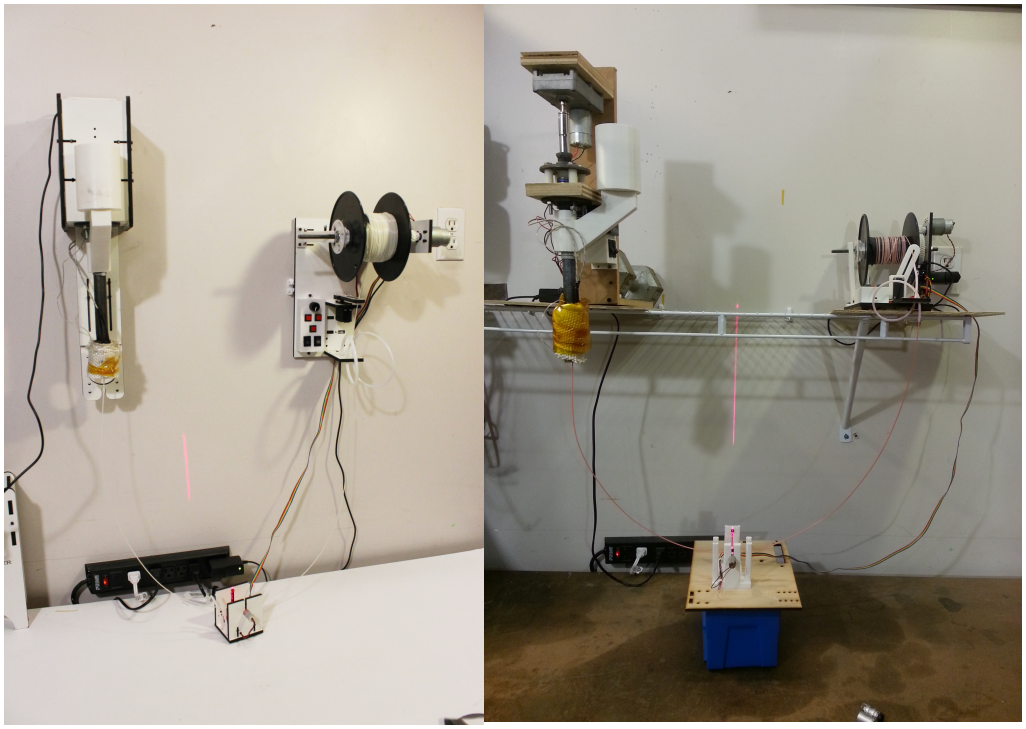
FilaWinder Setup and Operation

SETUP

The FilaWinder works best with the extruder positioned vertically. The filament will make only one bend on the way to the winder, and will behave more predictably.



The enclosure kit sold at Filastruder.com makes wall mounting easy, with slotted holes that make it convenient to take it on and off the wall. If you don't have wall space to use, you can also set the extruder on a shelf. Cut a short length of board the same width as the Filastruder base and screw it on to the bottom perpendicular to the base with some angle brackets for strength. Place a heavy weight on the board and hang the nozzle over the edge. There are some vertical hoppers on Thingiverse-

http://www.thingiverse.com/thing:109650
http://www.thingiverse.com/thing:160545
http://www.thingiverse.com/thing:219463

If you are wall mounting the winder, set the intake plate into the slots so it is perpendicular to the base. If you set it on a shelf, mount the intake plate flat to the base. The filament should always come up to the intake from below.

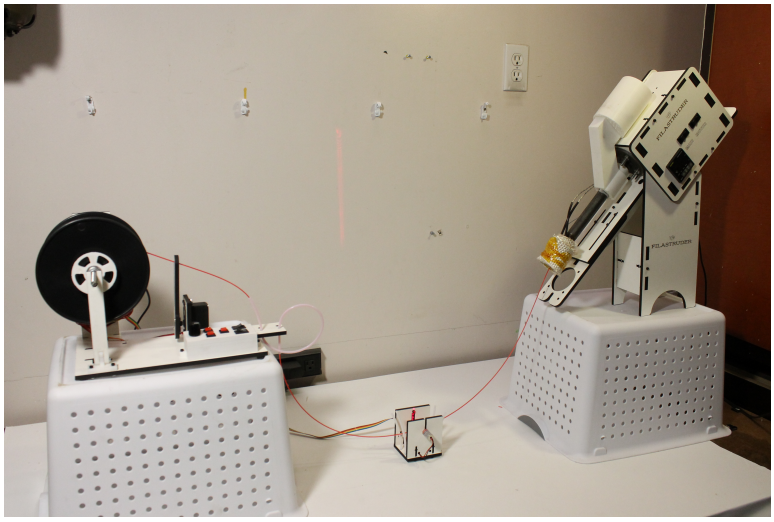
Set the extruder and winder at least “18 (.5m) apart, with the sensor half the distance below them so the filament makes a semi circle as it loops to the winder. The filament has a tendency to twist as it extrudes which can cause the loop to move sideways rather than down. The weight of a longer length of filament hanging between the extruder and winder counters this tendency to twist. As extrusion speeds up relative to the winder you want the loop to drop. If the loop is too short to counteract the twist, it may move sideways instead, failing to trigger the sensor and speed up the spool.

There are a couple of options for setting up on a tabletop. The first is drilling a 90 degree nozzle. Take an undrilled nozzle (available at Filastruder.com) and drill a hole from the back, stopping just short of the face. This is easily done with a drill press where you can set it to stop at a given depth. Then drill another hole sideways into one of the flats to meet up with it. Due to the size of the flats this may not be feasible for 3mm filament. Elevate both the extruder and the winder, with the sensor on the tabletop between them. Here is an example, with an early prototype of the winder-

http://www.youtube.com/watch?v=9tr6OhLTw3U

The other option is setting the winder at a 45 degree angle. If you are using the enclosure kit, there are are plans for a stand on Thingiverse –

http://www.thingiverse.com/thing:192076



Another solution uses PVC pipe to set the extruder at an angle-

http://www.thingiverse.com/thing:165464

The key to consistent filament is to isolate the pulling from the nozzle so there is no variation in the stretching that occurs as the filament is extruded. The loop makes

this possible by causing changes in the pulling force to raise and lower the loop rather than stretching the filament directly from the nozzle. The constant adjustment of the spooling speed keeps the bottom of the loop in one place so the weight of filament hanging from the nozzle (and it's stretching force) stays constant.

Setting the extruder at a 45 degree angle begins to direct some of the pulling force toward the nozzle and not only on the loop. If you take this approach, make sure the filament still drops down from the nozzle and keep a careful eye on the tolerance.

It is also possible to place the extruder horizontally on the table, level with the sensor. This is a simple, easy setup but is the most likely to produce filament with a wide tolerance and requires more experimentation.

OPERATION

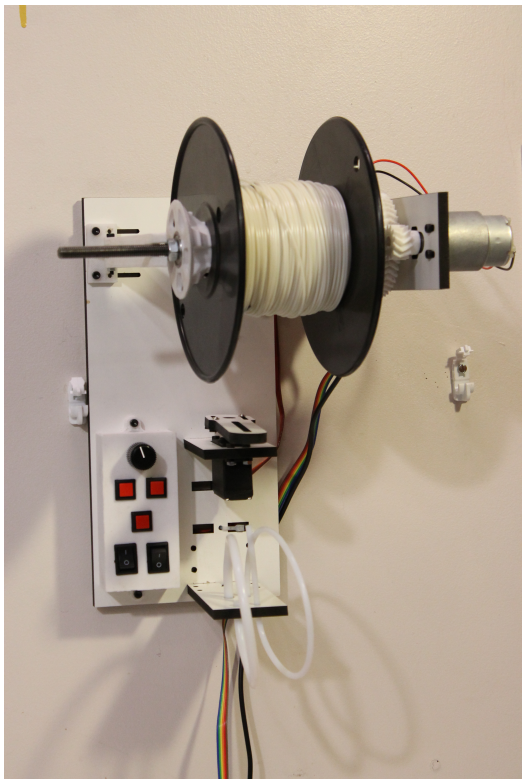
Before turning on the winder put it into Auto mode by setting the left switch to the ON position (|).

Turn on the power by setting the right switch to ON.

Set the left guide limit by holding down the left button and turning the knob until the guide has moved to the left edge of the spool

Set the right guide limit by holding down the right button and turning the knob until the guide has moved to the right edge of the spool.

While in Auto mode, the middle button will set the current position for the guide. Hold the middle button and turn the knob until the guide has moved to the position where you want it to start, usually at one edge of the spool. While spooling, the guide will continue to move in last direction it moved before the middle button was released. If you want the guide to start at the left side of the spool, hold the middle button and turn the knob left until the guide has moved past the left edge. Then turn the knob right until the guide is just inside the left edge of the spool and release the button. As the spool turns, the guide will continue to move left to right until it reaches the right limit.



The left and right limit positions are saved in memory even when the winder is switched off. Once you have found the right positions, you will

not need to reset them. It is still a good idea to set the current guide position when turning the winder on just to insure it has a defined starting point.

Turn the knob all the way to the left, and switch to manual mode by setting the left switch to OFF . It's best to keep the spool from turning during the next step

While in Manual mode the knob controls the speed of the spool, and the middle button activates the sensor calibration. Pick up a short length of filament and press and release the middle button. The winder will enter calibration mode for the next five seconds during which you should wave the filament up and down between the laser and the photocells. It will record the lightest and darkest values received during that time, which it will use to recognize the filament's shadow.

When calibration is done, turn the knob up and down to check that the spool motor is working before switching back to Auto.

The spool might begin turning when you switched to Auto. Move the piece of filament down over the sensor. When the shadow passes the top sensor, the spool should stop. As the shadow moves below the middle of the sensor the spool should begin to turn and change speed as you move the filament up and down around the center of the sensor.

Turn on the extruder motor and begin extruding filament. Gently guide the filament over toward the sensor, and clip off the first couple of inches if the end is wiggly and uneven. Move the end of the filament down toward the sensor, and back up toward the winder's intake. The filament should leave the nozzle at an angle toward the sensor as you do this. Try to maintain that same angle as you handle the end of the filament and do your best not to let it harden into waves or kinks.

When it gets to the winder, push the end of the filament into the tube and keep feeding it through about as fast as it extrudes. Once the end of the filament is constrained by the tube it will start pushing back against the filament at the nozzle due to changes in curvature caused by handling it. Keep guiding the filament on the winder side in a way that maintains the angle coming out of the extruder.

When the end of the filament comes out of the tube, begin pulling it at a steady rate and thread it through the guide arm. Once it reaches the top of the spool, turn off the extruder motor for a few seconds to give yourself some time to work as you tape the end of the filament down to the spool.

Switch the extruder motor back on and let the loop drop between the PTFE guides on the sensor. As the filament reaches the sensor the spool should start turning to maintain the position of the loop. The shape of the loop will probably be uneven from all of the handling, and the bottom will tend to move back and forth between the winder and extruder.

Hold something smooth behind the filament a short distance below the nozzle, such as a piece of PTFE tube or something metal. As the filament tries to push behind the nozzle use that guide to maintain a constant angle of extrusion, forcing the loop to drop rather than move sideways. Don't be so aggressive with this that the filament kinks, however. If you can maintain that angle as the filament travels the full distance from extruder to winder, the loop will maintain a more consistent shape.

This time-lapse video shows the back-and-forth motion that is typical.

http://www.youtube.com/watch?v=TbsIDJNjq2M
Just before the end you can see me steady the loop by using a piece of PTFE tubing to restrain the filament each time it tried to push behind the nozzle.

TROUBLESHOOTING

The Guide Won't Move-

Try going through the startup routine again. Set the left and right limits, and set a guide position. Make sure that the spool isn't turning, sometimes having the hall sensor trigger while setting up the guide will cause problems.

If the guide still won't move as the spool turns, the magnet may have the wrong pole facing out. Take the magnet out of the gear and wave it past the hall sensor (the small black square at the top edge of the control board). The guide should move as the magnet nears the sensor. If not, turn the magnet over and try again.

When you know the magnet is facing the correct direction, glue it into the gear. Once my guide stopped working because the magnet slipped out and stuck to the M8 nut. If the magnet slips part way out it will be too close to the sensor and may trigger the guide too often. It's best to keep it flush with the face of the gear.

If the magnet is correct, check the plugs for the left and right buttons, and make sure they are plugged in to the correct headers. Try switching them around.

The Sensors Stop Responding

If the filament gets bumped or jerked and moves quickly past the sensor, it can lose track of its position and may stop responding. If you cast a deep shadow across the sensor by leaning over it, the light values will go beyond its calibration and the program may stop functioning correctly.

Turn off the extruder motor and use the manual control to pull the filament above the sensor. Turn the winder off, set it to Auto, then turn it back on. Set the guide position and direction back to where it left off. Before you hit the middle button to set the guide position, turn the knob to approximately where it will need to be. If

you left the knob turned all the way down from controlling the motor, the guide will fly off to the side as soon as you press the button.

Switch to manual and calibrate the sensors. Switch back to Auto and turn the extruder motor back on. The winder should go back to operating as normal. When left alone, the sensors should function properly without fail as long as the lighting conditions in the room stay constant. Each time I have seen the sensor fail it has been by own fault from interfering with the filament or leaning over it to check the diameter.

The Motor is Turning but the Spool is Not

If there is a bit of a wave in the filament or it begins to get too thick, it will get harder to pull through the tube. If the nut holding the spool hub isn't tight enough, the gear can slip against the spool, spinning as the spool remains still. Tighten the spool hub nut with a wrench until the spool presses against the gear hard enough to be turned by it.

Ideally the spool will be held tight enough that the gear will turn it through a difficult patch of filament, but slip if it hits a kink that cannot fit through the tube. You can also reduce the tension of the filament by making the PTFE loop wider.

If the spool is tight, but not turning consistently, check the drive gear. If the set screw was tightened too much, the nut may have risen up the screw and broken its slot. This will loosen its hold on the motor shaft, so the shaft might intermittently slip inside the drive gear.