Bi-Weekly Report

30 January 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

In the three weeks since term began the team has achieved a great deal. The term began with the team planning and then delivering an elevator pitch to a panel of examiners and our classmates which briefly outlined the project, explaining how we are solving the problem set to us.

Following this elevator pitch, the team began work on the development of the final system. The first part of this work was to create a work plan for this term, which can be used to check whether the team is on track to finish the project in good time and details the tasks to achieve. The first part of this plan is to develop a program which can identify feigned surgical tools in its field of view, and then tell how far away these tools are from the camera. Once that functionality is achieved, the program can be further developed to tell the distance between the background and the tool.

The first major challenge of this piece of work was to identify the tool in the camera feed. The team conducted some research into how this could be done, discussing this with our supervisor, Dr Agapito, and with PhD student Aron Monszpart. We then experimented with identifying tools in images of laparoscopic surgery using Java. There was some reasonable success here - the general region in which the tools were could be identified. However this was not sufficiently accurate for surgery, more advanced techniques would have to be used. It was at this point that the team came up with a new approach.

Doing these advanced statistical techniques would take a very long time to implement, and this project should be focused on depth sensing and not on tool identification. We therefore decided that the props we will use in our system will have bright green markers on them, which the system will be able to track with ease. This advocates simplicity, which is a principle of good design. These would be fluorescent green, a colour which will not be found in the body, so the system can simply track these bright green markers to provide all necessary information. This vastly simplifies the tool identification part of the project, allowing us to focus on the depth sensing functionality of the system.

Finally, the two team members with Macintosh computers have, at last, got the Kinects to work with them. It has taken a considerable amount of time to work out how to do this as virtual machine software such as Parallels and VMWare did not work, Bootcamp had to be used in the end.

Summary of Team Meetings

Date	Topics Discussed	Time
16 January 2015	Discussion of work plans and elevator pitch.	2 hours
20 January 2015	Meeting with Dr Agapito to receive advice on progressing with technical aspects of the project.	45 minutes
23 January 2015	Discussion of preliminary work assignment and technical discussion with PhD student Aron Monszpart.	1 and a half hours
30 January 2015	Discussion of work for the next week.	1 hour

Difficulties Encountered

The primary difficulty encountered was tool identification. Identifying a surgical tool in the camera feed without some kind of physical marker on the tool is certainly possible, but would require several weeks worth of work - time we cannot afford. Our solution is to use bright green markers on the tools which are easily trackable to identify the tools and then monitor their depth in relation to both the camera and the feigned body tissue.

Progress Target

By Friday 13 February, the team aims to have:

- Created a first iteration of a program to identify a bright green tool in the camera feed, and then monitor its distance from the camera, presenting this information to the user ideally through visual augmentation.
- Develop the above program to give visual feedback reliant on how far away the tool is from the background, which in a real life situation would be the body tissue.

Our longer term goals include adding several other visual augmentations to give depth feedback such as one to give an explicit numeric measurement of how close the tool is to the body, as well as adding a form of audio feedback. We will also create a Heads-Up Display (HUD) for the system and make it voice controllable. If this is all achieved in good time, we will look into developing advanced aspects of the system like haptic feedback.

Individual Description of Tasks

Ed Collins

I have worked on four main things in this time: getting the Kinect to work with my Mac, creating a work plan for this term, writing some test Java code to identify surgical tools and writing and delivering the elevator pitch. Getting Windows installed on the Mac using Bootcamp took a much larger than proportionate time due to lack of disk space, but finally the Kinect sensor works with my laptop. I also created a work plan for this term, which involved mapping the exact tasks that needed to be completed to dates, then deciding which team members should work on what aspects of the project. Finally I wrote some Java code which analyses images of laparoscopic surgery to try and identify the surgical tools in the camera view. I had reasonable success with this, as I could identify the general region in which the tool was. However "general region" is not accurate enough for surgery, so I developed the idea of using bright green markers on the tools to identify them by, meaning the system would simply track the green markers in relation to the body rather than having to identify the whole tool each time the frame changes.

Finally I wrote and subsequently delivered our team's elevator pitch to a panel of examiners and our classmates, summarising our project and explaining briefly our design for the depth sensing endoscope.

Tom Page

Over last two weeks we have completed the elevator pitch. This involved describing the aims of the project and the work we have managed to achieve so far. It also helped us to establish the key goals which we will complete over this term. In addition to this I also conducted some research into how we will push forward with creating the software over the next few weeks: this involves mapping the depth data to the colour image in order to be able to establish the outline of the tool and then establish the distance from the tool to the background. Over the next couple of weeks I will work on realising this process and implementing it in a simple program which we will eventually be able to add on the HUD.

Kirthi Muralikrishnan
We met with Dr.Agapito who gave us ideas about starting our project. She also reinstated that our first priority was working on our system's depth sensing ability. She pointed us towards different algorithms and software that would help us. The team had planned to look into using the C++ programming language for the Kinect, but since the purpose of that was to enable a few applications that were beyond the scope of our project we decided to program with C#.
I have tried to program bits of the Kinect over the last week. The initial aim is to give a depth of the green highlighter from the Kinect. I intend to learn more about C# and depth sensing ability of the Kinect.