WHAT IS IT? The Via Filler uses its Vision Alignment System to fill small via holes of a PCB completely with soldering paste or via ink. Air pressure fills all holes uniformly with no use of a vacuum.

PROJECT GOAL: Replace the manual operation of the Via Filler’s current stage and implement a vision alignment system.

CURRENT ISSUES: Manual operation of Via Filler stage through micrometer knobs is not efficient. Vision alignment parts proposed by Spring 2014 team were not fully compatible with each other.

APPROACH: Find a fully compatible PC or PLC controlled vision alignment system to operate the Via Filler.

OPTION 1: Omron System (PLC)

PROS:
- System guaranteed to work due to EtherCAT connection
- Built in software integrates motion & vision together allows high speed performance
- Technicians & resources readily available in SoCal & user friendly to help succeed
- Very fast data transfer due to EtherCAT
- Omron System is available within 1-2 days

CONS:
- Most expensive, & “overkill” for what we are trying to achieve
- Must use cameras and motors from Omron which aren’t available for 1-2 weeks

COST: $30,000

OPTION 2: PC Controller

PROS:
- Inexpensive relative to Omron
- Fastest shipping, and online and phone technical help available
- Comes with software to control motors and camera controls, but needs MATLAB or OpenCV libraries for edge detection

CONS:
- Needs a computer running Windows 7 along with MATLAB or Visual Studio
- We are unexperienced with functions needed
- Memory allocation could be an issue with such high resolution images
- Heavy image processing programming beyond our knowledge
- We are not specialized in optimizing code to ensure fast execution

COST: $12,000

OPTION 3: Zhongxin System (PLC)

PROS:
- Inexpensive relative to Omron
- Outputs positions through RS 232 serial port, numbers can be used to calculate motor positioning
- Ease of connections & programming through Panasonic FPWIN Pro software

CONS:
- Longer lead time (1-2 weeks)
- Doesn’t have English software interface, Chinese only
- Position unit from Panasonic is 2 axis (2 motors), & machine automation may require a 3rd axis

COST: $11,000

FINAL SELECTION: Option 3

PC vs. PLC (programmable logic controller): Some advantages of the PLC controller include its connection compatibility, data transfer speed, hardware integration, security, and reliability. Therefore, the PLC is the favored option. The PC controller would only win by its relatively lower cost and wider range of programming options and functions.

CMOS vs. CCD cameras: CCD has more uniform shuttering which is good for capturing images in motion whereas CMOS uses a rolling shutter. However, CCD has overexposed pixels & larger buffers between pixel rows which reduces the fill factor of the sensor. CMOS has good windowing which can be read from only a portion of the whole sensor whereas CCD is done in a sequential order instead. Therefore, CMOS is preferred.

Automation: The heart of our vision alignment system is our machine vision system, the MGG-620. Built into this machine vision system is software, logical components, and ports to receive data from two connected cameras (through ISB 2.0). The software has several different machine vision algorithms such as shape detection, edge detection and color detection. For our purposes, edge detection will be used to find the edge of a small, circular via hole. The two cameras will be placed on opposite corners of a via hole plate, diagonally across from each other. Once the cameras have the via hole in view, the machine vision system will run its software and output a position. This position can be sent through the RS232 serial port to our PLC. After the plate is shifted a bit, the camera will detect the same via hole and output another position. Using these two positions, we can subtract them from one another and find the displacement between the two. The displacement acts as our input to our PLC. The PLC will then output a signal generated through closed looped feedback with a PID controller to drive the motors to the correct position, ensuring that the via hole returns to its original position.

Next steps: Once the parts have arrived, we will integrate motion and vision with the Via Filler machine, begin testing the motors, and set up the cameras and the complete machine in our laboratory.