CNC MACHINE

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Synopsis

• CNC Machine
• 3 axis
• Accessible
• Fast
• Precise

www.surface-grinder.org
Stepper Motors

- Discrete vs. surface mount circuitry
- Specifications of motors
- Tolerance and torque

www.sparkfun.com
Discrete

L297/L298 Stepper Driver
Positional Feedback

• Ball mouse positional tracking system
• System mount to screw rod
• Precision? Adjust accordingly
SVG Interpreter

• Parse SVG images and convert them to G-Code vectors
• Create shortest-path algorithms between line segments
• Extra: Create a GUI that will take position and speed data from microcontrollers and display the data on a computer
Scalable Vector Graphics

- W3 Standard
- XML Format
- Inkscape – open source graphics editor

G - Code

- Standardized control codes for CNC control
- ISO 6983, RS-274D, other proprietary variations
- Commands are encoded as ASCII characters
Interpreting on PC

- Interpreting may be too complicated on microcontroller so it could be done on the PC
- Communicate lower level commands like motor step & direction
Machine Interface

Interface: Microcontrollers
• RS -232 available on most microcontrollers & PCs
• Doesn’t provide packet or data protocol

Machine Control
• EMC2 is open-source machine controller
• EMC2 is extensible and machine independent
Schedule Flow

1. Machine screws for each axis with proper tolerances
2. Build machine frame
3. Test positional feedback system from track ball
4. Create analog circuit (between motors and micro-controller)
5. Interface stepper motors with micro-controller
6. Test stepper motor torque load
7. Create GUI program that receives positional feedback data
8. Create algorithm which converts SVG to g-code
9. Write test g-code to pass to EMC open source program

Week: 1-3
Week: 4-7
Week: 8
Integrate positional feedback system with stepper motors

Test EMC program with micro-controller and stepper motors

Integrate GUI program with EMC

Integrate Inkscape with GUI program
<table>
<thead>
<tr>
<th>Task</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Driver Circuit</td>
<td>Anh</td>
</tr>
<tr>
<td>Positional Feedback System</td>
<td>Jared</td>
</tr>
<tr>
<td>Frame</td>
<td>Will</td>
</tr>
<tr>
<td>Software</td>
<td>Ashton</td>
</tr>
</tbody>
</table>
## Bill of Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Vendor</th>
<th>Price - USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Stepper Motors</td>
<td>Priceless</td>
<td></td>
</tr>
<tr>
<td>3 Micro-Controllers</td>
<td>Sparkfun</td>
<td>8 per unit for replacement</td>
</tr>
<tr>
<td>Positional Feedback System – Track Mice</td>
<td>DigiKey</td>
<td>10</td>
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<tr>
<td>Angle Iron</td>
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<td>Free</td>
</tr>
<tr>
<td>Rails</td>
<td>Home Depot</td>
<td>7</td>
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<tr>
<td>Acme threaded rod</td>
<td>Machine Shop</td>
<td>20</td>
</tr>
<tr>
<td>Linear Bearings</td>
<td>Home Depot</td>
<td>20</td>
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<tr>
<td>Driver Nuts</td>
<td>Home Depot</td>
<td>5</td>
</tr>
<tr>
<td>Coupling</td>
<td>Home Depot</td>
<td>10</td>
</tr>
<tr>
<td>Transformer – 24 V 10 A</td>
<td></td>
<td>Free</td>
</tr>
<tr>
<td>L297, L298, discrete components (resistors, capacitors, etc...)</td>
<td></td>
<td>Free</td>
</tr>
</tbody>
</table>
Risks

• G-Code: It might be very complicated to convert from SVG to G-Code
• 3 Drivers: Danger of having part failures, need to be able to easily get replacement parts as needed
• 3 Motors: May not be precise enough; Could cost a lot of money for good enough motors
• Questions?