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Ripening and quality detection of mango using Arduino

Akshay Ramesh Amrutkar
akshayamrutkar.97@gmail.com
Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded, Maharashtra

Hemant Balu Jaisingpure
jaisingpurehemant@gmail.com
Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded, Maharashtra

Pavan Ashokrao Bhujade
pavanbhujade123@gmail.com
Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded, Maharashtra

ABSTRACT

Ripening is the methodology of maturing fruit to become more palatable. The ripening procedure of mango contains different stages in which a mango develops. There is a specific example in which the way toward maturing of mango is satisfied. In this paper, we are developing a technique for identifying the different ripening stages of Climacteric fruit like mango by utilizing an Arduino framework which will predict the quality of mango and show the total ripening procedure as per the color changing stages with the help of MATLAB. The HSV color space is used to read the color changes of mango and the information about the ripening is send to the user via GSM module using Arduino.

***Keywords*:** *Ripening, Climacteric fruit, Mango, Arduino, Quality, MATLAB, HSV color space, GSM module*

1. INTRODUCTION

Mango is the most important fruit of India and is called as "King of fruits". There is a huge amount of mango produces in every year all over the world.as per the 2010 survey India had to acquire the first rank amid mango developing nations of the world. In India, the mango fruit is harvested in the largest area i.e. 2,312 thousand hector and the all over manufacturing is about 15.03 million tons, devoting 40.48% of the total world manufacturing of mango. It covers a domain of 4946 thousand hectors with a making of 37.12 million tons on the planet in the midst of the season of 2010. [5].

There are two types of fruit such as Climacteric fruit and Non-Climacteric fruit. In climacteric fruits, there are huge changes founds during ripening. Such as color change, flavor, quality, sweetness etc. while in Non-Climacteric fruit there is no any major changes found [1]. This paper presents a technique for identifying the different ripening stages of Climacteric fruit like mango and comment on quality utilizing an Arduino. The ripening procedure of mango takes after a specific example which includes different stages as shown in fig.1 [2] [3].

In this paper, we have utilized an Arduino because of its different preferences. It is considerably less expensive when contrasted with other detecting gadgets. Additionally, it can be utilized on different stages.

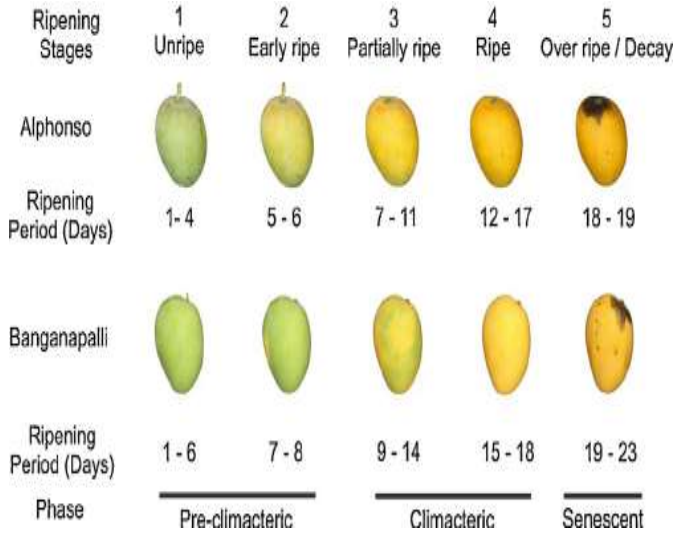

Fig. 1: Ripening stages of Mango

An Arduino microcontroller is a programmable electronic device which can control a specific task and sense physical world. It takes a decision among the different ripening phases of mango. This is completed by checking the color changes amid different development stages. This color change is regulated calculation in view of MATLAB R2016a variant. The HSV color space is used to recognize the color feature of the picture and this information is sent to Arduino which detects this data and show the message likewise [7] [9].

2. RELATED WORK

Vishal and Mohit [2] exhibited the Arduino Based Tomato Ripening Stages Monitoring System. The framework begins the procedure by catching the tomato pictures. Is transmitted to the MATLAB for highlight extraction and L*a*b shading space estimation of gained pictures are being gotten and this esteem is contrasted and the putaway database. By looking at also Brijesh, Piyush and Yashika [3] exhibited "Arduino Based Supervision of Banana Ripening Stages".

Mandeep and Reecha [4] presented the "Quality Detection of Fruits by Using ANN Technique". The system utilizes image-processing to classify and grade quality of fruits. They use Artificial Neural Network strategy for grades and classify fruit picture on the basis of obtained feature values by utilizing the cascaded forward network.

Suma, Punith, Shilpa, Triveni, and Amitha [5] presented the "Mango Quality Analyzer". It uses the color sensor for acquiring RGB values. This data is sent serially to the microcontroller which will predict the color of an object by doing some calculation and it takes a decision accordingly.

Suresh Kumar [6] presented the "Smart Farming a Prototype for Field Monitoring and Automation in Agriculture". In this system, they use GSM and DTMF technology to control various farming activities through mobile.

Mohammed, Ahmed and Mohammed El Hassouni [7] presented the "A graph-based approach for color texture classification in HSV color space". This paper proposes a color surface examination strategy in light of the chart hypothesis, in which they change over the surface being referred to into an undirected weighted diagram and inspect the most limited ways between four sets of pixels as indicated by various scales and introductions of the picture.

3. METHODOLOGY

3.1 Ripening cases of mango

I. Un-Ripe stage
In the un-ripe stage, the color of Mango is naturally green.

II. Early Ripe stage
In the early ripe stage, Mango realizing the first change in color due to ripening. The natural green color changes from natural green to light green.

III. Partially Ripe stage
In the partially ripe stage of maturity, approximately 70% of mango is ripe and the color is much yellow than the early ripe stage.

IV. Ripe stage
In this stage, the color of mango is full yellow and at the tip some of the portions are orange. This type of Mango is eatable and best quality of fruit.

V. Over Ripe stage
In this stage, The Brownish spots find on Mango. This stage is used for identifying the quality of mango.

3.2 Method for quality detection

The quality of fruit is an important criterion associated with the market value of the fruit. Hence grading of it is important for the farmers before they sell their product. The color of mango indicates the quality of it. The quality of mango is decided depending on the number of brownish spots and its darkness of brownish spot finding on mango [4] [5].

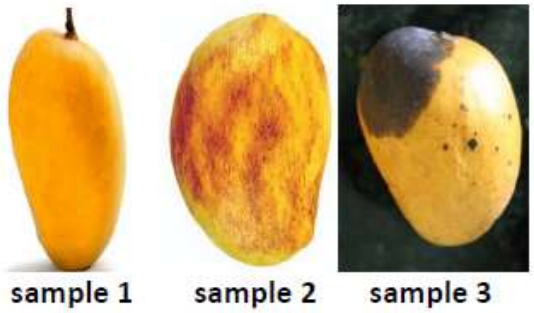

Fig. 2 Mango samples

Table 1: Grading based on samples.

S. No.	Number of fruit samples	Category of quality of fruit samples
1	sample 1	Best quality fruit
2	sample 2	Medium quality fruit
3	sample 3	Poor quality fruit

4. SYSTEM BLOCK DIAGRAM

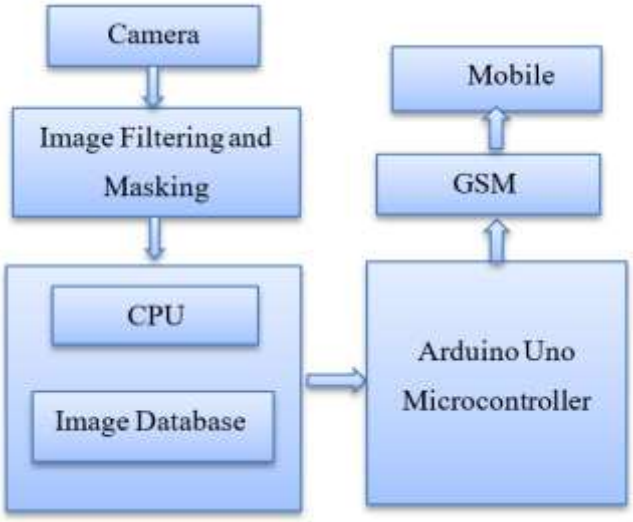

Fig. 3: Block diagram of Mango ripening monitoring system

The block diagram of the system is shown in fig. 3 this system consists of the USB camera which is used for the image Capturing of Mango fruit from agriculture field. It is processed with the help MATLAB R 2016a the reading of the image is done in the same. After this analysis, the HSV color space values of acquired images are being obtained and these values are compared with the stored database. By comparing images, we get information about ripening stage of mango as well as the quality of it corresponding to the quality grades are assigned to mango. This data will send to Arduino microcontroller serially and then it is transferred to the user via GSM module [7] [8].

5. HARDWARE AND SOFTWARE IMPLEMENTATION

Fig 4 and Fig 5 shows the experimental setup and flowchart of the system respectively. It consists of different blocks and their functionality in that there are four main sections such as camera, Matlab, Arduino and GSM or communication device.

The process starts with the image captured by the camera is sent to MATLAB and it processed further. The MATLAB uses HSV color space algorithm it gives pixel information in the form of numerical HSV values. This numerical value compared with the ideal sample values pre-stored in the database with the help of MATLAB. Then we come to know the color of an image depending on the different maturity stages of mango the MATLAB send the unique code of that color to the Arduino. If the ripening of mango is done then it goes towards quality detection in that it simply check the brownish color threshold and take a decision.

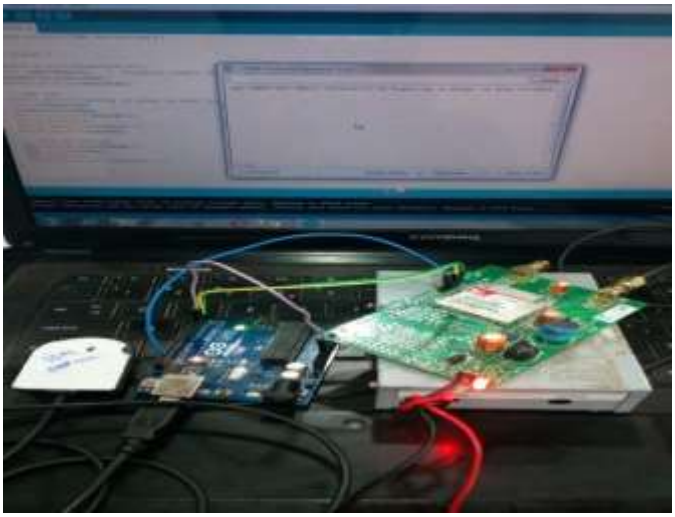

Fig.4: Experimental setup

Let's us begin the work of Arduino, the message unique code receives from MATLAB compares with Arduino coding and generate the message accordingly as per Table 2. This generated message is sent to the user via GSM [6].

Suppose the Arduino receives 'r' from Matlab then this character is assigned to any variable (char a) and Arduino finding the meaning of that character. As per Table 2, the 'r' means "Ripening of mango is done". This message generated by Arduino sends to the user via GSM.

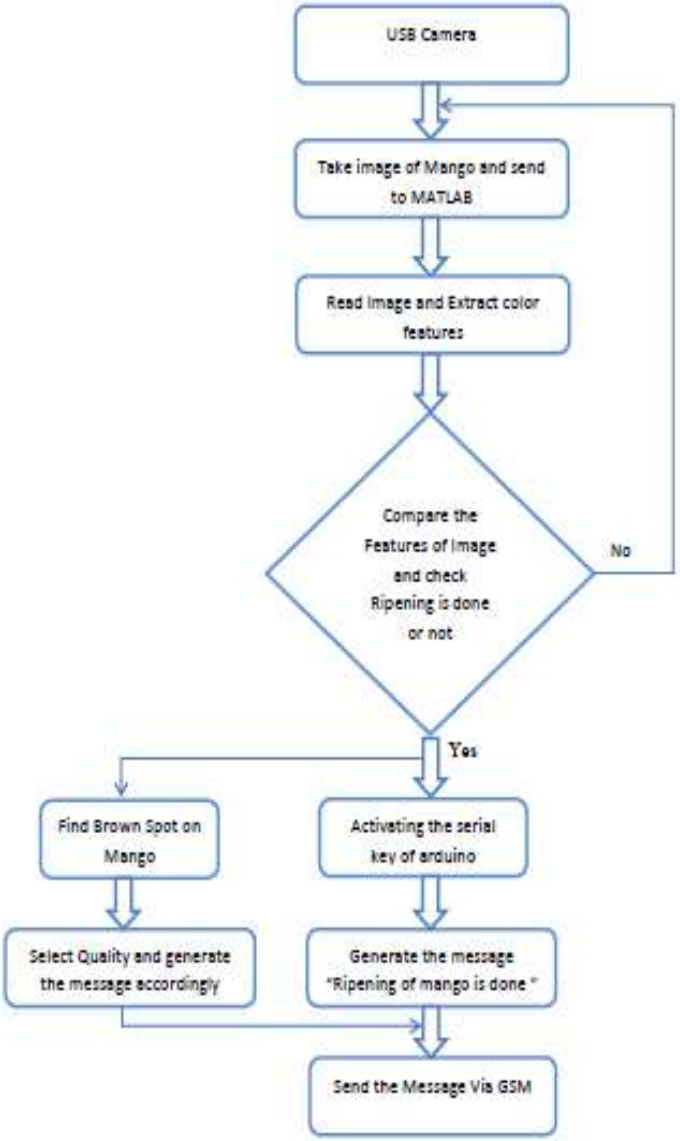

Fig. 5: Flowchart of the system

6. RIPENING AND QUALITY DETECTION EXPERIMENTAL RESULT AND DISCUSSION

In this paper, we have utilized masking technique for the recognition of 5 distinctive color phases of Mango. Masking is the strategy which used for extricating specific pattern of picture, for example, edge, sharpness, color etc. For masking we utilized HSV color space. It gives us matrix which involves HSV numerical values. Using this system, we have tested approximately 200 samples and out of which 193 samples are accurately identified.

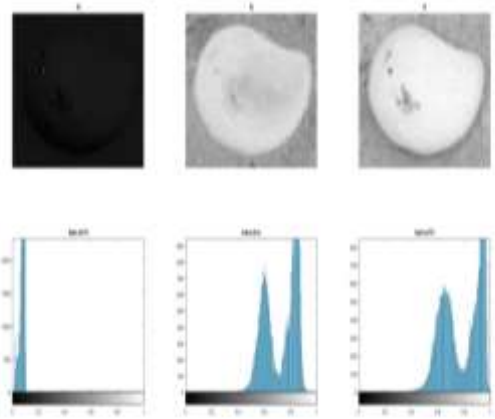

Fig.6: HSV color histogram of captured image.

Table 2: Messages as per ripening stages.

Ripening stage / quality	Unique code from Matlab	Arduino generated message as per unique code
Un-ripe	ur	Ripening of mango is in stage 1
Early ripe	er	Ripening of mango is in stage 2
Partially ripe	pr	Ripening of mango is in stage 3
Ripe	r	Ripening of mango is done
Poor quality	pq	Poor Quality Fruit
Medium quality	mq	Medium Quality Fruit
Best quality	bq	Best Quality Fruit

The quality of mango is decided depending on the number of brownish spots and its darkness of brownish spot finding on mango. Table 2 shows the messages generated by Arduino according to the unique code receives from MATLAB. The experimental results of the project are shown below. This Experimental work utilizes thresholding technique and makes a different cover for each shading (as indicated by the development of mango natural product) to perceive in the picture. Also, the embedded platform is used to send the result remotely using GSM module. This approach is beneficial to monitor not only the mango fruit but also any other fruit/crop farmer wishes to monitor.

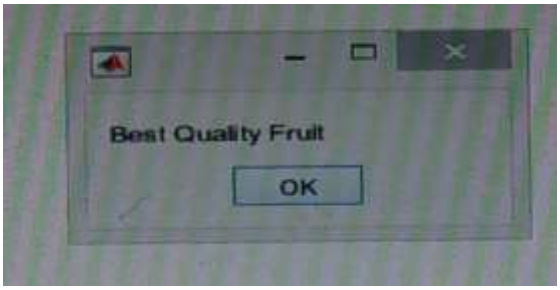

Fig. 7: Quality identified by MATLAB

Fig. 8: Message sent by Arduino through GSM to the user

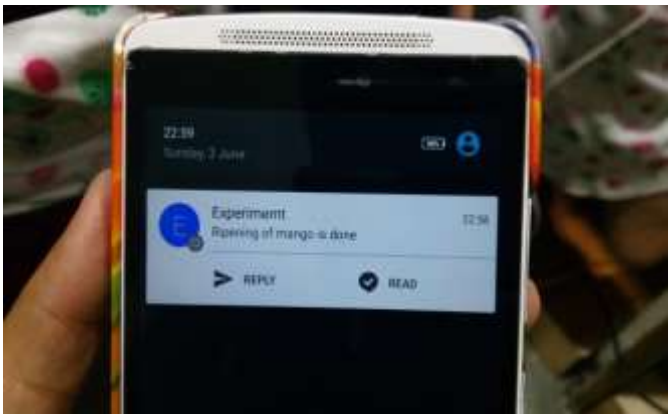

Fig. 9: Message obtained at the receiver end

7. CONCLUSION AND FUTURE SCOPE

This paper presents a new technique for ripening and quality detection of mango. It starts by capturing the fruit's image using regular digital camera or any mobile phone camera. The features like color, size etc. are efficiently extracted from the sampled image. In this the HSV color space technique is used for checking the ripening stage of mango and quality. This kind of system can be employed in juice plants, fruit and vegetable farms, packaging as well as is used to avoid the spoilage of fruit due to over or under ripening. In future using the similar concept, the ripening stages and quality of other fruits and vegetables can also be detected. For Further improvement advance communication technique can be used.

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BIOGRAPHY

Akshay Ramesh Ramesh
Student

Hemant Balu Jaisingpure
Student

Pavan Ashokrao Bhujade
Student

