Group Conceptual Design

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ME 407

Preliminary Design of Robotic Systems

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1 Introduction

The terminator T-2000 is a science-fiction spectacle of a manipulator– until you see the price. Channeling the inspiration many high school students may have for robotics, MEIOSIS robotics aims to provide an affordable manipulator to educators and enthusiasts. MEIOSIS uses primarily 3-D printed components and easily accessible materials. Among these materials are a Raspberry PI , smart servos and metal tubing. These features create an open-source manipulator accessible to the public to further robotics education.

2 Physical System Overview

Figure 1 shows the overall design for the manipulator. Much of the system's physical design will be determined during the actual design of the manipulator, after the specifications stage. The figure below shows the basic overall conceptual design of the manipulator, having all six rotational joints, the latter three of which being in a spherical wrist configuration.

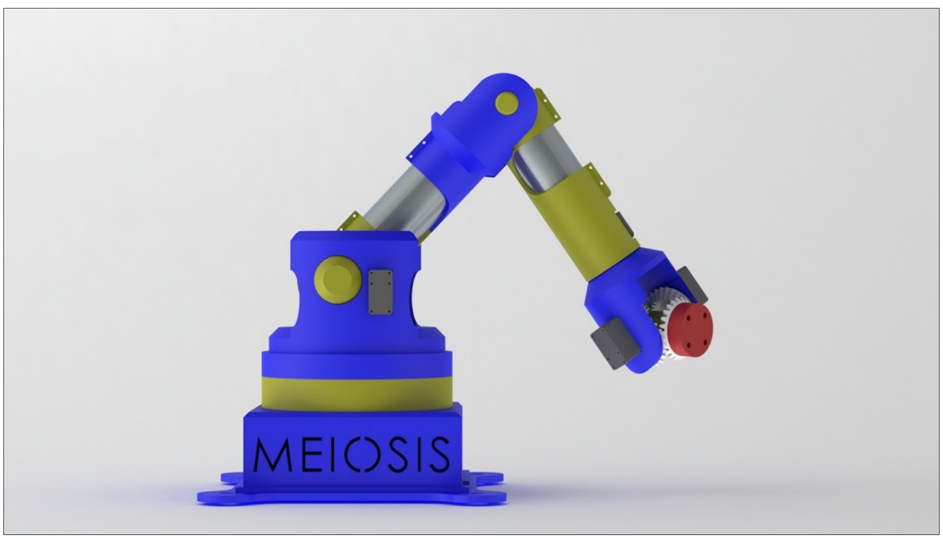

Figure 1: Overall System Conceptual Design

The colored links in *Figure 1* distinguish the different joints and links of the manipulator. The overall reach of the robot will be 500 mm. This length was chosen to decrease material cost and weight while still satisfying requirement 2.1.2 and 2.1.5, allowing the manipulating to pick and place objects to perform basic tasks. The base of the robot will be made to contain the Raspberry Pi and other electrical components.

2.1 Base

The base of the manipulator will house several of the electronic components, such as the computational sytem, power supply, and motor controller. A cross section of the base can be seen in *Figure 2*.

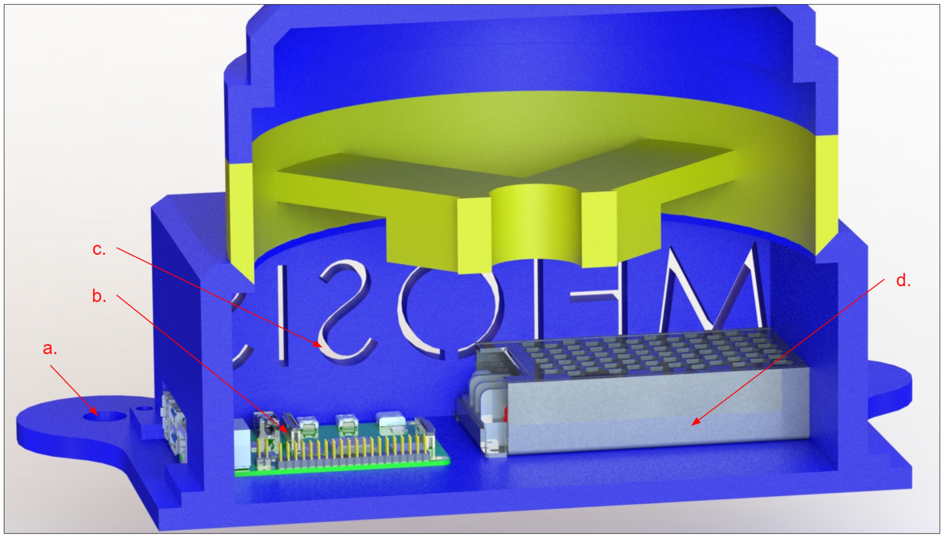

Figure 2: Manipulator Base with Callouts

From *Figure 2*,

a. *Base Supports:* The base supports are located at each corner of the base and will allow the base of the manipulator to be securely attached to a variety of surfaces with either standard bolt/fastener hardware or suction cups.

b. *Computational System:* The computational system will consist of a Raspberry Pi; the primary reason for this system being chosen is to fulfill the budget requirement, 2.1.1. The Raspberry Pi will perform the necessary computations for solving the kinematics of the manipulator and command the motors accordingly.

c. *Airflow Cutouts:* The side of the base will have cutouts to allow for the maximum amount of airflow to pass through; since the power supply is housed inside of the base as well as the computational system, the temperature must be regulated to prevent overheating.

d. *Power Supply:* The power supply will be housed in the base as well; this allows the system to be more accessible and therefore more modifiable, where the end-user can easily expand the system to fulfill their needs.

3 System Functions

The system consists of two primary categories, the electrical and software systems. The electrical subsystem includes the wiring and hardware computational components, power system, actuators with drivers, and sensors. The software subsystem includes the algorithm flowchart for the computational system as well as the intended end-user interface platform.

3.1 Electrical System

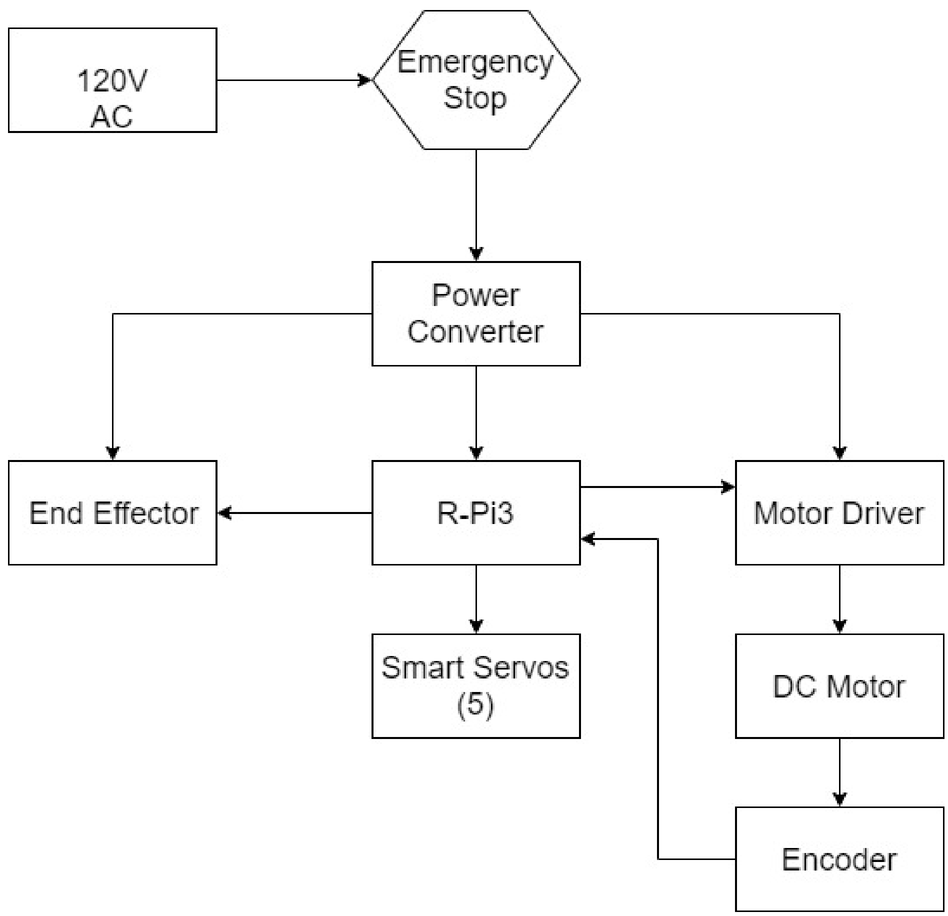

Figure 3: Electrical System Block Diagram

Figure 3 shows that the electrical systems of the manipulator will be relatively simple, with power being supplied by the standard 120V AC available from wall outlets. A power converter will be used to adapt the AC voltage to the required voltages for each component. To control the system, a Raspberry Pi will perform the necessary calculations for motor control (described below in software). It will then send these signals to the DC motor driver and the five smart servos. The smart servos have an on-board controller, so no feedback will be necessary. However, the first rotational joint between the base and the first link will be actuated by a DC motor with an encoder to minimize cost.