

Visual Yield Estimation of Vineyard Production: Automated Crop Analysis Approach

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Abstract- The yield of vineyards varies with the changing weather conditions and other environmental and external factors. It is highly significant for the viticulturists to know about their yields to manage them with efficacy and raise the production to meet the increasing demands of the market. The current methodologies are traditionally sparse, laborious expensive and more importantly not very efficient or reliable. The proposed approach presented is an automated perspective which with computer vision and making use of all visual cues as colour, texture, etc helps to get an estimate of the yield in form of count, weight and provide more reliable management solutions and in-expensive platform of guidelines for the production.

Index Terms—vineyard, yield, automated, production.

I. INTRODUCTION

The classical methods employ huge labor and cost investment to understand and cater to the needs of yield. Several of the techniques involve manual counting and estimation of the berry count of the vine which is tedious and unreliable. The other significant aspects of the vine management like water, fertilizer, pesticide supply which is done without any analysis of the needs and remains ignorant of effective utilization of resources. Small samples are collected and studied applying same results over the whole yield without taking into account the irregularities and discreteness of the crop distribution. For effective vineyard management, viticulturists should get a more clear vision of the yield and manage the production accordingly to maximize the outcome and ensure judicious use of resources. The presented methodology provides an inexpensive solution to the mentioned issues with an automated approach. A fixated camera on a tractor can move within the fields and take images of the vines at regular intervals. Computer vision helps to understand and segregate the grapes though low extent of color contrasting background and occlusions creates a problem but gives an approximated analysis of the yield in terms of count, weight and quality analysis with color, texture and other visual cues. The trained module thus guides over the necessary management.

II. METHODOLOGY

The methodology used is in two different approaches:

A. Preprocessing of the images

The input images obtained contain various undesired pixels consisting of leaves, stems, soil which

needs to be filtered. The filtering is done using Gaussian filters to reduce the noise.

B. Obtaining the region of interest

After noise reduction the area of interest is to be obtained which is difficult to capture due to difference in light intensities and lack of contrasting backgrounds which makes the area of interest difficult to capture. The area occupied by grapes is captured with color segmentation against standard light conditions which accurately help to obtain the desired area of interest.

C. Detecting grapes

After obtaining the area of interest as shown in the preprocessed image, the image is analyzed to detect grapes understanding its features. The methodology used to detect grapes was Radial Symmetry [1] and Hough circle Transform[3] where better results were obtained with combination of both.

D. Berry count

On detecting the grapes, Hough Circle transform gave vague results which were further improved with training the module which gave results with greater efficiency. The counting module initially took into account overlapped grapes and led to re-counting same grapes multiple times which was improvised and reached a more reliability.

III. RESULTS

The images of vine clusters and grapes under as a dataset and following results were obtained. With the application of proposed methodologies, following results were obtained:

A. Weight of the yield

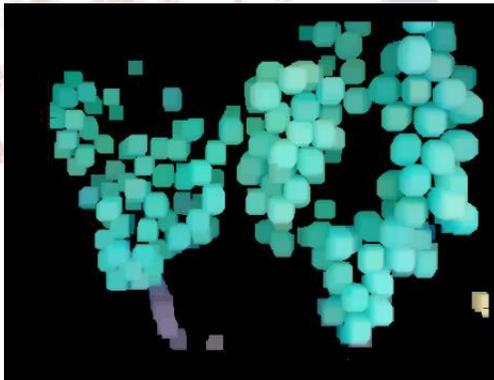
It was calibrated from its obtained dependency and correlation with the area occupied by the clusters in an input image. The segmented results with preprocessing techniques and reducing noise with tools like Gaussian blur. The image labelled area gives an estimated weight of the cluster with the trained module relating the area to weight.

B. The berry count

An estimated count of berries is obtained by segmenting the cluster area and obtaining features with “Hough Circle Transform” which further improvises the results from 221 to 184 to 84 against a ground truth of 95 with results varying from 42% to 51% to 88% accuracy across results 1 to 3 shown in the images labelled 1 to 3.



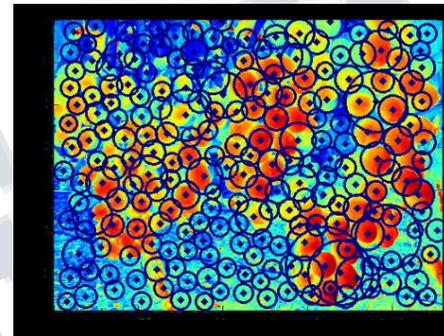
INPUT IMAGE



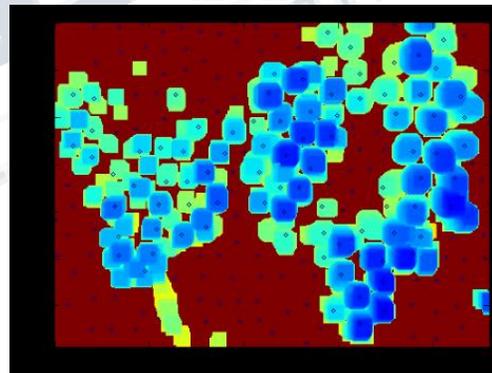
PREPROCESSED IMAGE



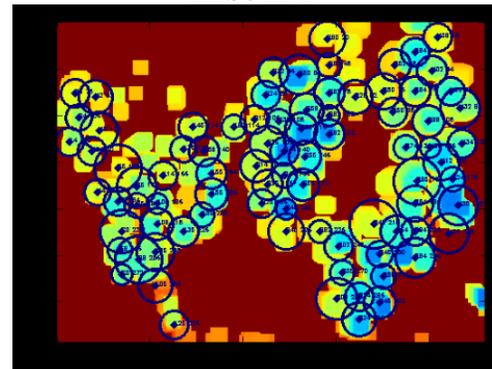
AREA SEGMENTATION



RESULT 1



RESULT 2



RESULT 3

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IV. CONCLUSION

Thus, the obtained results can be used to improve the yield with the stated automated approach. The results not only help to give reliable results but also help to cut down the laborious tasks in an in-expensive way. The estimated count and weight of the yield at different stages of production can be used to improve the outcome and take the necessary vineyard management steps accordingly to meet the target yield.

V. FUTURE SCOPE

The obtained results can be further automated with a completely autonomous vehicle to drive in fields and vineyard can be mapped in a digital miniature form to analyze which part of the field needs attention in specific to boost the yield further. Other modules can be integrated as understanding and catering to irrigation, fertilizer requirements with appropriate sensors installed in the fields to manage the complete vineyard with a more automated approach giving estimated weight and all necessary guidelines for a good yield.

REFERENCES

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