

# 1 Introduction

## 1.1 Current Technology

Currently many manufacturing robots do not utilize computer vision to accomplish their tasks. Many manufacturing robots simply run a simple preset routine without much intellect driving them. As computational power becomes cheaper and computer vision algorithms become more mature, these new technologies can offer much needed improvements to manufacturing robotics. High tech areas, such as computer vision, can be very profitable targets for our sponsor, Bay Area IP, LLC. Our sponsor seeks to generate intellectual property to license out to companies in the robotics field, so it will be profitable to focus on the high tech areas.

There exist some manufacturing robots on the market that are utilizing computer vision to accomplish complex production line tasks. One such robot is produced by Italy based SIR SpA. The robot utilizes stereoscopic 3D vision systems to find and pick up parts from an unstructured bin. However, this system utilizes a large camera and complex algorithms to find and detect individual parts in a disorganized bin full of such parts[?]. Our Capstone technology seeks to provide a simpler computer vision solution for less complex object detection problems.

Computer vision technology has many tools for object detection and recognition. There are many machine learning paradigms that can be applied to the task of object detection. Neural Networks and Support Vector Machines(SVM) are two technologies that are commonly used in this area. Neural Networks are very complex to tweak and configure, but can achieve great accuracy while being light weight at run time. SVM is a well understood mathematically and configuration of such systems is also well understood. They are light weight if used with simple linear kernels, but more complex kernels would be difficult to implement on a robot[?]. However, all these technologies can be difficult to implement on an embedded system such as a robot, so we will attempt to do develop new techniques that will be lighter on computational power.

The other component of our robot is the robotic hand. There are many different companies and research groups constructing robotic hands for many different applications. There are hands designed to be prosthetics, as well as hands designed to be integrated into robotic systems. One of the most complex is the UB Hand IV, this hand is nearly the same as a human hand in terms of capabilities. However, the hand is very heavy and very power hungry, so it is not very suitable for most applications[?]. We want to leverage some modern technology to make a robotic hand that is smaller and light weight.

## 1.2 Capstone Technology

We will be attempting to produce a cheap and simple computer vision technology for object detection. Accomplish this, we will be utilizing lasers to make the image processing challenges simpler. Processing live video using common machine learning based computer vision algorithms may prove to be challenging for the smaller computers we will be utilizing for the robot. To help make the task simpler, we will utilize a laser on the head to scan the space. By using the laser to scan the image, and utilizing the live video of the laser motion, we can easily detect edges without using complex algorithms. Using these edges we can find objects. We will also have another laser on the arm. Once we have an object detected, we can use the laser on the head to point at the object, and try to line up the arm using it's own laser. By using the two lasers we can try to guide the arm towards the object.

To make the robotic hand, we will be trying to use small components as much as possible to reduce the size and weight. By using smaller motors, we can make the hand small and still have many degrees of freedom. We cannot make the hand as complex as a human hand, so we will need to sacrifice some capabilities to make the hand small and low power. A major technology that we plan to implement is Shape Memory

Alloy(SMA). SMA is a new material that can contract when heated this allows us to use it as an actuator. We can utilize wires of SMA to control joints and other areas of the hand where space is very limited. Combining these various technologies, we can make a hand that is very human-like.