an InternetProtocol(IP) addressand isabletotransfer dataoveranetwork.

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such asprocessors, sensors and communication hardware, to collect, send and act on data they acquirefrom theirenvironments. IoT Devices share the sensor data theycollect by connectingto anIoT gateway or other edge device where data is either sent to the cloud to be analyzed oranalyzed locally. Sometimes, these devices communicate with other related devices and act onthe information they get

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from one another. The devices do most of the work without humanintervention, although people can interact with the devices -- for instance, to set them up, givetheminstructionsor accessthedata.
In this system waterfall drop by drop at the position of the roots. It is the best technology forwatering fruit plants, gardens and trees. Water flow through a main pipe and divided into subpipes. Special prepared nozzles are attached to these sub pipes. In this system waste of wateris very less and No worker need for irrigating. When the farmer knows the status of the farmfield then start the motor and chose the direction from nozzles. Then automatically wateringthe plants and after some time the farmer check the status of the field and while the wholecropareirrigating then OFFthemotor.
Above three systems are generally operating by a user but a smart irrigation tells that the totalsystem is controlled by autonomous mean automatically control the total irrigation systemwhether the farmer is not present his farm field and send messages to the farmer about theinformation of farm field and change in operation of the farm field. Which require no workerforoperating,andalsoless wasteofwaterwithcomparedtoprevious threemethods.

Uses of IOT:

Uses of IoT (internet of things) are the industries that are implementing IOT Devices andtechnologies for technical advancement. The uses and new capabilities are adding to thistechnology and are growing in year on year basis. Most organizations are using this technologyto help human life easier. Several industries use IoT, such as resource optimization throughsensors in the manufacturing industry, real-time crop and water resource monitoring in theagriculture industry, and IoT appliances in the Healthcare industry. It is crucial to set securitystandards to controltheadverseeffects of IoTuses.
ProjectObjectives:

1. ToAutomateAgricultureIrrigation.
2. Implementationofagriculturemonitoringusi ngIOT.
3. If the Moisture Content in soil decreasesthe motor automatically gets ON and will get OFFafterdesired moisturelevelisreached.

Scopeof Work:
Underthis projectwearegoingtoautomateagricultureirrigationin ordertosavewaterandreducehuman efforts.

NecessityofWork:
In this project we have used IOT for irrigation for the optimum use of water. The soilmoisture sensor that will record the data from soil which will be sent to Arduino whichact as the brain of system. If soil moisture goes below a predetermined threshold it willactivate the water pump. The same data will be sent to cloud using ESP8266 WIFImodule.

II. LITERATURESURVEY

Chandankumarsahu,PramiteeBehera(2015)

Thispaper focuson a smart irrigation system which iscost effective and a middle classfarmer use it in farm field. Today we are living in 21st century where automation is playingimportant role in human role in human life. Automation allows us to control appliancesautomatic control. It not only provides comfort but also reduce energy, efficiency and timesaving. Today industriesare use automation and control machine which ishigh in cost andnot suitable for using in a farm field. So here we also design a smart irrigation technology inlow cost which is usable by Indian farmers. The objectives of this paper were to control thewater motorautomaticallyandselectthedirectionoftheflowo fwaterinpipewiththehelpof soil moisture sensor. Finally send the information (operation of the motor and direction ofwater)of thefarmfieldto themobilemessageand g-mailaccountof theuser.

III. SYSTEM COMPONENTS

1. SOILMOISTURESENSOR:

The working of the soil moisture sensor isprettystraight forward. The fork-shaped probewith two exposed conductors, acts as a variable resistor (just like a potentiometer) whoseresistance varies according to the water content in the soil. A typical soil moisture sensor hastwo components. The sensor contains a fork-shaped probe with two exposed conductors thatgoes into the soil or anywhere else where the water content is to be measured. Soil moisturesensor includes comparator (LM393) which converts analog data to discrete. Two soil probesconsist of two thin copper wires each of 5 cm length which can be immersed into the soilunder test. The circuit gives a voltage output corresponding to the conductivity of soil. Thesoil between the probes acts as a variable resistance whose value depends upon moisturecontent in soil. The resistance across soil probes can vary from infinity (for completely drysoil) to a very little resistance (for 100% moisture in soil) his variation in resistance across theprobes(R_S)leadstovariationinforward-

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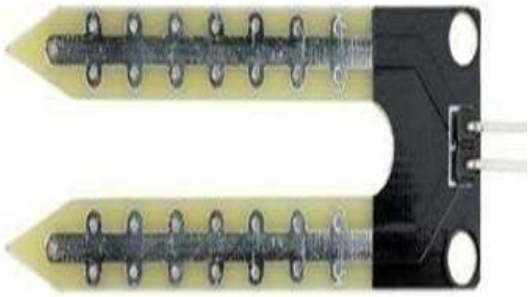
biasvoltagewhichleadstocorrespondingvariation.



2. Arduino-Uno:

Arduino boards areable to readanalog ordigital input signals from different sensors andturn it into an output such as activating a motor,turning LED on/off, connect to the cloudandmanyotheractions.Youcancontrolyourboardfunctionsbysendingasetofinstructions to the microcontroller on the board via Arduino IDE (referred to as uploadingsoftware). Unlike most previous programmable circuit boards, Arduino does not need anextra piece of hardware (called a programmer) in order to load a new code onto the board.You can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version ofC++, making it easier to learn to program. Arduino provides a standard form factor thatbreaks the functions of the micro-controller into a more accessible package. The Arduino-Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins(of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, aUSB connection, a power jack, an ICSP header, and a reset button. It contains everythingneeded to support the microcontroller; simply connect it to a computer with a USB cable orpoweritwith aAC-to-DCadapter or batteryto getstarted.

3. ESP8266Wi-FiModule:

The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stackthat can give any microcontroller access to your WiFi network. The ESP8266 is capable ofeither hosting an application or offloading all Wi-Fi networking functions from anotherapplication processor. Each ESP8266 module comes pre-programmed with an AT commandset firmware, meaning, you can simply hook this up to your Arduino device and get about asmuch WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266moduleis anextremelycost-effectiveboardwithahuge,andevergrowing,community.

This module has a powerful enough on-board processing and storage capability that allows itto be integrated with the sensors and other application specific devices through its GPIOswith minimal development up-front and minimal loading during runtime. Its high degree ofon-chip integration allows for minimal external circuitry, including the front-end module, isdesigned to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applicationsand Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to workunderalloperating conditions,and requiresno externalRFparts.

FeaturesofESP8266WiFiModule:

- Lowcost,compactandpowerfulWi-FiModule.
- PowerSupply:+3.3V only.
- CurrentConsumption:100mA.
- I/OVoltage:3.6V(max).
- I/Osourcecurrent:12mA(max).
- Built-inlow power 32-bitMCU@80MHz.
- 512kBFlashMemory.
- Canbeusedas StationorAccessPointorbothcombined.
- SupportsDeepsleep(<10uA).
- SupportsserialcommunicationhencecompatiblewithmanydevelopmentplatformlikeArduino.
- CanbeprogrammedusingArduino IDEorAT-commands orLuaScript.

Figure8
ESP8266

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4. PumpMotor:

The working principle of a water pump mainly depends upon the positive displacementprinciple as well as kinetic energy to push the water. These pumps use AC power otherwiseDC power for energizing the motor of the water pump whereas others can be energized otherkinds of drivers like gasoline engines otherwise diesel. The water pump is a portable deviceand can be applied in several household applications.

These pumps are used for pumping thehuge amount of water from one place to another. The main purpose of a water pump isversatile. A quality pump which can be selected carefully may be perfect for draining waterfrom a low flooded region, refilling the swimming pool, and bathtub, circulating pesticidesotherwise fertilizers. The collection of water pumpsare very large, therefore, while selectinga strong and consistent one, one shouldthinkabout the requirement.Water pumps areclassified into two types namely positive displacement and centrifugal. These pumps aremainly designed for supplying water from one location to another constantly. Water pumpsareusedfordewateringreasonsdecreasingthed owntimefromhugerainevents.Thecommon applications of these pumps include buildings, wells, boost application, circulationof hot water, sump pits, protection of fire systems, etc. Thus, this is all about water pumpswhich arefrequently usedinconstruction fields for removingsurplus wateras wellasdewatering. Because of heavy rains, the flow of water can increase & water pumps let yousupply the water rapidly to reduce downtime. These pumps are appropriate for applicationslike electric, hydraulic, gas-powered, and otherwisemanual. These pumpsare vast additiontoourlifebecausetheymakepossibleahugevar ietyofindustrial,agriculturaland household tasks. But, the variety of water pumps in the marketplace is so adaptable andplentifulthatselectingthecorrectpumpappropriate foryourrequirementsischallenging.

5. L923DMotorDriver:

L293Disatypical Motordriveror Motor DriverIC which allowsDC motorto drive oneitherdirection.L293Disa16-pinICwhichcancontrolasetoftwoDCmotorssimultan eously in any direction. It means that you can control two DC motor with a singleL293D IC. DualH-bridgeMotorDriver integrated circuit(IC).

- L293DPin Configuration Features:-

i. CanbeusedtorunTwoDCmotors withthe sameIC.
ii. SpeedandDirectioncontrolispossible.
iii. MotorvoltageVcc2(Vs):4.5V to36V.
iv. MaximumPeakmotorcurrent:1.2A.
v. MaximumContinuousMotorCurrent:600m A.
vi. SupplyVoltagetoVcc1(vss):4.5V to7V.
vii. Transitiontime:300ns(at5Vand24V).
viii. AutomaticThermalshutdownisavailable.
ix. Availablein16-pinDIP,TSSOP,SOICpackages.

IV. DEVELOPMENT OF CODE

ArduinoUnoIDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains atexteditorfor writingcode,amessagearea,atextconsole,atoolbarwit hbuttonsforcommon functions and a series of menus. It connects to the Arduino hardware to uploadprograms and communicatewiththem.

Writing Sketches:

Programs written using Arduino Software (IDE) are called sketches.These sketches are written in the text editor and are saved with the file extension.ino. Theeditor hasfeaturesfor cutting/pastingand for searching/replacing text. The message areagives feedback while saving and exporting and also displays errors. The console displays textoutputbytheArduinoSoftware(IDE),includingco mpleteerrormessagesandotherinformation. The bottom right hand corner of the window displays the configured board andserial port. The toolbar buttons allow you to verify and upload programs, create, open, andsavesketches, and open theserialmonitor.

Sketchbook:

The Arduino Software (IDE) uses the concept of a sketchbook: a standard placeto store your programs(or sketches). The sketchesin your sketchbook can be opened fromtheFile>Sketchbookmenuorfromthe Openbutto nonthetoolbar.Thefirsttimeyourunthe Arduino software, it will automatically create a directory for your sketchbook. You canview or change the location of the sketchbook location from with the Preferences dialog.Tabs, multiple files and Compilation allows you to manage sketches with

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more than one file(each of which appears in its owntab). These can be normal Arduino code files (no visibleextension), C files (.c extension), C++ files (.cpp), or header files (.h). Before compiling thesketch, all the normal Arduino code files of the sketch (.ino, .pde) are concatenated into asinglefilefollowingtheorderthetabs areshownin.Theother filetypes areleftas is.

Libraries:

Librariesprovideextrafunctionalityforusein sketches,e.g.workingwithhardware or manipulating data. To use a library in a sketch, select it from the Sketch > ImportLibrary menu. This will insert one or more #include statements at the top of the sketch andcompile the library with your sketch. Because libraries are uploaded to the board with yoursketch, they increase the amount of space it takes up. If a sketch no longer needs a library,simplydeleteits #includestatementsfromthetopofyour code.

Third-Party Hardware:

Support for third-party hardware can be added to the hardwaredirectoryofyoursketchbookdirectory.Platf ormsinstalledtheremayincludeboarddefinitions (which appear in the board menu), core libraries, bootloaders, and programmerdefinitions. To install, create the hardware directory, then unzip the third-party platform intoits own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override thebuilt-inArduino platform.)To uninstall, simplydeleteitsdirectory.

ThingSpeakIOTPlatform:

ThingSpeak™ is an IoT analytics service that allows you to aggregate, visualize, and analyzelive data streams in the cloud. ThingSpeak provides instant visualizations of data posted byyour devices toThingSpeak.Withthe abilitytoexecute MATLAB® code inThingSpeak,you can perform online analysis and process data as it comes in. ThingSpeak is often used forprototypingand proof-of-conceptIoTsystemsthatrequireanalytics.

You can send data from any internet-connected device directly to ThingSpeak using a RestAPI or MQTT. In addition, cloud-to-cloud integrations with The Things Network, Senet, theLibelium Meshlium gateway, and Particle.io enable sensor data to reach ThingSpeak overLoRaWAN®and 4G/3Gcellular connections.

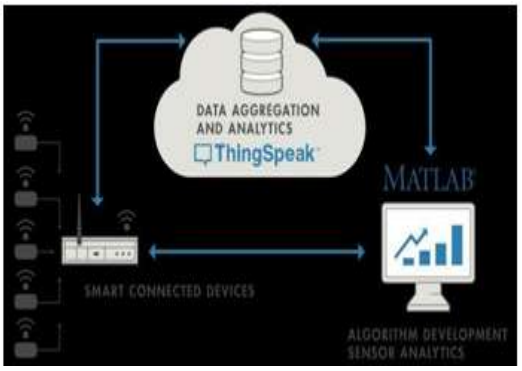

Figure: ThingSpeak

With ThingSpeak, you can store and analyze data in the cloud without configuring webservers, and you can create sophisticated event-based email alerts that trigger based on datacominginfromyourconnecteddevices.ThingSpe akhasintegratedsupportfromthenumerical computing software MATLAB from MathWorks,[4] allowing ThingSpeak users toanalyze and visualize uploaded data using MATLAB without requiring the purchase of aMATLABlicensefromMathWorks.

V. SYSTEM CODE

```
#include<SoftwareSerial.h>

int srdata;
intprdata;
int pump_status;
SoftwareSerial esp8266(3,4);
#define SSID "Hammad"
#definePASS"Hammad1234"
StringsendAT(Stringcommand,constinttimeout)
    {
String response = "";
esp8266.print(command);longinttime=millis();
while((time+timeout)>millis())
{
while(esp8266.available())
 {
char c = esp8266.read();response+=c;
 }
}
Serial.print(response);returnresponse;
  }


voidsetup()
{
// put your setup code here, to run once:Serial.begin(9600);esp8266.begin(9600);send AT("AT+RST\r\n",2000);sendAT("AT\r\n",1000);s endAT("AT+CWMODE=1\r\n",1000);
```

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```
sendAT("AT+CWJAP=\""SSID"\",\""PASS"\"\r\n"
,2000);
while(!esp8266.find("OK"))
{
}
sendAT("AT+CIFSR\r\n",1000);
sendAT("AT+CIPMUX=0\r\n",1000);
pinMode(A0,INPUT);pinMode(8,OUTPUT);
}
voidloop()
{

// put your main code here, to run repeatedly:srdata=analogRead(A0);prdata=map(srdata,0,1023,100,0);
Serial.print("Sensor Data:");Serial.println(prdata);
Stringsensor_value=String(prdata);
 if(prdata>50)
  {

  digitalWrite(8,LOW);
  pump_status=100;
 }
else
 {
  digitalWrite(8,HIGH);
  pump_status=0;
}
String pump = String(pump_status);updateTS(sensor_value,pump);delay(2000);
}
voidupdateTS(StringT,StringP)
{
Serial.println("");sendAT("AT+CIPSTART=\"TCP\",\"api.thingspeak.com\",80\r\n",1000);delay(2000);
Stringcmdlen;
Stringcmd="GET /update?key=6WOGO9NED4Q9S7RZ&field1="+T+"&field2="+P+"\r\n";cmdlen=cmd.length();sendAT("AT+CIPSEND="+cmdlen+"\r\n",2000);
esp8266.print(cmd);Serial.println("");sendAT("AT+CIPCLOSE\r\n",2000);
Serial.println("");delay(15000);
}
```

VI. RESULTS AND CONCLUSIONS

Results:

Following graph shows different data taken from soil moisture sensor and water pump. Thedataobtainedfromsoilmoisturesensorandwaterpumpis usedtoplotagraphusingthingspeakIOTplatform.

Conclusion:

The proposed model explores the use of IoT (Internet of things) in the agriculture sector. Thismodel aims at increasing the crop yield by

helping in predicting better crop sequence for aparticular soil. thingspeak helps in real time sampling of the soil and hence the data acquiredcan be further used for analyzing the crop. Data on the cloud also helps the agriculturists inimproving the yield, evaluating the manures, illness in the fields. This system includes sensornode andcontrol node.The sensornode isdeployedinirrigationfieldforsensingsoilmoisture value and the sensed data is sent to controller node. On receiving sensor value thecontroller node checks it with required soil moisture value. When soil moisture in irrigationfield is not up to the required level then the motor is switched on to irrigate associatedagriculture field. The experimental results show that the system is capable for automaticcontrolling the experimental results show that the system is capable for automatic controllingof irrigation motor based on the feedback of soil moisture sensor. This system is used in aremote area and there are various benefits for the farmers. By using theautomaticirrigationsystemitoptimizestheusageof waterbyreducingwastage and reduce the humanintervention for farmers. It saves energy also as it automatic controlling the system. So thereare the system is OFF when the field is wet and automatically start when the field is dry. It isimplemented in all type of irrigation system (channel, sprinkler, drip). And we present alsoless number of sensor nodes to use in a large area of field so the cost of the system alsodecrease. And power consumption of the wireless network devices are also less and thesystemperformalong timefunction.

Future Scope:

The current working model can be improved by adding different sensors like DHT sensor tocalculate humidity of the environment, temperature sensor, rain sensor etc. The future aspectof this system can be mad into an intelligent system, wherein the system predicts the useractions, rainfall pattern, time to harvest and many more which will make system independentof human operations. This can be achieved by machine learning.

It includes making differentdataminingalgorithmssuitablefordataanalysisinagriculture.Thiswouldmakethepredictingand analysing processes moreaccurate.

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