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# Date Palm Crop Yield Estimation – A Framework

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**ABSTRACT - Saudi Arabia is the home land of the date palm tree and the dates are considered to be one of the most important national products. As the dates are part of their heritage, therefore, Saudi Arabia is the largest consumer of dates. Saudi Arabia has more than fifty date-processing facilities, which process large amounts of these products. Right now, Saudi Arabia ranks second in the production of dates. There are more than twenty-five million date palm trees that cover more than 150,000 hectares of land in Saudi Arabia. Date production is estimated to be more than 1.1 million tons each year which accounts for around seventy two percent of the total agricultural output of Saudi Arabia. It is very vital to predict the yield so that stakeholders will be prepared to market their product in a better way. Crop yield estimation can be done either through conventional method or through image processing methods. The former are often costly, complex, time consuming methods, that cannot be applied on a large scale. So, it is essential to employ those methods for crop yield estimation that are time saving as well as cost effective and image processing method fulfils these conditions. Since image processing extracts different features from an image that can be used not only in recognizing different types of crops but also estimating their yield. Recently, crop yield estimation have been developed using Artificial Neural Networks (ANN) have exhibited improved performance and self-adaptability as compared to traditional statistical methods. Keeping in view the importance of this topic, this paper presents a framework for crop yield estimation through image processing by using the ANN.**

**KEYWORDS — Date palm, Image Processing, Neural Networks, Deep Learning.**

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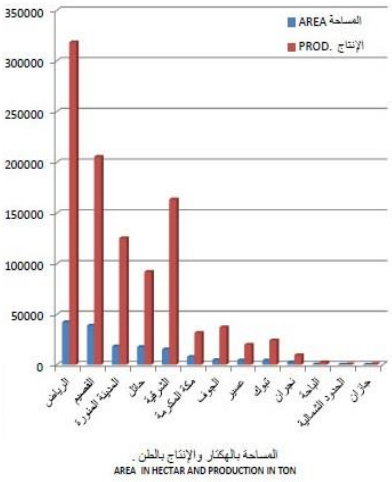
## I. INTRODUCTION

Saudi Arabia is the home to dates which are considered to be one of the most important national products in Saudi Arabia. The Kingdom is the largest consumer of dates, on the grounds that the natural product is a piece of their legacy. There are 50+ date handling plants in the kingdom which process large amounts of the product and right now it ranks second in the production of dates. The date market generates billions of USD annually. Date generation, evaluated at 1.1 million tons every year, represents around 72% of the nation's aggregate rural yield.

Since dates constitute major part of Saudi agriculture and because of this reason government is supporting the initiatives to increase the production as well as to improve




| Regions | 2012 الإنتاج PROD. | 2012 المساحة AREA | المناطق |
|---|---|---|---|
| Riyadh | 318303 | 42262 | الرياض |
| Makkah | 31779 | 7770 | مكة المكرمة |
| Madenah | 125177 | 18217 | المدينة المنورة |
| Qaseem | 205603 | 39022 | القصيم |
| Eastern | 163576 | 15351 | الشرقية |
| Aseer | 19900 | 4350 | عسير |
| Tabuk | 24301 | 4254 | تبوك |
| Hail | 92091 | 17634 | حائل |
| Northern | 460 | 121 | الحدود الشمالية |
| Jazan | 609 | 107 | جازان |
| Najran | 9601 | 2595 | نجران |
| Baha | 2547 | 383 | الباحة |
| Jouf | 37135 | 4782 | الجوف |
| KingDom | 1031082 | 156848 | المملكة |

Fig 1: Date Production in Saudi Arabia

the quality of dates. It is because of these initiatives that the area under date palm cultivation has increased by more than 150% from 1995 to 2010, and the production of dates has also increased by 150% during the same period. There are nearly 25 million date palm trees in Saudi Arabia and the aggregate territory under date palm development is almost 1,56,000 acres as of 2012. There are more than about 400 varieties of dates which are grown in the various regions in Saudi Arabia, especially in Qassim, Riyadh, Medina and Eastern Province. Areas like al-Qassim and al-Ahsa are the

most profitable date locales in the kingdom and well known for creating the finest assortments on the planet. Al-Qassim area (North West of Saudi Arabia) alone has more than 6 million palm trees and delivers more than 2,00,000 tons of dates every year.

Monitoring of date growth and estimation of its yield can provide vital information for commodity traders, producers and government agencies for effectively managing the crop harvest, storage, packing, transporting and marketing of the date crop. The earlier and quicker this valuable information is made available, it will result in low economic risk as well as increase in the return on investment. In fact, several studies have revealed that as far as normal per capita utilization of dates every year, Saudi Arabia positions first on the planet [1]. Because of expanded development and surplus date generation in Saudi Arabia, there is incredible accentuation on fares of dates [2]. Saudi Arabia sends out dates to India, Germany, France and different nations with Egypt, Iran, Israel and Iraq, being the principle competitors.

Keeping in view the importance of date palms on the economy of these countries, this paper presents a framework for the date palm yield prediction by implementing the feature extraction using image processing through Artificial Neural Network (ANN).

## II. Review of Literature

Date fruit is a natural product and is a decent source of nourishment giving fiber sugars, minerals and vitamins [3, 4]. A couple surveys exhibited that the Kingdom of Saudi Arabia has the primary rank on the planet in regards to ordinary per capita use of dates each year, which accomplished 34.8 kg/year in 2003 [1]. In context of the extending advancement and surplus date era in the Kingdom, there is an emphasis on exportation [2]. The Kingdom sends out dates to Germany, France and India. The list of potential competitors in date exports to Saudi Arabia include Israel, Algeria and Tunisia. Dates possesses a pivotal place in the financial structure of Saudi farming as for generation, utilization and advertising because of the Kingdom's support in request to expand production while enhancing quality. The region planted with palm trees had expanded by 152 percent amid the period from 1997 to 2009, and the generation expanded by 153 percent amid a similar period. The aggregate planted region with date palm trees in the Kingdom amid 2009 was around 162,000 hectares, while the quantity of palm trees had come to almost 23,000,000 trees; with more than around 400 assortments. The best of these assortments being Ajwah, Ruthana, Khalas, Segae, Sukkary, Helwah,, Barhi and Rushodia. Palm trees are developed in the different locales of the Kingdom, which are portrayed by the assorted qualities of atmosphere; the most essential palm developing districts are Eastern Province and Madinah Munawwarah, Qassim and Riyadh. Constant observation of date palm health and growth along with estimation of its crop yield can provide important information to the stakeholders for the effective management of the crop harvesting, storing, transporting and marketing of the fruit. The quicker and earlier this vital information is obtained, more will be return on investment. Many countries use conventional techniques of data collection and field reports for the estimation of crop yield [5]. There are variety of statistical and mathematical models that have been proposed in recent years for the estimation of yield for many crops [6, 5]. But these methods are expensive, time consuming, and subjected to big errors mainly due to incomplete and inaccurate ground observation data which results in inaccurate crop yield prediction and estimations of area under cultivation [5]. To overcome these difficulties, image processing technology has been successfully used in these areas. Image processing technique acquires information about the objects without any physical contact.

Now image processing is being used to characterize various attributes of vegetation in order to estimate the area of biomass, to predict the yield, and to monitor the growth and health of the plants [7]. Image Processing technique can use reflected light (Visible) and absorbed light (near-infrared) to identify vegetation stress due to pests, water shortages, salinity and lack of nutrients [8].

Estimation of crop harvest by using the images taken by digital camera was practiced for crops such as wheat and wild blueberry.

Nowadays, various machine learning techniques including SOM, decision tree, association rule mining and artificial neural networks are being used to predict the for crop yield.

## III. Framework for Predicting Crop Yield

In Fig.2, a framework for predicting crop yield is presented, which consists of following components: (iii) Feature

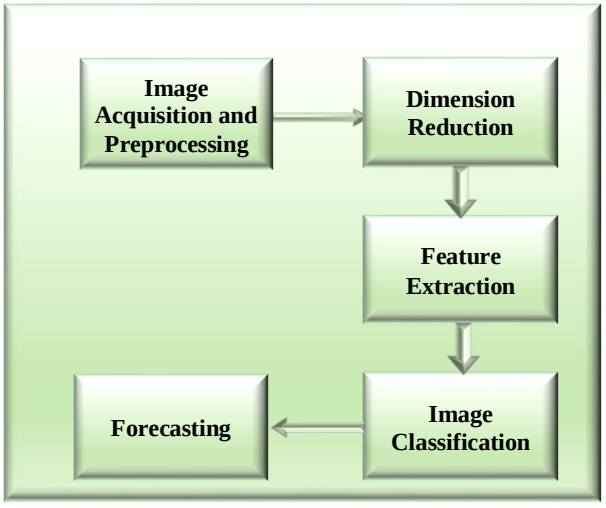



Fig 2: Framework for predicting crop yield

extraction (iv) Image classification (v) Forecasting. These components are described below in detail.

### *A. Image Acquisition and preprocessing*

The first step of any vision system is acquisition of an image. This is done by capturing an image either from a camera, video or input stored images. This process aims to have a source of input that operates within such controlled and measured guidelines that the same image can be perfectly reproduced under the same conditions so any anomalous factors are easier to locate and eliminate. A typical approach of storing an image digitally on a computer is by sampling the image at a rectangular grid. The colour or intensity at each of these points is converted into a numeric value and stored in the computer.

### *B. Dimension reduction*

This step performs a linear mapping of the data to a lower-dimensional space in such a way that the variance of the data in the low-dimensional representation is maximized. It maps training images into a lower dimension using the ANN network and the weight matrix of each image stored in the training database [9]. During recognition, trained images are reconstructed using weight matrices and recognition is through untrained test images using Euclidean distance as the similarity measure.

**Training:** In training phase, labelled vectors are input to the ANN one at a time. For each node, the number of "wins" is recorded along with the label of the input sample. The weight vectors for the nodes are updated. By the end of this stage, each node of the ANN have two recorded values: the total number of winning times for subject present in image database, and the total number of winning times for subject not present in image database.

**Testing:** During the testing phase, each input vector is compared with all nodes of the ANN, and the best match is found based on minimum Euclidean distance.

### *C. Feature extraction:*

It involves obtaining relevant features representing interesting parts of an image from the image data. These features can be certain fruit texture, variations, angles or measures.

### *D. Image Classification:*

Image classification is employed to label images into one of a number of predefined categories. Classification can includes pre-processing, detection of objects from the image, segmentation of objects, classification of objects etc. In an identification task, the system will report an identity from a database. It is in this phase that fruit crop yield is identified.

### *E. Forecasting:*

In this phase, total crop yield is estimated and forecasted.

## IV. CONCLUSION

Various image processing operations are being performed on images for recognition and estimation of the fruit crops. A number of processes including pre-processing, dimensions reduction, feature extraction and classification are performed and the fruit yield is estimated and forecasted. Nowadays, various Machine Learning techniques especially Artificial Neural Network are used to perform these processes on images which yield higher prediction accuracy of the fruit crop yield. This paper has presented the framework of predicting the fruit crop yield especially date palms more accurately by using the Artificial Neural Network.

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