4th Year Project: Automated soldering/solder paste machine (C-PJGL2-7) Technical Abstract

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Project Summary

The aim of the project was to develop a tool to assist the process of producing boards with surface mount components. The main problems that were the focus of the project brief were:

- How to place components accurately on to the board.
- How to solder them in place.

Two further goals were added during the course of the project:

- The ability to produce the PCB itself.
- The ability to drill any holes for through-hole components and vias, as well as routing out the board outline.

Project Approach

It was decided to build a three-axis CNC machine with a number of interchangeable tools which collectively could support all the required functions.
The three-axis system uses commonly-available drawer slides as a novel and inexpensive slide mechanism. Small stepper motors coupled to threaded rod are used for actuation. An attempt was made during the design phase to have the three axis as similar as possible, a "generic unit", that would simplify design and ensure all errors and calculations were the same.
A number of tools were constructed to perform the various actions:

- A spindle that would accept both milling and drilling bits. A novel design was used that surrounded the bit with small ball bearings. The bit was loosely coupled to a brushless motor, so that only rotational motion was transferred. In this way both run-out and cost were both reduced compared to a more traditional spindle.
- A solder paste extruder was designed to accurately dispense small volumes of solder paste from the syringes in which it is commonly supplied.
- A vacuum needle tool was designed to pick and place the surface mount components. This has an integral pressure sensor to detect the presence of a component.
- A hot air tool was designed to heat and reflow the solder paste when the board was populated

Report Structure

TODO!
Detailed description of project goals
Design thoughts
Chosen design
Manufacture and testing
Improved designs
Results and Conclusions

Results and Conclusions

The machine that was designed during the course of the project has proven to be capable of PCB manufacture and population. Some problems with reliability are apparent, however the design shows promise and could be improved with further work.
During testing it has been the author's conclusion that while the original project goals have been proven to work, the pcb manufacturing aspect of the project has not proved to be practical for the smallest of traces. This does not present as much of a problem as it may appear, as boards with particularly fine traces are likely to need several layers and therefore be impractical for hobbyist manufacture.