Minutes 1

Date: 6/20/18
Venue: GJ Design Suite
Time: 12:30

I. Product Requirements Document

Make the objective be the outcome of your project, not just the completion of this document (probably something similar to the problem statement)

Dramatically expand references. Include the wiki site of the last team, various user manuals, and references from class.

Towards the front of the document, include a map/layout of the current cell for reference throughout.

Add Denso specific terminology related to programming the controller as well as the pendant.

On what the device should do... include some of the specifics about different part manipulations/modifications (i.e. material handling, fastener insertion/removal, optical scanning, acceptance of mixed load of parts, final storage by part type).

Take a look at UL (and Boeing company) recommendations for collaboration between robots and humans. There are probably some principles about safety that we need to follow. Ankit may have addressed some of these.

On the reliability side include something about collision avoidance.

II. Interview Questions

Objective is to integrate two arms in a mini assembly line, illustrating supervisory control

Freedom to change anything from previous projects

Budget of about 1000 dollars

If we use a screwdriver, consider Arduino intervention

Look up: FANUC, DENSO, KUKA, small manufacturing lines

Use the controller to manually get coordinates

Should design different tools to utilize during process

Minutes 2

Date: 6/27/18
Venue: GJ Design Suite
Time: 12:30

I. **Product Requirements Document**
Elaborate more on objective
Explain what the references are/why they are important
Input more acronyms for the project
Include a spot to explain some of the code used
User-Interface (4.1) vs User-Interface (7.2)
Reliability Requirements (5.7) – Emergency Stop

II. **Design Ideas**
Idea of Lego/Duplo/Mega Blocks assembly
Build or research products for pushing pieces together
Potentially stacking cups – one robot does one row, the other does next, etc.

III. **Gantt Chart**
Should have a "lead" for each sub-project

IV. **SEL Inspiration**
One arm pushed buttons, maybe we are thinking too complex
Screw station seemed to detract from the goal of the project

Minutes 3

Date: 7/3/18
Venue: GJ Design Suite
Time: 12:30

I. **Product Requirements Document**
Missing from Document:
Process Description
Fixtures to be Designed
Software Operations
Include Goals of the project in object

II. **Design Idea**
Process essentially:
Incoming Parts queue…Sort by type of part after scanned…loops until all parts are sorted…Pick and Place Bottoms from sorted parts…Pick and Place Tops onto Bottoms…Pusher tool assembles pieces…Pick and Place Assembly into Finished Parts Location.
Use two parts: Male and Female

III. **Design Validation Plan**
Finish Product Requirements, then look into this more

IV. **WikiPage**
Include Minutes/Agendas, Team Contract, PRD, Schedule, Budget at bottom
Process Learning
What goals of project are
How this project will benefit future

V. **Portfolio**
Send layout via email by Monday

Minutes 4

Date: 7/10/18
Venue: GJ Design Suite
Time: 11:45

I. Design Ideas

Parts:

Male and Female Parts are good the way they are. Consider using "Vandal Swag" to make it more interesting for those not in the project.

Get first part prototype made this week!

Once we have the parts, we can start coding.

Pile weights onto the parts to test the weight to push them together.

Barcode scanner will scan the parts no matter the orientation.

Ramp:

Potential Feeder Bowl to dish out the parts? Look into buying a small vibrator.

Gripper:

Good idea, try to 3D print the parts.

Pusher:

For push finger, go to Bill and gather his opinion. See if it is manufacturable; if anything needs to be better designed, revise the design. Try to make it 3D printable, if possible.

Use the same concept as the previous group for the base. This will save time and material.

Fixture:

Andre, Sarah, Sammy – if we need to use laser cutter or 3D printer. Feel free to buy any material necessary.

II. Product Value Proposition

Collaborative manufacturing of an object is what our value proposition is. Imagine it to be a 30 second elevator speech.

III. Concept Design Review

Refine the flowchart:

Say what each part of the process is and what is controlling it.

1. OP – Operator
2. R1 – Robot 1

3. R2 – Robot 2
4. SC – Supervisory Control

Show off parts made, fixtures made – a formal review of what has been accomplished. Give a basic concept of the idea.

Target Date: 12:00 pm July 26.

IV. Design Validation Plan

Refine operations. What can be done to ensure everything operates correctly?

Add more to the PRD in order to verify all of the requirements.

V. Available Materials

Check with mentors, there should be material available – aluminum, wood, brass, potentially 3D printer material.

Check with Bill for any scrap material.

New printer is available for use – need to speak with Andre or Dr. Perry to use.

VI. Misc.

Training to use robots with Ankit at 12:00 pm Thursday 7/12.

We will need several iterations of each part, so do not worry too much about whether they work the first time vs. what you can learn from it. Can always make them better. Prototype this week, if possible.

Minutes 5

Date: 7/17/18
Venue: GJ Design Suite
Time: 11:45

I. **<u>Concept Design Review</u>**

Shoot for July 26 at 11:30 pm

Slides to offer:

- Problem Definition
- Problem Statement
- History of UI Robotic Cell
  - Evolution to Current State
  - Future State Potential
- Specs/Reqs.
  - Process Needs
  - Constraints
- Process Description (Initial/Final)
- Compenent Design Development
  - Delivery System
  - End Effector
  - Scanner
  - Assembly Fixtures
  - Storage Area
  - Product
  - Robot Programming
- Schedule
- Budget
- Unresolved Questions
- (More detail than the Wikipage presentation)

II. Product Value Proposition

Format up to us. Can do written, verbal, video format if desired.

III. Parts Design

Should be low friction and able to push together.

Make the slot larger in the male part to push easier together

IV. Pusher Design

Can create a large, flat end piece on the tool to cover more surface area.

V. Fixure/Storage

Have both fixture and storage in a set location, so it does not move when inserting the parts.

VI. Code Testing

Tested code, did not work. Changed settings in the controller from CRLF to CR as well as commented out code that seemed unnecessary. Able to achieve TCP/IP protocols.

Minutes 6

Date: 7/24/18
Venue: GJ Design Suite
Time: 11:45

I. Concept Design Review

Send powerpoint to Dr. Beyerlein for review before the target date.

II. **Code Testing**

Ankit will send code for gripper.

Goal: Create a sample code for the robots to show them working together, might need to calibrate points

Need to calibrate robots so they stop completely before the other starts its task.

III. Misc.

Find current limits for each axis – depends on the position, but you can find the torque limit from this.

Takes a .2 kg load to fit the parts together.

Shigley use is perfect for guessing the material and coming up with data to prove a point.

To find the spring constant, we should stack weight onto the compression spring to see how far it has moved. Using F=-kx, this gets the spring constant.

IV. Snapshot

Show how efficient the code is. How many lines are there? Can it loop? Show goals, progress, metrics of the code.

Come up with a list of items with what we have done and progress so far.

Show how many different designs have been created for each part.

Minutes 7

Date: 7/31/18
Venue: GJ Design Suite
Time: 11:45

I. Snapshot

We can show a demonstration of the robots working together, as well as a video. Don't spend too much time to initiate the program though.

We can have a continuous cycle of the manufacturing process as long as it does not take too much time. What we want to show is up to us.

Audience will include mostly the class, but some outsiders may join.

Part of our team can stay to explain the project while others mingle about. Take turns doing this so we can understand others' work.

Have features, fixtures, and process available for audience to see.

We can show code in the snapshot, but make sure it is dumbed down so people can follow.

II. Wikipage

Can upload a GIF file to Wikipage, however a video is not possible. We should put this in the Design Concept section to demonstrate our progress.

Final Design section should be changed to Design Concept for now. Once our Final Design is complete, we should revert it back to its original heading.

If people can understand the code during the snapshot, we can use this for our Wikipage.

III. Portfolio

Keep the same organization we have already established, update the documents and insert into the portfolio, as well as new ones such as the Design Validation plan, Design Review, etc.

For the Design Validation, show what has been tested, what still needs to be done.

Turn in with Logbooks on Thursday.

IV. Logbooks

Turn in on Thursday, will get them back on Friday.

Minutes 8

Date: 8/20/18
Venue: GJ Design Suite
Time: 9:30

I. Gantt Chart/Goals for the week

Integrate the scanner; make sure it functions properly.

Design a 3D model for the ramp

Prepare a short speech on our project for the first day of scheduled class. (CS and EE students will be participating as well.) Should be about 1- 2 minutes.

Stop by Dr. Beyerlein's office to gather our portfolio

Email Ankit about the summer class (ME 404 – Industrial Automation) and volunteer suggestions on what we liked or did not like

On October 1st there will be an advisory board meeting. Try to be done with the project by then.

II. Faihan Drawing

For the conveyor belt, have a specification in mind for how heavy of pieces we want it to be able to handle

Purchasing a conveyor belt might be more ideal than making one, take this into consideration

III. Suggestions with other classes/work

Dr. Beyerlein suggests we use a laser cutter for the ramp – quick, easy to re-prototype, cheap

We should potentially use a vibrator to keep the parts moving down the ramp as we want them to

Minutes 9

Date: 8/27/18
Venue: GJ Design Suite
Time: 9:30

I. Scanner Integration

ME 430 (Senior Lab) project, we should use the scanner and test its limitations (e.g. different colored barcodes, different sized barcodes, different speeds, different distances, etc.)

Created 6 different barcodes for each colored male and female part.

II. Ramp Design

Ramp is almost complete, just need to tweak a few things on SolidWorks before we laser cut it.

Laser cutting will happen this week

III. Gantt Chart Overview

Conveyor belt will need a little bit more time. We need to make sure we record these changes on the Gantt Chart.

Ankit says we should aim to be completely done with the project by November, so that the last month we can do quality checks on the project.

Look into the parts for purchasing, will discuss Friday

Minutes 10

Date: 8/31/18
Venue: GJ Design Suite
Time: 9:30

I. Scanner Integration

We successfully read the barcode on the part using the robot and scanner together, however, the gripper broke in the process.

II. Ramp Design

All pieces have been laser cut

Need to glue pieces together, will be doing this after the meeting.

III. Purchases

List of parts to purchase:

- Belt
- 80/20
- 80/20 connection nuts
- Arduino w/ Ethernet
- Stepper Motor
- Stepper Motor Controller
- Aluminum Rods
- Bearings

IV. Gripper Redesign

Gripper Broke in the process of integration the scanner, due to the shear stress of the robot moving while the plastic piece was stuck across a part

To make it sturdier in case this happens again, we will implement aluminum gripper end effectors

Minutes 11

Date: 9/10/18
Venue: GJ Design Suite
Time: 9:30

I. Purchases

All conveyor belt parts are purchased, aside from motor and controller

We need to wait on things for the next couple of weeks due to shipping

II. Gripper Redesign

Andre wants us to research how to create CAM files in order to use the CNC machine to create our desired new grippers

Using the CNC machine, we can create a more aesthetic looking part, so we need to round some of the edges and create a less blocky design

We also need to make a designated right and left side, so it is easier to chop off the excess material

III. Ramp Design

We need to adjust the angle of the ramp so that the male will be flipped. Currently it does not work, but when tilted at the right angle it does the trick.

The slot for the male part is also slightly too small. The O-Ring on the male part just barely slides into it when it does flip.

IV. Stepper Motor and Controller

Marshall Townsend, who has knowledge on stepper motors and controllers, gave some good input on what exactly to purchase for the stepper motors and controllers

We also need to do some research about IP Protocols on the Arduino and research what part to buy in order to make this work

Minutes 12

Date: 9/17/18
Venue: GJ Design Suite
Time: 9:30

I. Stepper Motor and Controller

Spoke to Marshall about these, he suggested to use the Arduino Ethernet capability. At first, we could not find one available, as they are no longer produced, so he suggested to use a BeagleBoard. However, we eventually found one and made the purchase.

Marshall suggested to use a NEMA 23 stepper motor, any works

For the controller, we need to buy one that is NEMA 23 capable, and Marshall directed us to the STEPPERONLINE controller

II. Gripper Redesign

This week we will use the CAM files Andre helped us to create in order to create new gripper end effectors

The 3D models have already been created and are much smoother looking

III. Purchases

Most of the parts came this week, still waiting on a couple more items. Should begin the conveyor belt construction starting next week when all the parts are delivered.

IV. Scanner Integration

We need to test the speed limitations of the scanner this week in order to see how fast the robot can go to try to make this process as streamlined as possible

A code is written for this, increasing the speed each time it passes over the scanner, however it is not working. Need to speak to Ankit this week to see what the problem is, whether it is the scanner not taking input or something else

Minutes 13

Date: 9/26/18
Venue: GJ Design Suite
Time: 9:30

I. Purchases

Arduino with Ethernet is not programmable without a controller

We purchased this controller, should be here later today

Still need to buy a belt for the pulley system in order to attach the motor to the conveyor

II. Ramp Design

Changes that need to happen are to create a flat part at the end so the gripper is able to grab the part not at an angle

The angle of steepness needs to be greater in order to flip the male part as we want

Potentially need to put a small flat piece of wood at the tiered area of the ramp in order to create the moment for the male to flip

Make a queue in order to distribute one part at a time

III. Gripper Redesign

Gripper has been milled, we just need to put holes in the base in order to attach the parts to the arm

IV. Scanner Integration

Scanner seems to be reading the barcodes in its program looking at the video, but it does not record the string within it

Need to meet with Ankit ASAP to figure this out

V. Final Design Review

What to include:

- Ramp Design
- Conveyor Design
- Gripper Changes
- Plan to conclude the project
- Point of view for testing the process
- Should be about 20 slides (~20 mins)
- Meet in GJ 112 at 9:30
- What is our plan to address some of the problems?

VI. Advisory Board

Will be on Monday October 1st from 4:30 to 5:00

Basically a snapshot of what we have completed so far

VII. Conveyor Belt Update

All the parts are here for the conveyor, we will be machining the tightening mechanism and shafts this week so we can put together the main part of the conveyor belt.

Still waiting on the belt itself, should be here today

Minutes 14

Date: 10/3/18
Venue: GJ Design Suite
Time: 10:00

I. Ramp Design

Make one of cardboard to get a better idea of what we need. Easier than a solid model; faster than a laser cutter.

We were about halfway through the model before we had difficulty with the angle.

II. Conveyor Update

Going to make the belt endless next week. Need to travel to Spokane to do so.

Almost done. Just need to turn the last shaft.

Need to purchase a belt for the motor. Will make the pulleys after.

On the shaft, we will make a key for the pulleys, then 3D print them and press fit them onto the motor and to the shaft.

III. Snapshot 3

Overview of what the final process will look like.

Implementation of the scanner. Provide setup for what the final project will look like.

IV. Portfolio/Logbook

Meet with Ankit to see what he would like to have included into our Portfolio.

Both will be due in the next meeting.

Minutes 15

Date: 10/10/18
Venue: GJ Design Suite
Time: 10:00

I. Ramp Design

Made a cardboard version, works well

Currently reworking the model for the ramp on Solidworks, should be done by next week

II. Conveyor Update

Traveled to Spokane, belt is in the process of being connected. Will be done in a couple of days,

just waiting for a call from the person who is taking care of it

The first shaft is turned, but we are still working on the other one

The belt for the stepper motor was purchased, currently making 3D models of the gears

We made a key for the shaft in order to get the gears to fit and spin

Minutes 16

Date: 10/17/18
Venue: GJ Design Suite
Time: 9:30

I. Ramp Design

3D model is completed and all the pieces are laser cut

Need to glue all the pieces together, but should be assembled by the meeting next week

II. Conveyor Update

Belt is done, but needs to be redone because it was too long

Shafts are completed

Gears have been printed

Conveyor is complete, just waiting on the belt again

Minutes 17

Date: 10/24/18
Venue: GJ Design Suite
Time: 9:30

I. Ramp Design

Physical ramp is completed. Works as planned except for a high amount of friction at the bottom

All parts make it down the ramp, but do not move after one is removed

II. Conveyor Update

The belt seems to be sliding over the top of the shafts

Using the variable tension system, we can prevent the sliding slightly but not completely

Most likely going to turn the shafts more on the inside part, so the belt doesn't go over the top of the shafts

III. Area Cleanliness

Begin working on the mess from previous years, cleaning the corner area and organizing the drawers

Use our own discretion to determine where things should go

Minutes 18

Date: 10/24/18
Venue: GJ Design Suite
Time: 10:00

I. Ramp Design

We found out that using Scotch tape helped a lot with reducing friction. No problems anymore.

II. Conveyor Update

Shafts were turned more to create a larger depth, forcing the belt to not slide over the top of the shafts

Everything seems fine now, just a matter of calibration between the tension and the motor/controller

III. Area Cleanliness

The corner has been organized and drawers are more presentable

IV. Arduino Integration

The Arduino is giving trouble, cannot figure out how to send a signal from Robot 1 to the Arduino for it to start moving

Talking with Marshall, he suggested to use another library rather than the general Arduino one due to the STEPPERONLINE controller.

Minutes 19

Date: 11/7/18
Venue: GJ Design Suite
Time: 10:00

I. Arduino Integration

Because we cannot figure out how to get the TCP/IP protocols to work properly, we decided to go with the scanner protocol. This means the Arduino will receive a signal via the scanner in the form of a string.

We have a code for it, but there are a couple of problems. This code stops the motor from running, but the speed is uncontrollable, and too slow. We have also made another code which has variable speed control but will not stop when we would like it to.

Minutes 20

Date: 11/14/18
Venue: GJ Design Suite
Time: 10:00

I. Arduino Integration

Decided to try a couple more things to get the code to work. Getting rid of the AccelStepper library in the Arduino program helped set a variable speed so we could both control the speed and stop the motor when we wanted. This was the last part of the project before we could start putting it all together.

II. Portfolio

Include Scanner Instructions:

- Types of barcodes it can use
- Speeds/distances
- Put ME 430 report in it

Different section for programming, conveyor

Only put final products into portfolio

Put Models/Drawings in the same section

Move reference to project learning section

Create a user guide for someone who does not know how to do it

III. Presentation

Should be about 12-15 slides – 1 slide per minute

Process overview of all final products

Dress up for it – formal wear

Send over vacation so he can go over it

IV. WikiPage

For each part, make a table showing the solid model on the left, description in the middle, and the physical product on the right

V. Poster

Go around looking at old posters to gather ideas for how ours should look

Minutes 21

Date: 11/28/18
Venue: GJ Design Suite
Time: 10:00

I. Poster

Use black wording on gold background so it easier to see than white on gold

Print a paper version for Friday

Change lessons learned to Key Features

Change the Flowchart

Update the wording on the problem statement/goal

For the Process Description, make larger so it is easier to see

Make the title bigger, change to Robotic Manufacturing Cell 2018

II. Presentation

Include a video of the whole process

Get rid of the wordy slides to have more pictures

Change heading of Conveyor Belt to just Conveyor

For the Problems and Solutions, make a table and include pictures so it is not as wordy and a summary of what was done can be shown

Include the protocols section rather than having the deliverables

Create some slides to answer some foretold questions

No Budget/Schedule/code in presentation

III. Logbook

Due Friday before finals week

Minutes 22

Date: 12/3/18
Venue: GJ Design Suite
Time: 10:00

I. **Poster**

Change the orientation of the right side section to reflect the order of the process

Make all gold lines aligned

Put the University of Idaho logo on there

Print on 40 x 30 foam core board

II. **Logbook**

Write a two page reflection on the entire project, what you learned, etc.

No need to backfill from the last evaluation, or to put an evaluation in our logbook

Due Friday