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PhD thesis summary of MSc. Marek Hryniewicz

Title: Contactless evaluation of fruit size and quality

The main aim of this study was to evaluate the possibility of implementation of structural light method for contactless registration of fruit shapes. The specific objectives, which were adopted at the same time as the operational tasks were the next: determining the method applicability for registering of convex and concave surfaces, determining the method ability for registering of smooth and matt surfaces and its sensitivity to reflections, determining the method applicability for registering of surfaces with different colours, determining the method accuracy for fruit classification according to European standards.

The practical value of the achievement of the main objective of the work and the specific objectives will allow for progress in the field of automation and robotics work in orchards and gardens in determining the shape of the fruit, their size, colours detection on the fruit surface, fruit maturity determination, early identification of disease symptoms, determination of appropriate time for fruit harvesting and fruit harvesting facilitation.

There was elaborated and prepared a measurement stand for three dimensional fruit shape investigation with the help of structured light method. The method relies on throwing sinusoidal patterns and Gray code on an investigated real object. The intensity of thrown light changes according to sinusoidal function value. Gray code is implemented to unequivocal pixels identification. The code is in the shape of appropriate pictures thrown on the object. At this way, with the help of special software for pictures analysis, pixels can be distinguished at pictures and gave a three dimensional object representation in digital form. Experiments with this method implementation were conducted on apples due to their surfaces consisted of convex and hull parts. There were chosen four Russet apples, four Gala apples and eight Golden Delicious apples. There were selected apples with different shapes, colours and surface state (glossy and mat). Positive results were obtained which indicated that this method was useful for evaluation of fruit size and quality. The method accuracy was verified by water displacement method. The method was implemented to investigated apples and the method results were compared with apples digital models. The maximum volume difference reached 0,06%. The calculation of the total error along each axis, expressed in units of length for each of the apples reached a maximum of 0,5 mm, which was in the range of European standards.