

LINE DETECTION FOR AGRICULTURAL VISION-GUIDANCE USING OBJECT-ORIENTED SOFTWARE FRAMEWORK WITH FLEXIBLE BASE ARCHITECTURE

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Introduction

Decreasing computer costs and increased use of electrical and electronic systems have allowed a rapid increase in the development of autonomous and automatic vehicles in agriculture. Machine vision is the most appealing method to find guidance lines such as paths, crop rows and aligned trees for vehicle control because it follows human practice taking guidance from scenes. Until now, many successful researches have been done to detect lines for vision guidance systems; however, they have a limitation: the line detection vision system is only useful for a specific target. The objective of this research was to develop an object-oriented software framework with flexible base architecture and an algorithm library that contains many typical image processing techniques used in the software framework. The software framework should provide an effective way for developing line detection applications for any programmer (novice or advanced). Also, the software framework should demonstrate its capability of developing concrete vision system for several targets, for instance: crop rows, agricultural paths, aligned trees, etc.

Method

Considering that there are already several researches about line detection for machine vision, it would be desirable to integrate all the vision systems into a versatile one. It was noticed that all the different processes have a common pattern that consists of two steps: simplification and line search. Simplification step converts a original image (containing big amount of information) into a much simpler simplified image (containing small amount of information) and line search step finds the guidance line from the simplified image. After integrating the common parts of the different processes an abstract process of line detection was defined, this abstract process has the flexible base architecture. The software framework is the implementation of the flexible base architecture where several algorithms can be injected into the simplification series and line search place folders for the creation of particular target vision system. An algorithm library with typical image processing techniques is available for developers, who can write very simple code for just injecting those algorithms into the software framework.

Results and Discussion

In this research -for demonstration- paths and crop rows detection systems were created using different methods. It was demonstrated the simplicity of changing from one method to another by just replacing the concrete algorithm components from the library. The root mean square (RMS) value was used as the index for evaluating the accuracy of line detection; the best method was the one with the smallest RMS value. Other targets like trees, wheel tracks, harvested rice boundaries and rice fields could also be detected using the framework and algorithm library.

Conclusion

A software framework for line detection with flexible base architecture and an algorithm library with the typical image processing techniques were successfully developed. Injecting the concrete algorithms into the software framework allowed the creation of particular vision system for detecting lines in specific situations.