**Software Description:**

The main program for our control system was written entirely in the programming language "C". This was chosen so as to ensure compatibility with the Sensoray 826 DAQ board used for control. The program begins by asking the user to disconnect the grounding cable of the welder and waiting for an input from the user confirming this task is completed. Upon receiving that input the machine then runs a calibration procedure by running a PWM procedure to turn the stepper motor until the system sees the homing switch is triggered. The program then turns on the welder's gun to feed wire while measuring the wire speed and setting the average of those wire speeds as the new homing offset.

The next step of the program asks the user to input the speed the CNC machine will be running at for the duration of the print in in/sec. It uses this value to find a corresponding nominal wire speed in an array of nominal wire speeds found via testing, and sets the welding machine to that wire speed. The program then waits for a signal from the CNC machine that it has switched from Relocation mode to Deposition mode. Once the system sees that we have reached Deposition mode, it stops the CNC movement and makes sure the welder is not triggered, in order to check the temperature of the base plate being welded to. If the base plate's temperature is too low the system will pause and wait for a torch to heat the base plate up to above a given threshold value.

On completion of the torch routine the system enters the main loop, this begins by reading a timestamp from the 826's onboard timestamp generator, this value in microseconds will be used to keep track of how long the machine has been in deposition mode later. The system then starts the welder and runs a check for spikes in the current seen by the Current Sensor, if it sees none the system will end the program and return an error report, otherwise the program moves on and starts the CNC's movement back up so that we can check if the machine is still in Deposition mode. If the CNC machine is still in Deposition mode at that time it moves on to take measurements of the number of "peaks" seen by the current sensor, the temperature of the weld's base plate, and the incremental encoder used to measure wire speed. Amongst the measurements it checks and updates the mode of movement seen by the CNC in order to avoid issues with our system trying to deposit while in Relocation mode.

At the end of checking all sensor measurements, the system begins comparing the observed value with the pre-programmed threshold values. The first check is to make sure that the current plate temperature is at an acceptable value. If the temperature has fallen or risen too far, the whole system stops, and runs the torch routine before starting the system back at the initial timestamp read. If the temperature is at an acceptable value, the average droplet spacing is checked against a nominal value found through testing. If the error between the two values is greater or less than 20%, the system terminates with an error, asking the user to double check that the entire system is working. The last check is to see if the droplet spacing is greater or less than a 5% tolerance, and if so the system makes an appropriate proportional adjustment to the wire speed before continuing on.