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Intelligent Machines Design Laboratory

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Written Report 1

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## Abstract

I will build two identical robots that will work together to achieve a task that neither could complete alone. Both robots will have relatively simple designs, but many precisely coordinated movements and constant communication will be necessary for the robots to cooperate. The robots will be able to avoid collisions, search for objects in a room, pick up and move these objects, and communicate with each other to intelligently organize them. My goal is for the robots to collect several boxes and, by helping each other, stack them in a designated area.

## Executive Summary

*To be written in Final Report.*

## Introduction

My idea to build two robots was partially inspired from a project being conducted in University of Florida's Machine Intelligence Laboratory by Adam McLeod. His project involves numerous identical robots that travel as a swarm and communicate via radio waves. However, I am more interested in the problem of two robots working to achieve a task that is impractical for one robot. Examples of this occur often in nature when a group of simple animals unite to build intricate nests, or collect and store huge supplies of food. The two robots I am building will be representative of a large group. The simplicity of the two robots is vital not only due to time constraints but also to demonstrate the complex patterns that can emerge from their basic behaviors. In this report I will describe how I will construct and control these robots.

## Integrated System

## Mobile Platform

My platform will be similar to the TJ™ chassis designed by Mekatronix. This generic platform is practical because it allows for precise movements that are necessary in maneuvering about tight spaces. The robots will be able to work closely together because they will be circular and able to rotate about their central axes. The differential drive system will also be the simplest to control, and I will be able to use the designated servo outputs on the Mekatronix board. I plan to add an arm, controlled by servos, to the front of both robots to enable them to manipulate objects. The arm will lift objects only up or down while the robot base turns and maneuvers. The arm must also have the ability to keep objects level with the ground while it picks them up to stack them. This will involve using another pair of servos within the arm and programming both joints in the arm to move in sync.

## Actuation

I will use the MEKAVR128 board from Mekatronix in both of my robots. This board has an Atmega128 chip and several input/output ports as well as analog to digital converters and special servo outputs built in. The servos I have ordered will have to be hacked and I plan on adding hardware to enable me to count the number of wheel turns. I decided against using dc motors because of extra ports on the Mekatronix board. Although dc motors would allow my robots to move faster, speed is not essential. Also, the servos used to control arm movement will cause the robot to lean forward. To solve this problem I plan on positioning the batteries in the back of the robot and centering the base of the arm along the central axis of the robot. If balance problems persist I will have to find another way to redistribute the weight.

## Sensors

I plan to have bump sensors, infrared transmitters and receivers, sonar emitters and detectors and radio frequency transceivers on my robots. The bump sensors will let the robot know it must turn if it has unexpectedly hit something or notify it when it reaches the object it was approaching. The IR receivers and transmitters will let the robots know that a wall is nearby and they must head in the other direction. The robots may also use IR to detect a marked area on the floor where they will drop off what they are carrying. The RF transceivers will allow the robots to share information such as how many items they have found and if they are ready to begin stacking. This system permits both robots to track how much work they have accomplished together. I will use ultrasonic waves to determine how close small objects are so the robot can steer towards them. Sonar is much more precise for applications such as this. The robots will be able to make an accurate estimate of how to approach objects and position themselves correctly. With all of these sensors working together the robots will be able to work autonomously.

## Behaviors

The robots will conduct searches on their own while being fully aware of what the other is doing. Both robots will have counters so that both know when their job is done and all items have been recovered. When trying to stack objects the robots will go communicate using the RF transceivers at every step. The process of stacking will be meticulously choreographed to prevent the robots from hitting each other or the objects they are carrying.

## Experimental Layout and Results

*To be written in Final Report*

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## Conclusion

As of now some of my ideas are vague and my plans have not all been fully thought out. I realize that coordinating separate robot movements will not be a simple task. However, by using the basic TJ™ platform and making both robots completely identical I hope to have more time to focus on debugging and programming. By methodically adding systems one at a time I hope to have two fully functional cooperative robots by the end of the semester.

## Documentation

## Appendices