Controller Card

A control system for the next generation of global automation

The world is becoming increasingly automated. From cars to factories, drones to self checkout, the modern world is run by machines. The people who need to interact with those machines are several technicians removed from understanding how the technology works, which can make it difficult to run any system.

With the Controller Card, an automated system can be brought from concept to prototype to deployment easily and efficiently. A high level of usability, coupled with a robust control system technology allows the Controller Card to be inserted into a wide range of applications.

With protection against bad wiring and faulty code, the future of controlling our modern world will be left to rapid development tools such as the Controller Card.

Albert Jansen

Specification	Value
Digital I/O	8 Input, 8 Output
Input Voltage	3.3VDC—5VDC
Isolation	Up to $600V_{RMS}$
Voltage Supply	5V DC Jack
Communication	Full Speed USB 2.0
Interface	Modern PC User Interface
Controller Speed	90MHz with CLA co-processor
Max Program Size	1MB
Recommended OS	Windows, Linux

Above is an artists rendition of what the Controller Card module will look like. Up to 8 inputs and 8 outputs will be provided on the initial prototype, and indicator LED's as well as override switches provide an easy way to debug programs in a real world environment.

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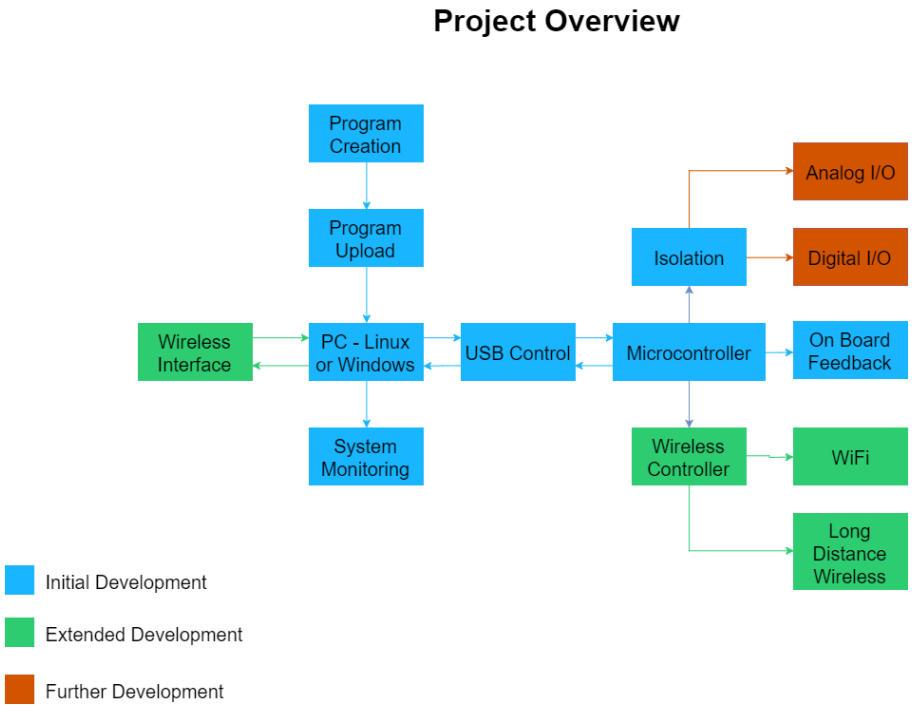
Development Goals and Technical Overview

The Controller Card project has a wide range of applications, and therefore has a very large project scope, much of which is relegated to future development. The initial version will consist of a few, simple, core components. First, a PC program with a modern GUI will be created that can program ladder logic programs, as well as upload and monitor those programs while they are on the Controller Card. The Controller Card must be able to read and store ladder logic programs, and control isolated digital outputs based on the user uploaded program. Additionally, basic real time control options will be given to the user. Below is a bock diagram that illustrates these goals.



Python will be used to create the PC program. To create the GUI and package the program for Windows, Kivy will be used. Kivy is a plugin for Python designed to aid in the creation of user interfaces as well as to assist in the packaging process.

PySerial will provide the means of communicating over a serial port with Python. This library makes connecting over a COM port much easier, and provides functions to monitor the status of connection.

The microcontroller that has been selected is the TMS320F28069 C2000 series from TI. This microcontroller is specifically designed for control applications.

The F28069 provides several features that are attractive for this project. First and foremost, it provides an easy to use prototyping platform via a TI Launchpad (low cost dev board). Secondly, it provides a built in USB 2.0 connection, as well as libraries that support this connection and do the low level communications interfacing. The F28069 is built with a CLA co-processor, making it much faster in real time control applications. Finally, since it is built with control in mind, the libraries and support provided with the controller are heavily focused on my application.

The digital isolators are found from either Maxim or TI, and are pin identical to one another (MAX14850). Both the digital isolator and the microcontroller are reasonably priced, and widely available from several different retailers. They are also both available in QFP packages, which should make assembling a board easier.

The last two peripherals to the microcontroller are the flash memory for storing the program, as well as the power system for powering the device when it is away from the PC. The flash memory will be SPI Flash, with at least 1MB available memory. The power system will be a 5V DC Jack, stepped down to 3.3V to run the controller.

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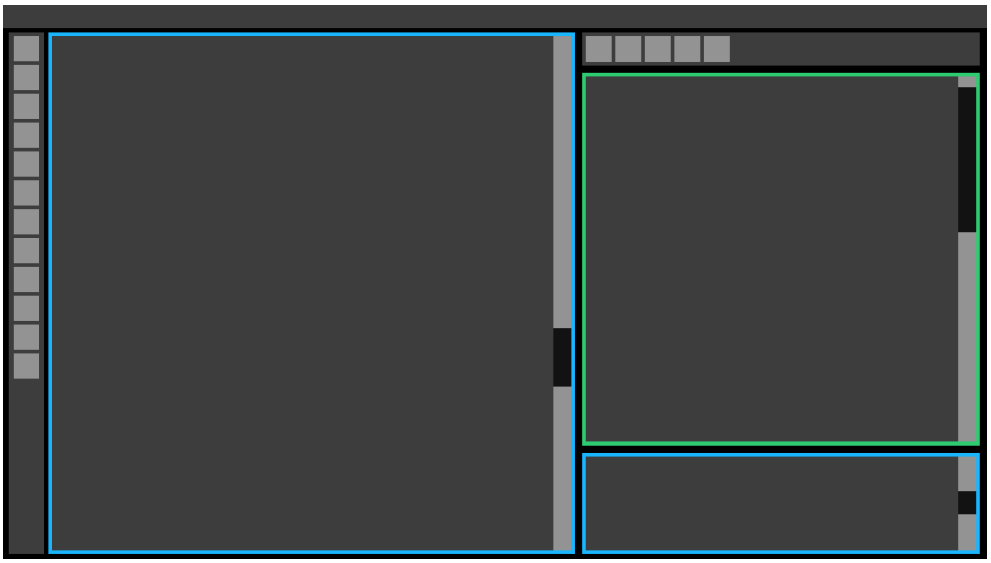
Renderings and Future Development



To the left is a simple wireframe of how the final program will be structured. The large blue section to the left will be for creating programs using the left hand toolbar. The green window will be used to monitor programs, and the toolbar above that window will be used to interact with the Controller Card. The small blue box in the bottom right will give the user useful, text based information such as program size and logical errors.

Once the initial project goals have been completed, additional goals can begin to be explored. The primary extended development goal is to incorporate a wireless interface into the Controller Card, so that all of the functions that the PC based GUI program provides can be completed over WiFi or a different wireless protocol. The wireless development will also include a system to allow different Controller Cards to communicate with each other.

If the WiFi (or other wireless connection) has been added and is fully functioning, industrial digital and analog adapter modules will be created that can interface with the Controller Card, simplifying the final development of a product for the end user even further.

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