Smart Agriculture System

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Abstract— Agriculture is the broadest economic sector and plays a vital role within the overall economic development of a nation. Technological advancements within the arena of agriculture can ascertain to extend the competency of sure farming activities. During this paper, we've projected a unique methodology for sensible farming by linking smart irrigation systems through wireless communication technology. The target of this analysis work is to make sensible agriculture system victimization embedded systems and smartphones to connect the tools used for farming. Our system focuses on the look to check the specified parameters of the soil, and recommend the simplest doable pointers relating to crops, pesticides and fertilizers. Current advances in knowledge management square measure creating sensible Farming grow exponentially as knowledge becomes the key part in trendy agriculture to assist producers with vital decision-making. This sort of observational managed farms trust knowledge which will increase potency by avoiding the misuse of resources and therefore the pollution of the surroundings. During this system the information is distributed by user over the net and therefore the user will visualize the rules victimization Associate in Nursing humanoid application. supporting the parameters of soil, the NodeMCU triggers the pump to sprinkle water over the crops to take care of an appropriate atmosphere for the expansion of crops. The careful modeling and management methods irrigator and smart farming system square measure are incontestable during this paper.

Keywords-Embedded Systems; NodeMCU; IoT; Smart Phone;

I. INTRODUCTION (*HEADING 1*)

India is an agricultural country blessed with a ton of fertile land having 3 cropping seasons. It suggests that we are able to use our land throughout the year for the aim of cultivation that covers a significant part of our gross domestic product further joined by our basic wants, food that is one among the foremost primary issues for the individuals worldwide. without doubt there is not any substitution of food and higher farming method is that solely thanks to increasing the assembly of food. So as to supply a comfortable quantity of food we have a tendency to have to realize some ways to build agriculture easier, time saving and digital. Once, over sixty % of our total occupied individuals were directly and indirectly concerned in farming. As time passes by, we have a tendency to currently see a fully completely different situation. Nowadays, in our country individuals are individually centralized towards cities as a result of farming is not a straightforward task and farmers don't get enough earnings through farming. Recent statistics show North American countries that the expansion rate of farmers in India has stalled over the last decade and is inflicting the autumn in rice production growth.

Here we've got to return up with a thought wherever farming will be thought of as a less sophisticated task. individuals will simply monitor cultivation methods from time to time even once they are a unit not on the market in the field. We have a tendency to area units living in the trendy era wherever everything is obtained digitized and farming is not exceptional among them however here we have a tendency to area units proposing one thing terribly that will farm itself and will offer all types of data that is incredibly essential for a farmer. During this time, most of the farmers lack correct data concerning farming and agriculture creating it additional erratic. Most a part of farming and agricultural connected activities area units supported prediction and statement. once it fails, the farmers have to be compelled to bear Brobdingnagian losses and a few find yourself committing suicide. Since we have a tendency to area unit alert to the good thing about quality of soil and air, irrigational and within the growth of crops such parameters can't be neglected.

II. RELATED WORK

Research is carried out under the following Constraints, such as Understanding the existing approaches and methodology, Understanding the requirements, developing a better system.

In [1] The proposed model (Smart Digi-farming) aims at providing smart solutions to the farming community. The farmer needs to here and there for all the different and integral work of farming. This model emphasizes the use of technology for efficient and feasible solutions. Several important works which they can easily and remotely manage. The process of farming which is mainly divided into three parts: 1. Sowing seeds 2. Maintaining crops 3. Crop ready for Digi-farming˙ The main focus of the model is on the crops and it's monitoring using IOT sensors and cameras. The main objective of the model is limited to Crops only.

In [2] this paper, they have proposed a novel methodology for smart farming by linking a smart sensing system and smart irrigator system through wireless communication technology. They had used two modules, namely a smart farm sensing system and movable smart Irrigator that moves on mechanical bridge slider arrangement. Both the systems consist of microcontrollers, sensors, and the GSM module to communicate with each other and with the external environment. The smart farm sensing system senses the moisture content with the aid of the soil Moisture sensor. The measured data from the smart farm sensing system are sent to the smart irrigator via the GSM module. The farmer can have control over the system by having a wireless communication with a gsm module through his mobile phone. Smart irrigator is mounted on an overhead crane system and it consists of two main sensors that are connected to different pins of the microcontroller. It receives the signal from the smart farm sensing system via the GSM module. The recorded

readings are then transferred to a central database server from which all the crop-growth details are analyzed and transferred to the irrigator system. In the meantime, sensors trigger the optocouplers that are connected to green manure, seeds, compost, and water containers. After the triggering action, the necessary components are splashed on the field. As Solar panels and GSM modules are used, Solar panels will be unable to sustain so many motors, as a result more panels will be

controlling the soil moisture by monitoring the level of water in the water source. The farm would be regularly irrigated automatically at particular time intervals. The motor will be turned ON and OFF by the microcontroller as the soil moisture sensor indicates availability of moisture in the soil. The farmer will be informed via an SMS. A GSM modem is used to 1]SMS Gateway i.e., to send and receive SMS 2]Telemetric i.e. to collect data from remote terminals. The main objective of the model is limited only to Automated Irrigation. The main drawback of the system is GSM Modem which has a particular range.

In [4] In this research a device was established in the Arduino platform in order to detect the soil moisture to save such excess quantity of water being wasted by the farmers. It shows slow response to changes in soil water content after rainfall or irrigation. Andalso, it requires intensive labour to collect data regularly.

This [5] proposed work includes an embedded system for automatic control of irrigation. This project has a wireless sensor network for real-time sensing of an irrigation system. This system provides a uniform and required level of water for the Automation of irrigation system using IoT 81 agricultural farm and it avoids water wastage. When the moisture level in the soil reaches below threshold value then the system automatically switches ON the motor. When the water level reaches normal level the motor automatically switches OFF. The sensed parameters and current status of the motor will be displayed on the user's android application.

III. SYSTEM OVERVIEW

The system consists of a NodeMCU using which communication can be established between the publisher and the subscriber. The user can get a suitable guideline with a proper irrigation schedule based on the status of the farm. The guidelines can be accessed through the Android application. Based on these guidelines and scheduled irrigation provided, the pump delivers water to the crops.

IV. Methodology

The main idea of our system is to automate the farming techniques. Such as providing the suitable treatment with a proper irrigation schedule. First the user has to submit the soil parameters based on that the user will receive guidelines. Based on the soil parameters submitted the Agriculture Engineer will suggest the suitable crops, fertilizers and pesticides to be used. The user will have a choice of crops to plant. Based on the selection of the crop a proper irrigation schedule will be given. A proper plan for farming will be provided. To develop a system which will optimize the use of time and cost.

A. NodeMCU

NodeMCU is a low-cost open-source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware based on the ESP-12 module. The firmware includes the Lua scripting language. It can be optionally overclocked to 160 MHz, Instruction RAM is 64 Kbytes, Data RAM is 96 Kbytes, USB Connector Style is Micro-B Female, Board Dimensions (PCB) 69 x 53mm (2.7 x 2.1″). Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features that make it ideal for IoT projects [3]. The GPIO pins can be used for interfacing with peripherals like sensors, service.

It supports UART, SPI, and I2C interface. The NodeMCU Development Board can be easily programmed with Arduino IDE for its easy use.

Fig. NodeMCU Development Board

B. 12V 1 Channel Relay Module

A 12V 1 channel relay is interfaced with the controller to control the DC Pump whenever a signal is received. To run the 12V pump with the maximum capacity of a controller being 3.3V, the relay acts as a switch between external voltage source and pump. It is used for switching action. If the relay would not be used when there is a chance that the pump might destroy the development board.

Fig. 12 V 1 Channel Relay Module

C. Electric diaphragm water pump

It is a micro submersible pump. The pump works using the water suction method which drains the water through an inlet and releases it through the outlet. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. These pumps are durable and easy to maintain. The use of advanced technology and optimum material makes these products suitable for varied purposes [4].

It is the actuator that waters the crop when required. When the soil becomes humid, then the pump comes into action. Using a pump reduces labor cost and time.

Fig. 12V DCWaterPump

D. Hardware Connection

The Hardware consists of a controller to actuate the actuator and connect with the IOT Server. An amplifying Circuit to run the DC pump with high current and voltage rating. TheDC pump which is the actuator in this case to sprinkle the water to maintain the moisture level of the soil.The Amplifying circuit is used in the system to avoid the relay module to make the product cost effective and to reduce weight of the system also our pump will be of low rating so relay is not necessary. For simulation purposes Arduino uno is used, practical NodeMcu Will be used as it has an inbuilt WIFI module to connect the server which makes it an ideal low priced IOT application Controller. The Switch in the circuit is optional, the pump will be started using the smartphone. But if manual interference becomes necessary, a switch will come in handy. The farmer will be briefed about the water timetable when the soil report is analyzed. He then can use his smartphone to actuate the pump in his farm without actually being present physically on the farm.

E. Software

The NodeMCU was programmed using the Arduino IDE.The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++[5]. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.
The communication between the circuits was established using the Cloud Server. This will work as middleware between IOT and Android System. It is ideal for connecting and storing the data. Cloud Servers today is used in a wide variety of industries. Proposal System work on two main module android and web application to make system dynamic subsequently user don't want to update application every time, changes can be done at run time where user can use the new feature and functionality easily the android module is used for user interface and web application is used for admin and agriculture expert, so here if agriculture expert do some changes in user crop treatment this change can be easily accessible to the user at runtime so the dynamic functionality is implemented with PHP at the software level fig 1.1,

Android module consists of following four phases Authentication,
Data Collection,
Data Presentation,
Receiving Guideline

Authentication is only authorized user can able to access feature and functionality of proposal system so here authentication is provided to the user by the time of the user registration process if user registration is done successfully then user become an authorized person to use proposal system feature and functionality.
The Data Collection process can be done by user registration with three-phase
1.User- Bio Data, where user enter bio-data manually
2.Land Data, in which the user needs to submit land-related data manually
3.Atmosphere Data, which can be collected automatically from the user's land location

All this collected data stored in the database server at a remote location from where admin and agriculture expert can easily access this user data Now Web Application consists of two Panel admin and agriculture expert Panel Admin Panel consists of the following functionality Authentication, User and Agriculture expert Monitor, Adding new features and functionality, Authentication in which only authorized admin can use the proposal system User and Agriculture expert monitor in this phase admin can view which agriculture expert appointed for user crop treatment and also admin can manage user as well as an agriculture expert Adding new features and functionality, in this phase admin can add a new feature like Product, Crop, Pesticides, Weather information at run time and also manage where user and agriculture expert can easily access this information at runtime Agricultural expert Panel consists of the following functionality
View Report,
View Treatment Request
Create Treatment,
Send Guidelines

View Report in this phase agriculture expert view user data which is collected from user android panel and stored in a database server so agriculture expert can easily access this data agriculture expert send the suggestion to the user for which crop is suitable for land, which pesticides and fertilizers user need to use which irrigation system is good to use and send all farming-related information than user from android, interface go through agriculture expert suggestion and choose the crop, irrigation system type and send a request for treatment to agriculture expert agriculture expert view this user treatment request and create a treatment with user choice in fixed algorithm format where this treatment can modify from agriculture expert panel but not from user panel user only view treatment and follow this treatment when the user follows this treatment by the time user receive a notification like its time to irrigation, its time for pesticide when user receive notification for irrigation then the user can turn on the water pump from any remote location, even user don't want to need to turn off water pump it will turn off automatically with the help of sensor detection then the user needs to follow this treatment.

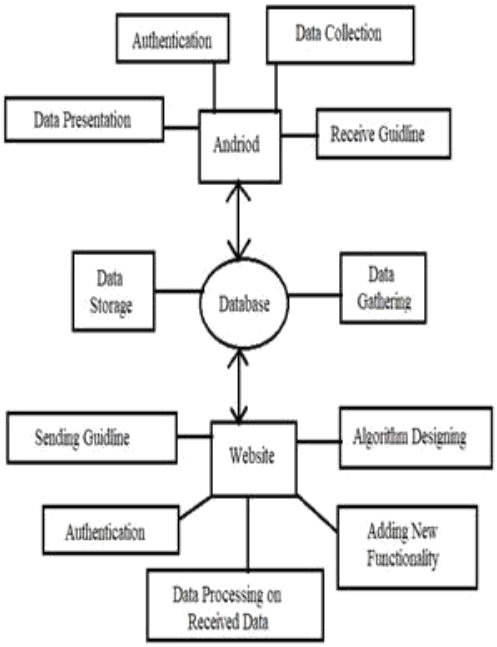

Fig. Architecture of the system

V. RESULTS AND DISCUSSION

This compound system of hardware and software will ensure the higher yields of the farmer. As the process is highly automated the farmers need not to worry about the pumping time and diseases harming crops. Using the internet of things the farmer can access the farm data and the suggestion by the agricultural engineer from wherever they want. Earlier the testing, analysis, suggestion and automation worked separately and thus was not precise in many aspects, this system comprises everything a farmer needs and thus will help them in increasing the yields and protection of that yield.

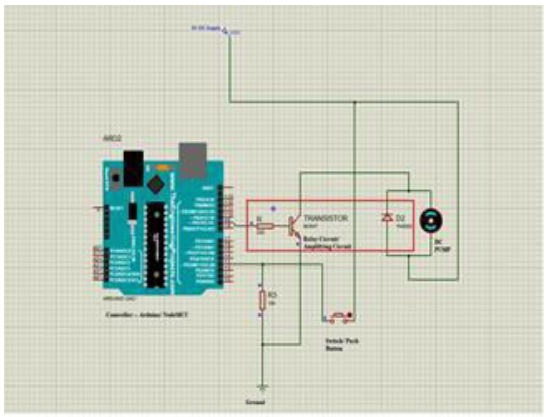

Fig. Simulation for automatic irrigation

The user application is designed using MIT App Inventor. The user can access real-time data using the designed Android application. MIT App Inventor is a web application integrated development environment originally provided by Google and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programming to create application software(apps) for two operating systems (OS): Android, andiOS. The Android application receives data from the publisher the Through the Cloud Server. The user receives data at particular I in intervals and the subscriber system performs suitable action.

Fig. Application for farmers

IV. CONCLUSION

This embedded system will bring revolution to our agriculture business. It will ease farmers' life by reducing farming prices, reducing labor prices, and time. The irrigation are going to be machine-controlled with none labour intervention and with none water wastage. it'll increase the assembly of crops. a rise in production will bring a leap in our economy All these techniques projected within the system is economical for farmers for cultivating crops and for correct use of fertilizers and pesticides. In the coming back future, these embedded systems may be steam-powered with AI algorithms to perform showing intelligence. This kind of system can take agro-based industries' tone weights. The application of agriculture networking technology is would like of the trendy agricultural development, however additionally a crucial image of the longer term level of agricultural development; it'll be the longer term direction of agricultural development. once building the agricultural water irrigation system hardware and analyzing and researching the network hierarchy options, practicality and therefore the corresponding package design of preciseness agriculture water irrigation systems, really applying the web of things to the extremely effective and safe agricultural production incorporates a vital impact on guaranteeing the economical use of water resources furthermore as guaranteeing the potency and stability of the agricultural production. With additional advancement within the field of IoT expected within the coming back years, these systems may be additional economical, abundant quicker and fewer costlier. within the Future, this method may be created as associate intelligent system, wherever within the system predicts user actions, precipitation pattern, time to reap, animal unwelcome person within the field and human action the data through advanced technology like IoT may be enforced so agricultural system may be created freelance of human operation and successively quality and large amount yield may be obtained.

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