

## Project Proposal: Sign Language Translator

### Motivation and Rationale

#### The Context:

Communication is an essential part of our society and when it is hindered, we need to be able to provide solutions to ensure the inclusivity of all people. When our ability to communicate effectively becomes impaired, it can severely affect the quality of an individual's life. In the context of this paper, these individuals are people who are Deaf, so they experience the audiological condition of not hearing. In order for Deaf people to communicate, they use a variety of different signs which have been compiled into a number of different languages e.g. British Sign Language (BSL). Nowadays, a variety of technologies are used in order to aid with communication between Deaf individuals and those who are not Deaf. The need for this type of technology becomes integral for people's lives as we move towards a more digitally ubiquitous living environment. This is especially true since the total number of people of all ages in the UK with deafness ranging from mild to profound is 9 million (1 in 7 of the population). [1] This alongside an extreme growth in technology has contributed towards the expansion of research within field of Deaf communication.

#### The Problem:

Currently a number of different technologies are used for the translation of a variety of different sign languages, which achieve their core functionality to varying levels of success. The main issue with most of these applications and devices is that they do not translate sign language to a high level of accuracy for a number of different reasons. For example, some existing technologies struggle to detect non-dexterity markers such as facial expressions that have an impact on the meaning of certain signs. The basis of some of these technologies are out of date or ineffective tech or equipment that have since been updated meaning that most of these solutions are not viable nowadays. Certain pieces of equipment are okay at detecting and translating signs but their major problem is that they are expensive and so are not readily accessible. These are just some of the problems that my application will need to solve to some extent in order to provide a higher quality translation application. These problems will be tackled so that people who primarily use sign language to communicate will be able to communicate easily with people who cannot.

#### The Rationale:

In my project, I intend to produce an application, which will allow someone who has never used sign language before to learn how to communicate with someone who uses British Sign Language (BSL). The idea is that they will be able to translate whilst having a conversation with someone who uses BSL but will also allow them to learn how to sign in their own time, allowing for better inclusion of Deaf people. This is important due to the effect of exclusion caused by an inability to cross-communicate. An example of this is deaf children who cannot make themselves understood within their family are four times more likely to be affected by mental health disorders than are those from families who successfully communicate [2]

I aim to solve a majority of the issues I have found in pre-existing systems by using more up to date technologies such as the Google ML kit for accurate object detection. The application will also be significantly more accessible to a range of people as it will be easily distributed on application markets such as the Google Play store.

### Aims and Objectives

The overall aim of this project is to create an accessible application for the translation and teaching of sign language. I intend to measure the effectiveness using user feedback alongside a comparison of my application and the technologies that already exist in the field. I will test the application on a group of people with no knowledge of British Sign Language (BSL) as well on some individuals who understand BSL

quite well. Testing on both novices and experts will allow me to evaluate the performance of my final application effectively.

**1) Analyse and summarise three published examples of existing accessibility (hard of hearing) technologies and applications.**

Developing an understanding of the existing technologies and means of support for non-professional sign language translation will allow me to better understand the requirements for my own application. I will have achieved this objective when I have fully analysed three existing applications, all of which are found in my sourced papers.

**2) Understand the needs/ requirements of the end user and develop the application based off this data.**

For this objective, I will need to collect a large amount of high quality data relating to the functionality and design of the prototype. This will include data regarding the user interface, preferred styles of teaching, which functionality to prioritise and many more factors. I will have achieved this goal once I have collected enough research to make conclusive design and functionality decisions.

**3) Collect Qualitative information from users through the use of questionnaires and interviews to expand upon the wants/ needs and issues with Accessible applications.**

This objective will be used as a means to collect further research into the requirements of the prototype from the perspective of a Deaf translator/ Deaf individual. This will allow me to ensure quality control with the teaching aspect of the prototype, preventing me from implementing incorrect signs. This objective will be achieved when I have developed an understanding of the fundamentals of sign language and can implement them into the prototype.

**4) Implement the Accessibility prototype with translation and teaching functionality then improve based on feedback from users and experts.**

The minimal functionality of my application will be a basic application, which is able to identify a number of individual signs in sign language and be able to process these into text for the user to be able to read. The application will be used for teaching and as a result will have appropriate functionality. I will get both novice and experienced users to evaluate the quality of the implementation. The scale and frequency of improvements will be directly related to the quality of the first implantation and the feedback I receive from both the novice and experienced users. I will have completed this objective when I have created a prototype that can achieve the described functionality.

**5) Summarise and evaluate the performance of the Accessibility application.**

This last objective will be used to assess whether or not the final prototype I have designed has been an effective means of translating and teaching sign language at the end of the project. This objective will therefore be used to decide whether I achieved my overall goal or not.

Background

<b>Mobile Translation System from Speech Language to Hand Motion Language IEEE. [3]</b>	<b>Description:</b> This paper discusses the concept of automatically translating speech language into sign language. It highlights a number of existing technologies relating to sign translation and mobile cloud computing (used for abstracting the infrastructure). The paper heavily discusses the potential issues regarding the translation of non-static signs as well as the need for facial recognition.
---	---

	<p><b>Relevance:</b> As the project is used for translating and teaching sign language this paper is a useful means of highlighting some key issues with translation technology, which I will need to tackle. The paper also highlights some advantages of technologies that may have some relevance to the project.</p>
<p><b>Accessible options for Deaf people in e-Learning platforms: technology solutions for Sign Language translation. [4]</b></p>	<p><b>Description:</b> The paper presents a study into the existing solutions for improving the communication process for deaf people via e-learning platforms through translation of Sign Language (SL). The paper shows a clear concentration on the use of digital platforms alongside currently existing solutions, researched to improve inclusion on e-platforms.</p> <p><b>Relevance:</b> It is important to understand the requirements of an end user when developing an application. This paper identifies a variety of relevant requirements for the application, specifically the need for spatial-visual language identification and reducing the need for extra technology e.g. interactive gloves.</p>
<p><b>Video Stream Analysis in Clouds: An Object Detection and Classification Framework for High Performance Video Analytics. [5]</b></p>	<p><b>Description:</b> The paper discusses the use of a cloud based video analytics framework as a means of scalable and robust analysis of video streams. It discusses the accuracy and reliability of the framework and its effectiveness as an object detection and classification system.</p> <p><b>Relevance:</b> A key part of the project will be the detection of object movement, specifically the tracking of fingers, hands, forearms, arms and to some extent facial expressions. Using the cloud based analytical framework will be an important part of the translation process, as video streams will contain the sign language input.</p>
<p><b>Methods of data collection in qualitative research: interviews and focus groups [6]</b></p>	<p><b>Description:</b> This paper discusses a number of useful methods for collecting high quality research, conducting effective interviews and the use of focus groups. The paper then relates these methods to practical scenarios within the dental field.</p> <p><b>Relevance:</b> A key aspect of my research relates to collecting high quality research and using a number of different methods to collect useful and accurate data. The paper discuss methods which I intend to implement to conduct my own research and has made it clear to me how I can assess the effectiveness of each method for my field of study.</p>
<p><b>A variational approach to simultaneous multi-object tracking and classification [7]</b></p>	<p><b>Description:</b> This paper presented a framework that is very generic, and can be used for various tracking applications. It can handle objects with different dynamics, such as cars and pedestrians and it can seamlessly integrate multi-modal features.</p> <p><b>Relevance:</b> The research highlights and considers a number of important factors that are needed when developing applications using object tracking/ classification. This paper has helped me understand how I will implement these features myself.</p>

### Work plan

I have developed a Gantt chart in order to highlight the key tasks in the development process for the project, represented in a weekly format. The chart suggests the estimated time of completion as well as a difficulty rating for each of the individual stages of the project. The general structured has been designed to fit into the waterfall development cycle I have decided to implement. As you can see from Figure 1, I will be working on the written section of the dissertation continuously throughout the year.

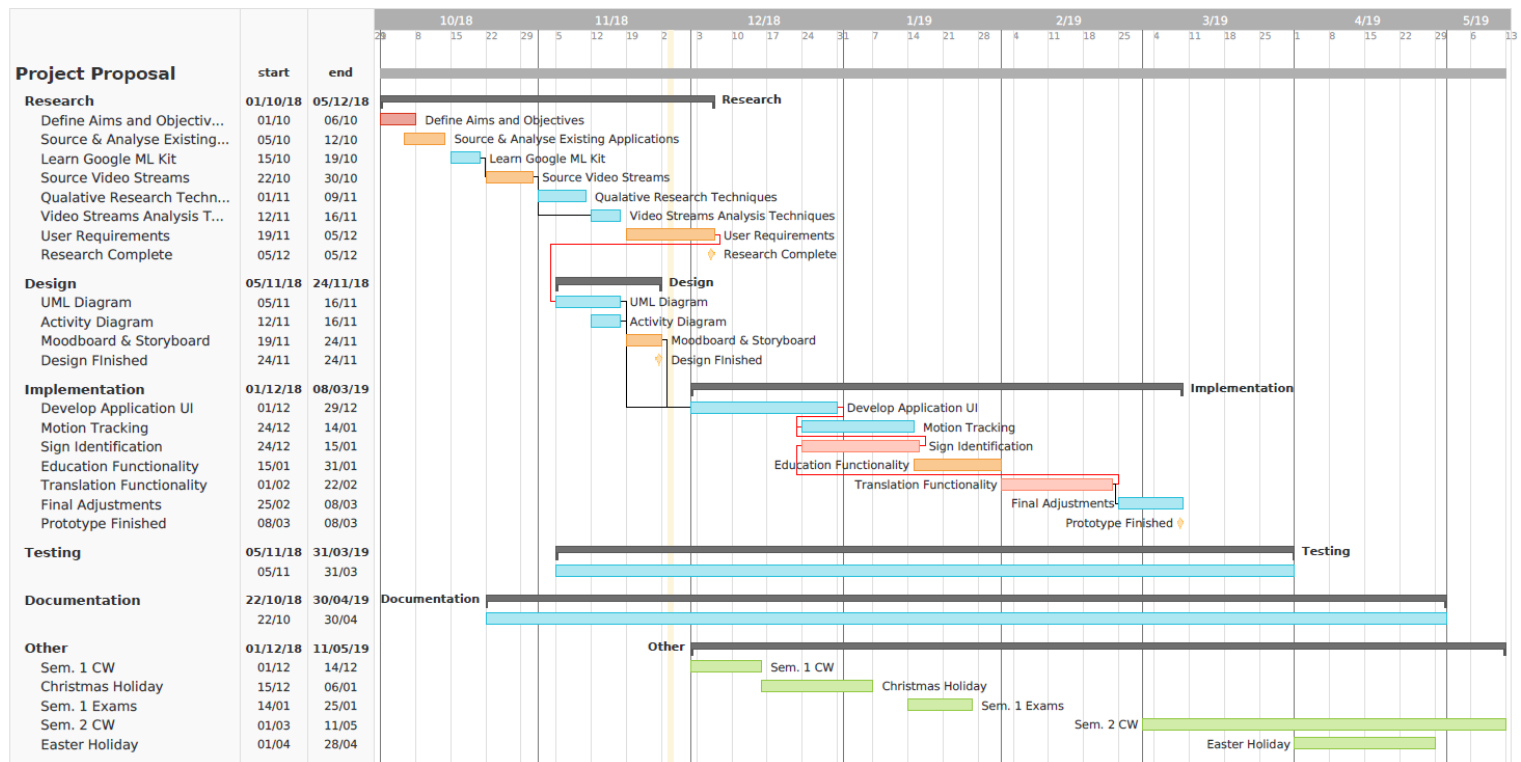


Figure 1: Project Gantt chart

## Overview

The chart highlights the core stages of my development process for this project over the course of the next year. This starts with the research stage, which covers my first two objectives as I am initially researching a variety of existing applications. From these applications and from my group research I will be able to identify a number of different requirements, which will allow me to develop a high quality application. The implementation stage covers the development of individual functionality for my final prototype in a logical progression. As you can see from the highlighted dependencies on the chart, each phase builds upon the previous phase, to allow for a well-organised development structure. The development phase of the project will cover the remainder of the objectives for the project, which will also be the most intensive part of the overall assignment.

## Risks and Contingencies

In the Gantt chart, (see figure 1) I decided to highlight non-project tasks, as these will have an indirect effect on my time allocated to work. These tasks include holidays, coursework deadlines and other similar factors. All of my tasks around these times have been specifically formed around these dates so I have a good understanding of my other commitments.

A Risk that I have identified in my project is the dependencies on each phase during the implementation stage. Any delays caused by one task may then lead onto causing delays for the rest of the task that are depended on the first one. If this occurs, it could sufficiently hinder my agenda and put me behind schedule causing a knock on effect. My contingency plan is to skip minor tasks such as a detailed UI design and concentrate on the core functionality of the application i.e. sign translation.

My most significant risk for this project is that I may not be able to source the video streams needed for translating signs. My contingency for this scenario would be to generate my own data which can be fed to the video intelligence API I will be using. This will restrict the capabilities of the prototype but will still allow me to achieve my aim and objectives. I will ultimately attempt to stick to this schedule in order to allow me to prevent the need for my contingency plans.

## References

- [1] - Disability Resource Centre (2018). UK Statistics & Facts.  
<https://www.disability.co.uk/sites/default/files/resources/UKStatistics%26Facts.pdf>
- [2] – Fellingner, J., Holzinger, D., Pollard, R. (2012). Mental health of deaf people.
- [3] - Rekha, K., Latha B. (2014). Mobile Translation System from Speech Language to Hand Motion Language IEEE.
- [4] - Martins, P., Rodrigues, H., Rocha, T., Francisco, M., Morgado, L. (2015). Accessible Options for Deaf People in e-Learning Platforms: Technology Solutions for Sign Language Translation. *Procedia Computer Science*, 67, pp.263-272.
- [5]- Anjum, A., Abdullah, T., Tariq, M., Baltaci, Y., Antonopoulos, N. (2016). Video Stream Analysis in Clouds: An Object Detection and Classification Framework for High Performance Video Analytics. *IEEE Transactions on Cloud Computing*. 1-1. 10.1109/TCC.2016.2517653.
- [6] – Gill, P., Stewart, K., Treasure, E., Chadwick, B., (2008). Methods of data collection in qualitative research: interviews and focus groups. *Nature Publishing Group*
- [7] - Romero-Cano, V., Agamennoni, G., & Nieto, J. (2016). A variational approach to simultaneous multi-object tracking and classification. *The International Journal of Robotics Research*, 35(6), 654–671.  
<https://doi.org/10.1177/0278364915583881>