UNIVERSITY OF
CENTRAL FLORIDA

Infrared Automated Optical Inspector

Senior Design: Divide and Conquer 1.0

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1. Description of Project

1.1 Introduction

AOI (Automated Optical Inspection) is a modern method of enacting quality control to small electrical and optical components that would be tedious for humans to do alone. AOI machines can be programmed to find both quality and catastrophic failures in printed circuit boards or other electrical components, or they can be designed to find catastrophic defects in optical/imaging systems. The process is simple. Technicians begin with a reference or benchmark of what a passing component should look like. The software is then introduced to photos that are common failures, with the goal being to teach the software what to look out for during manufacturing. As manufacturing begins, the components go through AOI checkpoints where they are inspected for any predetermined defects.

1.2 Motivation

The Chromorphous Research Team here at UCF has reached out to one of the members of this team with the request to build them a unique AOI device. Traditionally, AOI devices use visible light in order to determine quality of the component. However, visible light is not possible for effective QC for the Chromorphous product. The e-textile's highest failure rate that needs to be analyzed is ultrasonically welded under an electrical bus, meaning that it cannot be visibly seen with the naked eye. However, due to the nature of the e-textile connection, it is assumed that infrared imaging can be used to analyze the quality of the electrical connection instead. IR is not normally used in the AOI process, because introducing IR light can cause reflectivity issues and keeps the machine from seeing surface failures that would need visible light to see. However, we would not be introducing IR to the system. We would be using the assumed IR emission from the fabric to image and determine failure/passing.

1.3 Goals and Objectives

The project is to complete a working prototype that can be used in small scale manufacturing for the Chromorphous team. This prototype needs to be a module in the sense that it can be upgraded and added to in the future when higher levels of production are achieved by the Chromorphous team. Creative solutions must be designed in order to be within the budget cap that has been suggested by the team, and multiple facets of the AOI must be designed to complete the autonomous system.

1.4 Project Functionality

There are three crucial functionalities for the project: A laser counter to determine the amount of metal fibers that have passed through a specific checkpoint, the actual AOI machine, and a mountable electrical system that can test each of the metallic fibers for isolated testing.

2. Requirements and Specifications

PCB Specifications

Housing Dimensions (W) x (D) x (H) mm(in.)	850 x 1340 x 1230 (33.5 x 52.8 x 48.4)
Weight	Approx. 450 Kg (992.1 lbs)
Electric Power Requirement	Single-phase ~100-120/200-240V +/-10%, 50/60Hz
Resolution	18μm
Air Requirement	0.5MpA, 5L/min (ANR)
Target PCB Size (W) x (D) mm(in.)	50 x 60 to 460 x 500 (2 x 2.4 to 18 x 20)
PCB Clearance	Top: 40mm (1.57in) Bottom: 40mm (1.57in)

General Specifications

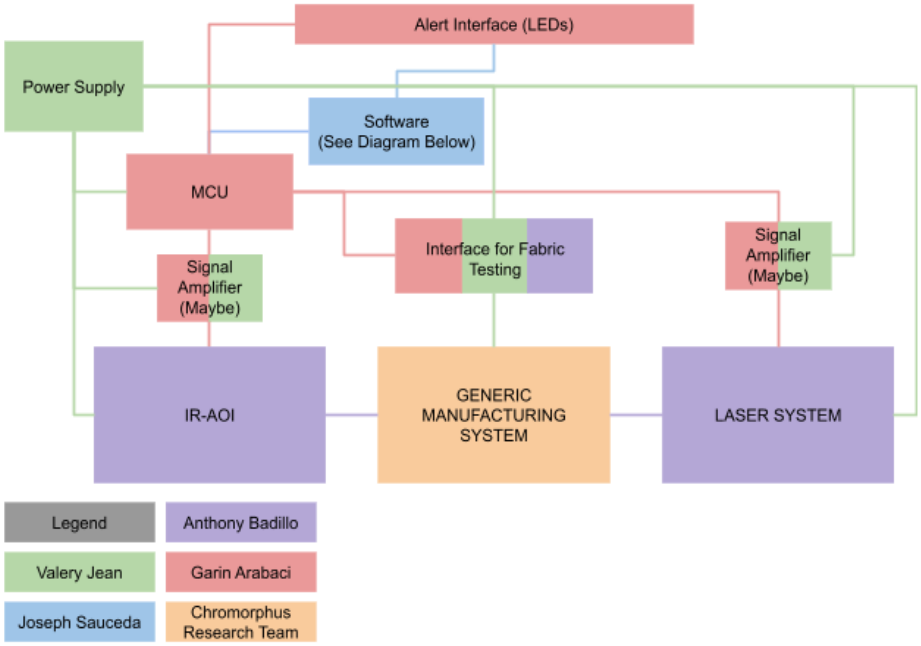
- Preliminary size of 19.25″ x 11″ x 8.50″
- All systems must be housed on variable height stand
- AOI camera and the measuring laser must at six inches above the line
- 120 V AC power preferred if possible
- System must be capable of upgrades
- All optic components must be housed internally
- Can operate within a manufacturing environment, regardless of air cleanliness
- External PC support (air gapped, log collection)
- Power supply must be either internal or must fit a 1.5 ft. x 1.5 ft cube for walkway safety
- System must be rigid enough to be moved without fear of misalignment
- Measurements, data collection and automation must match operation speed of 1 ft/s

Possible Project Constraints

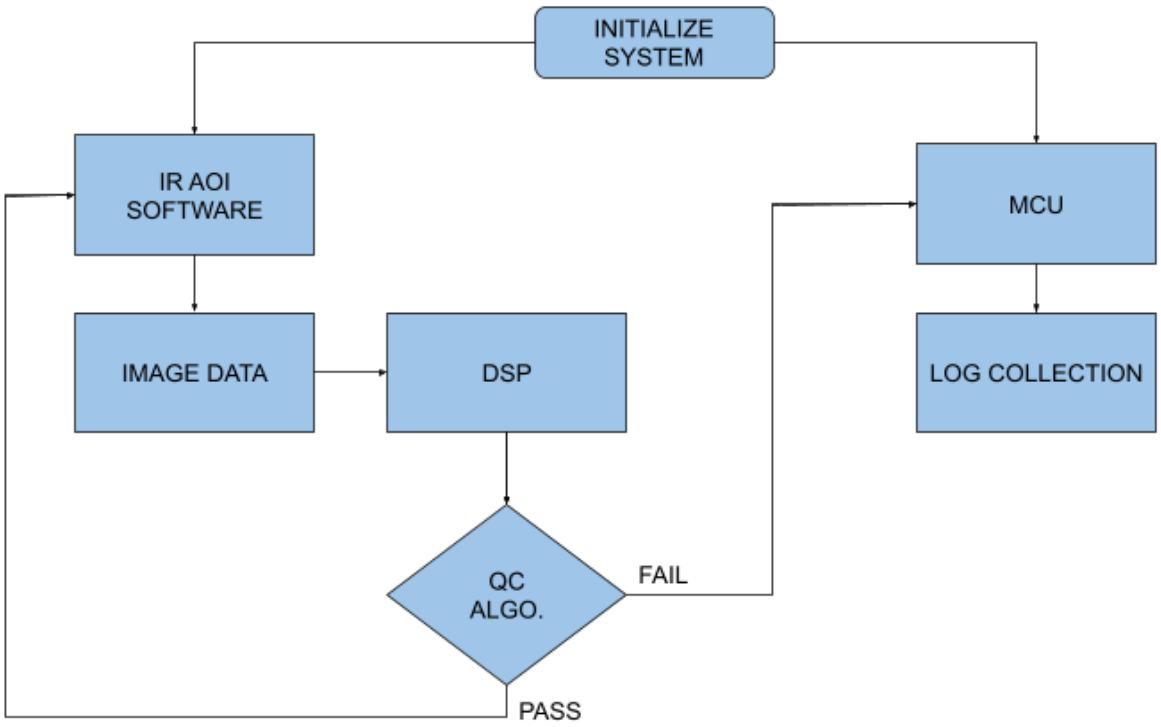
- DC/DC Power supply
- Safety design
- Testing Process
- Reliability
- All standard connections
- Programming languages

3. Block Diagrams

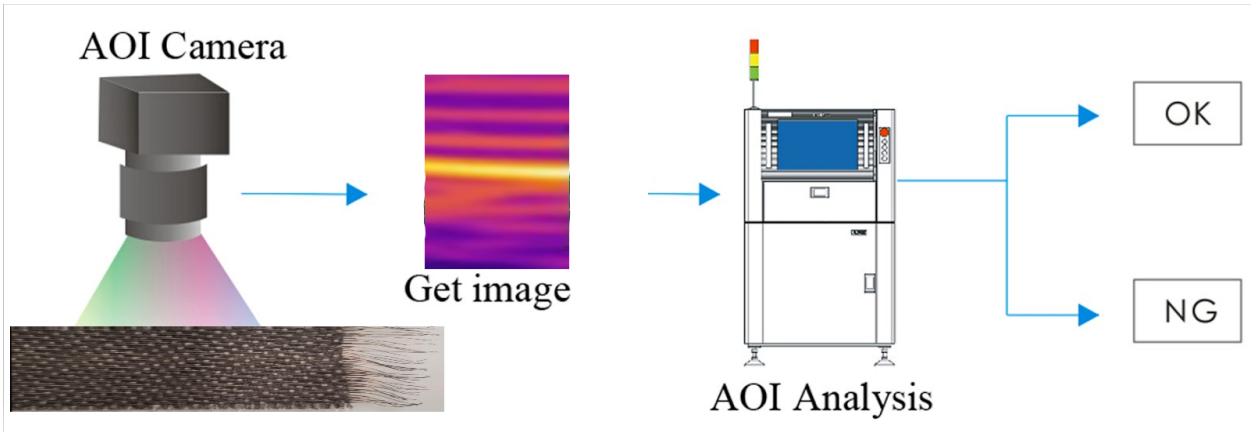
3.1 Hardware Flow



3.2 Software Flow



Prototype Illustration



4. Budget and Financing

Our Budget will be funded through the **Chromorphus Research Team** with a maximum of $2500 and the potential for more if it is determined to be vital to the success of the project. A majority of the cost in this project will go towards the Optical Sensors themselves and to a lesser extent the power supply to run it. As a cost-saving measure, we can make the enclosure for all this into a 3D print with a metal brace.

Electronics/Power

Item	**Cost Estimate**
Custom Power Supply	$300
Custom PCB	$150
Custom Enclosure (3D print)	$20
Microcontroller	$80
MISC/Unforeseen	$150
Total	$700

Optics (Tentative)

HeNe Laser	$592 (Can be borrowed for Demos)
NIR or IR camera	Upwards of $1000

Lenses	Upwards of $600 (Can be borrowed for Demos)
Mirrors	Up to $700
Total (Borrowed)	$1700
Total	$2892

Total Estimated Cost of Electronics/Power and Optics: $2400

5. Milestones

Table: Senior Design I Milestones

Number	Milestone	Tasked	Start Date	End Date	Status
Introduction to Project					
1	Meeting with the team, advisors, and/or customer	Group 1 CREOL	5/19/2022	5/23/2022	Completed
2	Project Familiarization	Group 1 CREOL	5/23/2022	5/27/2022	Completed
3	Role Assignments with team (Group)	Group 1 CREOL	5/27/2022	6/1/2022	Completed
4	Part Identification and Classification	Group 1 CREOL	6/1/2022	6/10/2022	In-Progress
Project Documentation					
5	Initial Project Document-Divide & Conquer	Group 1 CREOL	5/27/2022	6/3/2022	Completed

6	Updated Divide and Conquer Doc.	Group 1 CREOL	6/3/2022	6/17/2022	In-Progress
7	First Draft Senior Design I	Group 1 CREOL	6/20/2022	7/8/2022	Pending
8	Second Draft Senior Design I Rev.	Group 1 CREOL	7/11/2022	7/22/2022	Pending
9	Final Report	Group 1 CREOL	7/25/2022	8/2/2022	Pending
Research and Development					
10	Software and Communication	Joseph	5/27/2022	6/17/2022	In-Progress
11	MCU	Garin	5/27/2022	6/17/2022	In-Progress
12	IR-AOI and Laser	Anthony	5/27/2022	6/17/2022	In-Progress
13	Power Supply	Valery	5/27/2022	6/17/2022	In-Progress
14	Filtering and Amplification	Group 1 CREOL	5/27/2022	6/17/2022	In-Progress
15	Board Prototyping V1&V2	Group 1 CREOL	6/20/2022	7/22/2022	Pending
16	Final Prototypes Stress Tests	Group 1 CREOL	7/15/2022	8/1/2022	Pending

17	PCB Layout	Group 1 CREOL	7/22/2022	8/1/2022	Pending

Table: Senior Design II Milestones

Number	Milestone	Tasked	Start Date	End Date	Status
1	Working PCB V1 Stress Test	Group 1 CREOL	//2022	//2022	Pending
2	Final PCB Stress Test	Group 1 CREOL	//2022	//2022	Pending
3	MTC IR-AOI	Group 1 CREOL	//2022	//2022	Pending
4	Conference Paper	Group 1 CREOL	//2022	//2022	Pending
5	Design Demonstration	Group 1 CREOL	//2022	//2022	Pending