4th Year Project: Soldering Machine

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11th June 2013

1 Existing Solutions

There are a number of hobbyist solutions to deal with SMD parts:

- Solder paste + heat:
  - Solder stencils: Expensive setup costs, very quick to use. Not suitable for this project.
  - Manual solder paste application: Mostly expensive dispenser, or with a syringe.
  - Hot air gun: Can be relatively difficult to get the right temperature profile.
  - Converted toaster over: seems quite common.
- Soldering by hand:
  - Dragging a bead of solder along pins, then cleaning up with solder sucker/wick. Too much feedback required to automate?
  - Some devices (SOIC?) have slightly bendy pins. A small amount of downwards pressure on the pin onto a tinned pad works.

2 Design

2.1 X/Y axes

The X/Y axes have the same requirements. 0.5mm pitch smd devices common - 0.05mm repeatability reasonable target? Choice between stationary "bed" and moving tools, or vice-versa. Stationary bed reduces likelihood of jolting parts around, but tools are bulkier and heavier than the bed, which increases demands on driving mechanism. I quite like the idea

Driving mechanisms:

- Toothed belts + pulleys + stepper motors: Simple, as used in repraps. Can be run open loop very easily. Requires: stepper motor + driver, belt, pulley.
- Threaded rod + stepper motors: Cheap, slower but probably fast enough. M3-5 easy to couple to motor shafts (http://www.thingiverse.com/thing:9622).
- Closed loop: dc motors + feedback. Linear potentiometers: relatively expensive, and potential issues with electrical noise. Rotary encoders: cheap, accurate (m4 pitch is 0.5mm, not much travel/turn, might only need 10 slot encoder)

Linear slides:

- Drawer slides: cheap, surprisingly high precision.

- 3d printed bushings + steel rod. If 3d printer existance assumed, then very cheap solution.
- LM8UUs (or smaller): About 1 each, so probably too expensive.

2.2 Z axis

The Z axis will not require as much precision as the X and Y. Potential mechanisms:

- Micro servos: cheap (2 on ebay). Require no drivers, and simple to drive. Z axis potentially does not need to be linear (UP/DOWN only?) so rotary-¿linear mechanism simpler. If not linear, then hinging out of the way is a cheaper mechanism than slides.

2.3 Part placement

- Manual placement. Much more of a problem for a large number of SMD resistors/capacitors etc, than larger components.
- Vacuum "tweezers". Mechanically relatively simple, but problems of intelligent control, as well as well as storing the components before placement.

2.4 Heated Bed

Soldering to a hot board is easier (smaller temperature difference). Probably not worth the cost/complexity.

2.5 Flux application

Flux application may be a significant problem, unless a manual brush with a solder pen is sufficient.

2.6 Soldering iron

Designing a mount for a cheap and widely available soldering iron may well be cheapest.

2.7 Electronics/Firmware

3 Tools

I have a small mill, a 3d printer and a lathe. It may be worth considering that a lot of people/schools have access to a laser cutter and perhaps mill/lathe, so if possible all custom components could be 3d printed or lasercut.