CNC Router Table

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Background:
Calumet High School’s pre-engineering students are in need of a CNC router table to create wooden 3D prototype parts designed through Autodesk Inventor and machine code generated from MasterCAM software to demonstrate CNC technology to students. Design constraints include cost, lightweight setup, small enclosure, and design for safety.

Requirements:
- 3-axis travel
- Minimum 36” travel for X-axis
- Minimum 36” travel for Y-axis
- Minimum 6” travel for Z-axis
- Router with interchangeable tools
- Meet all OSHA safety requirements
- Stay within a budget of $2000
- Low maintenance

Data Gathering:
- Internet
- Patents
- Do-it-yourself CNC websites
- JoesCNC.com was used the most
- Current Designs
- Rob Piaget - former MET student
- Rob’s design was used for our base design idea
- Mark Bonenfant - Calumet High School Teacher
- Mark’s personal CNC machine was used as reference

Design Considerations:
- House of Quality
- Used to determine customer requirements
- Quality Functional Deployment
- Used to develop three different base designs
- Pugh’s Decision Matrix
- Used to compare each design and select final design
- Failure Modes and Effects Analysis (FMEA)
- Manufacturing FMEA used to find possible failures in assembly
- Design FMEA used to find possible failures in final product

Conclusion:
- Constant research resulted in several design changes.
- Motion simulation was used to analyze vertical Z-axis travel.
- All testing done on actual router table
- Client communication was key. Kept in touch regularly with Calumet High School.
- Organization was vital in all areas of project.
- Timeline was updated continuously throughout both semesters.
- Team meeting progressed from once per week to multiple times per week.

Selected Materials and Components:
- Table - Cost: $200
  - Welded angle iron frame - provided by CHS
  - MDF table base with T-slot for securing part
- Gantry - Cost: $150
  - MDF sides with extruded aluminum supports
  - Extruded aluminum used for movement along Y-axis
- Router Mount - Cost: $100
  - Custom design and milled aluminum
- Movement Assembly - Cost: $750
  - V-rollers for movement on all X&Y-axis
  - Rack and pinion for X&Y-axis
  - Pillow block for movement on Z-axis
  - Acme rod with timing belt for Z-axis
- Electronics - Cost: $450
  - Mach3 program to run machine
  - Four 425 oz.in motors - two to move X-axis
  - Two limit switches per axis
  - Three emergency stops

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Manufacturing Process:
CNC machining aluminum parts