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WSN Application: Insects Monitoring in Smart Greenhouse through Image Processing

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Abstract: ***The population needs are greater that to the production, highlighting this issue this paper focus on the insect monitoring with the help of wsn and the smart greenhouse. These insects are the one that plays a vital role in the crop growth or production .There are few insects that are proved to be beneficial for the crop but few are the insects which give a greater harm to farms so to increase the yield of crops the insects are being monitored and as well as the proper pesticides amount is mentioned with respect to the infected plants after monitoring it through image processing. The smart greenhouse is maintained to measure several parameters at a time. The results taken through experimental process suggests that the crop yield isimproved.***

Keywords: Pesticides; Image Processing; Smart Reenhouse, Insect Monitoring.

I. INTRODUCTION

Extremely large attention has been taken by wireless sensor networks in last few decades. Wireless sensor network is basically a group of various sensor nodes or also known as sensor devices .Each sensor nodes posses the quality of being able to supervise few aspects of nearby environmental and as well every individual is capable to communicate with other devices that are placed at the destination [1]. These WSN nodes are generally crowded together to prepare and arrange in the fields to monitor several parameters.The wsn in itself includes its several applications, but here we enlighten the application of wsn in agriculture. In this sector it helps to increase the productivity by implementing low cost sensors which helps in maintaining the temperature, humidity, soil moisture, water level, light, insectsand as well as the amount of pesticides. The advantage of implementing multiple sensors at a time is that each and every situation can be handled at a same time. In this way the required conditions can be provided to crops, as we can set a threshold value for any kind of crop by changing few steps in the program and any unseasonal crop can be easily grown with proper accuracy. In this model atmega 16 is used so that several sensors can be deployed on a single board and complexity can be reduced. The whole system works on the wireless link as the sensors sense the data and display it on lcd and as well as send the message to the farmer of each and every parameter, so that farmer doesn't need to come and check the fields again and again manually[2]

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As we have practically observed the problems in RARI(Rajasthan Agriculture Research Institute) that the methods that were used in greenhouse were operated manually as the thermometers were implemented in greenhouse to measure the temperature, after few hours the farmer come and measure the temperature and according to the need if low temperature is needed than the coolers are switched on, at the time of irrigation the farmers fixed the duration for the sprinklers due to which the water is wasted and in the case of insect monitoring farmers check each and every crop, if disease is introduced then they spread the pesticides according to their estimation which in result harm the crops as well as human body also, as to resolve this issue the concept of smart greenhouse and smart irrigation is introduced in which the crops are monitored through sensors in sufficient quantity by saving the natural resources forfuture. Several problems occur in greenhouse, one of the major problems is the insects that are harmful for the crop growth and quality. To monitor the insects several ways are introduced before such as by sensing their odour, flying beats, sound, honey bee dance tracking etc, but new idea is introduced in that is by capturing the images of insects and by monitoring it through MATLAB and as well as the amount of fertilizer is advised according to the quantity of insects so that wastage of pesticides can be controlled and the uneducated farmers too can easily operate [3].

II. SMARTGREENHOUSE

As the change in climatic condition doesn't allow the crops production according to the needs .when the ideal conditions are provided to the crops for their particular growth. A fixed temperature, humidity, soil moisture etc is maintained in a close area is known as **"Greenhouse/glasshouse"**. Resolution on the concept that combining multiple proximal sensors within a wireless sensor network with spatio-temporal will enhance the capacity to monitor the farms or greenhouse vegetation. The main aim of this work was to design a low cost "open hardware" platform for multi-sensor measurements for the implementation in agricultural farms. The system is based on an open source atmega 16 programmed in a simple integrated developmentenvironment. The farmers in India works merely on predictions, there is no accuracy which results in the wastage of money, time and low production so here we engender the concept of wireless sensor networks in agriculture. In this we introduce a concept known as precision agriculture for enlightening the issue of water management, soil moisture, temperature, humidity and time management [4].

Precision agriculture is the method which is used to apply the right amount of resources on the right time and at right place. This will directly impact on the production of crops, its quality and quantity. As these discussed parameters can help the farmers to save their time as well as their money[5].
The major problem with the farmers is that they are less skilled about proper quantity of fertilizers, type of soil suitable for plant, proper ph value to be noted, the temperature conditions suitable for plant and the moisture in soil and humidity. The main focus of this paper is on the control andmaintaining of these parameters by using wsn .As the observation of last few years shows that farmers bear a huge loss of money and crops due to these predictions and improper quantity of input to the farms.To overcome this issue we introduce the concept known as **"smart greenhouse",** it comprises of six parameters that are controlled at a same time. It includes insect monitoring as well as fertilizer amount is monitored, temperature, humidity, soil moisture, light and water level. The figure 1 shown below explains the complete architecture of the model in which the parameters are controlled through atmega 16 which is connected to the external sensors, pc and control circuit. This control circuit is further attached to sprinklers, cooler and light switch, these are switched on and off according to the conditions provided or threshold set by us which are suitable for the crop growth[6].

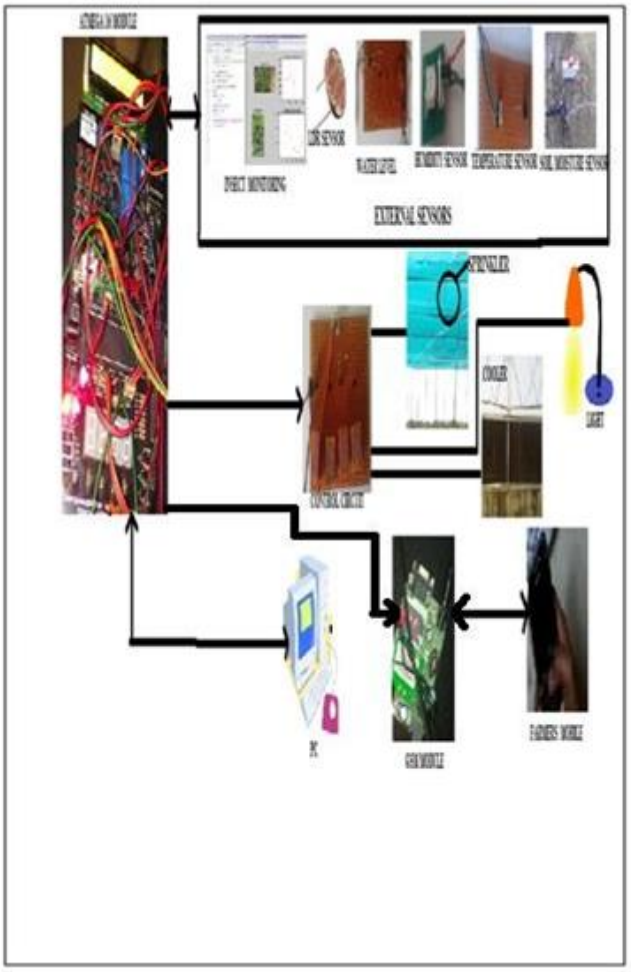


FIGURE1:-Architecture model for smart greenhouse.

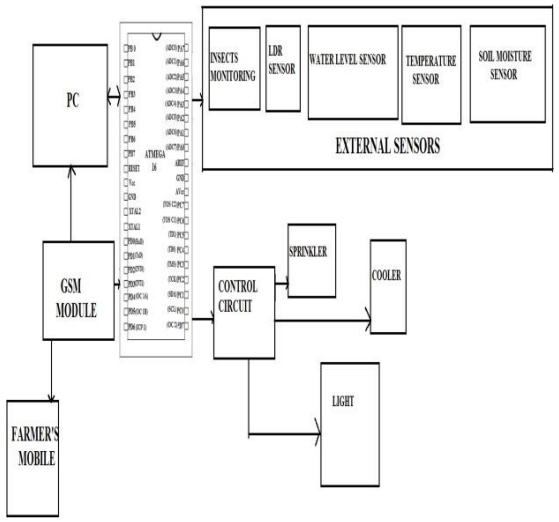


FIGURE 2:- Circuit diagram.

Including this model in greenhouse we analyse the increase in crop growth to 20%, by using this model the farmers can also feel ease to work as this system provides the output of all measured values to the farmer on its mobile phone by just sending a single message on the SIM that is installed in GSM module in response we will receive output of all the parameters on our cell phone within a minute. As this facility is also secured no other person can access the information and in case if someone tries to hack the system you will receive the message in which the hacker information isprovided.
The threshold is fixed for every individual parameter when the light intensity humidity, temperature, and soil moisture cross its threshold as a result the cooler and sprinklers are switched on. The personal computer is used here for the data that we receives about the insects as it is operated through Mat lab, it capture the images and further it passes to the user by which we can see the quantity of insects and as a result can easily remove it by the particular solutions provided in return that is fixed and suggested amount of fertilizers.
The implemented sensors sense the data and according to the fixed temperature it maintains the temperature in greenhouse for each crop and then it also send the data to the farmer respectively through GSM. The GSM works as the farmer sent a known code to the SIM that is inserted into the GSM module if that code is correct the information is sent back to the farmer otherwise a message written as incorrect code is sent and in any way some other mobile number rather than whichisregistered in GSM module tries to access the information the message with proper information of that hacker is sent to the user.The whole programming for this project is done in c language to make it compatible the thresholds for each parameter is explained in the program. After the completion the whole setup looks like that is shownbelow:-

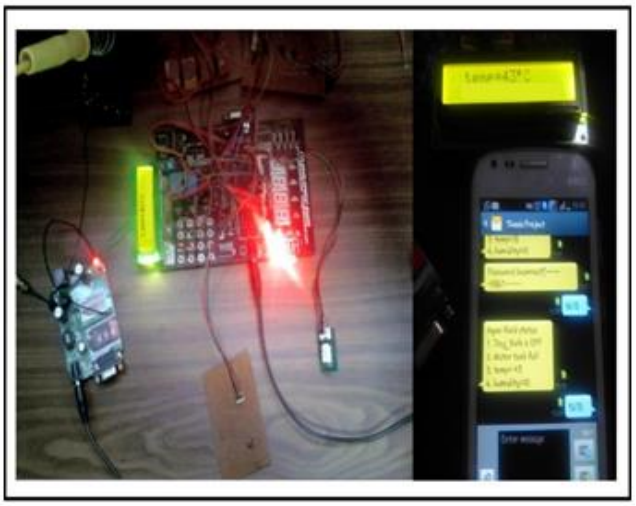


FIGURE 3:-Proposed model

III. TEMPERATURE MONITORING

In this we have measured the temperature through manual method and on the other hand by WSN also, as we have shown the difference in the accuracy of both themethods.

12THAPRIL DATA FOR CHILLI

Temperature measured manually:-

TEMP. READING	MOR.NING	NOON.	EVENING	NIGHT
ACCURATE TEMP.	72^{0}F	79^{0}F	77^{0}F	73^{0}F
SUITABLE TEMP. FOR CROP.	68^{0}F	86^{0}F	75^{0}F	79^{0}F
DIFFERENCE	4^{0}F	7^{0}F	2^{0}F	6^{0}F

The above reading has been taken at RARI (RAJASTHAN AGRICULTURE RESEARCH INSTITUTE)foraperiodofweekfromwhichwe have presented the readings above. The critical temperature according to the crop is highlighted in the table as above we did, whenever this critical value is crossed the coolers get switched on automatically.

Temperature measured through WSN:-

TEMP. READING	6AM	8AM	10AM	12PM	2PM
ACCURATE TEMP.	71^{0}F	78^{0}F	80^{0}F	83^{0}F	90^{0}F
SUITABLE TEMP. FOR CROP.	67.4^0 F	70^{0}F	73^{0}F	78^{0}F	80^{0}F
DIFFERENCE	3.6^{0}F	8^{0}F	7^{0}F	5^{0}F	10^{0}F

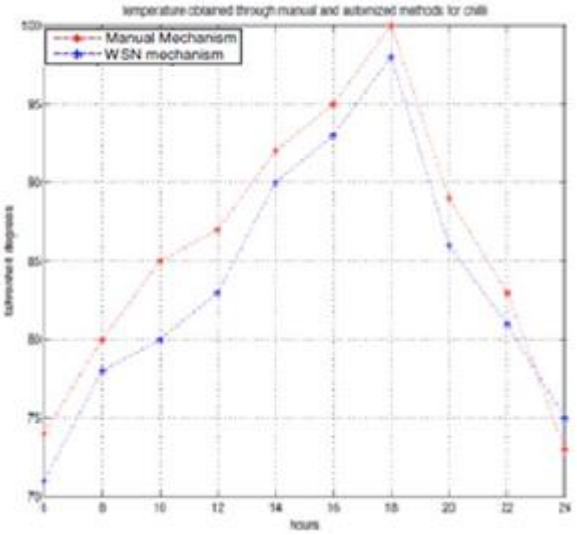
the parameters that should be maintained for the proper growth of crops [7].

The previous research in this field is done like the insects are detected by their behaviour such as honey bee dance. Bees perform several dances having different meaning by analyzing that tracking can be done and the conditions of weather can also be predicted. The other ways include by tracking the sound; the robots are used to sense the sound as they have two lateral eyes which measure the lateral flows in left and right direction. Odour; it simply means that a different kind of material is used that attract the insects and then they are trapped, and the flying beats; in this the amplitude of their flight iscontrolled[8]-[11].

IV. GRAPH TAKENFORABOVE VALUES

The introduced technology includes the detection of insects through image processing. The insects are being captured through the camera and then the images are being operated through theimage

THROUGH MATLAB:-



The above graph indicates the difference between both the methods. The benefits to the smart greenhouse can be easily measured from above, using WSN method the accuracy is better and the parameter can be measured at any instant of time and can be saved also for further record.

V. INSECTSMONITORING

Insects are the essential part of agriculture, few insects are proved to be beneficial for the growth of crops and few are the insects that are harmful for the crops. Insect monitoring is also essential because it is the subset of greenhouse;it is one ofprocessing as this are converted and further sent to the destination where the amount of insects is calculated and as a result the amount of fertilizers is suggested by the user to the farmer automatically. The results have been shown below:-

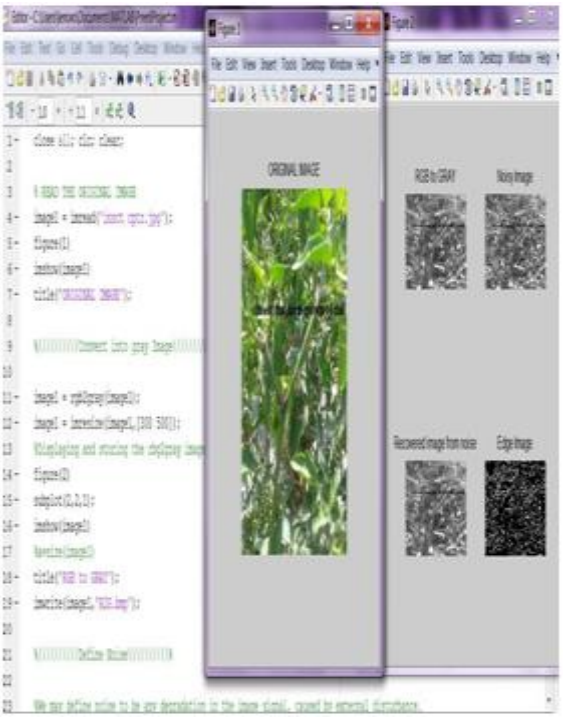


FIGURE 5:- Infected chillies due to thrips

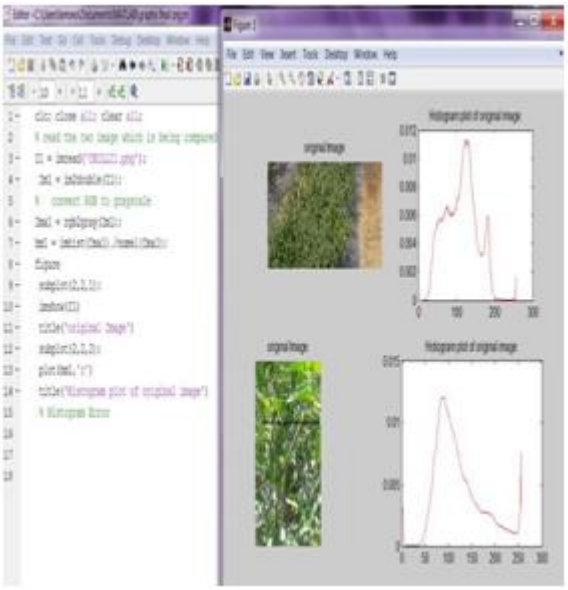


Figure 6:- Respective graphs for healthy and infected chilli for the comparison.

The above graph shows the difference in between the healthy crop and infected, we can individually calculate this for every crop so by comparing it further we can apply or propose the adequate amount of fertilizers.

PROGRAM:-

Image Processing:-

```
MATLAB PROGRAM FOR IMAGE PROCESSING
close all; clc; clear;
% READ THE ORIGINAL IMAGE
image1= imread ('tmato.jpg'); figure
(1)
imshow(image1) title('ORIGINAL
IMAGE');
%//////////Convert into gray Image\\\\\\\\\\% image1 =
rgb2gray (image1);
image1= imresize (image1,[300 500]);
%Displaying and storing the rbg2gray image figure(2)
subplot (2,2,1); imshow(image1)
%a=size(image1)
title ('RGB to GRAY'); imwrite
(image1,'R2G.bmp');
%//////////Define Noise\\\\\\\\\\%
%We may define noise to be any degradation in
the image signal, caused by external
disturbance.
image2=imnoise (image1,'salt & pepper', 0.1);
%image2=imnoise (image1,'speckle', 0.05);
%image2=imnoise (image1,'poisson')
%Displaying and storing the
noised image subplot(2,2,2);
imshow(im
age2);
title('Noisy
Image')
imwrite(image2,'noisy.bmp');
%//////////Denoising\\\\\\\\\%
noise1 = double(image2) -
double(image1);% noise
image3 = double(image2) - double(noise1); %
recovered image
image3 = uint8(image3);
%Displaying and storing the
denoised image subplot(2,2,3);
imshow(image3)
title('Recovered image from noise');
imwrite(image3,'denoise.bmp');
%////////Edge
Detection\\\\\\\\\\%
image4=edge
(image1,'prewitt', 0.06);
%Displaying and storing the edged
image subplot(2,2,4);
imshow(im
age4);
title('Edge
Image');
imwrite(image4,'edge.bmp');
```

As these thrips are the soft bodied and minute insects which occur through the whole year. The larva of these insects and adults lacerate spoil the leaf tissues and they also ooze on the juice of plants that is essential for the nutrients of plants. Due to which the young leaves also get infected and the leaves become shortened and as a result the growth of the plant is affected, the leaves are converted into brown and then they are dropped off**[12].**

The suggested treatment that is accurate for these infected chillies is that the seed treatment should be given with imidacloprid at the rate of **5 grams/kg** seeds. In the infected field, spray it with imidacloprid that is at the rate of **1 ml** in the content of water that is up to 3-4 liters. Taking this treatment we can easily remove the thrips which are harmful to the crops ,this result is likewise will be sent to the farmer through GSM module and the proper fertilizers amount can be spread on to thecrop.

VI. FUTUREWORK

The future work that can be added to the above research is that we can measure the frequency or wavelength of sound of the insects. As we can measure the frequency and can store it in the module whenever the insect with the same frequency enters the greenhouse ,the frequency matches and the buzzer is switched on automatically, as a result the module work to it. The insects can be also monitored according to their migration, for example in the field of potato the farm is damaged by mouse it can be easily monitored through its odour, the farming of mustard can be protected from insects by tracking or monitoring insects through their sound and smell. However in the fields of brinjal and pea the insects like cutworm, wireworm and beetles can be monitored by sensing theirliquid.

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