Improvised Farm Automation using IoT and its Evaluation

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Abstract-This paper examines the role of Internet of Things (IoT) in Agricultural Sector. Agriculture is becoming an important growing sector due to increasing population. Crucial challenge in agriculture sector is to enhance farm productivity and grade of farming without continuous human intervention. The motive of this work is to propose a smart agricultural method based on Internet of Things (IoT) to deal with the adverse situations. This paper gives information regarding devices, protocol, sensors and systems, which are widely used to monitor farming and specific algorithms are used as optimization methods to achieve the required accuracy. The aim of this work is introduce a system to collect field data at regular and frequent interval and to reduce manual labor with the help of Arduino and Raspberry Pi an IoT based system for successful gathering and processing all data, information transfer, make decisions and provide automation and control function for efficient and cost effective crop yielding. It also performs a comparative study on higher end development board, Arduino and Raspberry pi in Smart Farming. In view of the specs and execution investigation Raspberry Pi certainly raises as a champ with regards to fulfilling most of functional requirements of an IoT systems basic blocks.

Keywords- Smart Farming, IoT, Raspberry Pi, Arduino

I.INTRODUCTION

Farming in India is done using the mundane ways. The fact that most of our farmers lack proper knowledge makes it even more unpredictable. A sustainable part of farming and agricultural activities are based on the predictions, which at times fail. Farmers have to bear huge losses and at times they end up committing suicide. Since we know the benefits of proper soil moisture and its quality, air quality and irrigation, in the growth of crops, such parameters cannot be ignored.

We, therefore, have come up with a new idea of crop monitoring and smart farming using IoT. We believe that our concept will be a benchmark in the agribusiness due to its reliability and remote monitoring. Our idea tries to digitalize farming and agricultural activities so that the farmers can check on the requirements of the crops and accurately predict their growth. This concept will surely accelerate their business to reach new heights and also be more profitable. The implementation of our project largely depends upon the awareness among farmers, which, we believe will be easily created due to its numerous advantages. The aim of this project is to introduce the latest technology into the agriculture business and better crop production by collecting real-time status of crop and informing the farmers about it.

Importance of IoT in Smart Farming:

1. IoT can be used to improve cultivation of food crops, by monitoring effective food crop cycle.
2. To attain effective control over the production process and maintain higher standards of crop quality and growth capacity through automation.
3. Cost management and waste reduction by increased control over the production. Ability to see any irregularity in the crop growth or livestock health, you will be able to lighten the risks of losing your yield.
4. Increased business efficiency through process automation.
5. Enhanced product quality and volumes.

Role of IoT in Smart Farming:

1. Water management can be efficiently achieved using IoT with no wastage of water using sensor modules.
2. Crop monitoring can be easily done to observe the growth of crop.
3. It is useful to control the use of insecticides and pesticides.
4. To monitor of climatic conditions.
5. Soil management activities such as PH level, Moisture content etc. can be identified easily using sensor modules so that farmer can sow seeds according to soil level.
6. Crop sales will be increased in global market. Farmers can comfortably connect to the global trade without restriction of any geographical area.

II.SMART FARMING

Smart Farming is a farm management abstraction using current technology to increase the quantity and quality of agricultural products. By exactly measuring differences within a agricultural field and adapting the plan accordingly, farmers can increase the power of pesticides and fertilizers, and use them more selectively. According to the World Bank evaluation, half of the population in India would be urban by year 2050. It is estimated that percentage of agricultural workers in total work force would drop to 25.8 per cent by 2050 from 58.3 per cent in 2001. Thus, there is a requirement

to intensify the measure of farm mechanization in the country.

Smart Farming is related with 3 interconnected technology discipline:-

1) Management Information System: Farm Management Information Systems (FMIS) is designed to assist farmers to perform various tasks ranging from operational planning, implementation and documentation for assessment of performed field work.
2) Precision agriculture: Precision agriculture is a modern method to make agriculture, which refers to optimizing the production through the fusion of traditional mechanized agriculture procedures with new technologies such as monitoring systems, command & control systems, geographical location systems and support information systems.
3) Agriculture automation and robotics: The activity of applying robotics, automatic control and artificial intelligence skills at all levels of agricultural production, including farmbots and farmdrones. It increases the efficiency and reduces the cost of industrial production and products. Environmental benefits are like more efficient use of water and optimization of inputs and treatment.

As the world's population is rapidly growing, farmers will need to produce more food from limited resources. Arable land is decreasing, water resources are depleting, and many more factors are looming food security threat could easily evolve into regional or even global instability. Majority of the large farms are increasingly using precision farming to reduce wastage and increase yields. It is also hugely feasible to the Indian agricultural situation as it increases farm productivity while decreasing production cost and minimizing environmental impacts.

III.SYSTEM DESIGN

The farm automation system is executed successfully only when, the system is intelligent to run a few predominant tasks automatically and plant growing media according to real-time soil level and plant developing media as indicated by constant soil level and plant climate need. The period delay between gathering information from sensor modules and sending it to the server for preparing to settle on a choice to change over actuators state must be extremely short. It implies estimating the water, humidity and temperature needs, pump water into a tank and executing irrigation process by pumping the water into the water system line. The system consists of water system line, set of pumps and feedback closed loop of soil moisture that measure the soil water saturation level and weather parameters by using the DHT11 sensor to measure humidity and temperature. Every one of the pieces of the framework separated into a couple of modules. The absolute most critical framework modules are quickly examined in area underneath.

IV.SMART FARMING METHODOLOGY-I

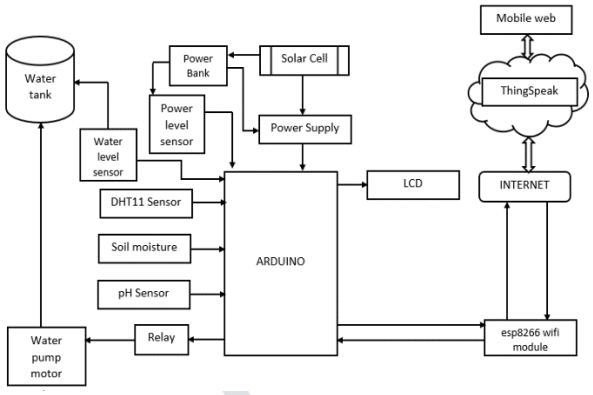

Fig 1: Architectural diagram of Smart Farming using methodology-I

A. Acquire Sensor data

DHT11 Sensor

It is a computerized multifunctional sensor which is fit for detecting both temperature and humidity. It includes a temperature and humidity sensor complex with calibrated digital signal output. So we can exchange these yields straightforwardly to the controller for basic leadership. The DHT11 sensor provides consistent reading when the temperature condition is in middle of 0℃ and 50℃ and humidity condition is in between 20% RH and 90% RH. The sensor has a genuine defect that it can get update information from it simply after at regular intervals. Its consistency is exceptionally guaranteed alongside an extraordinary dependability.

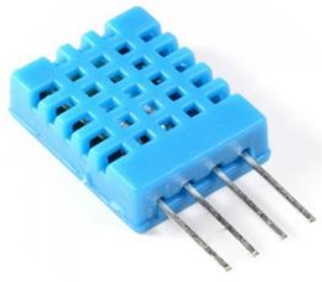

Fig 2: DHT11 sensor

Soil Moisture sensor

The Soil moisture sensor comprises of two probes which are used to measure the volumetric content of water by using some properties such as dielectric constant and electrical resistance of soil. The two probes are inserted in the soil and the information from the sensor is exchanged to Arduino to settle on choice to control the homestead exercises.

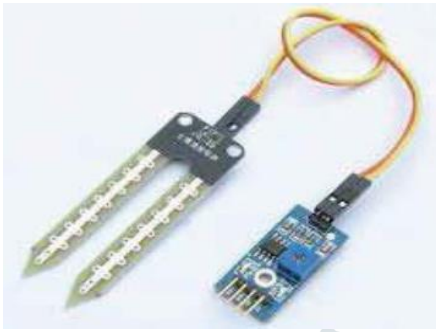

Fig 3: Soil Moisture Sensor

PH sensor

In agriculture system, PH is an important parameter to be measured and controlled. It is used to measure required nutrient content in the soil. It ensures that correct amount of nutrient is supplied to the soil. It is used for monitoring pH change during chemical reactions.

Fig 4: PH sensor

Ultrasonic sensor

Ultrasonic sensors are a type of acoustic sensors. Transmitters are used to transform electrical signal into ultrasound, receivers convert the ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound. Tank level sensor utilizes a ultrasound waves to identify the water level. A ultrasound is sent from sensor and surface of water is found by evaluating the time required for the reverberation return.

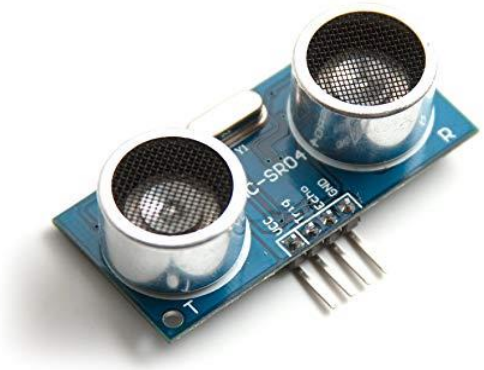

Fig 5: Ultrasonic Sensors

B. Information Processing and Real-time Decision making utilizing Arduino

In the framework, the fundamental controller for working the proposed mechanization is Arduino Uno. It is utilized in numerous applications as it gives a great handling. It is additionally utilized for running the framework easily, and when the assignments ought to be executed one after another and repeated the whole undertaking after the particular time hole.

Fig 6: arduino uno

C. Wireless Data Transfer and Communication ESP8266 Wi-Fi module.

It is a minimal effort module utilized for the wireless connection that can be connected to develop the endpoint Internet of things. It permits internet connections to incorporated applications. ESP8266 use TCP/UDP communication protocol to associate with server/customer. Microcontroller utilizes set of an AT directions and indicated baud

rate to speak with ESP8266 wifi module.

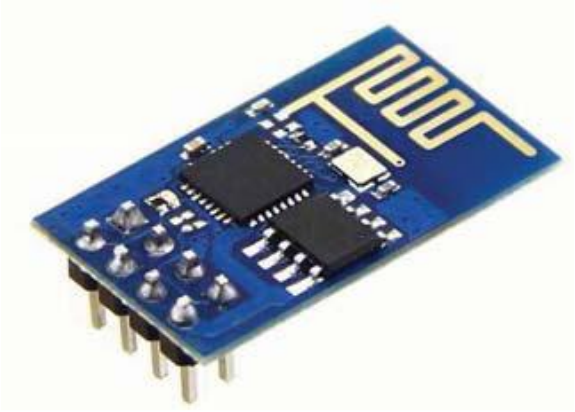

Fig 7: ESP8266 Wi-Fi module

D. Data gathering and cloud database ThingSpeak

ThingSpeak is an IoT open-source program started as a help to the IOT applications. It lets the production of logging applications of various sensors and applications following sites and interpersonal organization. It stores and recovers the gathered information from sensor modules utilizing the HTTP convention over the Internet or LAN.

V.SMART FARMING METHODOLOGY-II

Based on the availability of usable I/O interfaces for sensors, interfaces for Internet connectivity, memory and storage interfaces, and audio/video interfaces the following boards are evaluated. IoT devices when connected with raspberry pi as shown in figure below can also be used to a variety of other purposes, for instance, wearable sensors, smart watches, LED lights, automobiles and industrial machines. In this methodology, raspberry pi is the heart of the system i.e. the main controller of the system. The sensor modules can be directly connected to raspberry pi. The methodology-II provides some additional features such as camera interface which can be used for monitoring field by collecting images and also audio/video interface is also provided. It can also collects location information using GPS modules used for collecting information.

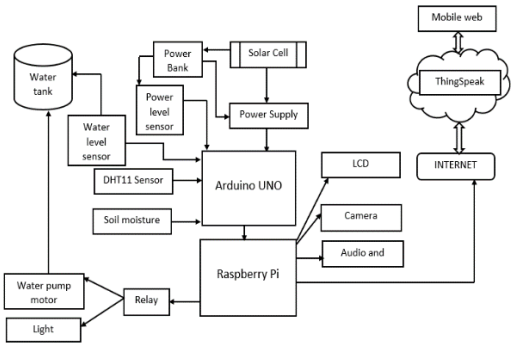

Fig 8: Architectural diagram of Smart Farming using methodology-II

Raspberry Pi

The Raspberry pi Development Board is small sized power minicomputer. It can be simply plugged into monitor because of its built-in GPU and audio-visual capabilities. Also it uses standard mouse and keyboard. This is easily programmable by powerful languages like C, python etc, giving it a potential to store and analyze the information. The built-in Wi-Fi, storage ability of this board and the accessible RAM being extremely huge in comparison to other boards enables it to act as an IoT server in most of the IoT network configurations.

Fig 9: Raspberry Pi

VI.COMPARISION ON ARDUINO AND RASPBERRY PI

The comparative study demonstrates how these platforms are advancing the development of IoT by utilizing the specific board as per the intended application. The point by point investigation demonstrate that higher end development boards such as Raspberry Pi-3 have higher performance in comparison with other boards like arduino in terms of its storage and computing speeds but at the cost of higher price. The raspberry pi can be effectively plugged into monitor because of its inbuilt GPU and audio-visual capabilities. Likewise it utilizes standard mouse and console. This is easily programmable by powerful languages like C, python and so on, giving it an ability to store and analyze the information. The inbuilt wifi, BLE, storage ability of this board and the accessible RAM being very huge in contrast with other boards such as Arduino enables it to act as an IoT server in majority of the IoT network configurations. Raspberry Pi equipped with inbuilt wifi and Bluetooth serves as a simple way to interface with web and push the information to the cloud servers if required for further handling whereas it is clearly visible from the examination that boards like Arduino being equipped with inbuilt analog to digital conversion has a better means of sensing the analog data readily when there is a need to sense some continuous analog signals coming out of analog sensors and also a wifi module esp8266 is required for internet connectivity. In view of the specs and execution investigation Raspberry Pi certainly raises as a champ when it comes to satisfying most of functional requirements of an IoT systems basic blocks.

For example, Arduino is most appropriate for assignments that need sensor information and respond continuously. Raspberry pi, then again, ought to be viewed as when the assignment may require a PC to work for example a versatile application for farmers. The pi streamlines the task when a ton of activities are required to oversee. This could be associating with web to peruse and compose information likewise incorporates associating with camera and video/sound interfaces which is beyond the realm of imagination utilizing Arduino.

VII.ALGORITHMS/METHODS FOR SMART FARMING

Basically, the algorithm is a process to solve a problem in step by step. The Algorithm renders an intelligence to the Smart Farming system. Different parameters are needed for an algorithm for decision making. Classification, Prediction, monitoring, recognition, categorization and evaluation algorithms. Artificial Neural Network (ANN) can estimate the state of Smart Farming by creating, evaluating and analyzing the activities of daily farming. Experimental data had been obtained via precision agriculture experiment. To train ANN systems we require huge amount of data, which require a long time to work efficiently. Multiagent System in the precision agriculture field offers many opportunities for faster completion of agricultural tasks. Statistics is a collection of tools. We use statistical methods such as Bayesian statistics for the reduction of agricultural data. Fuzzy logic is used for the development and simulation of agriculture control systems. A fuzzy system is developed to recognize the changes in humidity, temperature, and illumination. C5.0 is an advanced decision tree algorithm used to create a classification model for agricultural data analysis on cloud and also in the crop disease prediction. Support Vector Machine (SVM) are associated learning algorithms used for classification and regression analysis. It can be used to create a model for daily temperature prediction. Algorithms are used to process information of several parameters and execute a specific function. Total farm automation in a practical sense is a long time to achieve. Although different algorithms and methods are being used to automate, monitor and control farming remotely.

Table 1: Algorithms/Methods in Smart Farming

Category	Algorithms/ Methods	Purposes	Projects
Artificial Neural Network(ANN)	ANN	Create and evaluate behavioral model. Prediction of future of environment	Crop yield responding to soil parameters. Data analysis tool in precision farming
Multiagent System	Distributed intelligent system	Improving precision agriculture	Combining multiagent system for monitoring crop yields
Statistical methods	Multiagent system	Simulation of agent interactions and task interactions	Methods with Multiagent system in Latvian agricultural field
	Bayesian statistics	Reduction of data	Bayesian communication For smart agriculture applications
Fuzzy logic	Fuzzy logic	Recognize routines	A survey on applications Of Fuzzy logic in Agriculture
C5.0	C5.0	Decision tree algorithm	Crop disease prediction
SVM	SVM	Activity recognition	Model for daily temperature prediction

VIII.CONCLUSION

As per my studies and research it is important for farmers and agricultural companies to turn to Internet of things for analytics and greater production capabilities. We can find Arduino and Raspberry pi boards controls the high voltage farming equipment without human intervention and raspberry pi has more functionality when compared with arduino. We can find many algorithms and methods provides

an intelligence to the farm automation system to make better decisions.

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