JVALUE BASED BIOMASS AND GROWTH RATE ESTIMATION OF DUCKWEED

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Science in Electronic and Automation Engineering

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DECLARATION

"I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Name of the supervisor : Dr. Upeka Premaratne

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ABSTRACT

Duckweeds are known as Lemnaceae, comes under the family of small aquatic plants which grows forming a mat covering the surface of the water. Worldwide duckweeds are used as an effective wastewater treatment through conventional methods. These natural green plants remove the excess amount of nutrient or pollutants from the water body and maintain sustainable environmental conditions. *Spirodela polyrhiza*, *Lemna minor* and *Azolla pinnata* are some of the most popular duckweeds used in phytoremediation. Depending on the growing environment, these plants has ability to reproduce rapidly.

Rapid growth of duckweeds leads to dysfunction of water bodies and caused other problems. Because of that it is important to monitor the growth rate to control the growth and to avoid an excess duckweed. Traditional method of monitoring the growth rate by manually is laborious and time consuming. Automation of growth rate monitoring is important mostly for duckweed cultivation, modeling of waste water stabilization ponds and among researches.

Vision based image processing, used here to automate the growth rate monitoring of duckweeds. For that images of three plants were collected by capturing images from a camera once a two days. In this research two methods were used to estimate the green layer of the three plants *Spirodela polyrhiza*, *Lemna minor* and *Azolla pinnata*.

Here the biomass estimation of small fronded aquatic plants is performed by identifying the regions with texture using J- value which is homogeneity measure used in JSEG algorithm. To compare the accuracy alternative Green layer extraction (GLE) method was used.

The colour appearance of the surface of the three plants depends on light level, material properties, quality of the images and the view point. For each plant, it was done the green layer detection under two methods with three illuminance levels. Results were verified with the ground truth.

According to the results, it was calculated and compared the accuracy percentages and error percentages of two methods in different three illuminance levels. The mean accuracy under normal illumination for the proposed JVT method is *Spirodela polyrhiza is 85%*, for *Lemna minor* 82.93% and 83.71 % for *Azolla pinnata*. Furthermore, JVT method is robust enough to deal with different illuminance levels.

Finally, introduced JVT method effectively uses homogeneity measure known as the J- value to discriminate between the texture of the fronds of the plants from uniform water surface.

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LIST OF ABBREVIATIONS

JSEG - J value based Segmentation

DB - Data Base

JVT - J Value Thresholding

HSV - Hue Saturation Value

HIS - Hue Saturation Intensity

LED - Light Emitting Diode

GLE - Green Layer Extraction

GT - Ground Truth

IoU - Intersection over Union