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Research Article

IoT based SMART FARMING SYSTEM

M.V.Prabhakaran, Assistant Professor, Dhanalakshmi Srinivasan College of Engineering and Technology
Kavitha.G.,Assistant Professor, Department of Information Technology, Dhanalakshmi Srinivasan College of Engineering and Technology

ABSTRACT:

Internet of Things (IoT) technology has brought revolution to each and every field of common man'slife by making everything smart and intelligent. IoT refers to a network of things which make a self-configuring network. The development of Intelligent Smart Farming IoT based devices is day by dayturning the face of agriculture production by not only enhancing it but also making it cost-effectiveand reducing wastage. The aim/objective of this report is to propose IoT based Smart FarmingSystem assisting farmers in getting Live Data (Temperature, Soil Moisture) for efficient environmentmonitoring which will enable them to increase their overall yield and quality of products. The IoTbased Smart Farming System being proposed via this report is integrated with ArduinoTechnologymixed with different Sensors and a Wifi module producing live data feed that can be obtained onlinefrom Thingsspeak.com. The product being proposed is tested on Live Agriculture Fields giving highaccuracyover98%in datafeeds.

Key words:-Arduino, Moisture, monitoring, Farming, integrated, Sensors.

INTRODUCTION:

OVERVIEW:

The objectives of this report is to proposedIoT based Smart Farming System which willenablefarmers to havelivedataofsoilmoistureenvironmenttemperatureatverylowcostsothat live monitoringcanbedone.

The structure of the report is as follows: chapter I will cover over of overview of IoTTechnologyandagriculture-conceptsanddefinition,IOTenablingtechnologies,IOTapplication in agriculture, benefits ofIOT in agriculture and IOT and agriculture currentscenario and future

forecasts. Chapter II will cover definition of IOT based smart farmingsystem , the components and modules used in it and working principal of it. Chapter III willcover algorithm and flowchart of the overall process carried out in the system and its finalgraphicaloutput .chapter IVconsistofconclusion,futurescope and references**.**

IOTTECHNOLOGYANDAGRICULTURE:

IOT:CONCEPT ANDDEFINITION:

Internet of things IOT consists of two words Internet and Things .The term things inIOTreferstovariousIOTdeviceshaving unique identitiesandhavecapabilitiestoperformremotesensing,actuatingandlivemonitoringofcertainsortofdata.IOTdevices are also enable to have live exchange of data with other connected devices andapplication either directly or indirectly , or collected data from other devices and processthe data and send the data to various servers. The other term internet is define as Globalcommunication Network connecting Trillions of computers across the planets enablingsharing of information .Thus the IOT can be define as:"A dynamic Global NetworkInfrusturewithselfconfiguringcapabilitiesbasedonstandardandinteroperablecommunication to protocol where physical and virtual things have identities, physicalattributes,andvirtualpersonalitiesanduseintelligentinterfacesandareseamlesslyintegrated into the information network ,often communicate data associated with user andtheirenvironment."

An ideal IoT device consists of various interfaces for making connectivity to otherdeviceswhichcaneitherbewiredorwireless.

AnyIoTbaseddeviceconsistsoffollowingcomponents:

- I/OinterfaceforSensors.
- Interfaceforconnectingto Internet.
- Interface forMemoryandStorage.

- InterfaceforAudio/Video.

IoTdevicescanbeofvariousformslikewearablesensors,smartwatches,IoTsmarthomemonitoring,IoTintelligent transport systems,IoTsmarthealth devices etc.

IOTENABLINGTECHNOLOGIES:

Internet of Things has a strong backbone of various enabling technologies-Wireless Sensor Networks, Cloud Computing, Big Data, Embedded Systems, SecurityProtocolsandArchitectures,Protocolsenablingcommunication,webservices,InternetandSearchEngines.

Wireless Sensor Network (WSN): It consists of various sensors/nodes whichareintegrated together to monitor various sorts of data.

Cloud Computing: Cloud Computing also known as on-demand computingis a type of Internet based computing which provides shared processing resources and datato computers and other devices on demand. It can be in various forms like IaaS, PaaS,SaaS,DaaS etc.

Big Data Analytics: Big data analytics is the process of examining large datasets containing various forms of data types—i.e. Big Data – to uncover hidden patterns,unknowncorrelations,markettrends,customerpreferencesandotherusefulbusinessinformation.

CommunicationProtocols:TheyformthebackboneofIoTsystemstoenable connectivity and coupling to applications and these protocols facilitate exchange ofdata over the network as these protocols enable data exchange formats, data encoding andaddressing.

Embedded Systems: It is a sort of computer system which consists of bothhardwareandsoftwaretoperformspecifictasks.Itincludesmicroprocessor / micro-controller,RAM / ROM,networkingcomponents,I/Ounitsandstoragedevices.

IOTAPPLICATIONSINAGRICULTURE:

With the adoption of IoT in various areas like Industry, Homes and even Cities, hugepotential is seen to make everything Intelligentand Smart. Even the Agricultural sector isalso adopting IoT technology these days and this in turn has led to the development of"AGRICULTURALInternetofThings (IoT)"

ApplicationName	**Description**
Crop WaterManagement	In order to perform agriculture activities in inefficient manner,adequate water is essential. Agriculture IoT is integrated with WebMap Service (WMS) and Sensor Observation Service (SOS) toensureproperwatermanagementforirrigationandinturnreduceswaterwastage.
PrecisionAgriculture	High accuracy is required is required in terms of weatherinformation which reduces the chances of crop damage.AgricultureIoT ensures timelydeliveryofrealtimedataintermsofweatherforecasting,qualityofsoil,cost oflabour and much moretofarmer.
IntegrattedPestManagementorControl(IPM/C)	Agriculture IoTsystems assures farmers with accurateenvironmentaldataviaproperlivedatamonitoringoftemperature ,moisture,plantgrowthandlevelofpestssothatpropercarecan betaken duringproduction
FoodProduction&Safety	Agriculture IoTsystem accurately monitors various parameterslikewarehousetemperature,shippingtransportationmanagement systemandalsointegratescloudbasedrecordingsystems.
Other ProjectsImplemented TillDate	1. ThePhenonetProjectbyOpenIoT. 2. CLASSEquipment 3. Precisionhalk'sUAVSensorPlatform 4. Cleangrow'sCarbonNanotubeProbe 5. Temputech'sWirelessSensorMonitoring.

Table1.1 Variousprojectsandapplicationsareintegratedin Agriculturalfieldsleadingtoefficient management and controllingof various activities.

2. BENEFITSOFIOT INAGRICULTURE:

Thefollowingarethebenefits of IoTinAgriculture:

IoT enables easy collection and management of tons of data collected from sensors and withintegration of cloud computing services like Agriculture fields maps, cloud storage etc., datacan be accessed live from anywhere and everywhere enabling live monitoring and end to endconnectivityamongall the parties concerned.

IoT is regarded as key component for Smart Farming as with accurate sensors and smartequipment's, farmers can increase the food production by 70% till year 2050 as depicted byexperts.

WithIoTproductionscostscanbereducedtoaremarkablelevelwhichwillinturnincreaseprofitabilityand sustainability.

WithIoT,efficiencylevelwouldbeincreasedintermsofusageofSoil,Water,Fertilizers,Pesticidesetc.

WithIoT,variousfactorswouldalsoleadtotheprotectionofenvironment.

1.2.5IOTANDAGRICULTURECURRENTSCENARIO ANDFUTUREFORECASTS:

Table 1.2.Shows the growth of IoT based adoption in Agriculture sector from Year 2000-2016andForecasts ofyear 2035-2050.

Year	DataAnalysis
2000	**525MillionFarmsconnectedtoIoT**
2016	**540MillionFarmstillDateareconnectedtoIoT**

2035	**780MillionFarmswould beconnectedtoIoT**
2050	**2BillionFarmsarelikelytobeconnectedtoIoT**

OVERVIEWOFTHEPROJECT:

DEFINITIONIOTBASEDSMARTFARMINGSYSTEM:

IoTbasedSMARTFARMINGSYSTEMisregardedasIoTgadgetfocusingonLiveMonitoring of Environmental data in terms of Temperature, Moisture and other types depending on thesensors integrated with it. The system provides the concept of "Plug & Sense" in which farmers candirectly implement smart farming by as such putting the System on the field and getting Live Datafeeds on various devices like Smart Phones, Tablets etc. and the data generated via sensors can beeasilysharedandviewedbyagricultureconsultantsanywhereremotelyviaCloudComputingtechnologyintegration.Thesystemalsoenablesanalysisofvarioussortsofdataviabigdataanalyticsfrom timeto time.

COMPONENTSANDMODULES:

Inthissection,variouscomponentsandModulesbeingusedforIoTbasedSMARTFARMINGSYSTEM development is discussed:

ARDUINO UNO:

The Arduino Uno is a microcontroller board based on the AT mega328 (datasheet). It has 14 digitalinput/output pins (of which 6 can be used as PWM outputs),6 analog inputs, a 16 MHz crystal oscillator,aUSBconnection, apowerjack,anICSP header ,and areset button.

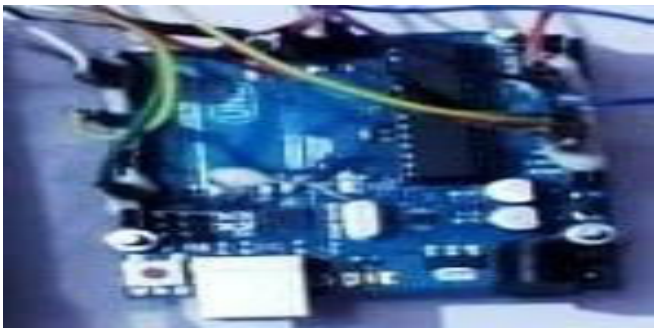

Figure2.1 ARDUINOUNO

WIFIMODULE-ESP8266:

SENSORS

Figure2.2 WIFIMODULE-ESP8266:

TEMPERATURESENSOR-DS18B20:

The DS18B20 temperature sensor provides 9-bit to 12-bit Celsius temperature measurements andhas alarm function with non-volatile user-programmable upper and lower

trigger points. The DS18B20has64-bit serial codewhich allows multipleDS18B20s to functionon same1-wirebus.

Technical Specifications: Unique 1-Wire Interface; Measures Temperature from -55^{O}C TO +125^{O}C;Covertstemperatureto 12-bit digital word in 750ms.

ESP8266Wi-FiModuleisSOCwith TCP/IPprotocolstackintegratedwhichfacilitatesanymicrocontroller to access Wi-Fi network. ESP8266 module is cost effective module and supports APSDfor VOIP Applications and Bluetooth co-existence interfaces. Technical Specifications: 802.11b/g/n;Wi-FiDirect,1MBFlashMemory,SDIO1.1/2.0,SPI,UART,StandbyPowerConsumptionof <1.0mW.

2.2.3.2SOILMOISTURESENSOR-FC28:

Figure2.4SOILMOISTURESENSOR-FC28

SoilMoistureSensorisusedformeasuringthemoistureinsoilandsimilarmaterials.Thesensorhas two large exposed pads which functions as probes for the sensor, together acting as a variableresistor. The moisture level of the soil is detected by this sensor. When the water level is low in the soil,the analog voltage will be low and this analog voltage keeps increasing as the conductivity between theelectrodes in the soil changes. This sensor can be used for watering a flower plant or any other plantsrequiresautomation.

POWERSUPPLY:

RECHARGEABLEBATTERY:

The sealed lead-acid (SLA) 12V, 9Ah rechargeable battery is rated at a 5-hour (0.2) and 20-hour(0.05C) discharge. Longer discharge times produce higher capacity readings because of lower losses.The lead-acid performs well on high load currents. This battery act as an internal power supply for thewholecircuit.

Figure2.5 RechargeableBattery

BATTERYCHARGINGCIRCUITWITHTRANSFORMER:

The circuit acts as a 12 volt battery charger for Lead Acid battery. It gives 12 volt and 5 Ampscurrent for quick charging of the battery. If the battery is partially discharged, full charge will beattained in one hour. The circuit is connected with a 0-14 volt 5 Ampere Step down transformertoconvert AC to DC. Since pulsed DC is good for Lead Acid battery, a low value smoothing capacitor isusedinthecircuit .Inthecircuit,LEDactastheCharger on status.

Figure2.6 Batterychargingcircuit

Figure2.7Transformer

EXTERNALACADAPTER:

A 12V AC adapter can also be considered as a component in the circuit for external power supplyfor the circuit which enabled the circuit to be switched 'ON' in case if the battery power is very low foruse. The adapter can directly act as an AC/DC convertor to provide pure DC current externally to thecircuit.

Figure2.8ExternalACAdapter

CIRCUITDESCRIPTION&WORKINGPRINCIPAL:

In this circuit there is a programmed ARDUINO which is connected with sensors(soilmoisture and temperature)and a wifi module .The working principal of the model based onstoring data from the sensors with the help of ARDUINO and passing it to wifi module .The wifimodulegivestheupdatesofdatainadevicethroughcloudcomputing.Inthedevicetherealtimedatacomes through wifi to the channelnamed SMART FARMING which we can accessthrough the URL :https//:thingspeaks.com/channels/625454.In the channel the graph is plottedthroughmatlabtechnology.Thereisachargeablebatterywhichconnectedwiththepowersupply of ARDUINO so that the circuit start working. There is also charging circuit with AC/DCconverter for charging battery .In the case if the battery is not charged there further an adaptorwhichcanexplicitlygives power to ARDUINO circuits.

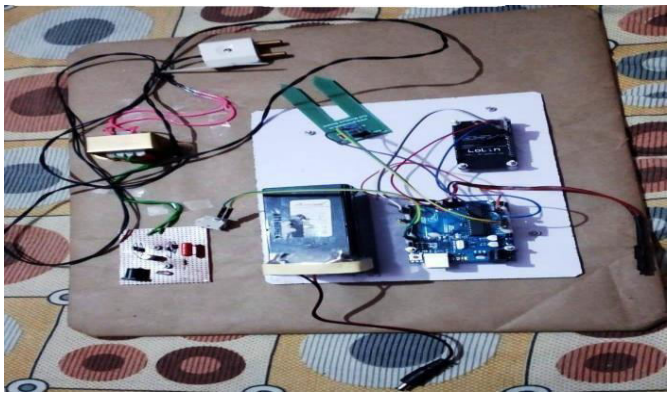

Figure2.9 Overallcircuitdesign

ALGORITHMS&FLOWCHART&OUTPUTGRAPHS:

ALOGORITHM:

THEALGORITHMOFOVERALLPROCESS**:-**

STEP 1: START THE PROCESS

STEP2:CONNECTEDTOWIFI

STEP3:READTEMERATUREANDHUMIDITY

STEP4:GETTEMPERATUREANDHUMIDITYVALUESFROMANOLOGPINS

STEP5: SENDDATATO THINGSPEAK API

STEP6:DELAYTO10SECONDS

STEP7: REPEATSTEP 4,5&6 UNTILTHE PROCESS END

STEP8: END

Figure3.1FLOWCHARTOFOVERALLPROCESS

OUTPUTGRAPHS:

Figure3.2LiveDataofTemperaturewithDateandTimefromThingspeak.com

Figure3.3 LiveData ofSoilMoisturewithDateandTimefromThingspeak.com

CONCLUSION:

IoT based SMART FARMING SYSTEM for Live Monitoring of Temperature and Soil Moisturehas been proposed using Arduino and Cloud Computing . The System has high efficiency andaccuracy in fetching the live data of temperature and soil moisture. The IoT based smart farmingSystem being proposed via this report will assist farmers in increasing the agriculture yield andtake efficient care of food production as the System will always provide helping hand to farmersfor getting accurate live feed of environmental temperature and soil moisture with more than 99%accurateresults.

FUTURESCOPE:

Future work would be focused more on increasing sensors on thissystemtofetch more data especially with regard to Pest Control and by also integrating GPS module in thissystem to enhance this Agriculture IoT Technology to full-fledged Agriculture Precision readyproduct.

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