Automation and Protection of Agriculture land using IoT

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***Abstract*— Smart agriculture is an emerging concept, because IOT sensors has the capability to provide information about agriculture fields and then act based on the user input. A large-scale agricultural system requires a lot of maintenance, knowledge, and supervision. In this Paper, it is proposed to develop a Smart agriculture System that make use advantages of cutting edge technologies such as Arduino, IOT and Wireless Sensor Network. The paper aims at making use of evolving technology i.e. IOT and smart agriculture using automation. Monitoring environmental conditions is the major factor to improve yield of the crops. The feature of this paper includes development of a system which can monitor temperature, humidity, water level and even the movement of animals which may destroy the crops in agricultural field through sensors using Arduino board and in case of any obstacle detected sends a notification on the application developed for the same to the farmer's smartphone using Wi-Fi. Hence everytime farmer will get to know the changes in his farm. This project will be more helpful for the farmer's welfare.**

Keywords*—IOT (Internet of things), sensors, automation, android application, WIFI module.

I. INTRODUCTION

India is a country of agriculture and farmers. Around 70% of the total population depends on agriculture for their sustenance. As the population of the country is increasing, the total cultivation and production has to be increased. As the total cultivation will increase, the total amount of water usage will also increase. There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones. Automation of irrigation systems is also possible by measuring the water level in the soil and control actuators to irrigate as and when needed.

In this paper a smart and intelligent agriculture system which can help the farmer to utilize the water level sensibly and also take care of other discrepancy factors like unrequired animal entry into the fields are discussed. One main purpose of the project is to develop prohibitive fencing to the farm, to avoid losses due to animals. Monitoring the environmental factors is not the complete solution to increase the yield of crops. There are number of other factors that reduce the productivity to a greater extent. Hence, automation must be implemented in agriculture to overcome many problems. So, in order to provide a solution to all such problems, it is necessary to develop an integrated system which will take care of all factors affecting the productivity in every stage. But complete automation in agriculture is not achieved due to various issues. Though it is implemented in the research level and it is not given to the farmers as a product to get benefited from the resources.

II.RELATED WORK

We conducted a literature review on Smart Agriculture and Automation using research papers, journals, articles. These are some of them:

In [1] **Dunna Naveen Preetham , Shaik Imam** proposed An Automotive Environmental Monitoring System using IoT Technology; The aim of the model is developing a smart system that would provide an ideal environment monitoring. The sensors sense temperature, gas and humidity levels and this information in digital format is sent via WI-FI to a remote computer. The remote computer will be capable of monitoring the values sent by the sensors using input-output technology.

In [2] **Abhinav V.Deshpande et.al** proposed work of fencing which is used as sensor. When animals come in contact with this open cable the circuit will be grounded and we get input signal that indicates presence of animals at fencing. After getting that initial input signal followed by amplifier circuit passed it for further processing. Then it will be sent to microcontroller. The system will be activated, immediately buzzer will be on, at the time of night flash light will be on and message will be sent to the farmer. Power supply will be given by solar panel or regulated power supply.

In [3] **Prof. Megha Yaligar, Shaini H Nagur, Nehaparveen Binkadakatti , Pavitra Gokavi , Mouneshwari Shinde** proposed Android and IoT based Agriculture System; This project aims at Improving the agriculture performance mainly used for providing the agriculture related information and solving the problems related to agriculture area. If the soil is dry then buzzer starts alarming or notification is sent to User. Using the notification user comes to know the soil is dry and he needs to put water to soil. All the information is stored in the cloud. Here, User can obtain the information as step by step procedure.

In [4] **Nirav Rathod**, **K. J. Somaiya** proposed their work on IoT Based Smart Sensor Agriculture Stick for Live Temperature and Humidity Monitoring; It focuses on Smart

Farming in terms of Pest control, Managing crops, Agriculture field monitoring through different sensors and even drones. This project is particularly developed for live monitoring of Temperature, Moisture using Arduino and various other electrical components.

In [5] **K. Lakshmisudha et. al**, Smart Precision Based Agriculture Using Sensors; It focuses on developing devices and tools to manage, display and alert the users using the advantages of a wireless sensor network system.

In [6] **Amaresh A M,** IoT Enabled Pesticide Sprayer with Security System by using Solar Energy; The aim of this project is to Improve the efficiency and productivity of agriculture by simultaneously providing safe cultivation for the farmers. Io T controlled robot, named, Agribot has been designed, built and demonstrated to carry out spraying pesticides in an agriculture field.

In [7] **Chetan Dwarkani M et. al**, Smart Farming system using sensors for agricultural Task automation; This idea proposes a novel methodology for smart farming by linking a smart sensing system and smart irrigator system through wireless communication technology.

In [8] **Nasreen Fathima, Ali Ahammed,** Optimized Neighbor Discovery in Internet of Things (IoT**);** Basic architecture of an IoT network and the functions of each of its layers. It briefs the architecture of an IoT system and identifies the importance of each layer.

In [9] **Swaraj C M,** IOT based Smart Agriculture Monitoring and Irrigation System; It aims to Control the agriculture monitoring in fields where the human being not capable to provide security. The sensors i.e. Tilt, Flame, Soil moisture, Temperature and Humidity and IR sensors respectively are deployed in each section will keep updating the parameter reading through a Wi-Fi communication module. The data is stored in the cloud. Analysis is done to the data stored in the cloud called Thing speak. This is effective and reliable system which helps in agriculture monitoring.

In [10] **Santhiya. P, Lakshmitha. G, Monisha. J, Akshaya**, Smart Irrigation System Using Arduino and Android; The proposed system is to ON/OFF the drip using bluetooth wherever we go. Android Microcontrollers used to control the system. The sensor reads the surrounding value and store it in a controller. If the reading of the controller is less than the threshold value then we can start the drip using an android app through a Bluetooth.

In [11] **Mathumitha. A, Ellakkiya. R. S, Prapalya. S, R. Thennarasu,** Study on use of Treated Waste Water for Surface and Drip Irrigation; The present project work was aimed at finding suitable methods of irrigation using drip and surface and how it differs between both. Water management is essential for optimum and efficient use of water for best possible crop production keeping water losses to the minimum.

In [12] **Dr. Aqeel-ur-Rehman, Smart Agriculture:** An Approach Towards Better Agriculture Management; This book aims at different techniques used to deal with different problems of watering, pesticide spraying, fertilization etc. Efficient use of agricultural water can be ensured through different water smart technologies to optimize productivity.
Some of the links are;

In [13] **Hank Will,** Design a homemade pasture gate; The aim is to Protect the farm.
https://www.grit.com/animals/homemade-pasture-gate-woodlot-to-fenceline-project

In [14] Automatic Farm Protection From Wild Animals With Alert Using PIC & GSM: Nevon Projects. The microcontroller sounds an alarm to woo the animals away from the field as well as sends sms to the farmer. It provides Automatic crop protection system from animals.
https://www.youtube.com/watch?v=0l414YpfQbM

In [15] Student invents device for farmers to save crops from birds - ANI News; Creating a sound device for farmers to save their crop from the animals and birds.Since it emits high frequency it scares away the birds and provide protection to the land.
https://www.youtube.com/watch?v=n1mQ0LL6vzU

III. PROBLEM STATEMENT

To automate the agriculture land and protects the land and crops using IOT

This system automates the agriculture land by supplying the water to the crops on the basis of temperature and their requirement. It also monitors the removal of excess water accumulated in the field

The protection is provided to the land using IOT, Sensors are used to detect any animals and birds entering the land and they are avoided.

IV.PROPOSED SYSTEM

System Architecture

FIG 1 shows the Architecture of the proposed system through the circuit diagram. It consists of Arduino Mega, Temperature and Humidity sensor –DHT11, PIR Sensor, Water level Sensor, ESP8266, Buzzer, Needle rotator, Pump motor, Driver are the hardware components. Arduino IDE, Blynk application is the software components.

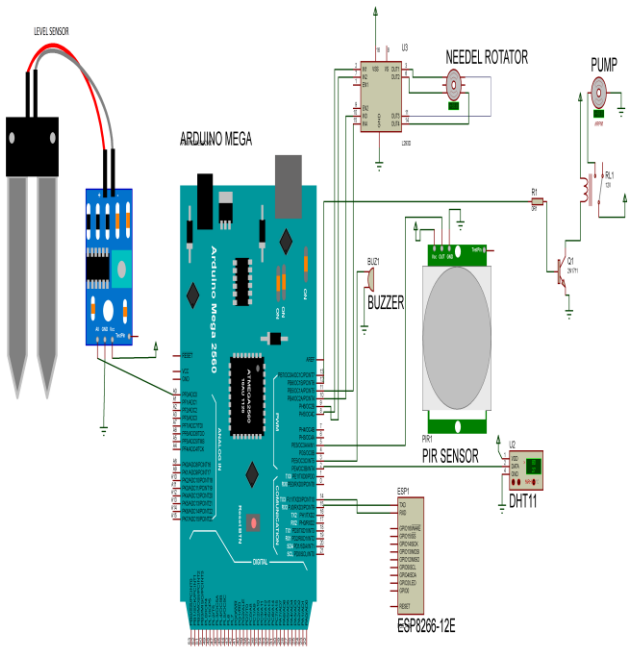


FIG 1: System Architecture

1) ARDUINO MEGA: It is an open source IOT development board whose firmware runs on the ESP8266 Wi-Fi module. It performs the operations such as the collection of data from the DHT 11 sensors and if temperature is greater than the threshold then it supplies the water through irrigation. Then if the water level is high the excess of the water is removed through the water pump. If the object is detected through the PIR sensor the needle is rotated and buzzers are switched on.

2) DHT 11: The DHT11 is a commonly used Temperature and humidity sensor. The sensor has a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers, Which gives the values of humidity and temperature.

3) PIR SENSOR: PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. Sensitivity range is up to 20 feet (6 meters) 110° x 70° detection range. If the object is detected then is sends information to the Arduino Mega.

4) WATER LEVEL SENSOR: This is a simple that can be used for the detection of water level. The module outputs a high level, when water is deficit, the output is low level. Using the sensor produces a watering device automatically.

5) ESP8266: The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability. This device is used to send the information to the online Blynk application. Through this the owner can get the information at anywhere.

6) BUZZER: A buzzer is a mechanical, electromechanical, magnetic, electromagnetic, electro-acoustic or piezoelectric audio signaling device. A piezo electric buzzer can be driven by an oscillating electronic circuit or other audio signal source. If the birds are present in the field the buzzer gets activated and the birds fly off.

7) NEEDLE ROTATOR: The rotator is used to avoid the animals entering to the field, the nails are been fixed to the to the fence and this is connected to the driver when the animals is passing near the fencing the PIR sensor detects and it sends the information then this needle rotates 90 degree and protects the field.

8) WATER MOTOR PUMP: The motor is used to pump the excess of water in the field. The pump incorporates an automatic pressure demand switch such that the pump will commence when a tap is opened and turn off when the tap is closed. Alternatively the pump can be connected to an open hose and a suitable12v switch used to turn the flow On/Off.

9) DRIVER: The L293D is a popular 16-Pin Motor Driver IC. As the name suggests it is mainly used to drive motors. This is the connected to the Arduino Mega. If the animal is detected near the fence the Mega sends the message to driver to rotate 90 degrees.

10) ARDUINO IDE: The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.

11) BLYNK: Blynk is a toolset for all makers, badass inventors, designers, teachers, nerds and geeks who would love to use their smartphones to control electronics like Arduino, Raspberry Pi and similar ones. We've done all the hard work of establishing internet connection, building an app and writing hardware code. The data at the farm field are been uploaded to the blynk application using ESP8266 module which is connected to the Arduino Mega.

V. HARDWARE AND SOFTWARE

1) ARDUINO MEGA: The arduino development board consists of many components. Here are some of those main component blocks that help in its functioning
   - Microcontroller: It is the heart of the development borad, which works as a mini computer and can receive as well as send information or command to the peripheral devices which are connected to it.
   - External power supply: This power supply is used to power the Arduino development board with a regulated voltage ranging 9-12 volt
   - USB plug: It is used to upload a program to the microcontroller using a USB cable.
   - Internal Programmer: The developed software code will be uploaded to the microcontroller via USB port, without an external programmer.
   - Reset Button: This button is present on the board and can be used to reset Arduino microcontroller.
   - Analog pins: There are some analog input pins also ranging from A0-A7. These pins are used for the analog input/output. The number of these digital pins also varies from board to board.
   - Digital I/O pins: There are some digital input pins also ranging from 2 to 16. These pins are used for the digital input/output. The number of these digital pins also varies from board to board.
   - Power and GND Pins: There are pins on the development board that provide 3.3, 5 volts and ground through them.

2) DHT11: Each DHT11 sensor is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size and consumes less power and up-to 20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to the request of the users.

3) PIR SENSOR: PIRs are basically made of a pyroelectric sensor (which you can see above as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion, not average IR levels. The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will switch high or low.

Along with the pyroelectric sensor is a bundle of supporting circuitry, resistors and capacitors. It seems that most of the small hobbyist sensors use the BISS0001 ("Micro Power PIR Motion Detector IC") , undoubtedly a very inexpensive chip. This chip takes the output of the sensor and performs some minor processing on it to give a digital output pulse from the analog sensor.

4) WATER LEVEL SENSOR: It is a liquid level control system by using a float sensor works on the principle of buoyancy, which states, "A float immersed in a liquid is buoyed towards upward direction by an applied equal force to the weight of the displaced liquid". As a result, the body drives partially and gets submerged on the liquid surface and covers the same distance the liquid level moves.
5) ESP8266: The basic principle of this module is A Wi-Fi hotspot is created by installing an access point to an internet connection. The access point transmits a wireless signal over a short distance. It typically covers around 300 feet. When a Wi-Fi enabled device such as a Pocket PC encounters a hotspot, the device can then connect to that network wirelessly.
6) BUZZER: Piezo buzzer is an electronic device commonly used to produce sound. Light weight, simple construction and low price make it usable in huge applications like car/truck reversing indicator, computers, call bells etc. Piezo buzzer is based on the inverse principle of piezo electricity discovered in 1880 by Jacques and Pierre Curie. It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and the vice versa is also true. Such materials are called piezo electric materials. Piezo electric materials are either naturally available or manmade. Piezo ceramic is class of manmade material, which poses piezo electric effect and is widely used to make disc, the heart of piezo buzzer. When subjected to an alternating electric field they stretch or compress, in accordance with the frequency of the signal thereby producing sound.
7) NEEDLE ROTATOR: The rotator is used to avoid the animals entering to the field, the nails are been fixed to the to the fence and this is connected to the driver when the animals is passing near the fencing the PIR sensor detects and it sends the information then this needle rotates 90 degree and protects the field.
8) WATER MOTOR PUMP: The pump may run for a short while after the tap is closed. The automatic switch located under the end cover has a small amount of adjustment if the pump does not shut On/Off as desired. Remove the end cover screw and adjust the internal screw no more than ¼ turn and test again.
9) DRIVER: It is tiny and lightweight with high output power. Stepper can rotate approximately 360 degrees and works just like the standard kinds but smaller. You can use any stepper code, hardware or library to control these stepper motors. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.
10) ARDUINO IDE: The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.
11) BLYNK: Blynk is a toolset for all makers, badass inventors, designers, teachers, nerds and geeks who would love to use their smartphones to control electronics like Arduino, Raspberry Pi and similar ones. We've done all the hard work of establishing internet connection, building an app and writing hardware code. The data at the farm field are been uploaded to the blynk application using ESP8266 module which is connected to the Arduino Mega.

VI. IMPLEMENTATION

Hardware Implementation:

Arduino UNO is interfaced with temperature and humidity sensor. When the temperature is risen up above the threshold level, the Arduino UNO is programmed such that it drives the motor and water is supplied to the plants.

PIR Sensor detects the object entering into the field and informs to the Arduino UNO. When an object (animals) are detected the Piercing needles which are moulded on the fencing (vertically downwards), rotate 90' (towards the object) to stop the entering into the land.

Ultrasonic Sensor is interfaced with Arduino so that if there is any bird entering the field could be detected and it can be made to fly away with the help of buzzers. At the end of water flowing path gates are installed. To this the water level sensors are attached. If the sensor detects high accumulation of water the servo motor is made to rotate which in turn opens the gate.Once the gates are opened the water is collected in underground tank and this water can be reused. Thereby water management is also achieved.

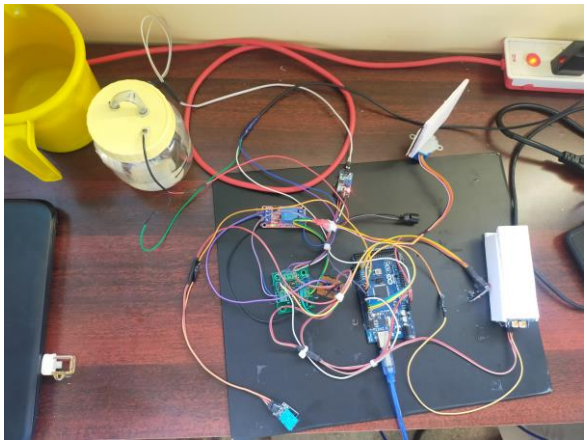


Fig: Hardware Implementation.

Software Implementation:

In order to run the actuators (motor, fan and fire illusion system) which are interfaced with Arduino UNO we need to code the Arduino UNO. Arduino IDE is open source software program that allows users to write and upload the code to Arduino UNO._Wi-Fi module is interfaced with Arduino

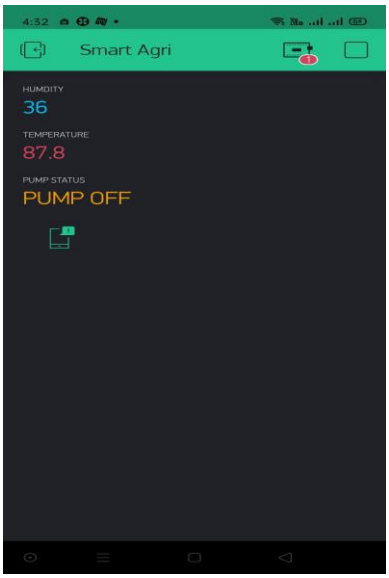
UNO which is used to connect to thing speak platform._Things speak allows users to analyse and visualise the data (output of the system).

VII. RESULTS

Whenever the temperature is above the threshold value, the motor runs to supply the water also humidity will be detected. Whenever there is an object detected entering the land PIR sensor detects it and needle will be rotated towards the object and prevents entering the object into the land.

When the rain water is accumulated in the land the water level sensor detects it and motor pumps the excess of water out of the land.

All these notifications are sent to the mobile phones using blynk application.



VIII. CONCLUSION

The interface of the Arduino Mega is made with the Humidity and Temperature sensor which is DHT11. The code for the DHT11 has been added to the Arduino Mega using the software Arduino IDE. The compilation of the code is done through the software. Code is been dumped to the Arduino Mega using the Arduino IDE. The results are verified.

IX. FUTURE ENHANCEMENT

- IoT smart farming solutions is a system that is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, crop health, etc.) and automating the irrigation system. The farmers can monitor the field conditions from anywhere.
- Large farm owners can use wireless IoT applications to monitor the location, well-being, and health of their cattle. With this information, they can identify sick animals, so that they can be separated from the herd to prevent the spread of disease.
- Io T-driven smart greenhouses can intelligently monitor as well as control the climate, eliminating the need for manual intervention. Various sensors are deployed to measure the environmental parameters according to the specific requirements of the crop. That data is stored in a cloud-based platform for further processing and control with minimal manual intervention

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