

Film Inspection and Disposition (FInD) System

Client: A Manufacturer of Precision Optics (Fortune 100 Company)

Technologies Integrated

- National Instruments LabVIEW
- National Instruments Vision Builder for Automated Inspections software
- (2) Basler high resolution color cameras
- Oriental Motor linear actuators

Background

Our customer processes a sheet of polarized film that had been cut into small pieces (chips). The most common chip size is a square 10mm x 10mm. Before cutting the sheet an operator visually checks the uncut sheet for defects. The operator had five (5) categories of defects to check for on each sheet. The defects on each sheet are physically marked by using five colored permanent marking pens. After cutting the sheet, the film chips are visually checked again, and the unmarked chips are set aside in stacks of fifty (50). The marked chips are considered scrap. This was a 100% manual process prior to engaging Performance Automation.

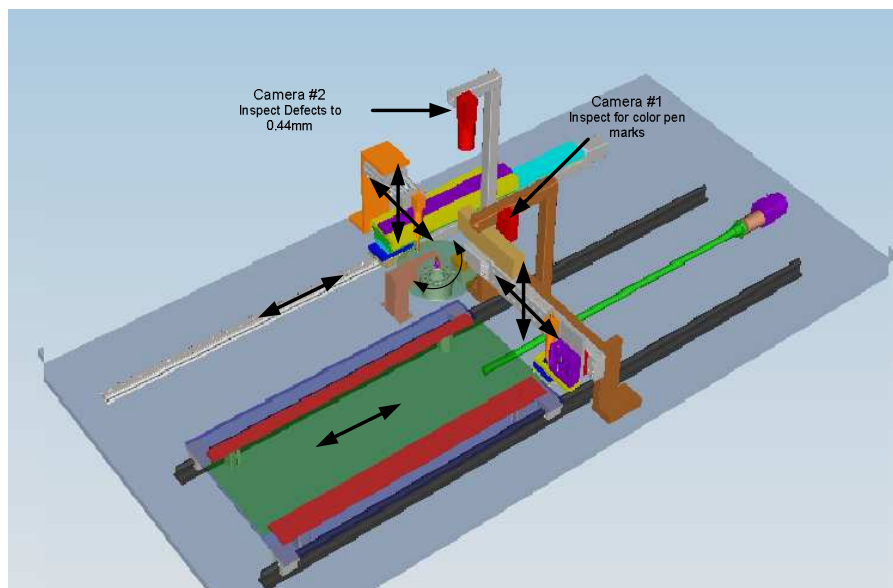
Project Scope

The project scope was to engineer and build an automated cell that uses machine vision to inspect first for the visual color marks, and then defects not detected by the human eye.

An operator will continue to mark defects with 5 different colored pens. But, then the cut sheet of polarized film would be placed into the work cell. The automated cell will then use a two camera system to make required quality inspections.

Stage 1, camera 1 identifies which chips on the sheet are free of color marks. Using multi-axis linear slides and a vacuum cup arrangement, the compliant chips are transported to Stage 2, camera 2.

The stage 2 machine vision camera will then inspect each film chips passed by stage 1. Stage 2 inspects for defects and flaws the human eye could not, as small as 0.04mm in size. Compliant chips that passed the Stage 2 inspection were then transported to holding bins. Each bin holds exactly 50 good chips. A sheet of 400 chips is processed in 18 minutes or less.



FInD Camera and Motion Patterns

Performance Automation Deliverables

Performance Automation (PA) provided a turnkey Film Inspection and Disposition (FInD) System that utilized National Instruments Vision Builder for Automated Inspections (VBAI) and LabVIEW as its core inspection technology. PA deliverables for the FInD System included:

- A flat surface designed for the polarized film and translucent mat to rest upon. This surface was motorized, with mechanical fixtures to insure accurate placement of the film. The time to transition from one sheet size to another could not exceed five (5) minutes.

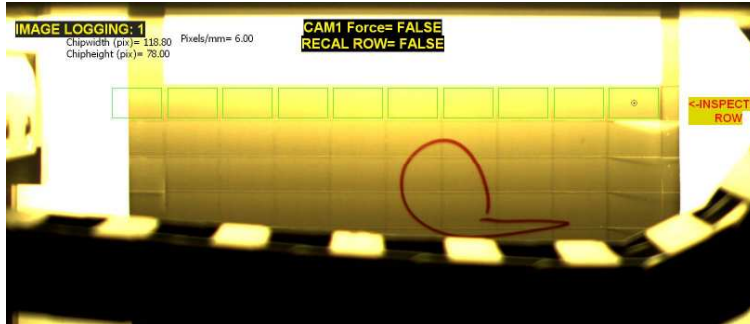


Image from Camera #1 processing a sheet of 10 mm x 10mm film chips

- A LabVIEW graphical user interface (GUI) running on a PC.
- A completely enclosed system protecting the operator from harm of moving parts.
- The system was capable of detecting a mark as small as **0.4mm**.



Film Chip – No Defects



Film Chip – Blue Mark Inclusion



Film Chip – with Hair Defect



Film Chip – Bubble Defects

- A pick-and-place mechanism that removed film chips passing stage 1 inspection for inspection at stage 2.
- A pick and place mechanism that then picked up final compliant chips at stage 2 and stacked them in groups of 50. The system was capable of handling up to 400 good pieces or 8 stacks.
- The LabVIEW GUI included for operator input the number of rows and columns, as well as the length and width of the chip.
- The LabVIEW GUI contained a manual "OVERRIDE" feature.
- The FInD System required cycle time per sheet to be no more than 10.5 minutes per 400 pieces measuring 10mm x 10mm. A sheet of film chips measuring 12mm x 10mm is processed at no more than 18.5 minutes.
- The FInD System created a report for each sheet processed. The report contained a time/date stamp of when the sheet was inspected, and reported the row/column id of each non-conforming chip, plus the color mark or type of defect found on each non-compliant film chip from either stage 1 or stage 2 inspection.

Additional Features of the FInD System:

- At the end of the inspection cycle the FInD System emitted one short tone, illuminated a green light on a stack light. A pop-up window on the LabVIEW GUI indicated "CYCLE COMPLETE".
- In the event the operator opened a safety guard or pressed the E-Stop button, the Pick-n-Place immediately halted. The FInD System continued where it left off when safety conditions were restored.
- Safety circuits were hardwired and included NEC directed Safety Devices.
- The frame footprint was 4'x8'. This included all guards, control panel(s) and operator panel(s).
- The floor height was 37".

