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IOT-ENABLED SMART AGRICULTURE MONITORING AND CONTROL SYSTEM FOR ENHANCED CROP MANAGEMENT

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Abstract:
Since agriculture is the foundation, most people in India rely on it. Plantation systems become more productive as agriculture expands. Water is a more valuable resource for irrigation. Water consumption typically takes one hour. Improved plant yields, less reliance on fertilisers, improved crop quality, more efficient irrigation, and improved usage of soil moisture sensors. Many techniques are used to assist farmers, however they are slower and provide less precise crop production recommendations. For irrigation to be successful, the soil moisture content in the irrigation fields must be regularly monitored. An Internet of Things (IoT)-based system is created for smart farming in order to automate the irrigation system and monitor the agricultural field using a soil moisture sensor. From any location at any time, farmers can keep an eye on the condition of the land. Therefore, compared to the traditional method, IoT-based smart farming is quite efficient.
Keywords: Microcontroller, Soil Moisture Sensor, Internet of Things.

I. INTRODUCTION

The "IoT-based Smart Agriculture Field Monitoring & Control System" keeps an eye on the soil's moisture content and intelligently regulates the motor pump. Agriculture is the primary source of food for all people. Life would not be possible without agriculture. It is necessary for nourishment, plant development, and seed germination. Therefore, there has to be enough water in the agricultural area. Crop productivity will be impacted by both too much and too little water. Therefore, it's critical to keep the field's water level constant. The soil's moisture content will be tracked using this suggested system. The motor pump will switch off if there is enough water; else, it will turn on. This is made feasible by measuring the soil moisture using a soil moisture sensor (SMS).

To determine the soil's moisture content, the device will use the relationship between electrical resistance and water content. Low soil water content results in poor electrical conductivity. As a result, a greater resistance value is acquired, indicating a low level of soil moisture. The motor pump is activated in this scenario. Water is pumped out for irrigation using a motor-pump. Soil with a high water content has a high electric conductivity. The motor pump is turned off as a result of the lower resistance level, which suggests high soil moisture.

As a result, this suggested technique will assist the agricultural sector in maintaining the ideal soil moisture content, which would enable appropriate irrigation.

II. RELATEDWORKS

BalajiBhanu et al [1], Describes a way to monitor the agriculturefield using wireless sensor network in order to increase the yield as well as the quality of farming without keeping eyeonitforallthetimebyhand.Temperaturehumidity andcarbondioxidelevelismeasureperiodically.Whenachange isobserved,thefarmerisintimatedthroughtext messageande-mail.

Joseph Haule and Kisangiri Michael [3], Using of IoT technology to collect information about scenario like weather,moisture,temperature,levelofwater,pestdetection,cropgrowth.Here,wirelesssensornetworkisusedt omonitorthecondition of farm and microcontroller is used to automate the farm process. This reduces the investment and increasestheproductivityoffarming.

B. Yahya et al [5], definesanirrigationsystemformanagingtheirrigationandtoproduce maximum yield as well as save water at the same time. This is achieved by using low-cost Bluetooth wirelessradiocommunication.

W. Zhang et al [7], this paper focusses about wireless sensornetwork technology for environmental monitoring of soil moisture. In this paper, moisture change during rainfall iscollected frequently in the form of data which improves the robustness and network life time. The sensor networkdelivers usefuldata overthe time ofrainfall.

Navarro et al [11], says in detail about Using wireless sensor networkfor the purpose of water irrigation. In this paper the design and implementation of wireless sensor network featuringzigbeetechnologywithIEEE802.4transceiverisproposed.Themonitoringsystemprovideslowcostin termsoflabouraswellas flexibilityinterms ofdistance.

Yunseop et al [12], gives the design as well as implementation of wireless sensornetwork for monitoring the temperature, humidity and ambient light intensity in the field which helps the end user orfarmertoadoptforthecropmanagement.Thissystemhasnodeswhicharemadewithsmallapplicationspecifics ensorand storage of sensor data into EEPROM. This also can be altered in the terminal according to the need of the formerorthe enduser.

Y.Kim et al[14], Using acoustic emission technology to detect water shortageinformation.PCI-2AEboard-card,R15sensor,temperature,humiditysensor,Co2sensorandPCI-8333DAQwereusedforhardwaredetectingsystem.Avirtualtechnologyisusedforsoftwaresystem.Thissystem aimstomakecropgrowthinoptimumsoilwaterenvironmentas well as toincreasetheutilizationof water.

III. METHODOLOGY

As Fig.1 shows the architecture of proposed system. It consists of two parts: monitoring and control parts. In themonitoring part, the soil moisture sensor is used. The microcontroller which is used to monitor the location of waterflowsinthesoil.Ifthereisanyvariationinthemoisturelevel,itwillbedisplayedontheLCDdisplay.Itautomaticallyswitchesoffthe motor pump oncetherange ofthe waterlevel increases.

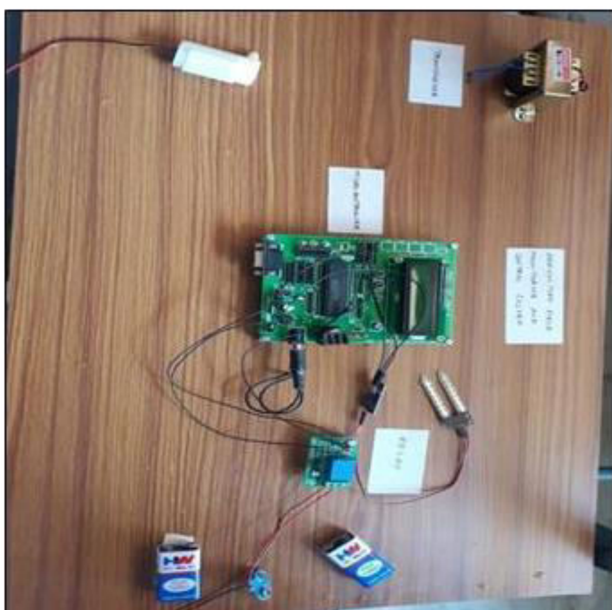

Fig 1: Architecture of Field monitoring and control system

Twostiffcopperprobesareinsertedinthesoiltodetectthesoilmoisturecondition.Thecomparatorusedheremonitorsthe sensors and when sensors sense the dry condition, the proposed system will switch on the motor pump, else it willswitch off the motor pump. A transistor is used to drive the relay during the moist

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condition. A 5 Volt double pole –double through relay isused to control the water pump. LEDindicationisprovidedforvisualrepresentationoftheloadstatus [1].

AswitchingdiodeislinkedacrosstherelaytoneutralizethereverseEMF.Thisproposedsystemrunswith5Vregulatedpower supply. Poweronthe LEDisconnected for visibilityof powerstatus.

i) SoilMoistureSensor:

Soil Moisture sensor will sense the moisture level in the sand as Fig 3. It is made of two probes.It permits the electriccurrenttopassthroughthesoil,which measuresthe moisturelevel ofthesoilaccordingtoitsresistance.Whenthereis sufficient water in the soil, the sensor conducts more electricity, which means it has less resistance. This indicates highmoisture content in the soil. Dry soil reduces the conductivity of the electricity. When there is less water; the sensorconductslesselectricity,whichmeansithasmoreresistance.Thisindicateslowmoisturecontentinthesoil. Thissensorcontrolsthe motor pump andalso monitors the moisture content of soil.

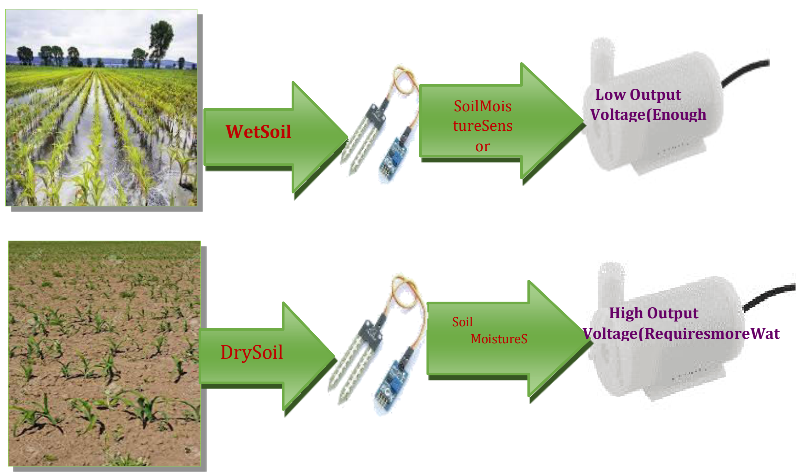

Fig. 2 Soil Moisture Sensorforwet &drysand

ii) SoilMoistureMonitoring:

Soilmoistureisthewaterheldwithinthesoilpores.Soilmoistureisoneofthemain agentdecidingharvest,asitaffectsthe water uptake of the crops. So measuring the soil moisture level always plays an important role for successful farmmanagement. The traditional method of evaluating soil moisture content as "look and feel" can be highly inadequate.The use of moisture sensors helps to evaluate soil moisture which leads to relevant irrigation decisions. The hardwareconsistsofan8051microcontrollerandapre-wiredsoilmoisturesensormodule.Thesoilmoisturesensormodule,builtaround the LM25 comparator, gives an active-low (L) level output when the soil is dry. Thus, the digital output (wetsoil/drysoil)isroutedtooneoftheI/Oterminalsofthe8051microcontroller.Accordingtothisinput,itgivesan active-high (H) output through I/O terminal if the soil condition is dry, and an active-low (L) output, when soil condition iswet [7].

iii) Components of the Architecture Design

a) StepDown Transformer:

Itisusedtoconvertthehighvoltageintolowvoltage.Itgiveslowvoltagevaluefortheelectronicappliances.Inthisproposedsystem, it converts 280-voltpowersupplyinto 12-volt powersupplyasshown inFig. 3

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Fig.3StepDownTransformer

b) Relay:

AsFig.4,therelayswitchisusedtoactsasaswitchonoroffhighpowercircuitfrom alowpowercircuit,whichuseselectro-magnetism.

Fig.4 Relay

c) Microcontroller8051:

The 8051 is an 8-bit microcontroller, has components like CPU, 5 or 6 interrupts, 2 or 3 16-bit timer/counters,programmablefull-duplexserialport,32I/Olines,RAMandROM asshowninFig6.The8051handlestheinterrupts.Vectoringtofixed 8-byte areasis suitable and efficient.

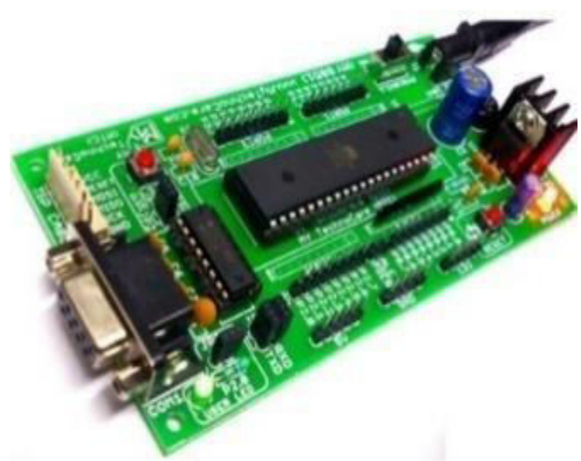

Fig.5 8051 Microcontroller

d) MotorPump:

The Fig.6is a Mechanical device, which it's use to pump out water for irrigation. In this proposed system

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it isautomaticallyturned on/off dependingupon the moisture contentofthe soil.

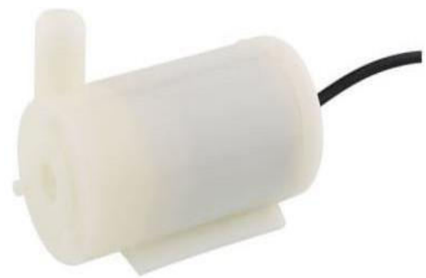

Fig.6MotorPump

iv) Algorithm

Step1:Switchon the System

Step2:PlacetheMoisture SensorProbesintothesoil

Step3:Connectthe motor pump tothebattery

Step4:Ifthemoisturecontent ofthesoilissufficient,thenthe motor willbeturnedoff.

Step5:Otherwise,themotorwill beturnedon.

Step 6:Motor on and off status will be displayed on theLCDScreen.

IV. EXPERIMENTALRESULTS

The hardware used in this system is interfaced with all the sensors in the board. The hardware components include the8051 microcontroller, a motor pump, relay, 9V battery and the soil moisture sensor. And power supply is given. Asshownin Fig.7, the systemistestedbywateringandthe soil moisturesensorisinsertedin thefield section.

Fig.7Testedinthefield

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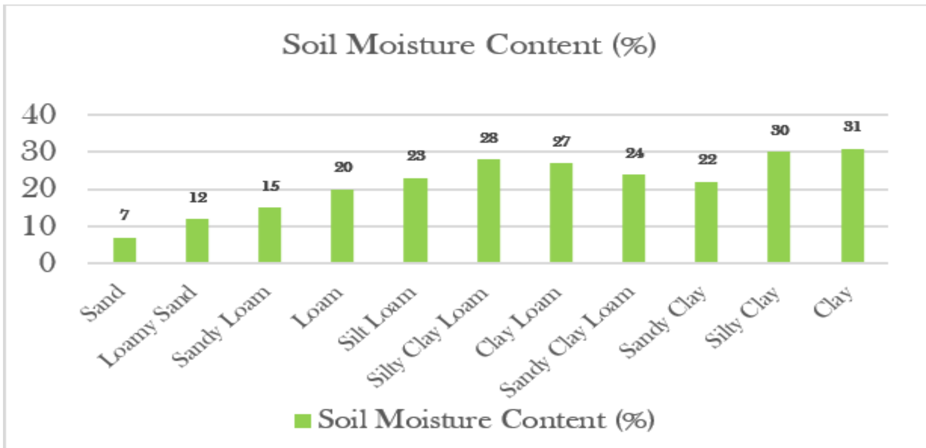
The sensor is used to sense the soil by using soil moisture sensor. Also, this system is automatically turned on, when the moisture content of the soil is low; the pump is turned on and off depending on the moisture content. The percentage of Soil moisture content varies from different soils at which irrigation should occur. The different types of soils are Sand, Loamy Sand, Sandy Loam, Loam, Silt Loam, Silty Clay Loam, Clay Loam, Sandy Clay Loam, Sandy Clay, Silty Clay, Clay. Implementation is carried out in Keil C compiler.

Fig.8 Tested in different soils



As a result, the soil moisture sensor cost is very low.With certain distance fixed in the whole field, it will monitor thewaterlevel.Testedin small area with differenttypes of soilsasshown in Fig.8

V. CONCLUSION

Therefore, to determine the amount of moisture in the soil, an Internet of Things-based agricultural field monitoring and management system is utilised. Humans can't always keep an eye on their field and check the moisture content when they're on vacation. Such issues may be resolved by putting our system into practice. Because it is an automated system that is self-sufficient, it can handle the problem without any human intervention. Wi-Fi connection technologies can be used to improve this suggested system in the future.

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