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Machine Vision based Real Time Trajectory Generation

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Chapter 1

Feasibility Study

1.1 Introduction

Most of the robotic arms used in industrial environments operate in a pre-programmed cycle. When it comes to the way a human does the same task is much different as the path planning for picking an object may change from cycle to cycle because of the perception obtained through human vision.

Machine vision is the technology and methods incorporated to mimic the human vision in order to gain the insights about the operating environment of the robotics system. However, when it comes to the real time object detection using machine vision, there is an inevitable trade-off between the accuracy and the speed of the operation. This depends entirely on the used machine vision algorithms and the computational power of the available hardware.

1.2 Challenges Encountered when Incorporating a Vision Unit to a Robotic System

If the robotic system/ arm in interest is not controlled through a dedicated industrial PC with adequate computational resources, the amount of resources that can be allocated to the vision unit becomes limited. This will eventually result in great delays (which is not desirable when it comes to real time operations) to produce the required outputs by processing the acquired images through the associated camera.

Due to this limitation in computational resources it is not practical to use Deep Learning based algorithms in time critical industrial applications. Because, by the time the decisions are made the environment may have already changed and the made decisions may no longer valid.

1.3 A Traditional Machine Vision Approach as the Solution

To overcome the challenges mentioned above traditional machine vision algorithms can be incorporated inside the vision unit. Unlike the deep learning based algorithms, traditional machine vision algorithms are less computationally expensive and no initial data is required to train the algorithm. As they are built upon strong mathematical foundations which are therefore well suited in almost all the situations when the parameters are tuned properly.

1.4 High Level Representation of the Algorithm

For real time trajectory generation we first need to track the objects on the conveyor belt. A typical object tracking framework generally consists of three major modules which can be identified as, 1. Object Detection, 2. Object Modeling and 3. Object Tracking. The following traditional computer vision methods will be used to implement those three modules.

Module	Method
Object Detection	Background Subtraction and Connected Component Analysis
Object Modeling	Contour Analysis and Representation
Object Tracking	Template Matching followed by Object moments interpretation

Table 1.1: Modules of a Typical Object Tracking Framework

Through the above framework we can identify and track the centroids of the objects on the conveyor belt and that information can be handed over to the trajectory generation algorithm to generate the required path in the real time to pick the object.