Automatic Plant Monitoring System

K. Krishna Kishore
Asst Professor
Dept of ECE
GMR Institute of Technology
Rajam, India
Krishnakishore.k@gmrit.org

M. H. Sai Kumar
Department of Electronics and Communication Engineering
GMR Institute of Technology
Rajam, India
mallavarapusaikumar9@gmail.com

M. B. S. Murthy
Department of Electronics and Communication Engineering
GMR Institute of Technology
Rajam, India
murthymukkavilli97@gmail.com

Abstract

The automatic plant monitoring system has recently attracted tremendous interest due to the potential application in emerging technology. More importantly, this technique is used to enhance the performance of existing techniques or to develop and design new techniques for the growth of plants. The plant monitoring system is helpful for watering the plants and to monitor few parameters for growth of plants. This system is very used in few areas like nursery farms and in agriculture. In this system a mechanism is established to find the moisture content in the soil with the help of soil moisture sensor and depending upon the condition of the sensor the water is controlled.Another important parameter is by capturing the images of the plant by using Arduino interfaced camera, and processing the image by using image processing to analyze and determine the disease effected by creating the feature vector database and retrieval of images from database similar to query image.This helps in providing the appropriate amount of water for plants so reduces some situations like mud cracks, water logging. This helps in irrigating the field even during night time, so does not require the farmer to switch ON the motor manually.

Keywords— Soil Moisture Sensor; Kekre's transform Relay; Content Based Image Retrieval; Euclidian Distance

Introduction

The Automatic Starters are provided by the government, which helps in switching the motor to ON condition after a temporary withdrawal or failure of an electrical power supply. But the main disadvantage is it needs the involvement of farmer to switch OFF the motor after a particular time. So to avoid this particular situation we can use Plant Monitoring System to avoid the drawbacks of automatic starters. This can be implemented by using various sensors like soil moisture, temperature, pressure and humidity sensing sensors. Providing water for the growth of plants during night time is a difficult task for the farmer. So this Plant Monitoring System helps the farmer in irrigating the land by the water motor based on the output of the Soil moisture sensor even during night. This reduces the difficulties of farmer even if he is not present at the field. This helps in proper utilization of water i.e. Reduces the wastage of water because when the soil has rich moisture content, then the motor will be switched to OFF condition. This helps in proper usage of water in the areas where the availability of water is less. This will be enhancing the growth of plants. The two modes of operations of this system are

A) When it detects if the plant need some water it will be watering the plants.
B) A manual mode where you can control the water motors by relays manually.

In this we take the crop or paddy leaf images, and then analyse the image by image processing. This process is carried out by image analysis which are Histogram analysis, feature extraction of image based on colour analysis and texture analysis.

I. THE PLANT MONITORING SYSTEM

Firstly arranges the field in the form of sectors after levelling of the entire field. Here we made four sectors. They are S1, S2, S3, and S4. We have to ensure that each sector should not have any contact with each other (i.e. The water molecules of one sector will not go to another). Each sector was provided with the one soil moisture sensor. That soil moisture sensor will measure moisture content of soil. We have to be sure that whether the soil moisture sensors are inserted properly into the soil, why because their operation plays a major role in the system.

Secondly, we have to arrange the relays and micro servos for the entire system and ensure that they are operating at the time or not. The workings of those were clearly explained below. Later all the sensors, relays and servos should be connected to an Arduino. We have to adjust that servo should operate in the 0 to 180 degrees. By this way each and every scale should be visible only through the display so we have used display is used. Hence the new technique of the plant monitoring system would work with high efficiency with the less involvement of men.

II. PROPOSED WORK

Initially we have to collect the analog output value from the soil moisture sensors. And we have to fix a particular threshold value for particular sensors. If the output analog value is greater than the threshold value, then it indicates that the soil is dry condition. So we have to switch on the water motor. The water motor is used to pump water to dry sectors to make them wet by using relay, which will be acting as the switch. Water is pumped into the dairy sector until entire soil will be becoming wet. After a particular time the dry soil becomes wet. If the output of the soil moisture sensor is less than the prescribed threshold values it indicates the soil is wet condition. So that water motor will come into switched off, this could be controlled by the relay acting as a switch. We have used servo motors for the watering of the dry soil, which will be watered according to the output based on the soil moisture sensors. We also use BMP180 sensor which measures the temperature, pressure values in the surrounding environment and it will be given information on weather, particularly based on temperature and pressure gives information to the heater, which will be turned on if the temperature is less. So we have used a heater. If the temperature of the surrounding environment is less than automatically the heater will be switching on by using Relay. We also used a display to print the present values of temperature and pressure of the surrounding environment. We used a DC motor in designing the water motor. The shaft of the DC motor is attached to a fan like structure and the entire shaft with a fan is enclosed in a closed structure and we attached two pipes one for water inlet and the other for the water outlet. When the motor is switched on then water from the inlet is sprinkled away due to centrifugal force and the water comes out through the outlet pipe.

Fig.1: Problems facing in Current System

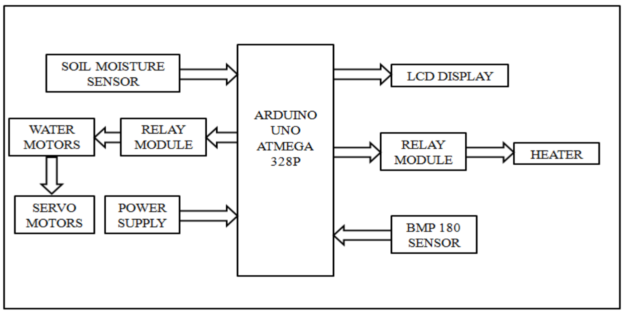


Fig.2: Block Diagram of Proposed System

III. HISTOGRAM ANALYSIS

An image histogram is a type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. By looking at the histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance. The intensity histogram shows how individual brightness levels are occupied in an image; the image contrast is measured by the range of brightness levels. The histogram can also reveal if there is noise in the image, if the ideal histogram is known. We might want to remove this noise, not only to improve the appearance of the image, but to ease the task of (and to present the target better for) later feature extraction techniques.

A. *SOIL MOISTURE SENSOR:*

The basic soil moisture consists of two electrodes, and those probes are kept in the soil. When the soil consists of water, as water is a good conductor of electricity, so water acts as a short circuit path for those two electrodes. As a result current flows between those electrodes and generates a voltage across the variable resistor. So the conductance values are the moisture content readings of the sensor. As it consists of NOT gate so it generates high values for dry soil, i.e. which doesn't contain moisture and produces lower values for wet soil. Soil moisture measures the volumetric water content in soil.

B. *BMP 180 SENSOR:*

Barometric pressure sensors measure the absolute pressure of the air around them. This pressure varies with both the weather and altitude. Depending on how you interpret the data, you can monitor changes in the weather, measure altitude, or any other tasks that require an accurate pressure reading. The definition of pressure is a force "pressing" on an area. A common unit of pressure is pounds per square inch (psi). One pound, pressing on one square inch, equals one psi. The SI unit is Newton's per square meter, which are called Pascal's (Pa).

IV. KEKRE'S TRANSFORM

Kekre Transform matrix is the generic version of Kekre's LUV colour space matrix Kekre Transform matrix can be of any size NxN, which need not have to be in powers of 2 (as is the case with most of other transforms). All upper diagonal and diagonal values of Kekre's transform matrix are one, while the lower diagonal part except the values just below diagonal is zero. Generalized NxN Kekre Transform matrix can be given as

$$K_{N\times N} = \begin{bmatrix} 1 & 1 & 1 & \dots & 1 & 1 \\ -N+1 & 1 & 1 & \dots & 1 & 1 \\ 0 & -N+2 & 1 & \dots & 1 & 1 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & 1 & 1 \\ 0 & 0 & 0 & \dots & -N(N+1) & 1 \end{bmatrix}$$

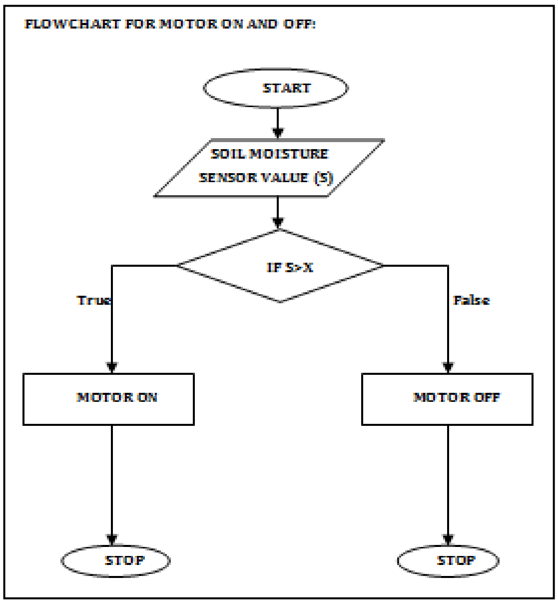
The formula for generating the term Kxy of Kekre Transform matrix is

$$K(x,y) = \begin{cases} 1 & ,x \le y \\ -N + (x-1) & ,x = y+1 \\ 0 & ,x > y+1 \end{cases}$$

For taking Kekre Transform of an NxN image, the number of required multiplications are (N-1) and number of additionsrequired are 2N(N-1).Image retrieval mainly has two steps Feature Extraction and Query Execution. Mainly three different techniques are used here for image retrieval, which are listed below.

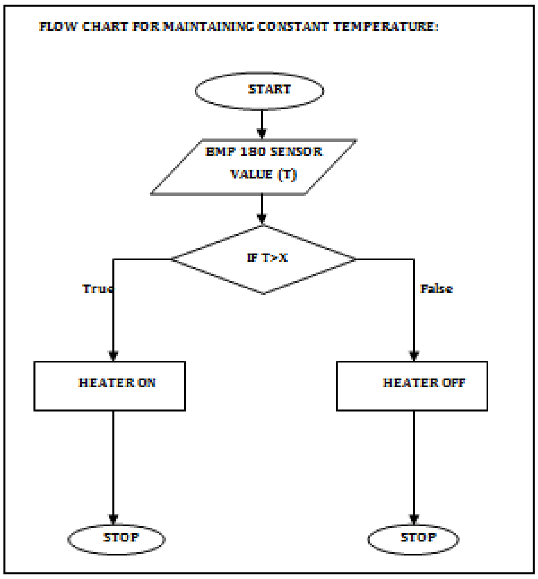
Kekre Transform Row Mean,
Kekre Transform Column Mean and
Kekre Transform Combination.

FLOWCHARTS:



X=threshold value

Fig.3: Flowchart for motor ON and OFF



X=threshold value

Fig.4: Flowchart for Heater ON and OFF

V. EXPERIMENTAL RESULTS

Fig.5: Prototype of Plant Monitoring System

Test images:

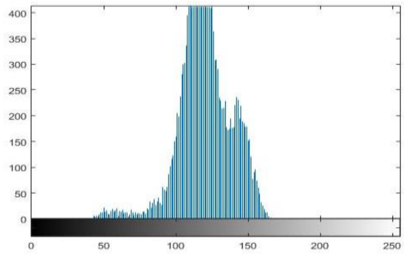


Figure 5.1: Test image and its histogramAnalysis:

The point of observation is dark spot that appear at the certain points on the lattice, which is visible in the histogram also. For the point around 120, the number of pixels are more than 400 thus depicting the dark spot which has arisen due to NPK Excess criterion on the lattice at some point. The dark spots are unique to this set and the histogram so generated clearly depicts the analytical capabilities of image processing. The N, P, K excess leaf and histogram is as shown in the figure.

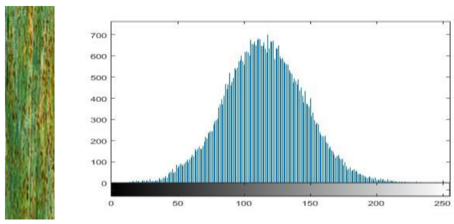


Figure 5.2: Test image and its histogramAnalysis:

The most critical observation is to notice the range from 0 to 50. Since in this the black spots have just started to emerge on the lattice. This means that there will be pixels that must correspond to the range 0 to 50. The number of such pixels will be less but the mere presence of pixels in this range is a significant observation that is clearly distinguishable from other histograms. Speaking in terms of counter-measures, on constant observation, if the number of pixels keeps on rising in the range of 0 to 50, it must trigger procedures to counter this specific cause which is dryness as shown in figure. In order to get accurate results we are combining both kekre transform and variance concept along with Histogram analysis.

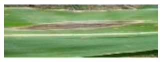
S.NO	Types of leaf	Range for number of pixels are high
1	Healthy leaf	Between 150 to 175
2	Dry leaf	Rising from 0 to 50
3	Excess Heat leaf	Between 200 to 255
4	Excess NPK leaf	Between 110 to 120

Table 5.1: Histogram analysis for leaf

5.2 KEKRE TRANSFORM RESULTS:

Query image

The leaf diseases is detected by combining Kekre transform and variance method. threshold value is obtained by combining both kekre transform and variance method. The values below the threshold value are similar to the query image.

S.NO	IMAGE	VARIANCE
1		8095.3
2		2662.3
3		1349000
4		70109
5		112120
6		1569.8

CONCLUSION

In this system the water controlled mechanism is worked very well depending on the condition of the soil moisture sensor.The Image retrieval process involves combination of both Kekre Transform and variance method for image retrieval. In Kekre transform the image vector is converted to a row mean and column mean vector and then multiplied with the Kekre transform matrix to get the Kekre row and column mean vectors. After this the Euclidean distance is computed using the query image and the database image. Thus the Euclidean distances for Kekre row and column mean vector which are combined together by taking the mean respectively for query and database images is obtained . After this the Euclidean distances for the individual regions is calculated using the query image and the summation of squares of all the regions is performed and under root is taken thereafter. After the Euclidean distance is calculated, then threshold value is calculated. The threshold value is calculated from the Euclidean distance. The database images below the threshold value are similar to the query image and by this we find the disease affected to the leaf. This method is more efficient than histogram analysis.

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