Group C1

Upgrade Student CNC 3-Axis Machine control system

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Project Aim

The Aim of the project is to upgrade the existing student CNC machine in Coonagh. The existing machine is not functional. An alternative control system must be installed and tested to ensure the final machine is fully functional. This will then be used for demonstration and showcase purposes.

Objectives

- Research and document the principles of CNC controls and machine movements methods and processes
- Review the existing CNC machine and document the machine configuration, control systems and constraints of the machines.
- Investigate low-cost solutions to replace the existing obsolete systems considering relevant safety considerations, cost, performance and ability to upgrade.
- Source and implement an new control system using control components that may be sourced easily suitable for the existing motors and systems
- Install, test and review the new control system and evaluate the function, operation and effectiveness of the new system and document the findings.

Background

CNC machining is a manufacturing process in which pre-programmed computer software dictates the movement of tools and machinery. They provide increased accuracy compared to a human. CNC machines are controlled using g-code, this instructs them how and where to move. This code is primarily acquired through CAM software. A basic CNC control system consists of a control board, power supply, drivers and motors. The CNC machine for this project will be using 3-axis movement. Modern CNC machines make use of wireless connection and USB instead of obsolete Parallel Ports, which the existing machine has.

Concepts

The concepts had many objectives that needed to be achieved, such as

- Improved Ports, such as USB
- New software, moving away from Mach 3
- Must be able to power NEMA 23 motors
- Control CNC machine in 3-Axis
- Low cost & Future proof
- Must have safety features

Figure 1: Existing Machine in Coonagh

The Mach 3 5-Axis CNC Board, a low cost control board was researched. This board was deemed unsuitable due to non-improved data ports and outdated software. It also lacked sufficient safety features, meaning this board could not be considered an upgrade on the existing machine.

The Fanuc Power Motion Model A, a high cost control board was also researched. This board provided the port upgrade required, along with improved safety but did not suit the motors provided making this concept unsuitable

Figure 2 : Fanuc Power Motion Model A

Final Design

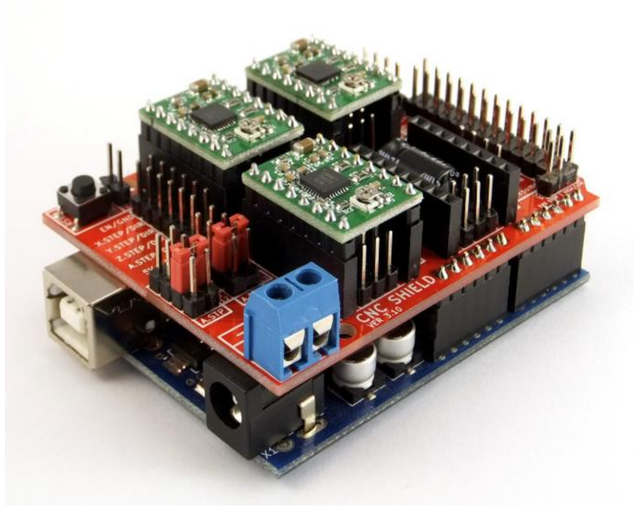

Figure 3: Arduino Uno with CNC Shield

The final concept achieved all the objectives that were set. The Arduino Uno R3 and CNC Shield provides improves ports in the form of USB. Arduino also comes with open source software, Arduino IDE, replacing the outdated Mach 3. It can control 3-Axis movement and provides power to the NEMA 23 Motors. It has built in safety features along with being Low cost. The Arduino IDE has frequent support and forums for assistance, making this solution future proof.

Installation

The existing machine had many problems at the beginning of project, the most prominent being a lack of wire diagram. Before installation of new components could take place a wire diagram had the to be constructed. The existing limit switches also had to be replaced with new ones due to damage.

Installation of the new components consisted of installing the Arduino, CNC Shield and new drivers, one for each axis. The components were wired and connected using the wiring diagram created earlier in the project.

Conclusion

- The research done at the beginning of this project was essential and provided most of the knowledge needed to complete this project.
- The components that were chosen as our final concept were a significant upgrade on the existing machine, providing increased safety and future proofing while also a much more responsive software to communicate g-code to the machine.
- Communication was a key part of this project. It allowed all group members to keep the project moving forward while working separately and together. It also allowed for individual ideas to be expressed and for all members to learn from each other.
- The process of installation was more difficult than was anticipated. This was due to the complications caused by the wiring diagram and limit switches.
- We feel this project was a success, as through testing we found that the motors, drivers and control board are functional and support the g-code used to test the components on the Arduino IDE.

Acknowledgements

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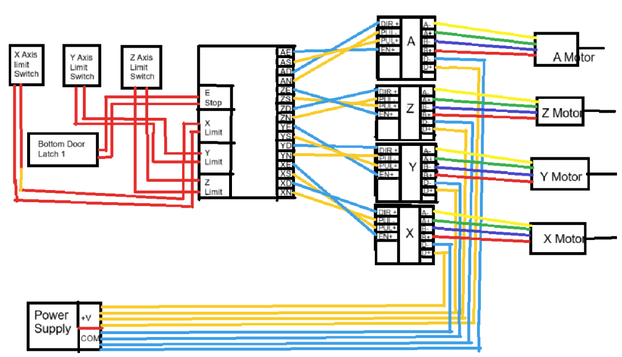

Figure 4: Wiring Diagram