Sinister Stooge
Design Document

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February 13, 2015—February 26, 2015

Abstract

We will design, build, and test an articulated robotic arm. The rotational motion of the arm will be driven by stepper motors.

1 War Council 1
February 13, 2015

Project History:

- CalHacks: Servo 2-joing arm
- HackSC: Cam-driven Hammer, Myo
- Bevel Gearmotor joint
- Lantern Modulex

Procedural Improvements:

- Formal Project Proposal
  - Schedule
  - Milestone Dates
  - Target Event
- Ongoing Documentation
  - Concept Sketches
  - Ongoing LaTeX doc
  - Private Github Repo
  - Data Logging
- Evaluations & Revision
  - Peer Revision / Diagram approval
  - Quality Control
  - Professional Design Review
- Bill of Materials
  - Ordering List
  - Budget

Future Goals:

- Research Sponsorship
- Open Source
- Expanded Team
- Research Club
- Present at Maker Faire Bay Area (May 16–17, 2015)

Brainstorm:

- Arm
- Pennyboard
- Hand
- Animatronic
- Smart Backpack
- Smart Light
- Holograms

Action Items:

- Research holographic projection techniques
  - USC Spinning Mirror:
    `http://youtu.be/eNWJ9XtRhLw`
  - Volumetric Helix:
    `http://makezine.com/2012/06/18/hacktastic-horizontal-helical-3d-display/`
  - Laser Display

- Define scope/specifications for mechanical arm
  - Hydraulic/Industrial
  - Machine Learning System
  - Force Feedback System

2 War Council 2
February 20, 2015

Discussion Topics:

- 3D projector may require high-speed projector
- Leap Motion & Solidworks
- Mechanical Arm

Design Matrix:

Projector	Arm	LeapCAD
Requres high-speed projector	Stability and accuracy	Working with Solidworks API
Working with Solidworks API	Stepper motors	No hardware
Stable projection surface	Goal: balancing and throwing	

Decision:

The holographic projector poses the problem of creating a good image while allowing for a reasonable refresh rate. This is a project that will require more funding and knowledge of optics to complete. We are removing this project from the list.

Using Leap-Motion to control CAD software could be a useful and interesting to develop. We could develop a deeper understanding of Solidworks and the Leap-Motion. However, the scope of this project is more suitable for a Hackathon. Therefore, we will shelve this project until a suitable occasion.

The mechanical arm can be applied to a large scope of tasks. Creating a mechanical arm with a focus on precision and stability makes it a particularly useful for machine learning and automation. In particular, three test cases stand out to us: writing letters on a whiteboard, balancing a hammer, and throwing a ball. By creating an accurate, quick, and stable arm, we establish a hardware platform upon which to experiment with machine learning.

3 Design Brief
February 23, 2015

Modularity:

The mechanical arm will designed to be modular. Addition or extension of joints should be simple and uncumbersome, with exception of extra load from the weight of the additional joint. The parts of each joint should be as universal as possible, and support the specified selection of motors.

NEMA Motor Chart:

Motor (STP-MTR-*)	Holding Torque (oz-in)	Weight (lb)
17040	61	0.6
17048	83	0.7
17060	115	0.9

Motor Links:

- https://www.inventables.com/technologies/stepper-motor-nema-17
- http://www.adafruit.com/products/324
- https://www.pololu.com/product/2267
- https://www.pololu.com/product/1477
- http://www.anaheimautomation.com/products/stepper/stepper-motors.php?tID=75&pt=t&cID=19
- http://www.kollmorgen.com/en-us/products/motors/stepper/hi-torque/km-series/

4 War Council 3
February 26, 2015

Decided on project name: Sinister Stooge.
Each joint houses a motor-driver board.
All boards are controlled via an Arduino.
Arduino and sensors connected to a computer.

Bill of Material:

1. NEMA 23 Stepper Motor ($35.50 + $6.00 Shipping): `http://www.automationdirect.com/adc/Shopping/Catalog/Motion_Control/Stepper_Systems/Stepper_Motors_-z-_Cables/STP-MTR-23055`