Towards Automated Agriculture

Prajwal N. Chavan[1] Leena A. Bhere[2]
[1,2]Department of Information and Technology
[1,2]B.K.Birla College of Arts Commerce and Science, Mumbai University, India

Abstract— The Internet of Things (IoT) where sensors, actuators and controllers come together to ease the human life and share information. The IoT is grabbing the field of agriculture too i.e. Precision Agriculture (PA). One third part of nation's capital comes from farming and 70%of our population id depending on farming. Betterment in farming will absolutely lead to the betterment of the nation. The hard work life style of the farmers can be eased with the use of IoT technology. But due to some reasons even after inventions of many different devices for PA, Automated farming, Automated Irrigation system, automated fertilization, disease detection etc.; which are been invented to provide the farmers some ease in their work, we can find only some amount of farmers are actually not implementing those devices invented just for them. The use of the system that farmers are more used to is to be done to increase the acceptance level and make the interface better so they must use the technology made for them easily. A smart irrigation system by EmbedGallery https://www.embedgallery.com/(Samarth mobile motor controller) with the use of mobile GSM technology operates the motor auto- manually from anywhere in India. The farmers are easily accepting this system because it's easy to use compared to others, we will move forward here by making use of IoT technology (sensors and controllers) making the system automated and more precise. (Note that the organization of the body of the paper is at the authors' discretion; the only required sections are Introduction, Methods and Procedures, Results, Conclusion, and References. Acknowledgements and Appendices are encouraged but optional.).

Keywords: Precision Agriculture (PA), Internet of Things (IoT), Moisture Sensor, Camera Image Processing, Smart Irrigation, Mobile GSM Technology, Aurdino

I. INTRODUCTION

With the ascent in world population, food consumption worldwide also grows rapidly. The world is witnessing one more basic modification with the wake of a new technological revolution that employs application of modern info and Communication Technologies into agriculture, in order to deliver a sustainable agricultural production. Smart agriculture involves integration of advanced technologies into already uninterrupted agricultural practices with a view to spice up production quality and efficiency for farming product. It helps in machine-controlled farming with the gathering of information for further analysis to supply the operator with correct information for better decision making to achieve prime quality output of the product. Interestingly, approximately 70 percent of the total volumes of water withdrawals in the world are used for irrigation, and that's precisely where most of the water waste happens. Around 60 percent of the water meant to be used for irrigation is lost, either due to evaporation, transpiration, land runoff, or simply inefficient, primitive usage methods. This, in turn, brings to light the importance of smart irrigation – powered by the internet of things (IoT) – which will go a long way in managing the rising levels of water stress worldwide. The dream of a future wherever farmers recognize whether there will be enough rain or sun, or whether the cattle walked or ate enough sounds rosy. However, most of our farmers are either illiterate or have elementary education and thus are cautious of mistreatment with digital devices, considering they are too complex.

The main motive of this paper is making agriculture smart, using automation with IoT technologies. The highlighting features of this paper includes smart irrigation system ,camera image processing and automation in the farm field for performing the tasks like moisture sensing, colour detection, keeping vigilance, less man power consumption etc. Controlling of all these operations will be through any remote smart device or computer connected to Internet and the operations will be performed by interfacing sensors, GSP/GPRS module and actuators with micro-controller and Arduino.

II. LITERATURE REVIEW

A technically advanced farming management system rooted on observing, measuring and responding to inter and intra-field variables in products. The goal of smart agriculture analysis is to ground a decision making network for farm management. A system that optimizes and examines the field with the help of sensors. And with actuators and controllers how high-tech farming can aid the production output is delivered as well as focuses on the preservation of resources. A number of IoT devices can be put in on the premises for measuring totally different farm parameters for collection of information. Analytics are performed on this information and reported via a dashboard. These systems are also referred to as farm productivity management systems. Such many smart irrigation systems are been developed in coming time and automated fertilizing system is also developed. Still farmers are very slowly adapting these advanced precision farming techniques as they are not used to it and following early traditional farming.

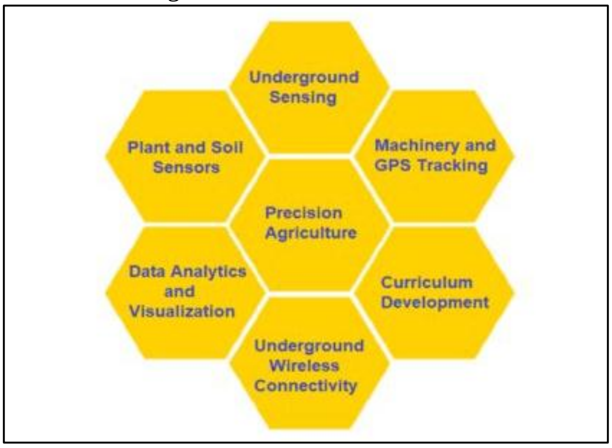
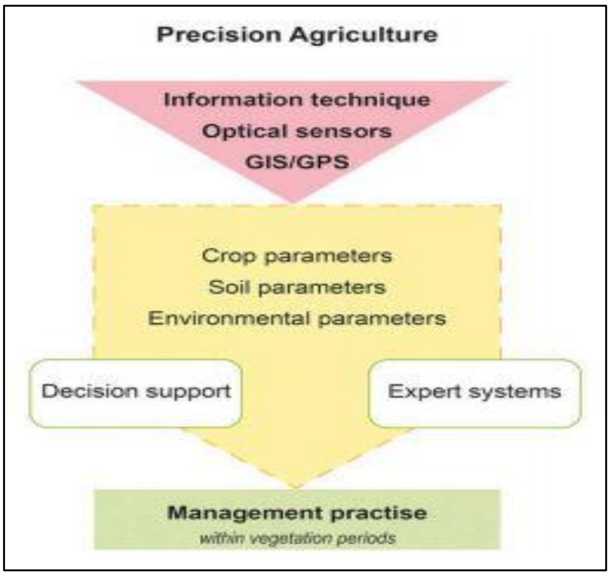


Fig. 1: The Different components of the precision agriculture.

All rights reserved by www.ijsrd.com



III. RESEARCH METHODOLOGY

A. *Automated/ Semi-Automated Irrigation System:*

In some past years as IoT came into trend many irrigation systems has been developed already, as it is one of the most important aspect in the way towards automated agriculture. Developing an automated irrigation system we are able to save huge amount of water and the crops too meets its expected water levels.

But even after development of such irrigation systems farmers are not accepting it easily as they are not familiar to it. EmbedGallery https://www.embedgallery.com/ (Samarth mobile motor controller) has developed a motor controller which is user friendly and even if the farmer is illiterate he/ she can easily use the device, just it is not automated. We are going to make it smart system by including a two way communication between the farmer and the system.

The earlier system is just a controller and we are going to make it interactive using soil moisture sensors which will get us the measures of water in the soil and how much is needed etc.

Thus we can communicate with farmer with these values with the help of GSM module and accordingly control the system with arduino controller.

1) IVRS (Interactive Voice Response System):
User can start or stop the motor through voice calling with the help of an IVRS system by just pressing the numeric buttons on their mobile phone.

2) Overload Protection:
Due to some reasons if motor gets jammed then motor derives very large current due to overload and it may burn the motor coils. In such cases this unit will protect the motor by turning it off and will inform the user through a voice call using GSM module.

3) Smart Timer:
By using the Smart timer function, user can start the motor for a specific duration of time and it will turn off automatically once the set timer is over. This is semiautomatic facility.

4) Missed Call Facility Whenever Power Resumes:
Due to very irregular power supply, it is very important for user to get an update about current electricity status. Motor side unit will notify user by giving a missed call whenever electricity resumes.

5) Number Registration Facility:
Users can register mobile number in this unit. Only this registered number will be allowed to operate and control this unit; enabling greater security and control.

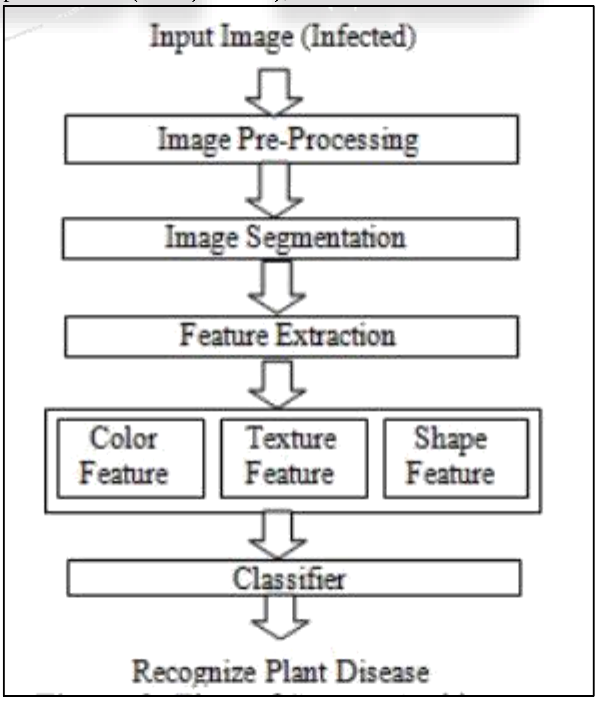
6) Password Protection:
Important settings like changing registered number are password protected.

7) For user side call:
User can call the system anytime to get the information and control the system.

B. *Plant Disease Detection:*

System has been developed to determine whether the plant is normal or diseased. The normal growth of the plants, yield and quality of agricultural products is seriously affected by plant disease.

The detection of plant disease is one of the important tasks. A plant disease reduces the production of agriculture. Every year the loss due to various diseases is challenging part in agriculture production. Although work is carried out till time on detection of diseases but proper segmentation of affected part based on type of plant family is still an open problem as a research area. Though most of the disease detection approaches are in existence but these approaches can be developed further to provide more accuracy in plant disease detection. From the schemes discussed in (International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438);



We have studied different techniques used for the plant detection and select the most relevant method. The study of different techniques use for plants disease detection is listed below. Given paper is referred for the study.

(http://ijesc.org/upload/ae8e6f4299919bca66e06e6f3e13dc34.Plant%20Disease%20Detection%20using%20IoT.pdf)

We have collected 100 sample leaves out of which 50 samples are normal and 50 samples are diseased. The images of the leaves collected are presented in the report. Initially the standard values of healthy leaves are stored in the database. Then we took the healthy leaves from the samples and tested them in the software to check the system accuracy. The Table.1 gives values obtained using temperature sensor based on which healthy or diseased leaves are identified.

Leaf	Minimum Temperature in Degree Celsius	Maximum Temperature in Degree Celsius	Obtained Temperature in Degree Celsius	Healthy Or Diseased
1	20	30	47	Diseased
2	20	35	31	Healthy
3	23	35	49	Diseased
4	22	36	56	Diseased
5	21	35	26	Healthy
6	20	35	59	Diseased
7	22	34	28	Healthy
8	29	35	49	Diseased
9	28	38	28	Healthy
10	20	35	45	Diseased

Table 1: Temperature Sensor Values

From the Table.1 it reveals that if the leaves under consideration fall within that range specified, then the leaves are healthy, if not then the leaves are diseased. Thus considering temperature values we infer that all the leaves are diseased in the table 2 as their temperature values do not fall into given range. The Table.2 gives values obtained using humidity sensor based on which healthy or diseased leaves are identified.

Leaf	Minimum Humidity value	Maximum Humidity value	Obtained Humidity value	Healthy Or Diseased
1	20	52	26	Healthy
2	31	53	91	Diseased
3	20	63	92	Diseased
4	20	62	25	Healthy
5	22	52	93	Diseased
6	23	52	25	Healthy
7	20	53	92	Diseased
8	21	64	95	Diseased
9	20	55	93	Diseased
10	21	60	91	Diseased

Table 2: Humidity Sensor Values

From the Table.2 it reveals that the leaves under consideration fall within that specified range, then the leaves are healthy, if not then the leaves are diseased. Thus considering humidity values we infer that all the leaves are diseased in the above table 3.1 as their humidity values do not fall into given range. The Table.3 gives values obtained using color sensor based on which healthy or diseased leaves are identified.

Leaf	Minimum Colour value			Maximum Colour value			Obtained Colour value			Healthy or Diseased
	Red	Green	Blue	Red	Green	Blue	Red	Green	Blue	
1	-20	10	20	10	45	40	-16	39	23	Healthy
2	76	94	68	82	119	68	114	115	80	Diseased
3	109	115	91	114	124	97	142	115	80	Diseased
4	125	136	102	131	141	108	142	64	23	Diseased
5	10	20	20	30	50	30	22	34	23	Healthy
6	93	107	87	93	124	91	190	111	85	Diseased
7	82	94	68	87	98	68	109	124	119	Diseased
8	85	100	70	88	130	78	255	136	68	Diseased
9	80	115	102	83	120	105	66	39	57	Diseased

Table 3: Color Sensor Values

From the Table.3 it reveals that the leaves under consideration fall within that specified range, then the leaves are healthy, if not then the leaves are diseased. Thus considering RGB values we infer that all the leaves are diseased in the above table 4 as their RGB values do not fall into given range.

We have collected 100 sample leaves out of which 50 samples are normal and 50 samples are diseased. Initially the standard values of healthy leaves are stored in the database. Then we took the healthy leaves from the samples and tested them in the software to check the system accuracy. We have calculated the system accuracy with the formula of precision given in the Table.4.

	Actual class (observation)	
Predicted class (expectation)	Tp (true positive) Correctly predicted	fp (false positive) Unexpected predicted

Table 4: Performance Evaluation

Precision is then defined as:

$$\text{Precision} = \frac{tp}{tp + fp}$$

In our system, we have considered two values from above table for result analysis i.e. tp (true positive) and fp (false positive). In tp, values which are correctly predicted are enlisted and in fp, mis-predicted values are considered. The Table.5, 6 and 7 gives performance accuracy of 86% using temperature sensor, 82% using humidity sensor and 88% using color sensor respectively.

All rights reserved by *www.ijsrd.com*

Total no. Of Samples available	No. of Samples correctly classified (tp)	No. of samples Misclassified (fp)	Accuracy of system in %
100	86	14	86%

Table 5: Performance Result using Temperature Sensor

Total no. of Samples available	No. of Samples correctly classified (tp)	No. of samples Misclassified (fp)	Accuracy of system in %
100	82	18	82%

Table 6: Performance Result using Humidity Sensor

Total no. Of Samples available	No. of Samples correctly classified (tp)	No. of samples Misclassified (fp)	Accuracy of system in %
100	88	12	88%

Table 7: Performance Result using Color Sensor

After studying all these existing techniques we have implemented and photo sensing technique. Where camera will be used to take image of a plants and there images will be compared with the standard images in the memory and notified if the plans are healthy or diseased.

IV. PROPOSED SYSTEM

Proposed system is the combination of Arduino (as a controller), SIM 800 GSM Module (for user interaction with the user), Moisture sensors (for sensing moisture in the field), Camera (for taking pictures of plants), Relay (for motor control), Motor (for water flow control).

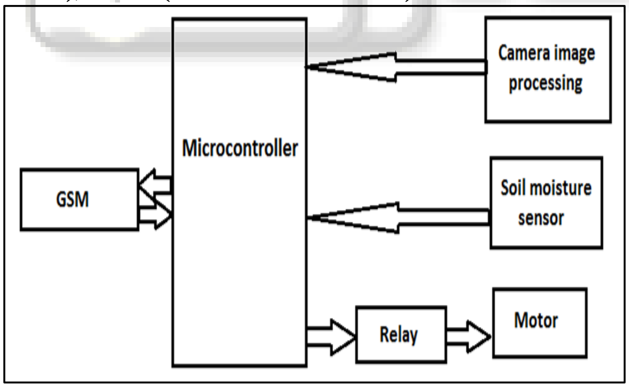


Fig. 4: System Architecture

A. *Hardwares Used:*

1) *Arduino Uno:*

In the automatic plant irrigation system using arduino, the system itself recognizes the condition of plant with the help of soil moisture sensor. Whenever the soil moisture level is detected low sensor sends message on cell phone which is connected to the system then the Arduino turns on the motor or pup. The water pump automatically gets off when it finds enough moisture in the soil.

2) *GSM Module:*

SIM800 GSM module is used to interact with the user via SMS or call. The SIM800 is a complete Quad- band GSM/GPRS module which can be embedded easily by customer or hobbyist. It provides an industry- standard interface; the SIM800 delivers GSM/GPRS 850/900/1800/1900 MHz performance for voice, SMS, Data low power consumption. Every time the system switches on or off the water pump a message is send to the user via the GSM module, giving the update of water pump and soil moisture.

3) *Soil Moisture Sensors:*

Depending on the information provided by tank side unit about the water level, motor side unit will decide whether to start the motor or not.

4) *Camera:*

Camera is used to get the images if the plants and then process those images with the standard images of diseased plants with the help of Arduino and declare if the plant is diseased, GSM module will alert the user.

5) *Relay:*

Relay is used to control the water flow with the help of water pump. Relay will turn the pump on & off based on the Arduino's instructions.

6) *Motor:*

Motor is used to control flow of water.

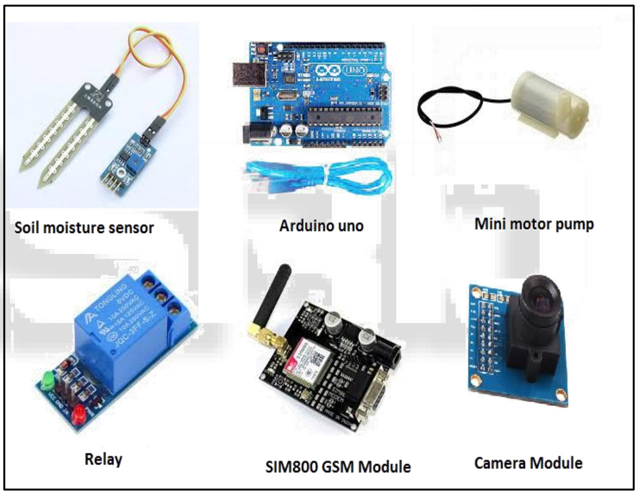


Fig. 5: Hardware used

B. *Softwares Used:*

1) *Arduino IDE:*

It is open source software, mainly used for writing and compiling the code into the Arduino module. It is official Arduino software. We have made use of this software to code the program in C/C++ programming language that will run the whole system.

2) *Fritzing:*

This software is used to create the whole system circuit and check the connections virtually without using original hardware. It provides with the options like schematic, PCB and code. Thus it becomes easy to manually assemble the hardware later.

V. WORKING

The system remains in loop checking on sensors till the sensors detect low moisture. Once the low moisture is detected system will call the user farmer to inform and ask to take further action (control motor and give information about the crops health and humidity in soil). If disease is detected

All rights reserved by *www.ijsrd.com*

in the image captured by camera then the system will call the user to alert about the disease.

The user may call the system anytime and get expected information and control the motor.

Fig. 6: Testing

VI. Results

1) We get the call as expected when the moisture is low.
2) We are able to control the motor from anywhere in the country and keep eye on health of your farm.
3) Fuel expenses will be incurred for travelling to the motor pump location.
4) There is a risk of electric shock/wild animals/reptiles while operating motor at night.

VII. Conclusion

All the hardware, sensors and actuators are successfully connected to Arduino UNO. Wireless connection is achieved with the help of GSM Shield (SIM 800 GSM/GPRS module). The results, tests and observations prove that the proposed project is going to solve the following existing problems.

1) Unwanted wastage of water in farms
2) Maintain the good yield of crops by alerting the farmer if the symptoms of disease are traced in plants.
3) Easing the work of farmers to some extent with the use of technology
4) As IVRS (Interactive Voice Response System) technique is been used farmers falling under illiterate category can also easily use the system as they are familiar with this technique.

Implementation of this kind of system in farming can definitely help the farmers to maintain their farms remotely and overall produce the good yield of farm product.

References

[1] IoT in Agriculture: 5 Technology Use Cases for Smart Farming (and 4 Challenges to Consider): Eastern Peak
[2] https://www.embedgallery.com
[3] Current and Prospective Methods for Plant Disease Detection
[4] A Survey on Methods of Plant Disease Detection
[5] PDIS03150340FE 241..251
[6] ae8e6f4299919bca66e06e6f3e13dc34.Plant Disease Detection using IoT.pdf
[7] How to build a basic IVR (Interactive Voice Response) menu system with DTMF/voice control in C# to improve your call center - CodeProject
[8] Arduino DTMF tutorial using SIM900/SIM800 modules - LIVE DEMO - YouTube
[9] Arduino SIM900A GSM Home Automation - YouTube
[10] https://www.arduino.cc/en/guide/introduction
[11] https://www.ieee.org
[12] Literature Review on IOT Based Smart Security and Monitoring Devices for Agriculture Keerthana B1 , Nivetha P1 ,Boomika M1 , Mathivatahni M1 , Niranjanaa2 1 UG students
[13] IoT based Smart Agriculture Nikesh Gondchawar1, Prof. Dr. R. S. Kawitkar2

All rights reserved by *www.ijsrd.com*