www.revistageintec.net
ISSN: 2237-0722
revista GEINTEC
Gestão, Inovação e Tecnologias

Machine Vision and Machine Learning based Fruit Quality Monitoring

C.S. Anita[1]; P. Nagarajan[2]; E. Lakshminarayanan[3]; M. Naveen Sankar[4]; V.R. Rishikanth[5]
[1]Professor, Department of CSE, R.M.D. Engineering College, Kavaraipettai, India.
[1]csa.cse@rmd.ac.in
[2]Professor, Department of ECE, Rajalakshmi Institute of Technology, Chennai, India.
[2]nagarajan.p@ritchennai.edu.in
[3]Programmer Analyst, Cognizant Technology Solutions.
[4]Programmer Analyst, Cognizant Technology Solutions.
[5]Programmer Analyst, Cognizant Technology Solutions.

Abstract
The efficiency of the logistics of agricultural food needs to assure that its products are safe and of quality. This would earn the trust of consumers. To provide smart farming and packing solutions, the proposed work is an intelligent system using machine learning and image processing on Apple quality detection. The Apple image dataset was used with two stages of fruit, one is healthy and another one is damaged. The machine learning model is trained with this dataset to identify the fruit quality. The proposed technique uses feature extraction using image processing technique and SVM algorithm is applied to train and detect the quality of fruit.

Key-words: SVM, Machine Learning, Classification, Image Processing.

1. Introduction

The appearance of a fruit is an important feature of fruit quality. The market value, consumer choice and the internal quality are certain factors which are influenced by the appearance of the fruit. Texture, scale, colour, and shape are all factors in determining the fruit's quality. Measuring the above parameters manually consumes time and incurs much labor. Using automatic computer vision tools for quality check of fruits have proven to be very powerful in the last few years.

These days, growing apples and its utilization all throughout the planet is getting progressively more extensive. Numerous rural investigations have been carried out to improve the quality of apples. The tomato nursery Shinchi Agri-Green executes IoT innovations for the screening of the stages of development on tomatoes. This framework also helps in the control of the supply of water and supplements. In addition with the experience of ranchers this framework helps the ranchers in plant observation with less human intervention.

2. Related Work

Thengane and Gawande in their work propose the algorithm for using a simple Arduino-based device to track various stages of tomato ripening. The data will be predicted and shown based on the tomato's colour changes. The mean of tomato colour space values is serially sent to the Arduino microcontroller using the acquired image, and the colour of tomato and the accompanying notification is sent to the farmer using the GSM module. 1st In their paper, Wspanialy and Moussa introduce a powdery mildew recognition machine vision device for greenhouse use [2]. A Hough forest is used to identify potential powdery mildew, and augmented lighting is used to eliminate clutter and reduce the search room. The identification rate on greenhouse tomato plants was 85 percent in field research.

In their paper, Shamshiri, Jones, Thorp, and Ahmad detail the optimal, marginal, and failure air and root-zone temperature, relative humidity, and vapour pressure deficit for effective tomato greenhouse cultivation [3].

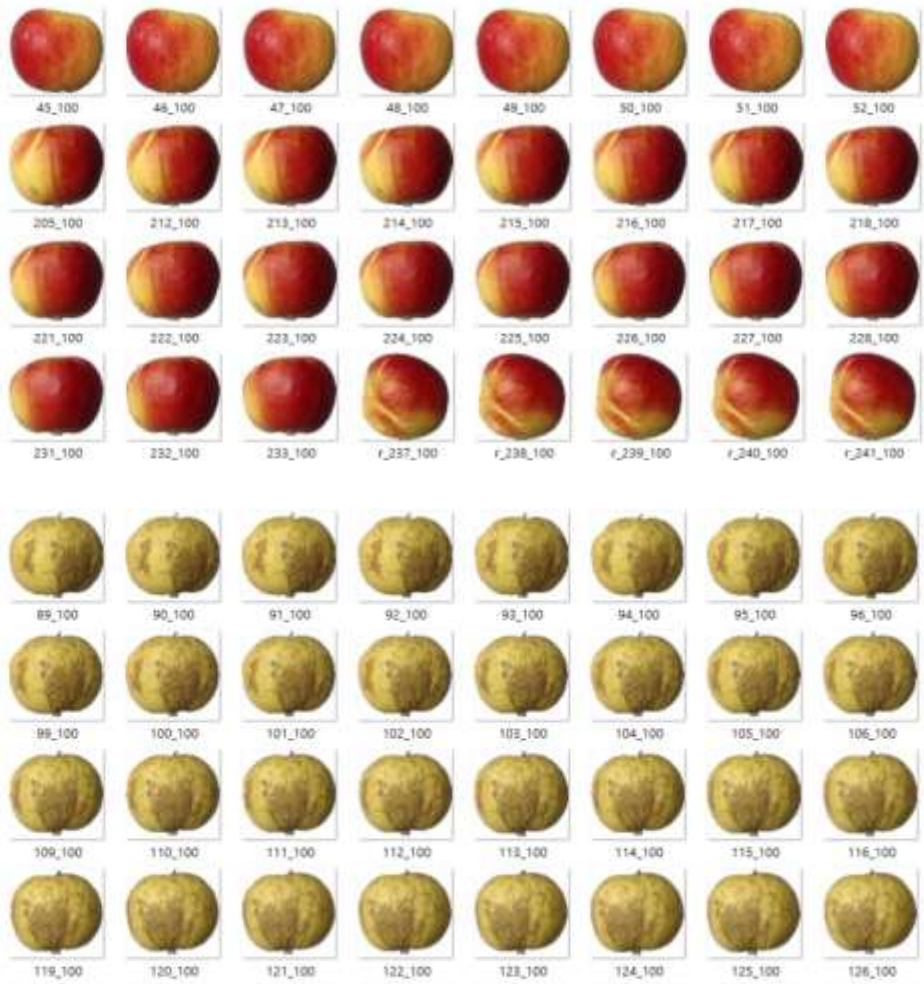
This system is developed using a variety of technologies, including machine learning algorithms, which are trained using a variety of datasets, and an advanced algorithm called the SVM (Support Vector Machine) algorithm, which influences the location and orientation of the hyperplane. We use these help vectors to improve the classifier's margin. If the support vectors are removed, the hyperplane's position would change. These are the considerations that will help us construct our SVM.

Greenhouse environment is different from growing fruits in the outside environment due to factors such as temperature variations. These factors definitely have an impact on the development stages and harvesting time of the fruit. Hence the factors that affect the growth of the fruit has to be monitored in order to produce quality fruit as well as to avoid conditions that will lead to abnormal growth. This paper proposes an IoT system that is used for monitoring the growth of the fruits using cameras. The images of the apple fruit are captured for further analysis. The study will detect and extract only the fruit region.

3. Technical Work

We trained and tested on the dataset which we had collected from the Kaggle website consisting of more than thousands of sample images of the fruit with which the algorithm is trained. Figure 1 shows the sample images from the dataset where all the images are of a particular kind.

Fig. 1 - Sample Images from the Dataset



Data Collection

Selection of quality data for analysis is the most important step in the data collection process. Here we used fruit images downloaded from Kaggle. We have taken images of apples with two classes damaged and healthy.

ISSN: 2237-0722
Vol. 11 No. 2 (2021)
Received: 22.03.2021 – Accepted: 25.04.2021

Data Visualization

In our approach, the fruit detection is shown as a visualization part [4]. Understanding the dataset with the help of charts and images is more appealing.

Data Preprocessing

The raw data is now converted into a form that fits an algorithm in order to get the cleaned data.

Image Pre-processing

In image pre-processing data is cleaned [5].The cleaned data is now taken to serve as input for the preprocessing stage.

Images from the dataset folder are taken for pre-processing, The cv2.cvtColor(image, cv2.COLOR_BGR2HSV) model is used to quantify the image color. The image's segment and histogram color features are extracted [8]. The extracted details are mapped for every image ID and feature values are written in dataset.csv. The sample of stored values for dataset images is shown in Figure 2.

Fig. 2 - Stored Values for Dataset Images

Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0
Training/damage/1.jpg	damage	1	0	0	0.991246	0	0	0	0	0	0	0	0	0	0

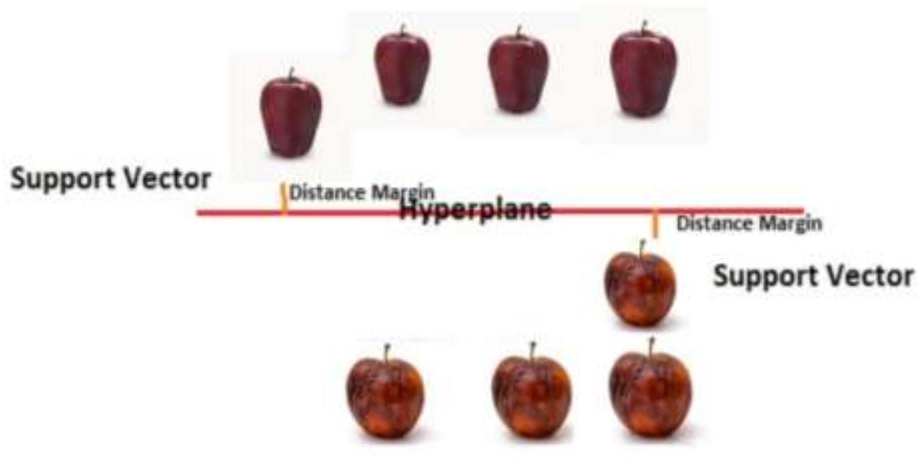
ISSN: 2237-0722
Vol. 11 No. 2 (2021)
Received: 22.03.2021 – Accepted: 25.04.2021

Support Vector Machine (SVM) Algorithm

SVM (Support Vector Machine) is a supervised machine learning algorithm for solving classification and regression problems [7]. Nonetheless, it is mostly used to overcome classification problems. The feature vector is the value of a particular coordinate in the SVM algorithm, and each data object is plotted as a point in n-dimensional space (where n is the number of features you have). Then, as shown in Figure 3, we perform classification by finding the hyper-plane that clearly separates the two classes.

SVM is a supervised machine learning algorithm that can be applied to classification and regression problems. It converts the original using a method called as the kernel trick, and then uses these transformations to find an ideal boundary between the possible outputs.

Fig. 3 - Hyperplane Differentiating the Two Classes



4. Fruit Quality Classification

Input image is taken and its features are extracted. The image features are applied pre-processing stages mentioned in the above module and the image is converted to features. The features are compared with dataset features from dataset.csv file by applying SVM algorithm. Figure 4 depicts the SVM algorithm's evaluation metrics, while Figure 5 depicts the fruit quality detection from an image [6].

Fig. 4 - Evaluation Metrics of SVM Algorithm

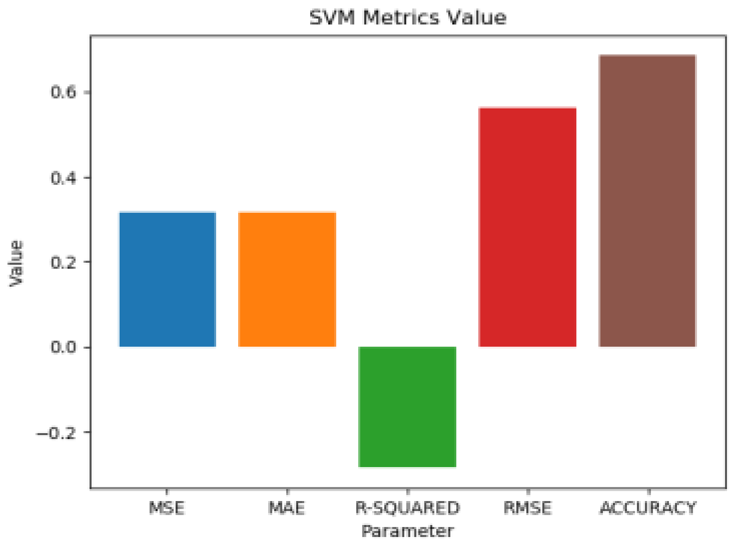
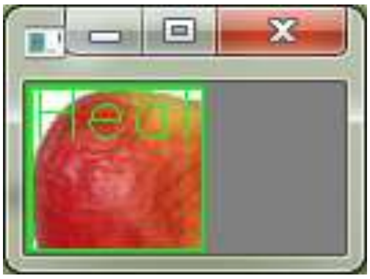


Fig. 5 - Fruit Quality Detection from Image



5. Conclusion

Fruits' external characteristics, such as colour, scale, shape, texture, and various defects, are critical for classification and grading. Currently, automated computer vision systems have replaced manual fruit classification and grading due to advancements in machine vision and the availability of low-cost hardware and software. Another advantage of non-destructive automation over manual labour is its ability to produce reliable, fast, objective, and effective results.

We believe that this machine vision device should be integrated into a storage process, and that the detection work should be done correctly before the agri-food is allocated and packed, in case blemished items contaminate others. We achieve a more robust algorithm through the machine vision system developed in this work, through which fruits skin defects can be detected in a more reliable and time-saving manner, as well as in a more effective and shorter logistics period, to ensure the protection and quality of goods to customers.

References

Thengane, V.G., & Gawande, M.B. (2018). Arduino based tomato ripening stages monitoring system. *International Journal of Innovative Research in Science, Engineering and Technology*, *7*(1), 530-536.

Wspanialy, P., & Moussa, M. (2016). Early powdery mildew detection system for application in greenhouse automation. *Computers and Electronics in Agriculture*, *127*, 487-494.

Shamshiri, R.R., Jones, J.W., Thorp, K.R., Ahmad, D., Che Man, H., & Taheri, S. (2018). Review of optimum temperature, humidity, and vapour pressure deficit for microclimate evaluation and control in greenhouse cultivation of tomato: a review. *International agrophysics*, *32*(2).

Cavallo, D.P., Cefola, M., Pace, B., Logrieco, A.F., & Attolico, G. (2018). Non-destructive automatic quality evaluation of fresh-cut iceberg lettuce through packaging material. *Journal of Food Engineering*, *223*, 46-52.

Sharma, D., & Sawant, S.D. (2017). Grain quality detection by using image processing for public distribution. *In International Conference on Intelligent Computing and Control Systems (ICICCS)*, 1118-1122.

Tiger, B., & Verma, T. (2013). Identification and classification of normal and infected apples using neural network. *International Journal of Science and Research*, *2*(3), 160-163.

Naganur, H.G., Sannakki, S.S., Rajpurohit, V.S., & Arunkumar, R. (2012). Fruits sorting and grading using fuzzy logic. *International Journal of Advanced Research in Computer Engineering & Technology*, *1*(6), 117-122.

Patel, H.N., Jain, R.K., & Joshi, M.V. (2011). Fruit detection using improved multiple features based algorithm. *International journal of computer applications*, *13*(2), 1-5.