

Use of Microcontroller and LBP Technique for Stone Fruits of Meghalaya

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ABSTRACT:

Fruit Cultivation in Meghalaya is a prominent business sector for earning a good amount of state's revenue. Meghalaya being a home of wide variety of fruits and vegetables holds a unique position in production figures among other states of North-East. Fruit crops are capable of giving higher tonnage of yield per unit area than other field crops. Meghalaya produces several stone fruits such as plum, peach, apricot in a restricted scale. Pear is widely grown in the Khasi Hills districts of the state. The flesh of pear fruit contains stone cells. This paper focuses on use of microcontroller for orchard management and also quality detection of stone fruits using LBP approach. It will reduce labour cost, improve tree health, increase fruit production and will surely play an important role in the economic prosperity of Meghalaya.

Keywords: microcontroller, sensors, Fruit quality detection, softwares.

INTRODUCTION:

The aim of calculating different weights for features like intensity, color, orientation and edge of the input test image. The weights of different features represent the approximate locations of the fruit within an image. S.Arivazhagan, Shebiah, Nidhy anandhan and Ganesan [20] has used color and texture features for fruit recognition. The recognition is done by the minimum distance classifier based upon the statistical and co-occurrence Meghalaya is a state in north-east India. The name means "the abode of clouds" [10]. The capital is Shillong, known as the "Scotland of the East". Nature has blessed her with abundant rainfall, sun-shine, virgin forests, high plateaus, tumbling waterfalls, crystal clear rivers, meandering streamlets and above all with sturdy, intelligent and hospitable people. Meghalaya is subject to vagaries of the monsoon. The climate varies with altitude. The climate of Khasi and Jaintia Hills is uniquely pleasant and bracing. It is neither too warm in summer nor too cold in winter, but over the plains of Garo Hills, the climate is warm and humid, except in winter. The Meghalayan sky seldom remains free of clouds [11]. The average annual rainfall is about 2600 mm over western Meghalaya, between 2500 to 3000 mm over northern Meghalaya and about 4000 mm over south-eastern Meghalaya. There is a great variation of rainfall over central and southern Meghalaya. At Sohra (Cherrapunjee), the average annual rainfall is as high as 12000 millimetres, but Shillong located at a distance of about fifty kilometres from Sohra receives an average of 2200 mm of rainfall annually [12].

Meghalaya has suitable climate for cultivation of wide variety of horticulture crops such as fruits, vegetables, spices, aromatic and ornamental plants, medicinal plants and plantation crops. The key fruits grown in the state are pineapple, citrus fruits, banana, papaya and strawberries. Other potential fruits include plums, peaches, apricot, pear, guava, mango, litchi, lemon, etc. Fruits are found to be a rich source of vitamins and minerals. Fruits crops are capable of giving higher tonnage of yield per unit area than other field crops. As the new technologies and developments have gradually become readily available in the country, the cropping and cultivating systems and production practices have also remained witness to significant metamorphosis. Fresh fruits and vegetables export has steadily increased. In order to make the thriving business, the industrial strategy of India has been expanded beginning from the lower level to the huge markets to deal globally. Fresh fruits and vegetables which are cultivated are sent to the small scale vegetable and fruit suppliers, then these items are dispatched to the fruit and vegetable exporters as well as to the local markets. The last few decades recorded an all

time high of number of Indian fruit and vegetable exporters and suppliers. Fruit production and cultivation in this country has witnessed a growth of near about 3.9 %, while fruit processing units have also grown about 20 % per year.

These fruits can also be processed in several products like canned fruit, concentrates and fruit juices, dehydrated fruit, jellies and jams. Cultivation of fruits chiefly depends upon the quality of soils, harvest, plantation and a perfect ambience of brilliant minds. There are ample investment opportunities for the expansion of export market for fruit cultivation in Meghalaya. But the low level of industrialization and the poor infrastructure base acts as a barrier to the interest of the state's economy. Plums, peaches, pear, apricots can be grown in abundance in Meghalaya. This is because Meghalaya has favourable soil and climatic conditions for stone fruit cultivation and thus holds a huge horticulture potential and also a great scope to augment business prospect.

The quality of fruit is determined by using features obtained with the help of Local Binary Pattern(LBP) approach. The proposed technique accurately detects the quality of fruits. The results are good for the chosen stone fruits of different colour, shape and size. This kind of system can be employed in juice plants, fruit and vegetable farms, packaging etc.

LITERATURE REVIEW:

Naggaaur and Sannanki [17] presented the sorting and grading of fruits using image processing techniques. The system starts the process by capturing the fruit's image. Then the image is transmitted to the matlab for feature extraction, classification and grading. Both classification and grading realized by fuzzy logic approach. C Arun Kumar[2] presented a system that utilizes image-processing techniques to classify and grade fruits. The developed system starts the process by capturing the fruit's image using a regular digital camera. Then, the image is transmitted to the processing level where feature extraction, classification and grading is done using MATLAB. The fruits are classified based on color and graded based on size. Both classification and grading are realized by Fuzzy Logic approach. Effendi, Ramli and Ghani [11] developed a pattern recognition system to identify the *Jatropha curcas* fruit maturity and grade the fruit into relevant quality category. The system is divided into two stages: the first stage is a training stage that is to extract the characteristics from the pattern. The second stages is to recognize the pattern by using the characteristics derived from the first task. Back propagation diagnosis model is used to recognition the *Jatropha curcas* fruits. It is ascertained for the developed system is used in recognizing the maturity of *Jatropha curcas* fruits. The paper presents a pattern recognition system of *Jatropha curcas* using back propagation. Patel, Jain and Joshi [12] discussed the fruit detection using improved multiple features based algorithm. To detect the fruit, an image processing algorithm is trained for efficient feature extraction. The algorithm is designed with features derived from the wavelet transformed sub-bands. Bindu Tiger and Toran verma [1] discussed apple recognition techniques based on entropy, shape of apple, colour, and boundary attributes extraction. Proposed method classifies and recognizes apple images based on obtained features values by using two-layer feed-forward network, with sigmoid hidden and output neurons. The toolbox supports feed forward networks, radial basis networks, dynamic networks, self-organizing maps, and other proven network paradigms. This work represents the MATLAB 7.8.0 software and the recognition of generated signals by artificial neural network technique. Sandoval, Prieto and Betancur [19] have proposed a machine vision based classification system to sort coffee fruits (cherries) according their ripeness stage is presented. Eight categories were defined and they include the entire coffee cherry ripeness process, from the initial stage (early green) to over ripe and dry stages. A Bayesian classifier was implemented using a set of nine features which include colour, shape and texture computed on an image of the fruit. V. Ramya, B. Palaniappan, Bobby George [23] proposed an embedded system for automatic mist irrigation for cardamom field, which has a wireless sensor network for real time infield sensing and control of an irrigation system. This wireless system supports the cardamom field which has both plain and slope areas. The irrigation system updates solenoid valves for specified location of mist emitters automatically according to the set point of temperature, humidity and soil moisture. This system also senses the water level of the tank and whenever the water level is too low then the system immediately provides a visual and sound alarm

and then it automatically switches ON the motor. When the water level reaches 90% of the tank then the motor is switched OFF through the remote system. Communication signals from the sensor network and irrigation controller to the base station is interfaced using XbeePRO communication. C. Arun, K. Lakshmi Sudha [2] discussed remote monitoring in agricultural greenhouse using wireless sensor and short message service (SMS); here they are sending data via sms. S. R. Kumbhar, Arjun P. Ghatule [21] presented a wireless application of drip irrigation system where irrigation is carried out using soil moisture values. Zhang Feng [28] discussed the design of wireless sensor network and Internet technology of farmland automatic irrigation control method. Emphasis on an analysis of the routing protocol of sensor network nodes to achieve the system hardware and software design, middleware, and applications such as mobile phone or wireless PDA of internet of things, will constitute a variety of sensors intelligent network, thus enhancing the overall automation system and monitoring levels. The final analysis of the network in the Internet based on the agricultural plants of farmland water-saving irrigation system integrated approach. User use mobile phones or wireless PDA can easily soil moisture content of online monitoring and control to realize the irrigation automation. Application results show that system through the embedded control technology complete intelligent irrigation, improve the agricultural irrigation water use efficiency and irrigation system automatization is generally low status, can well realize water saving. Vitthal S Saptasagare, Basappa B Kodada [22] proposed a system that has several types of sensors deployed in the crop field area. It captures the physical phenomena of soil moisture, temperature, water level of the tank and pH of soil. The sensed data from various sensors goes to the central Global System for Mobile communication (GSM) node. From that the sensed data is given to the personal computer, which is used by a farmer.

There are many other microcontrollers and microcontroller platforms available for physical computing. In this paper, the proposed embedded system is designed with Arduino. Arduino boards are relatively inexpensive compared to other microcontroller platforms. Arduino is available as an open-source on electronics platform and has a software package used to program the hardware part. It is developed to make easily accessible for designers and hobbyists and student to create an interactive and live environment to implement many objects based on electronics and automobiles. The concept of Arduino is developed by Massimo Banzi which is easily programmable and simple to deploy. The Arduino software runs on Windows, Macintosh OSX, and Linux. It has simple, clear programming environment. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, MaxMSP). Once we have downloaded/unzipped the arduino IDE, we can Plug the Arduino to our PC via USB cable. It is easy to implement in analog components, automatic engines, sensors, and other automobile and electronic automation devices. In the proposed system, sensors measure temperature and humidity, soil moisture, pH, rainfall. Also ultrasonic sensor, waterflow sensor, solenoid valve, water/fertilizer tank, motor, L293D IC, IN4007, TIP 120 are interfaced with Arduino. This is because Arduino can be deployed easily to establish many online functions that require many sensors. In the proposed work, the classification of the stone fruit as 'bad quality' or 'good quality' is done on the basis of the values obtained after applying LBP approach and the LAB color space approach and ANN; and the accuracy of the proposed system is obtained. LBP technique is used due to its high discriminative power, computational simplicity, invariance to grayscale changes and good performance. This method reduces chance of human error as it accurately detects the fruit's quality.

METHODOLOGY:

There are two types of designing methods, one is Top-down method and the other is Bottom-up method. This work adopts the Top-down method. The design is a solution, the translation of requirements into the way of meeting them. The design will determine the success of the system. Based on the proposed system objectives, the major modules are identified and the operations to be carried out are determined. In the design phase of the system the data flow diagrams, flowcharts, data base tables, inputs, outputs and screen are designed by using all the necessary fields in a compact manner. Major levels of abstraction in design process is shown below:

COMPONENT LEVEL: The Component level involves in designing the hardware and software components.

Hardware Implementation: If we buy the components then the design time will be reduced and also the implementation speed will increase. The following components are used for designing the proposed embedded system for stone fruits of Meghalaya:

Arduino mega 2560: The Arduino mega 2560 board [3] is shown below:



Rain Sensor Module: The rain sensor module [8] is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The rain sensor module is shown below:



Soil Moisture Sensor: The soil moisture sensor [6] is shown below:



There are two types of soil moisture sensor. One is frequency domain sensor, which has an oscillating circuit. It measures the soil water content by measuring the soil's dielectric constant, which determines the velocity of an electromagnetic wave or pulse through the soil. When the soil's water content increases, the dielectric also increases, which can be used to estimate how much water the soil holds. The other one is neutron moisture gauge which utilise the moderator properties of water for neutrons. The principle is that fast neutrons are emitted from a decaying radioactive source, and when they collide with particles having the same mass as a neutron (i.e, protons, H⁺), they slow down. As the main source of hydrogen in soil is water, so by measuring the density of slowed-down neutrons around the probe can estimate the volume fraction of water content the soil holds.

LM393 Driver: It consists of two independent low voltage comparators [5] designed to operate from a single supply over a wide range of voltages. Operation from split power supplies is also possible. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground even though operated from a single power supply voltage. Input offset voltage

specifications as low as 2.0 mV make this device an excellent selection for many applications in consumer automotive and industrial electronics.

DHT11 Humidity & Temperature Sensor: This DFRobot DHT11 Temperature & Humidity Sensor [4] features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. The DHT11 sensor is shown below:



Ultra sonic Sensor: This is a low cost Ultrasonic Distance Sensor [9] provides a non-contact distance measurement with a fine accuracy of 3mm. The module is capable of measuring distance from obstacles in range of 2 cm to 400 cm or 1" to 3 Ft. Unlike IR sensors, the performance of this sensor is not dependent on the sunlight or colour of the object. The module comes in a compact form factor with a ultrasonic transmitter, receiver and signal conditioning circuit on-board.

The ultrasonic sensor is shown below:



pH Sensor: “pH stands for power of hydrogen, which is a measurement of the hydrogen ion concentration in the body. The total pH scale ranges from 1 to 14, with 7 considered to be neutral. A pH less than 7 is said to be acidic and solutions with a pH greater than 7 are basic or alkaline”. The analog pH sensor/meter kit is specially designed for Arduino controllers and has built-in simple, convenient and practical connection and features [7]. It has an LED which works as the Power Indicator, a BNC connector and PH2.0 sensor interface. To use it, just connect the pH sensor with BNC connector, and plug the PH2.0 interface into the analog input port of any Arduino controller. The pH sensor kit is shown below:



Water flow sensor: The YF-S201 Hall Effect Water Flow Meter / Sensor sits in line with our water line and contains a pinwheel sensor to measure how much liquid has moved through it. There's an integrated magnetic hall effect sensor that outputs an electrical pulse with every revolution. By counting the pulses from the output of the sensor, the water flow can be easily calculated. The connection details are : Red wire : +5V ; Black wire : GND ; Yellow wire : PWM output.

The water flow sensor is shown below:



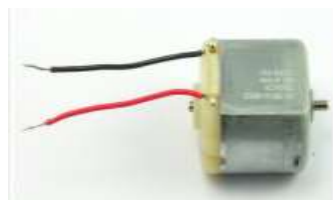
Solenoid Valve:

The 12V Solenoid Valve - 3/4" is a controlled fluid valve. Simply connect a fluid source to the 3/4" threaded inlet and it will interrupt the flow until 12V is applied to the fast-on connectors on the solenoid. The solenoid



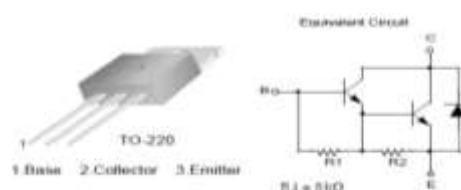
coil is used to translate the electric pulses into hydraulic pulses that enables opening and closing of specific solenoid valves. Solenoid coil, when mounted on the valve are connected to the controller by an electric cable. The solenoid valves are power operated devices which are used to modify the fluid flow or pressure rate in a process system. It is normally closed if there is no flow across the valve in its resting position with no current on the solenoid contacts. The quick opening of the valves, consisting of a metallic circular disc at right angles to the direction of flow in the pipe, which when rotated on a shaft, seals against the seats in the valve body. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design [14].

DC motor: Here a 6V DC motor is used. The operating temperature: $-10^{\circ}\text{C} \sim +60^{\circ}\text{C}$ and rated voltage: 6.0VDC.

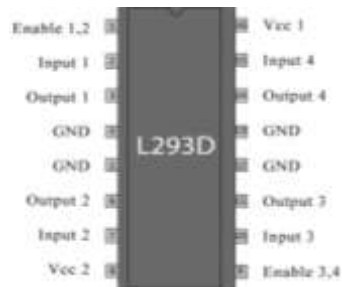


1N4007: A rectifier diode is used as a one-way check valve. Since these diodes only allow electrical current to flow in one direction, they are used to convert AC power into DC power. When constructing a rectifier, it is important to choose the correct diode for the job; otherwise, the circuit may become damaged. A 1N4007 diode is electrically compatible with other rectifier diodes, and can be used as a replacement for any diode in the 1N400x family [15]. The 1N4007 can sustain a peak repetitive reverse voltage of 1000 volts. When the maximum allowable consistent current amount is flowing through the diode, the voltage differential between the anode and the cathode is 1.1 volts. Under these conditions, a 1N4007 diode will dissipate 3 watts of power (about half of which is waste heat).

TIP120 NPN Epitaxial Darlington Transistor: TIP120 and its equivalent circuit is shown below:



L293D IC : L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction [16]. The L293D IC is shown below:



The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1. In simple words we need to provide Logic 0 or 1 across the input pins for rotating the motor. Lets consider a Motor connected on left side output pins (pin 3,6). For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic 0.

Water Tank: The same tank is used for supplying water to the field and for fertiliser application when required. Organic fertilisers such as bird and animal manures, blood meal, fish meal, feather meal, ecto and endo mycorrhizae etc can also be used. Organic-based ingredients promote stable consistent plant growth with no growth spikes.

Also connecting wire, resistors, pipe ,M Seal, breadboard etc are used.

Software Implementation:

Installing Arduino IDE:

Download the Arduino Software IDE from <https://www.arduino.cc/en/Guide/Linux>. [13]



Extract the package either using the command `tar -xvf arduino-1.6.10-linux64.tar.xz` through terminal or right click tar file and extract it.

Run the install script

Open the arduino folder created after extraction process and spot the `install.sh` file. Right click on it and choose run in terminal from the menu.

run `./install.sh` Through terminal

Navigate to the arduino folder through terminal and command. Installation will be done.

```

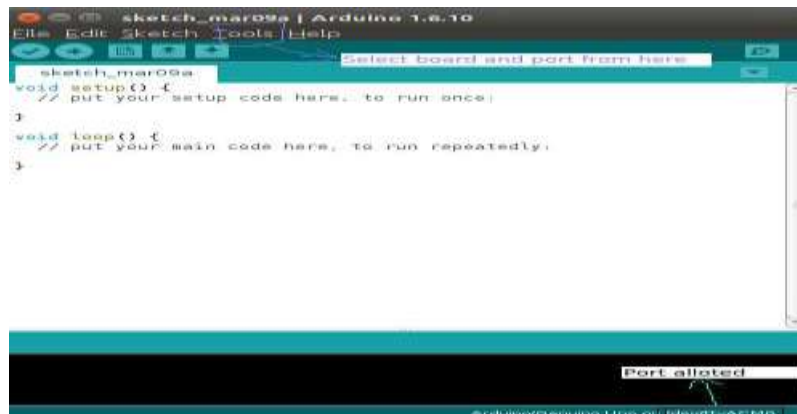
osboxes@osboxes: ~/Downloads/arduino-1.6.10
osboxes@osboxes:~$ ls
Arduino  Documents  examples.desktop  Pictures  Templates
Desktop  Downloads  Music             Public    Videos
osboxes@osboxes:~$ cd Downloads
osboxes@osboxes:~/Downloads$ cd arduino-1.6.10
osboxes@osboxes:~/Downloads/arduino-1.6.10$ ./install.sh
Adding desktop shortcut, menu item and file associations for Arduino IDE... done
osboxes@osboxes:~/Downloads/arduino-1.6.10$

```

Arduino IDE has been installed.

To upload our program on board:

- Let's connect the board to our system through USB port.
- Now select board and port from Tools.
- We also need to select port through terminal. Command for same is `sudo chmod a+r+w dev/ttyACM0`(port allotted by arduino).



This is how our IDE will look and we can select the board and port as mentioned.

Interfacing Arduino with MySQL using Python:

The following steps shows how to interface Arduino to MySQL using Python in Ubuntu-12.04.

1. Interface Arduino to MySQL using Python

Step 1: First of all Installing the Latest version of Python

- A) Install dependencies with the help of below command
\$ `sudo apt-get install python-software-properties`
- B) Add the repo with the help of below command
\$ `sudo add-apt-repository ppa:fkruill/deadsnakes`
- C) Update the repo index with the help of below command
\$ `sudo apt-get update`
- D) Install Python 2.7
\$ `sudo apt-get install python2.7`

Step 2: Install PYSerial Library for taking sensor data from serial port using Python Script.

- A) We can download the PYSerial library here:
<https://pypi.python.org/pypi/pyserial>
- B) For mac or linux users, download the file and extract it. Open terminal and cd into the extracted folder and run the following command:
\$ `sudo python setup.py install`

Step 3: Install Latest version of GCC .

- A) Add the ppa By


```
$ sudo add-apt-repository ppa:ubuntu-toolchain-r/test
```

B) Install g++ and GCC latest version

```
$ sudo apt-get update
```

```
$ sudo apt-get install gcc-4.8 g++-4.8
```

C) Run the following command one by one

```
sudo update-alternatives --remove-all gcc
```

```
sudo update-alternatives --remove-all g++
```

```
sudo update-alternatives --install /usr/bin/gcc gcc /usr/bin/gcc-4.8 20
```

```
sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-4.8 20
```

```
sudo update-alternatives --config gcc
```

```
sudo update-alternatives --config g++
```

Step 4: Install Latest version of MYSQL.

A) Update server package cache before proceeding

```
$ sudo apt-get update
```

B) Install MYSQL server with the help of below command

```
$ sudo apt-get install mysql-server-5.5
```

The only thing it will ask is to set the root password for MySQL . We should set a password instead of leaving it blank for doing it later.

C) Once installation has completed, we just need to check that mysql is running. To do this, run

```
$ sudo netstat -tap | grep mysql
```

If MySQL is running we will see output similar to the following:

```
tcp 0 0 localhost:mysql *:* LISTEN 2480/mysql
```

D) We can also view what packages have been installed by typing:

```
$ dpkg -l | grep mysql
```

Step 5: Install MySQLdb Python module.

A) We can download the MySQLdb files from below link

<https://sourceforge.net/projects/mysql-python/>

B) We should be ready (properly ready this time!) to build and install our MySQLdb wrapper.

```
$ sudo python setup.py build
```

```
$ sudo python setup.py install
```

C) Now open python command line and import the new MySQLdb module

```
$> python
```

```
>>> import MySQLdb
```

```
>>>
```

Step 6: now let's set up our Arduino with Sensor and write the following codes:

```
#include <dht.h> //DHT header file
```

```
//DHT11 pin connection
```

```
#define DHT11_PIN 5
```

```
dht DHT;
```

```
//UltraSonic Pin connection
```

```
#define trigPin 11
```

```
#define echoPin 12
```

```
//Motor pin connection
```

```
#define EnPin 6
```

```
#define in1Pin 7
```

```
#define in2Pin 3
```

```
//PHmeter pin connection
```

```
#define datapin A2
```

```
int npH=7.0;
```

```
int minpH=0.0;
```

```
int maxpH=14.0;
```

```
//Solenoid valve pin connection
```

```
int solenoidPin = 50;
```

```
void setup()
```

```
{
  Serial.begin(9600);

  //Ultrasonic pin set
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);

  //Rainsensor pin set
  pinMode(2,INPUT);

  //Motor pin set
  pinMode(EnPin, OUTPUT);
  pinMode(in1Pin, OUTPUT);
  pinMode(in2Pin, OUTPUT);

  //PHmeter pin set
  pinMode(datapin, OUTPUT);

  //Solenoid valve pin set
  pinMode(solenoidPin, OUTPUT);
}

void loop()
{

  long duration,distance,level ;
  int Tank_Depth_max = 18;
  int Tank_Depth_min = 4;

  //Rain drop sensor interfacing
  int RainIn = A0;
  int RainDigitalIn = 2;
  int RainVal;
  boolean bIsRaining = false;
  String strRaining;

  //Soil sensor interfacing
  int value= 0;
  int SENSE = A1; // Soil Sensor input at Analog PIN A1
  // you can adjust the threshold value
  int thresholdValue = 800;
  String strSoil;

  //Ultrasonic getting data
  digitalWrite(trigPin, LOW);
  delayMicroseconds(10);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH); //EchoPin received high start counting until the receiver to the low, return to the count
  value
  distance = (duration/2)/29; //calculating the distance cm,The speed of sound is 340 m/s or 29 microsecond per
  centimeter
  level = Tank_Depth_max - distance;

  //DHT getting data
  DHT.read11(DHT11_PIN);

  //Rainsensor getting data
  RainVal = analogRead(RainIn);
  bIsRaining = !(digitalRead(RainDigitalIn));

  //Soilsensor getting data
  value = analogRead(SENSE);

  //Motor getting data
```

```
analogWrite(EnPin, 255); // Run in full speed

//PHmeter getting data
int pHval=analogRead(datapin);
pHval=map(pHval,0,255,0,14);
String strPH;

if (level >= 18){
  //Serial.println("water tank overflow");
  digitalWrite(in1Pin, LOW);
  digitalWrite(in2Pin, LOW);
}
else if(level<=4){
  //Serial.println("water tank underflow");
  digitalWrite(in1Pin, HIGH);
  digitalWrite(in2Pin, LOW);
}
else if (level<=9){
  //Serial.println("water tank half filled");
  digitalWrite(in1Pin, HIGH);
  digitalWrite(in2Pin, LOW);
}

if(bIsRaining){
  strRaining = "YES";
}
else{
  strRaining = "NO";
}

if(value<thresholdValue)
{
  strSoil = "PDNW";
  digitalWrite(solenoidPin, LOW); //Switch Solenoid OFF
}
else
{
  strSoil = "PNW";
  digitalWrite(solenoidPin, HIGH); //Switch Solenoid ON
}

if((pHval>minpH)&&(pHval<npH))
{
  strPH = "ACIDIC";
}
else if((pHval>npH)&&(pHval<maxpH))
{
  strPH = "ALKALINE";
}
else if(pHval==npH)
{
  strPH = "NEUTRAL";
}

//Serial.print("Humidity: ");
Serial.print((float)DHT.humidity);
Serial.print("\t");
//Serial.print("Temperature: ");
Serial.print((float)DHT.temperature);
Serial.print("\t");
//Serial.print("water level: ");
Serial.print(level);
Serial.print(" cm");
Serial.print("\t");
//Serial.print("raining: ");
Serial.print(strRaining);
Serial.print("\t");
```

```
//Serial.print("soil_moisture: ");
Serial.print(strSoil);
Serial.print("\t");
//Serial.print("pH_value_type: ");
Serial.print(pHval );
Serial.print(" ");
Serial.println(strPH);
delay(2000);
}
```

Step 7: Let's go ahead and set up our MySQL

A) Login to MySQL (we will need an account)

```
user@server:~$ mysql -u mysql_user -p
```

Enter password:

B) Create the Database

```
mysql > create database db_name;
```

C) Verify that it's there

```
mysql > show databases;
```

D) Create the User

```
mysql > create user db_user;
```

E) Grant privileges while assigning the password

```
mysql > grant all on db_name.* to 'db_user'@'localhost' identified by 'db_password';
```

The above example grants all privileges, obviously. But we will likely want to limit privileges under many circumstances. These parameters include select, insert, and delete.

Choose all that apply and separate by comma:

```
mysql > grant select, insert, delete, update on db_name.* to 'db_user'@'localhost' identified by 'db_password';
```

F) create a simple MySQL table to store this data.

```
create table weathervalue ( weathervalueID int(11) AUTO_INCREMENT NOT NULL, datetime
TIMESTAMP DEFAULT CURRENT_TIMESTAMP, humidity decimal(4,2) NOT NULL, tempC decimal(4,2) NOT
NULL, waterlevel decimal(4,2) NOT NULL, Raining VARCHAR(10),
soilmoisture VARCHAR(10), PHvalueType VARCHAR(10), constraint weathervalue_PK primary
key(weathervalueID) );
```

G) For lookup data into MYSQL type below command into MYSQL

```
mysql > select * from weathervalue(Table name)
```

Step 8: Write Python script for interfacing with MYSQL in my case Script given below

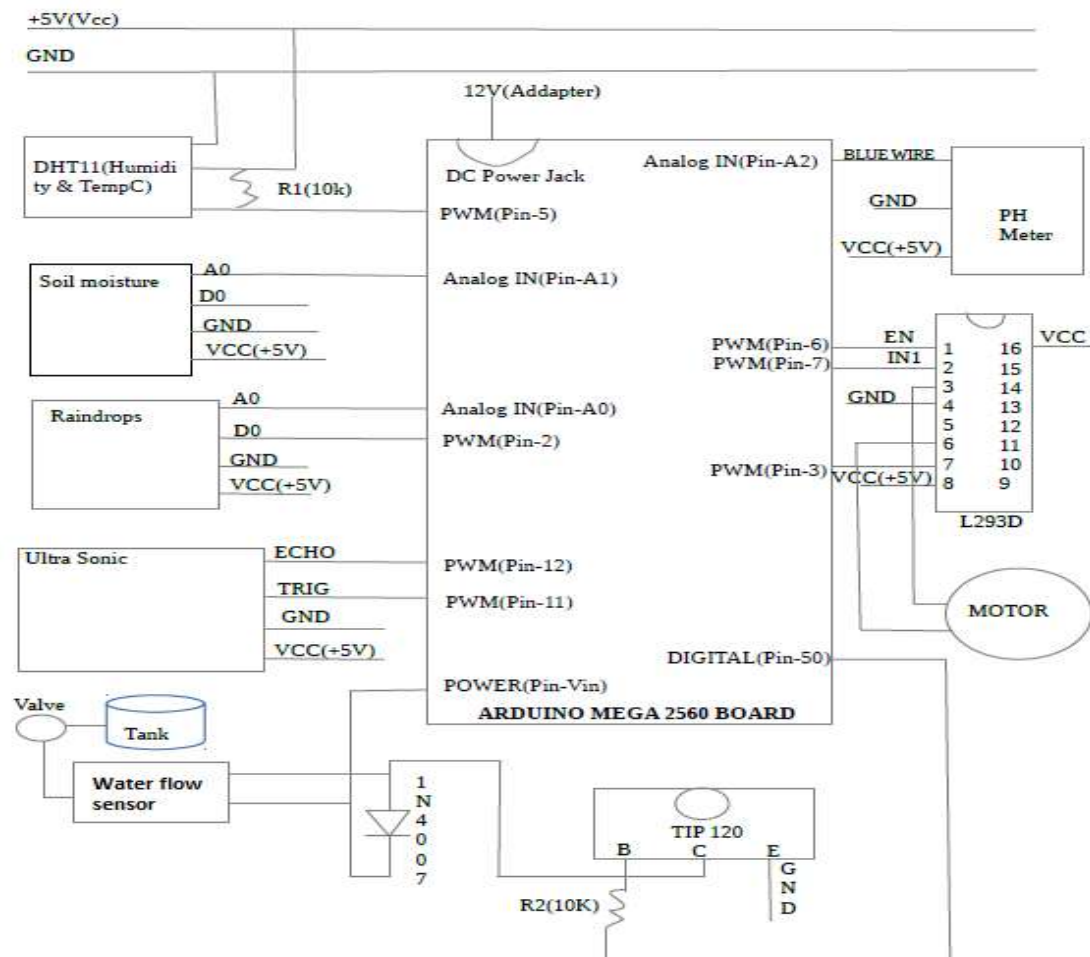
```
import serial
import MySQLdb
import time
import datetime
#establish connection to MySQL.
#dbConn = MySQLdb.connect("localhost","database_username","password","database_name") or
die ("could not connect to database")
#dbConn = MySQLdb.connect("117.203.179.176","root","root","semc") or die ("could not connect to
database")
dbConn = MySQLdb.connect("localhost","peach","ece123","weathersystem") or die ("could not
connect to database")
#open a cursor to the database
cursor = dbConn.cursor()
device = '/dev/ttyACM0' #this will have to be changed to the serial port you are using
print "Trying...",device
arduino = serial.Serial(device,9600,timeout=5)
count = 0
while True:
timestamp = datetime.datetime.now()
today = timestamp.strftime("%d/%m/%Y %H:%M:%S")
#print today
data = arduino.readline() #read the data from the arduino
#print data
pieces = data.split("\t") #split the data by the tab
for i in range(len(pieces)):
print pieces[i]
#Here we are going to insert the data into the Database
cursor.execute("INSERT INTO weathervalue
(datetime,humidity,tempC,Waterlevel,Raining,soilmoisture,PHvalueType) VALUES (%s,%s,%s,
%s,%s,%s,%s)",(timestamp,pieces[0],pieces[1],pieces[2],pieces[3],pieces[4],pieces[5]))
```

```

print"SQL Injected!"
count = count + 1
print 'SQL Update Count:', count #This is just to see how many updates have processed before an exception
# Commit changes in the database
dbConn.commit() #commit the insert
#cursor.close() #close the cursor
time.sleep(5)

```

Connection Diagram: The connection diagram of the proposed system is shown below:



Pest control: For pest control, traditional pest control method and electronic pest repellent are preferred.

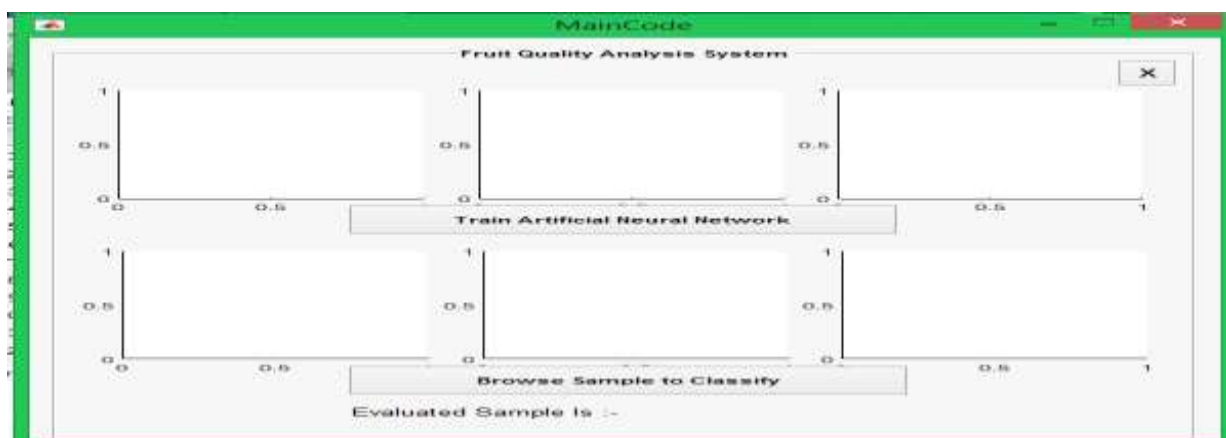
Fruit quality detection:

processing techniques. The system starts the process by capturing the fruit's image. Then the image is transmitted to the matlab for feature extraction, classification and grading both classification and grading realized by fuzzy logic approach. Effendi, Ramli and Ghani [3] presented that the quality of fruit depends upon type of defects, skin colour and size of fruit. In their research, they develop an image recognition system to identify the level of maturity of *Jatropha curcas* fruit and classify it into various categories. The system is divided into two stages: The first stage is a training stage that is to extract the characteristics from the pattern. The second stage is to recognize the pattern by using the characteristics derived from the first task. Back propagation diagnosis model is used to recognize the *Jatropha curcas* fruits. A back propagation diagnosis model (BPDM) is adopted to recognize the image of the matured fruits. Colour indices associated with image pixels are used as input. Patel, Jain and Joshi [6] presented the fruit detection using improved multiple features based algorithm. To detect

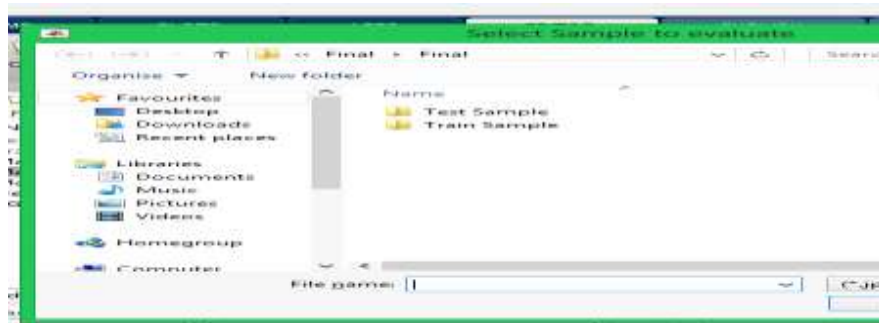
the fruit, an image processing algorithm is trained for efficient feature extraction. The algorithm is designed with the aim of calculating different weights for features like intensity, colour, orientation and edge of the input test image. Arivazhagan, Shebiah, Nidhyandhan and Ganesan [7] presented an efficient fusion of color and texture features for fruit recognition. The recognition is done by the minimum distance classifier based upon the statistical and co-occurrence features derived from the wavelet transformed sub-bands. Bindu Tiger and Toran verma [8] presented apple recognition techniques of normal and infected. Proposed method classifies and recognizes apple images based on obtained features values by using two-layer feed-forward network, with sigmoid hidden and output neurons. The toolbox supports feed forward networks, radial basis networks, dynamic networks, self-organizing maps, and other proven network paradigms. This work represents the MATLAB 7.8.0 software and the recognition of generated signals by artificial neural network technique. Sandoval, Prieto and Betancur [9] have proposed a machine vision based classification system to sort coffee fruits (cherries) according their ripeness stage is presented. Eight categories were defined and they include the entire coffee cherry ripeness process, from the initial stage (early green) to over ripe and dry stages. A Bayesian classifier was implemented using a set of nine features which include colour, shape and texture computed on an image of the fruit.

In this paper, fruit quality is detected by employing colour values of the fruit images by using MATLAB software. The images of stone fruits are taken as sample for quality analysis. Diseased fruit is detected by taking images of a fruit and then applying certain techniques of image processing for analyzing the quality. The colour of the fruit is analyzed for classifying the fruit as per its quality. The diseased fruit from the bunch of fruits is found by analyzing the images of the fruit. The classification of the fruit as 'bad quality' or 'good quality' is done on the basis of the values obtained after applying LBP approach and the LAB colour space approach and ANN. At first the RGB image is converted to LAB colour space. Conversion into LAB colour space enhances or highlights the colours in a digital image. After the conversion of the image into LAB colour space, LBP technique is implemented for making the pattern of that image. LBP technique generates histogram of the colour patterns in the image and this histogram contains information about all the features and the distribution of edges in the image. Then neural network is used for training the data. The fruit sample is selected for testing from dataset. The testing of fruit sample is performed by using ANN training module. ANN based results are obtained that shows "good quality" or "bad quality" of fruit. Also the accuracy of the system is calculated. This method helps in reducing manual labour as now the quality of the fruit will be found from the images. It is also believed to be more accurate and reliable as it diminishes all the chances of human error.

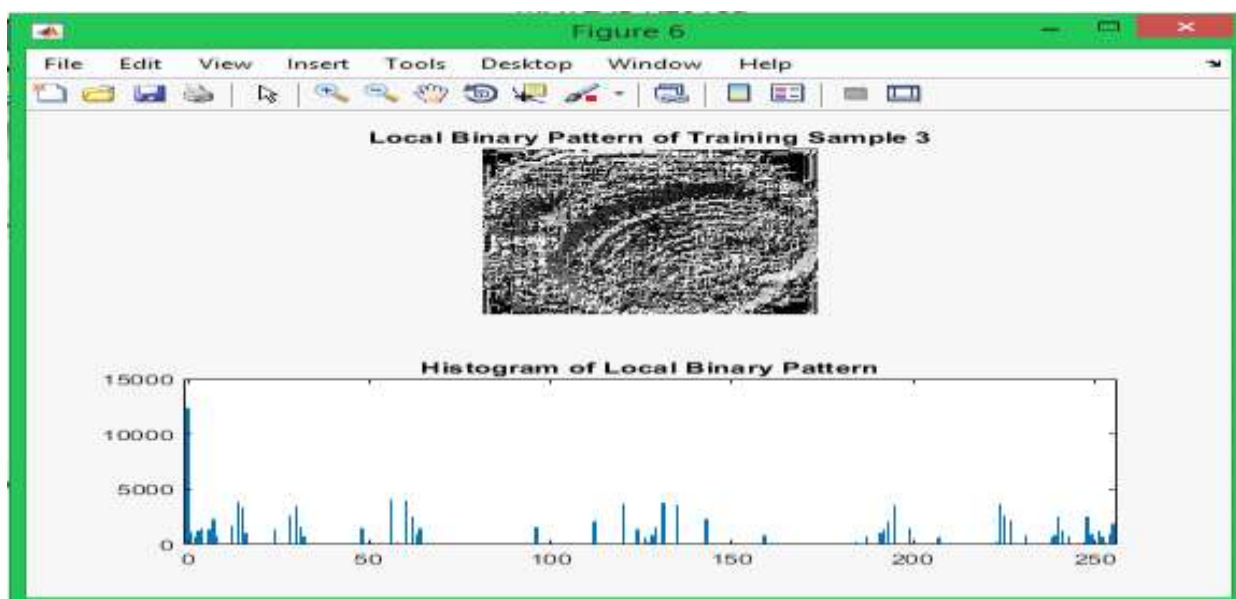
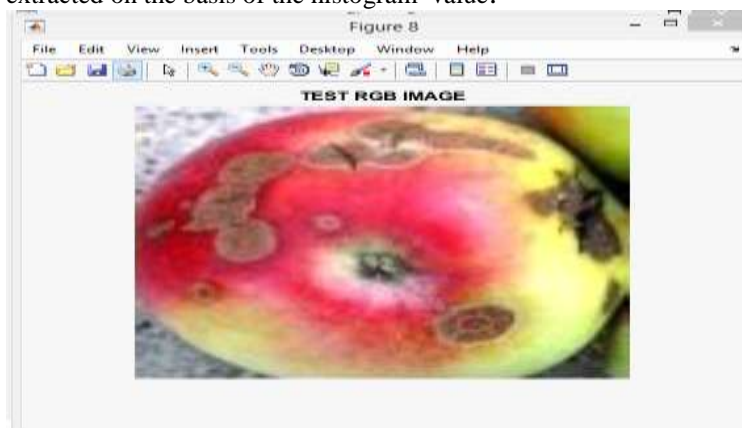
The Graphical user interface(GUI) for proposed work is shown below.

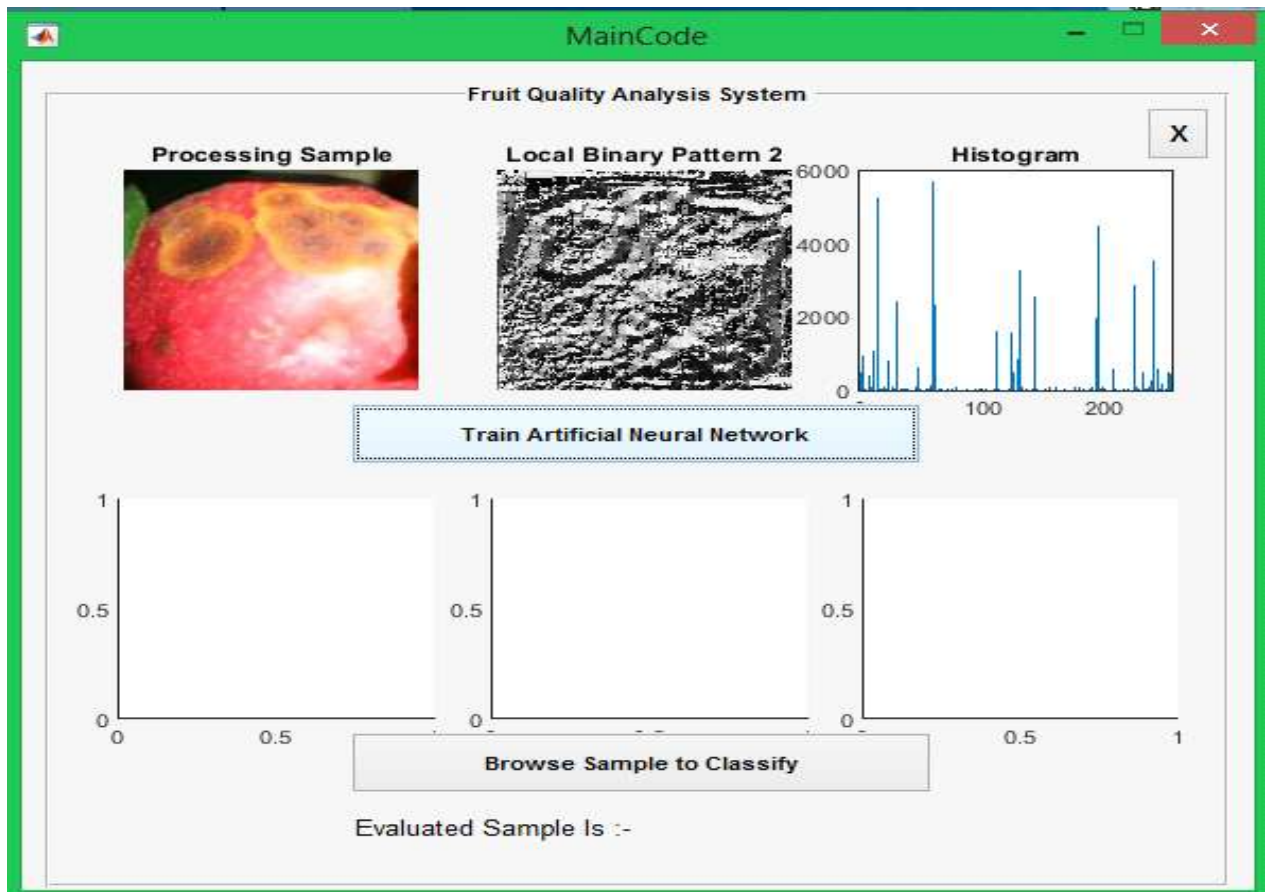


Select the fruit sample from 'Test Sample' folder. Data set of the testing samples of fruit image is browsed.

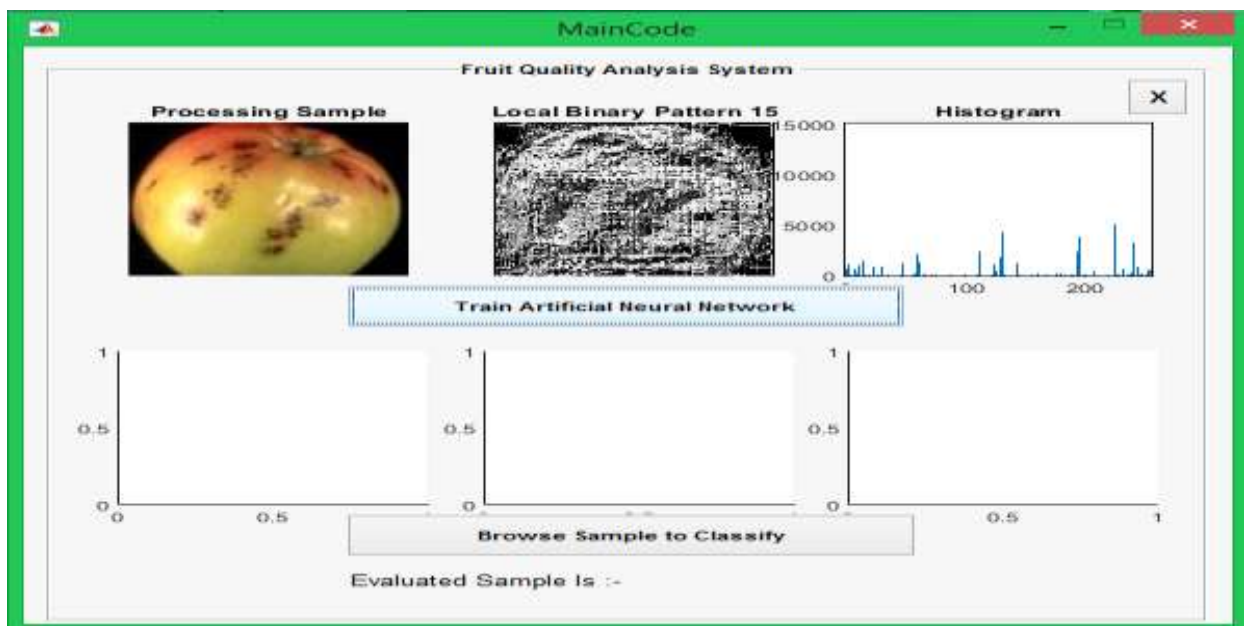


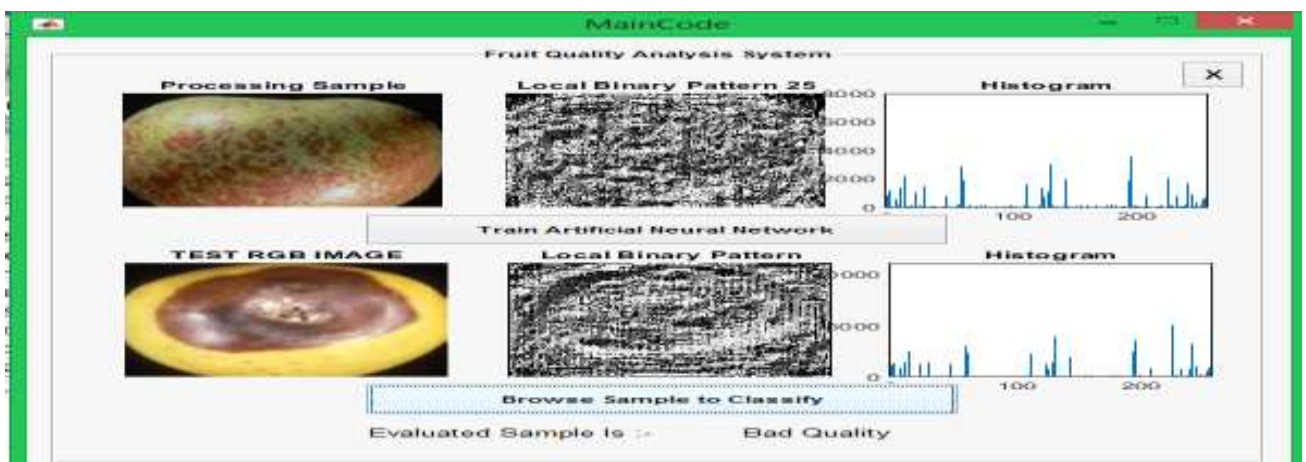
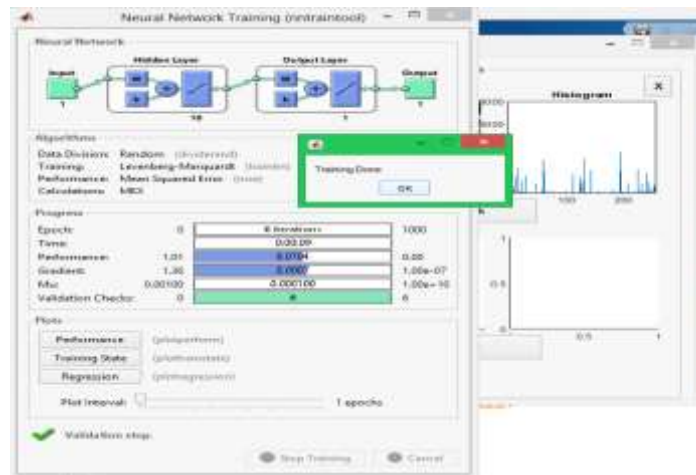
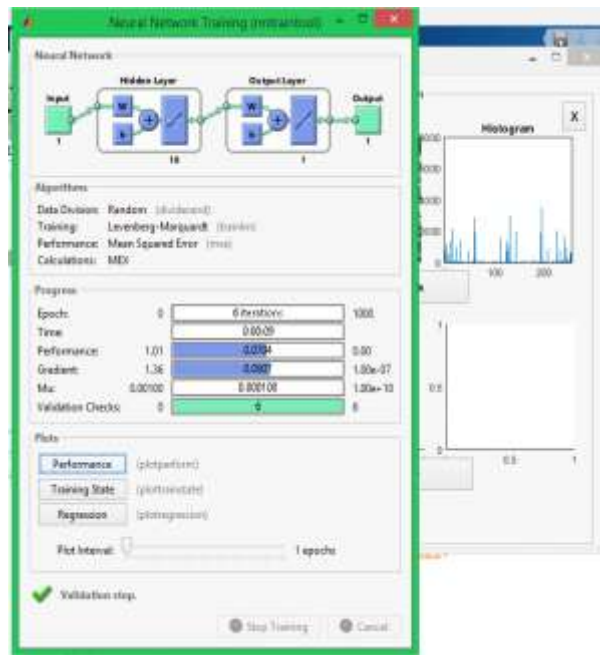
Now convert RGB image into LAB space and then apply LBP technique for making the patterns. The features of the sample fruit is extracted on the basis of the histogram value.



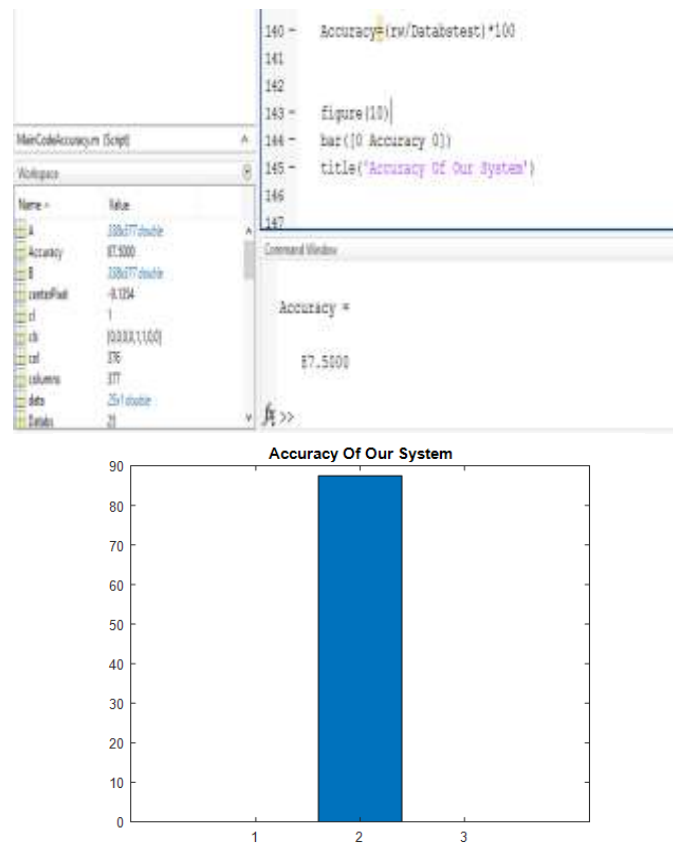


The next step is to train the neural network. In the graphical user interface, the user selects the testing sample and then click on ANN training module. It shows neural network training tool. After that click on 'performance' this will evaluate the fruit samples as 'good quality' or 'bad quality' sample (shown below).





The accuracy of the proposed system is calculated. It is shown below:



CONCLUSION:

Meghalaya is basically an agricultural state with about 80% of its total population depending entirely on agriculture for their livelihood.

Stone fruits like plum, peach, apricot are found in the central plateau of East and West Khasi Hills and Jaintia Hills. *Pear containing stone cells is widely grown in the Khasi Hills districts of the state.* These fruits have good commercial value. Now by implementing technology, stone fruits can also be grown in other parts of the state. Cultivation of fruits will surely play a vital role in the prosperity of Meghalaya as generally stated that the standard of living of the people can be judged by per capita production and consumption of fruits. Though the initial cost of establishment of an orchard is high, it is compensated by higher productivity or due to high value of produce. In the long term, the technological innovations as envisioned are revolutionary and they will dramatically alter the way tree fruit is produced, handled, and utilized.

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