EE/CprE/SE 491 - sdmay19-31:
Multi-Purpose Automated Robotic Mixer (mpARM)
Week 16 Report
February 23– March 2
Client: Alexander Stoytchev/Brett Altena
Faculty Advisor: Alexander Stoytchev

Team Members

Drew Caneff — *3D Printer Specialist/CAD Designer/Accountant*
Amos Hunter — *Electromechanical Specialist/Meeting Scribe*
Brett Altena — *Meeting Facilitator/ Computer Vision Developer*
Kristian Wadolowski — *Report manager/Front-end programmer/Computer vision Developer*
Jase Grant — *Embedded Systems/ Assignment Manager*

Summary of Progress this Report

- **FPGA-** Searching the internet for tutorials on how to do this in python. Started the new FPGA code with the python. Not sure if it is possible to use python in this. Having trouble with the camera because I can't test the input with the test bench yet. Waiting for the J-Tag to come in.
- **Frame-** The frame design continues to change, so communication through Slack and meetings remains important Stoytchev suggested using metal handles for the frame rather than the fabric handles I currently have. This is a minor change and should be easy to implement. As before, when cutting the aluminum strut, care was taken to be conscientious of noise, to avoid scratching our work surface, and to clean up afterwards. The cut ends were sanded by hand with sandpaper to smooth them down, removing burrs which might scratch or cut. I carried the aluminum and wood to the Senior Design room, where it remains with the other materials. It should be safe and secure there. When transporting the aluminum, care was taken to not bump door frames or other people. Various ideas of where and how to mount the base of the robotic arm have been discussed throughout this period. I have weighed in on these topics and helped the team to evaluate the best course of action.
- **Arm-** Concerns about the ability of the optical sensors working correctly continue. One of the 4 sensors seems to work as indicated, but the other ones are not aligning with their corresponding optical disks. This will not prevent the robot from functioning, but hinder the robot's ability to know when it has reached the max angle a joint may move without breaking. To overcome this issue the team feels that steps can be taken when programing to prevent system failure. Additionally, I am considering installing a couple of push switches so as to allow for a signal to communicate to the robot that the max angle has been reached on several of the articulations. More warpage in the 3D printed components was discovered while assembling the robotic arm. While have had made many subsystems using 3D printer filament I have never done a whole system to this scale. With such a mechanically intense system, the flaws of hobby level printer quality is apparent. While The parts received from our sponsored company are mechanically perfect in every way, the hobby level prints need constant manipulation with the Dremel among other tools. Great pains are being taken to sure up the system mechanically to improve our chances of success, however, I do expect some quirks to appear in the robot arm as the program is interfaced with the robot.
- **Computer vision code/Main program-** The Hough Circles algorithm is used for pancake detection and in one approach it is used for bubble detection. The algorithm works perfectly for detecting pancakes that are perfect/ imperfect circles due to their large size. Hough Circles allows the program to easily obtain the radius of the pancake in terms of pixels. Through testing of the algorithm, we were able to translate

how many pixels at a distance of 35 cm away from is equal to the actual pancake diameter measurement. This was done by cutting out paper circles with diameter 9 - 14 cm long, and observing the radius when the program detects the circle. This all led to a hard-coded array within the program to determine how many bubbles are required for thorough cooking by detecting the pancake radius. Using the algorithm for detecting bubbles has led to issues of not being able to count all the bubbles clearly due to angle of camera not seeing the circles clearly. However, the algorithm does a good job on ensuring that it does not count the same bubble twice.

The Background Subtraction/ Contour Detection algorithm focuses on removing non-moving parts of the image frame and highlighting any motion detected. The modified frame then allows Contour Detection to find any objects on the frame that looks semi-circulish. The program does not allow any contours that are not found within "pancakePoints" or any bubbles that have been found before. The issues with the two algorithms combined are the following: lighting changes can cause major disruptions and cause false bubbles, can count a bubble more than once due to changing contour shape, false positives can occur due to batter movement. However the algorithms combined can count every bubble that appears on the surface of a pancake.

During the testing phase, the user interface consists of text based input from the user. The arguments can be taken in through a simple user interface (method 1) or through the command line (method 2). Both methods ensure that the quantity received will not be negative, a string, and not greater than ten. The laptop will then send commands to the Arduino via outputting serial strings.

During the final phase, the program will be loaded onto and executed on a FPGA. The user interface will become a circuit of 4 buttons: increase quantity, decrease quantity, start, and emergency stop. The buttons will send a controlled electrical signal to the FPGA and the hardware will store a number for the quantity and a gate for whether the user pressed start or not. Once the user presses enter, the program will append the quantity to method 2. If the user presses the emergency stop, it will simulate a 'q' or 'Esc' being pressed and exit the program entirely.

Pending Issues

- Complete Computer vision code
- Assemble the arm
- Assemble frame

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Drew Caneff	➢ Started Connecting Thor arm Components	12	221
Amos Hunter	➢ Worked on Frame	9	171.5
Brett Altena	➢ Installed OpenCV-Python ➢ Wrote Project Proposal report for Computer vision project	21	182
Kristian Wadolowski	➢ Worked on project proposal report for computer vision project	4	113

Jase Grant	➢ Switched FPGA program to python ➢ Worked on Pipeline acceleration	8	93

Plans for Upcoming Reporting Period

Team Member	Plans
Drew Caneff	➢ Finish Thor Arm ➢ Start 3D modeling ➢ Print 3D modeled parts
Amos Hunter	➢ Continue work on frame
Brett Altena	➢
Kristian Wadolowski	➢
Jase Grant	➢ Research python pipelines ➢ Integrate camera

Gitlab Activity Summary

Action: joined, Tue Sep 04 2018
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