OKREŚLENIE GĘSTOŚCI KORONY DRZEW JABŁONI W CZASIE RZECZYWISTYM

mgr Maciej Kiecana

Praca doktorska napisana pod kierownictwem prof. dr hab. inż. Jerzego Weresa jako promotora

dr hab. Grzegorza Doruchowskiego jako promotora pomocniczego

Uniwersytet Przyrodniczy w Poznaniu

Wydział Inżynierii Środowiska i Inżynierii Mechanicznej

Katedra Inżynierii Biosystemów

Abstract

Key words: stereo camera, depth map, embedded system, real-time systems, paralel processing, precision orcharding, image analysis, integral plant protection.

In the era of constant development of information technologies - the algorithms related to image analysis in particular - it is justified to use them in mechanical engineering in order to improve the quality of production in fruit-growing activities. Linking the data obtained in the image acquisition process to generate a depth map, together with the creation of an IT system model, that operaties in real time and supports the effectiveness of agrotechnical treatments in the orchard, will enable to increase the precision of agrotechnical treatments, as well as improve care for environmental protection. A significant problem of the developed system is the quality of the obtained data and the time of their analysis.

The aim of this study was to determine the impact of the tree's development phase on the possibility to use stereovision image analysis algorithms in the orchard to determine the crown density of apple trees, as well as to find a hardware configuration that would meet the requirements of real-time data analysis during agrotechnical treatments in the orchard included in the discipline of mechanical engineering.

Due to environmental degradation caused by the use of pesticides and fertilizers in order to maximize agro-orchard production, solutions to protect plants while maintaining economic balance play an increasingly important role. An in-built system operating in real time, enabling the reduction of losses in plant protection products during agrotechnical treatments, allows to maintain high environmental standards. The research methodology covers three main stages. The first stage consisted in acquiring a TARA stereovision camera and creating software that enabled recording the video material in digital form on a data carrier for the left and right cameras, for subsequent, multiple analysis. The second stage consisted in obtaining research material in the form of video files. The TARA camera was used for this purpose. Data were obtained for each of the tree development phases. The third stage of the research concerned the creation of a 3D image and checking the possibilities of various hardware configurations in order to propose an appropriate solution for an embedded system operating in real time.

Based on the research carried out, it should be clearly stated that such a system will work efficiently regardless of the tree's development phase. The current technology provides equipment with sufficient computing power to make the analysis process run smoothly and continuously. In addition, the modularity of the analyzed system enables its scalability in the future, subsequently increasing its flexibility in agrotechnical applications. Such a system will be able to detect the crown of apple trees, thanks to which it can be used, inter alia, to calculate the increase in the leaf area between individual tree development

stages. The use of the system during spraying can lead to savings of the working medium used during agricultural operations, mainly due to the possibility of recognizing empty spaces between trees.