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Abstract-Appropriate climatic condition are necessary for plant growth ,improve crop yields, efficient use of water and to control the diseased plants. To protect the plants from the adverse climatic conditions such as wind, cold, precepitation, excessive radiation, extreme temperature, insects and diseases.The need for greenhouse automation arises. Our system uses different sensors such as temperature ,LDR,humidifier,soil moisture and camera.The sensed signal from the above sensors are send to ARM 7 controller and the parameters such as temperature,light intensity, humidity,soil moisture and pest are controlled .The pest is identified using camera, processed by Matlab. The sensed information and the environment condition is send to the mobile web server of the greenhouse owner via GPRS.

Keywords*: ARM 7,GPRS,Matlab,mobile web server.*

I.INTRODUCTION:

About 95% of plants,food and cash crops are grown in open field .Man has learnt how to grow plants under natural environmental conditions.In some temperate regions climatic conditions are extremely adverse and no crops can be grown.So automation is the only way for growing plants all around year by protecting plants from excessive cold and temperature[4] .Chemical application of nutrients and pesticide is one of the most important process in agricultural production.About 30-35% of production looses can be saved while harmful insects and diseases are eliminated by pesticide spraying.[2]

Greenhouse automation system controls the values of temperature ,humidity,soil moisture and light intensity using different control devices and transfers the data to the pc[1][6].An autonomous robot enables the greenhouse automation process for spraying the pesticide and caring the diseased plants[2][3].This system failed to care for diseased plants and updation of remote monitoring[1].The autonomous robot for pest spraying leads to high cost for construction of greenhouse automation[2][3].

This paper eliminates the drawbacks of[1][2].To increase the yield by 10-12 times higher than outdoor cultivation, the need for greenhouse automation arises. Our system comprises of ARM 7 controller which controls the parameter such as temperature,humidity,soil moisture,light intensity and pest identification using control devices such as heater,blower,pump and bulb.The pest identification is done using pc and camera,processed using MATLAB.The select vector machine (SVM) classifier is used for identifying the pest and automatic spraying is done by control device.The pest identified location are send to the webserver.The parameters are displayed in LCD and send to the mobile webserver via GPRS.The reference value for the temperature ,humidity,light intensity can be set by greenhouse owner from webserver.

II.SYSTEM DESIGN

The different parts of the system contains data acquisition system i.e sensors such as temperature sensor,humidity sensor,light sensor(LDR) and soil moisture sensor.The main processing unit ARM 7 microcontroller(LPC2148).The pest identification parts such as camera and pc.Device controlled water pump,pest sprayer,blower,heater,artificial lights are turned on using actuators.To display the datas LCD and to transfer and receive datas to webserver GPRS is used.

The data acquisition system senses the environment and sends the data to the processing units which is controlled by device controllers .The camera connected to pc moves in linear and rotational motion through the tracks provided around the plants to identify the pest processed by matlab using SVM classifier.The pest identified locations are automatically sprayed using actuators .The datas are send to web-server via GPRS and also displays in LCD.Fig 1 shows the block diagram of the model.

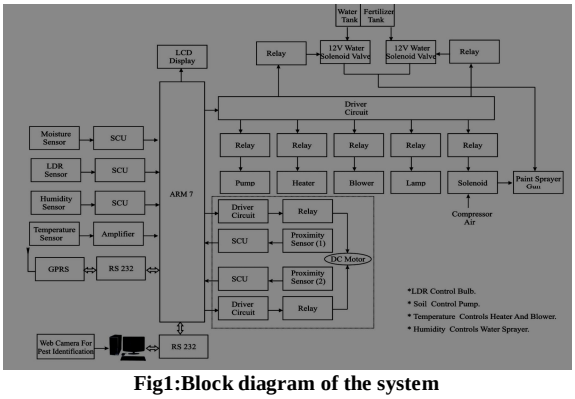


Fig1:Block diagram of the system

A.ARM 7 Controller:

The ARM 7 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty[5]

Key features:

- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory.
- 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
- In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader
- software. Single flash sector or full chip erase in 400 ms and programming of
- 256 bytes in 1 ms.
- One or two 10-bit ADCs provide a total of 6/14
- analog inputs, with conversion times as low as 2.44 µs per channel.
- Single 10-bit DAC provides variable analog output .
- Two 32-bit timers/external event counters (with four capture and four compare
- channels each), PWM unit (six outputs) and watchdog.
- Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.

B.Soil moisture sensor

The sensor is designed with two copper leads as sensor probes .It gives a voltage output corresponding to the conductivity of the soil.The conductivity of the soil depends upon the amount of moisture present in it.It increases with increase in the water content of the soil.It is examined under three condition.

Condition	Output voltage
Dry	0-0.5v
Optimum	1.9-3.4v
Excess water	>4.2v

C.Temperature sensor

The temperature sensor used here is LM35.It measures temperature with an electrical output propotional to temperature(in celcius).The temperature is measured accurately using thermistor.

Readings of temperature in celcius for different time

Time	Temperature in celcius
9 am	26
10 am	28
12 pm	31
16 pm	27
20 pm	25

D.Humidity sensor

Humidity sensor is used for sensing the humidity.Relative humidity(RH) is a measure in percentage of the vapour in the air compared to the total amount of vapour that could be held in the air at a given temperature.The change in RH of surroundings causes an equivalent change in the voltage output.The output is an analog voltage propotional to supply voltage.

Reading of relative humidity for different time

Time	Relative humidity
9 am	48
10 am	42
12 pm	23
16 pm	18
20 pm	31

E.LDR

Light dependent resistor is known as photoconductor which has a resistance varies according to the amount of light falling on its surface .It is made using cadmium sulphide (cd s).The light falling on the sensor causes the resistance of device to fall.

Reading of light intensity for different time

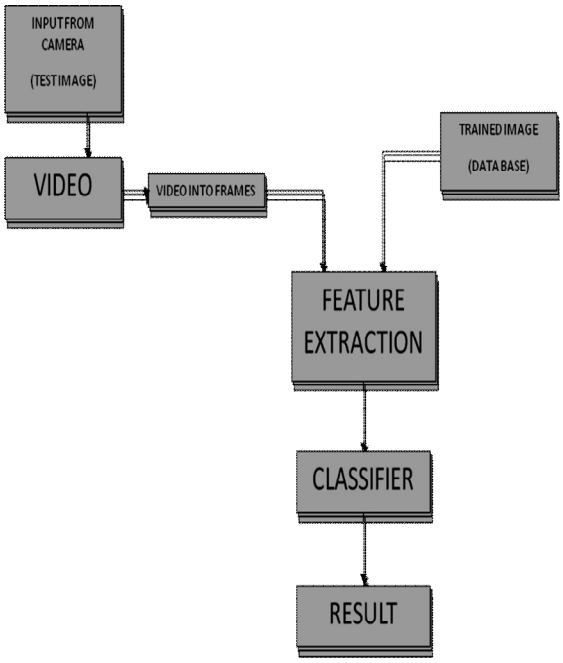
Time	Light Intensity
9 am	240
10 am	251
12 pm	265
16 pm	249
20 pm	242

F.Pest identification

The pest identification is done using pc and camera.The pest detection scheme follows i)enhancement of the plant ii)segmentation of pest iii)extraction of features from the segmented pest area iv)use of svm classifier

Image enhancement:

Image enhancement is conversion of image quality to a understandable level.It is filtered by Gaussian smoothing filter followed by top hat filtering ,gray scale input image to correct uneven illumination when the background is dark.



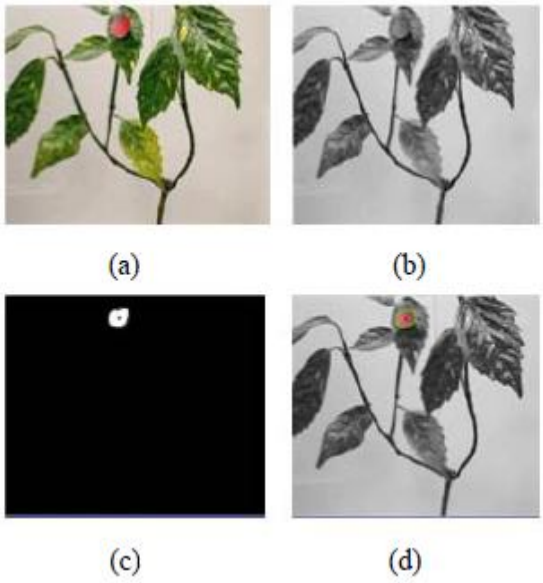
Segmentation and feature extraction:

The enhanced plant image are converted in to binary images through thresholding at different values.Gaussian smoothing filter is used to eliminate noise.The thresholding improves the detection of pest.

The feature extraction measures the properties such as area ,equivdiameter,solidity,eccentricity,orientation,major axis length,minor axis length and centroid.The area counts the number of pixels and centroid computes center of pest region.

SVM classifier:

Consider the pattern classifier, which uses a hyper plane to separate two classes of patterns based on given examples {x (i), y (i)} i=1n .Where (i) is a vector in the input space I=Rk and y (i) denotes the class index taking value 1 or 0.A support vector machine is a machine learning method that classifies binary classes by finding and using a class boundary the hyper plane maximizing the margin in the given training data. The training data samples along the hyper planes near the class boundary are called support vectors, and the margin is the distance between the support vectors and the class boundaryhyperplanes. The SVM are based on the concept of decision planes that define decision boundaries. A



a)input image enhancement
b)gray scale
c)image segmentation
d)pest identified region

decision plane is one that separates between assets of objects having different class memberships. SVM is a useful technique for data classification. A classification task usually involves with training and testing data which consists of some data instances. Each instance in the training set contains one “target value” (class labels) and several “attributes” (features).

Given a training set of instance label pairs (xi,yi),i=1,…,l where xi €Run and y€(1,-1)l,the SVM require the solution of the following optimization problem.

Min w, b, £1/2wTw + c Σ l
i=1εI
Subject to yi(wTØ(xi) +b)>1-εI,
εi>=0.

Here training vectors xi are mapped into a higher dimensional space by the function Ø. Then SVM finds a linear separating hyper plane with the maximal margin in this higher dimensional space>0 is a penalty parameter of the error term. Furthermore, (xi,xj) =Ø (xi) Ø (xj) is called the kernel functions.

There are number of kernels that can be used in SVM models. These include linear polynomial, RBF and sigmoid.
Ø= {xi*xj linear
(γxixj+coeff)d polynomial
Exp (-γ|xi-xj|2) RBF
Tanh (γxixj+coeff) sigmoid}

The RBF is by for the most popular choice of kernel types used in SVM.There is a close relationship between SVMs and the Radial Basis Function (RBF) classifiers. The SVM is the maximum margin hyper plane that lies in some space. The original SVM is a linear classifier. For SVMs, using the kernel trick makes the maximum margin hyper plane fit in a feature space. The feature space is a non linear map from the original input space, usually of much higher dimensionality than the original input space. In this way, non linear SVMs can be created.

Support vector machines are an innovative approach to constructing learning machines that minimize the generalization error. They are constructed by locating a set of planes that separate two or more classes of data. By construction of these planes, the SVM discovers the boundaries between the input classes; the elements of the input data that define these boundaries are called support vectors.

For Gaussian radial basis function:
K (x, x') =exp (-|x-x'|2/ (2σ2)).

The kernel is then modified in data dependent way by using the obtained support vectors. The modified kernel is used to get the final classifier

G GPRS

GPRS (General Packet Radio Service) is a packet based communication service for mobile devices that allows data to be sent and received across a mobile telephone network. GPRS is a step towards 3G and is often referred to as 2.5G.

III. SYSTEM OPERATION:

Each crop grows with different climatic condition.The parameters are set with reference values.

The temperature sensor senses the input and sends to ARM 7 controller .If the sensed temperature is below the reference value the actuator turn on the heater else if it is above the reference value it will turn on the blower.

The humidity in air can be sensed using humidity sensor.The reference value for humidifier is set .If it is below the reference dehumidifier will turn on else if it is above reference humidifier will turn on.

The intensity point is set. Light dependent resistor senses the change in input intensity of light. If the intensity of light sensed is below the low limit set, the controller unit will switch on bulb. Once it reaches the set limit it will switch off the bulb. In this way, intensity of light is controlled.

If the soil moisture is less than the low limit pump will turn on. If the soil moisture is greater than the high limit then pump will turn off.

Each plant is given with a location numberThe camera connected to pc is turned on and made to move in tracks.The captured input image is compared with trained image of the crop.If crop mismatches,pest is sprayed else the camera will move on to the next location.The pest identified location will be displayed in LCD and send to web server.

The set points of the parameters and the sensed input signal can be set from web-server.All the sensed datas are sent to web-server via GPRS.

IV Software used

The pest identification is done using Matlab and the other parameters are developed using embedded c language in keil.

V Results and conclusion

This system increases the yield to 10-12 imes and reduces the labour cost.The experimental results shows that the pest is accurately identified and pesticide is sprayed automatically which reduces the loss of production due to diseased plants.since only single camera is used the cost of the system is low. The remote monitoring from web-server helps the green house owner to set the reference point and make changes in reference value from anywhere.

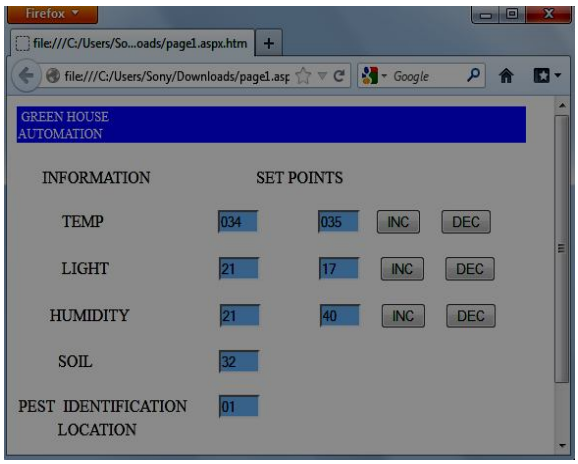


Fig3:Datas in web-server

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