Laidlaw Scholarship Research Project Report

A reflective report is required after each period of research (by 20th September).

This should be supplied as a Word document. Interesting photographs directly related to your research project or scholarship are welcomed and should be inserted into the body of the word document, not supplied separately.

There are six questions for you to complete. You are expected to write a detailed and thorough report; each section should be around 200-300 words.

Please note: This is NOT a technical research report. Scientific reports with a covering note cannot be accepted.

This report will need to be signed off by both you and your supervisor before submission.

If you have any problems or queries please contact the Laidlaw Scholarship Administrator, laidlawscholarship@leeds.ac.uk.

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Title of Scholarship Project:	AI for RoboCup@Home

Please describe the research you have conducted this period

Over my research period I have conducted work on human robot interactions specifically in communicating through gestures and through the use of a tablet user interface. My first three weeks of work were focused on learning about the ROS (Robotic Operating System) software, researching about gesture recognition and for a large portion, coding a detection for waving and pointing. In the end, I uploaded my work in a suitable format, making it easy for my code to be implemented as necessary into the larger software to be run on the Tiago service robot. During these initial three weeks, I was struggling to get the pointing recognition to work reliably, therefor I decided to return to this goal later.

For the next two weeks of my research period I worked on the Tablet interface, which was very different from my previous work and took me further out of my comfort zone. It required greater understanding of ROS, and required the use of JavaScript and html, both are languages which I was unfamiliar with. Despite this fact, I believe that this part of the project was the most successful as I was able to complete the goal without running into many major problems or concerns for reliability.

As the Tablet interface took less time than expected, in the final week of the six-week period I decided to revisit pointing detection. For this attempt, I decided to use a neural network which was more successful at detecting the angle of pointing than I had anticipated. However, as I still had some problems in other areas of detection, I ran out of time to get this method to work robustly, however I do plan on continuing this work in my spare time over this upcoming academic year.

How is the research work you have been undertaking impactful or important?

The work that I have done allows greater means of communication between the Tiago robot and the uninitiated member of the public. Furthermore, it is very useful for a robot to have other means of communication besides speech such as gestures, facial expressions and body language as these are evident and often very important in human to human communication. Additionally, the

use of a tablet interface and gesture recognition is important to service robot competitions such as Robocup@Home, as it can act as a redundancy or working collaboratively with speech.

I also want to note that both gesture recognition and a simple yes/no green/red button interfaces are methods of communication which transcend language, allowing a greater audience to communicate more easily with Tiago. This arguably already is and will become very important for the development of robots especially those that work alongside humans.

To serve the wider community, I have made my work publically available on GitHub (an online code sharing platform) which allows anyone access to the work that I have done and therefor is not only available to the LASR team but also the wider community of robotic research. As I have discovered through my research, gesture recognition is not a trivial matter especially for more complex gestures like pointing. Therefor I hope my work is impactful enough to get others inspired to work in this field all the same.

What impact has conducting research had on your degree course and university experience?

To begin working I had to get familiar with the ROS software which is widely used within robotics research and beyond, and is definitely a valuable skill for use in my university studies and career in robotics. In addition, over the span of the six weeks, I used and learnt about neural networks, robotics simulations, creating ROS packages, implementing ROS Bridge and understanding the software hierarchy for Tiago which include concepts such as Action clients/servers, parameter servers and task planners to name a few. Having researched into all these areas and learnt a tremendous amount has had a huge impact on how I view robotics and my course.

I also believe that being engaged in a topic of relevant to my course over the summer was helpful for my start into my second academic year at Leeds. Having gained further insight into the research done at Leeds will help me make a more informed choice as to furthering my education.

Lastly, I would like to say that this summer project was very valuable to me personally as it grew my confidence in working in a team of more experienced people than myself. It was lovely getting to know the LASR team and their work, and I look forward to working with the team again in the second year project period and in my spare time throughout my academic year.

What leadership skills do you believe you have gained from the research period? (Please refer to the university's Leadership Excellence Behaviours for guidance if necessary)

In this project I needed to be a Critical and creative Thinker. Having little direction in terms of technical approaches, I was given an idea and had to use

my skills, research ability and creativity to find innovative solutions and turn ideas into action. I also used critical thinking to critique my progress and approaches to efficiently divide my time between researching and coding work.

In our weekly project meetings, it was discussed what everyone in the team was up to and how we each would continue in our efforts. Having joined an already well established team, and being the less knowledgeable team member, my Social and Cultural intelligence skills were put to the test. At times there were challenges in keeping up to speed on what was being discussed, however I believe the experience itself was very educational for me. It pointed out that this is an area that I will have to work on in the future. Specifically, my goals are to engage more with my team members to get to know them better and their roles and to ask more questions on topics I am unfamiliar with.

One aspect of leadership that I am sure I used and improved is resilience and determination to achieve which was shown when I ran into problems with my code. One particularly memorable problem took three days of troubleshooting and left me quite frustrated. Despite this, I continued to preserver and was able to solve the problem in the end which ended up having a very trivial solution.

Lastly, by keeping track of my work hours and planning out which work to complete for the following days and weeks, I employed projects management skills. I also had to use management skills to deduce which goals of the project to prioritise and when to change my strategies in tackling problems.

Please talk about activities you've been involved in to disseminate your research, including but not limited to attending conferences, producing research posters, and promotion of the scholarship

I am in the process of writing a more technical summary report on my research, work and findings which I plan to publish on the Laidlaw scholars network. This is in an effort to document this project for future reference and to disseminate the work done by the LASR to other scholars.

I also plan on producing an informational poster to describe how to use OpenCV and neural networks for image recognition and analysis. I plan on beginning work on the poster after I have finished the work I am doing in my spare time focusing on pointing recognition in simulation. The poster will cover the concepts required to understand the multi-layered approach for image recognition and in the pointing recognition example, also image orientation.

Lastly, as I am a committee member of ShockSoc, the electronic and electrical engineering society, and as I myself had first heard of the Laidlaw scholarship by a 2nd year committee member, I plan to help promote the scholarship to first year students studying in the school of electronic and electrical engineering.

What are your future career or educational plans?

I plan to continue on my integrated masters course Mechatronics and Robotics, and I am considering taking a PhD after completion of this masters. I am also constantly on the lookout for year in industry opportunities and summer internships. I plan to apply to the 'Fly A Rocket' course run by the ESA as I want to further my understanding of what it would be like to work in the space sector.

I look forward to continuing my engagement with my school and the university in general, for instance by taking part in this year's Robot Fighting League. For the RFL I am planning to put my newly gained skills to use by making the fighting robot my team and I are building either fully or partially autonomous. I will also be engaging in my role of Treasurer of ShockSoc and aim to use the leadership skills I have learnt. Overall, I hope to gain a better sense of what exactly my ideal career would look like.

As for my career aspirations, I am currently in the process of identifying employers of interest, one of which is the ESA as I find space and spacecraft fascinating. I am also researching other well-known companies in the electrical engineering sector such as Texas Instruments, Airbus and Google research.

Signature of Scholar  Date: 18/9/2020

Signature of Project Leader _____ Date: ____/____/____