Bi-Weekly Report

27 February 2015

Team Information

This document contains a summary of all that has been achieved over the last three weeks by team 19 on the CTSNet Robotics project as a part of the module Systems Engineering II of the University College London Computer Science course. Team 19 is formed of three students, Edward Collins (team leader), Kirthi Muralikrishnan (website and documentation lead) and Tom Page (research and programming lead).

Client Information

Team 19 has three clients:

- Dr Shabnam Parkar, paediatric surgeon at Great Ormond Street Hospital.
- Dr Joel Dunning, cardiothoracic surgeon at James Cook University Hospital.
- Dr Lourdes Agapito, computer graphics and vision expert at UCL and primary supervisor.

Summary of Progress

Over the last two weeks the team has worked out how to map between the Kinect's depth and colour feeds. The mapping function aligns the depth and colour feeds of the Kinect, so both the depth and colour of a particular pixel can be obtained. The next step is to apply the coordinate mapping function to a frame with a green tool, identifying the tool and then determining the depth of the green pixel that make up the tool.

The other major achievement has been the development of an algorithm that finds the edges of the tool in an image, effectively giving an outline of the tool. Determining how far away the tool is from the camera is all very well, but the real ability of the system will be in telling how far away the tool is from the body tissue. To do this, the system needs to measure the distance to the body and the distance to the tool, and subtract them to get the distance between the body and the tool. The "find edges" algorithm will mean that the depth of pixels immediately surrounding the tool can be found, which are likely to be the closest parts of the body to the tool, providing a starting point for measuring the distance between the tool and the body.

Summary of Team Meetings

Date	Topics Discussed	Time
24 February 2015	Meeting with Dr Agapito to receive advice on progressing with the project.	1 hour
27 February 2015	Discussion with PhD student Aron Monszpart about technical aspects of the project.	1 hour

Difficulties Encountered

Although we can now use the coordinate mapping technique working, it needs to be tested to ensure it works as expected. In addition the team needs to decide exactly which aspects of the design we will implement for the final demonstration in April, and need to devise some realistic, larger-than-scale scenarios to test the system on. To complete these things we will need to consult with our clients. Finally we may be facing an issue in that our prop is too thin to be accurately recorded by the Kinect, so we may have to develop a larger prop.

Progress Target

Over the next two weeks the team hopes to:

~Determine which aspect of the design we will focus on implementing, and which have lower priority.

~Design test scenarios.

~Begin adding more content to the website to cover what has been achieved this term.

~Use the coordinate mapper to be able to extract the depth values of green pixels.

In the longer term we hope to give several different versions of visual augmentation to provide depth feedback, and add voice control to the system. We will potentially also add audio feedback.

Individual Description of Tasks

Ed Collins

I have primarily been working on understanding the coordinate mapping function, although I have not had much success with this. I have also begun to work on the documentation surrounding the project, particularly on the development work done this term. Finally I have been researching how to properly use source control, particularly from Visual Studio using GitHub.

Tom Page

Over the past two weeks I have succeeded in mapping the colour image to the depth image, and as such been able to extract the depth information for a given pixel in the colour image. I have also managed to create an algorithm which successfully finds the edges of the tool. The main issue I have come across in doing this is all the tests I have conducted so far have led to incorrect results. I believe the main reason for this is the fact the mapping was not completely accurate and meant that the position of the values were not correct.

In order to overcome this issue I intend to conduct some additional tests and play and with some values until I can produce tests that work. Some ideas I have for this include creating a new array which is the size of the colour image but each value is representative of the depth value, where values are undefined I intend to take averages from neighbour values. One other thing I intend to do is to improve the find edges algorithm in order to find edges vertically as well as horizontally in order to give a more appropriate outline of the tool.

Kirthi Muralikrishnan

In the last two weeks, we have programmed using the Kinect. We have got the initial colour segmentation done. But the only obstacle that we are facing is the task of mapping the depth frame to colour frame. Once we have done that, we can devise an algorithm for finding the closest point to the tool and judging how far away it is. Tom has come up with an algorithm that would help us find the edge of the tool, this would help us calculate the distance. PhD student Aaron Monzspart told us about his view on edge detection and different algorithms to help achieve these. He also encouraged us to use Matlab to achieve faster and easier results. I haven't got much work done in the last two weeks. I plan to start devising algorithms that will help us with the edge detection and depth mapping.