

Project Title

Interim Report

DT228

BSc in Computer Science

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Abstract

The goal of this project is to investigate the use facial expression recognition technology to improve software usability and user experience testing. The application will be of use to software developers who will have users complete test cases and the application will record the user’s facial expressions to better detect the problem areas in the software.

This project is going to use machine learning to automatically detect the user’s emotions and display the data to the developers for further analysis. The advantage of automatically detecting emotions is that video footage does not have to be watched by anyone and data is automatically collected and stored. Declaration

I hereby declare that the work described in this dissertation is, except where otherwise stated, entirely my own work and has not been submitted as an exercise for a degree at this or any other university.

Signed:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student Name

Date

Acknowledgements

Body text

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# **1. Introduction**

## Overview

The purpose of this project is to explore facial expression recognition technology as a way to improve usability testing for software. This project will focus mainly on usability testing on websites. Usability testing is a very important aspect of software development and especially crucial when the application has a large amounts of users with varying degrees of ability. Usability testing involves testing the functionality of an application, a website or digital product by observing how real people with no prior knowledge of the website attempt to navigate through it and attempt to complete tasks [[1]](https://www.hotjar.com/usability-testing/).

Usability testing reveals issues that are not obvious to developers, designers and people who have in-depth knowledge and understanding of the product. By observing the user, the designer can not only identify problems but also uncover opportunities to improve and learn about the target user’s preferences. For a website to be successful it must allow its users to efficiently and effectively get to where they want to be and complete the tasks they want to complete without confusion and frustration.

Research has been conducted on the number of participants needed to reveal the most problems with the best returns. In a study conducted by Virzi (1990, 1992) random samples of different sizes of participants were created, it was found that on average, four or five participants would reveal about 80% of the usability problems uncovered by all the participants, with diminishing returns with additional participants [[2]](https://nces.ed.gov/fcsm/pdf/C2_Fox_2015FCSM.pdf). Faulkner (2003) also concluded that testers may want to include more than five participants. With 100 random samples of five participants, she found that on average, the five-person samples uncovered 85% of the problems [[2]](https://nces.ed.gov/fcsm/pdf/C2_Fox_2015FCSM.pdf).

The purpose of this project is to implement a website usability testing tool and investigate if usability testing can be improved upon with the use of machine learning and more specifically facial expression recognition.

## Project Description

*UsabCheck* is usability testing application and consists of two applications. The first application is a web application that will be used by the researcher, they could be the developer or designer of their website. The researcher will access the *UsabCheck* web application to create and configure their usability study. The researcher will provide the link to the website they want to conduct the usability test on and provide instructions for the tasks they want the participant to complete and questionnaires and questions they want the user to fill out at any point within the study.

The *UsabCheck* web application will provide statistics on how participants have performed in the tasks and their responses to questions and other forms. The researcher will have the option to view the screen recording and a camera recording of their face while they are completing the tasks. This includes the audio of the participant speaking. The researcher will also be provided with a journey map of the user completing the task and their facial expressions to help better identify the problem areas.

The second *UsabCheck* application will run locally on the computer the participant is using and will be recording their screen and monitoring their facial expressions. After the usability test is conducted the data is uploaded to the cloud. This data includes video’s and screen captures.

## Project Aims and Objectives

The aims and objectives that should be achieved by the end of the project include the following.

1. Provide a usability testing website that allows the researchers to create usability study tests.
2. Provide the researchers to view the results of the tests on the website. This includes viewing of the footage, answers to questions and questionnaires, viewing a journey map of facial expressions.
3. Provide a local usability testing application that will record the screen, record the test participants face from the camera, show the participant the test instructions, and upload the data to the cloud.
4. For the above aims to be achieved, smaller goals and objectives have to be met. This includes a machine learning algorithm that will classify facial expressions.
5. The machine learning algorithms and dataset have to be researched and implemented.
6. Cloud storage has to be obtained in some way, whether it be creating my own or paying for a service to store the videos for streaming on the website.

## Challenges

1. The dataset for the face expression recognition will be a very important factor in the success of the classification.
2. The various algorithms for face classification need to be researched and considered as this will have an impact on the accuracy of face expression classification.
3. The usability testing aspect has to be researched well for the application to be useful. The scope of this project is big in that regard.
4. There are various ways of going about cloud storage, the pros and cons of each will have to be considered.
5. Time management is a challenge that is very important to the success of the project.

## Project Scope

The scope of this project involves designing and implementing a usability application for desktop applications. More specifically the focus will be on website usability testing. The application will not be intended for usability testing on mobile applications. The application will involve the use of machine learning to detect facial expressions of the participant who is completing the tests created by the researchers or developers. The project will involve two applications; a web application and a local application.

## Thesis Roadmap

One sentence explaining what each of the following chapters is about.

# **2. Research**

## 2.1. Background Research

Landowska (2015) reviewed and evaluated the applicability of emotion recognition in usability testing procedures. They looked at various techniques of extracting the emotion, an example would be from a questionnaire, facial expression analysis and sentiment analysis. They also looked at the accuracy of emotion recognition, susceptibility to disturbances, independence on human will and interference with usability testing procedures. They found that there is a lot of evidence that human emotions influence interactions with software products. They also found accuracy and granularity of emotion recognition from facial expression analysis was medium to high, however the robustness to disturbances was low. [[1]](https://www.researchgate.net/publication/301454217_Towards_Emotion_Acquisition_in_IT_Usability_Evaluation_Context)

Esterwood (2018) has discussed the application of facial recognition technologies in usability testing and provided analysis of these tests. They looked at journey mapping as a way to display emotion recognition data. Journey mapping tracks the user as they move through the task and shows the user’s emotions along with the task they are trying to complete. The recommendations of the study is to ensure that users are limited to a strict time limit as a way to allow for averaging of emotional states and combining them into one journey map. Another recommendation is to have a second camera exclusively for the face as cropping decreases the resolution. [[2]](https://medium.com/@cesterwo/facial-recognition-journey-mapping-for-improved-usability-testing-37269a50b71f)

Halder et al. (2016) proposed a prototype system which classifies the six universal emotions. A neural network approach was combined with image processing. The system includes face detection and feature extraction for emotion classification. The results of the classification were left out of the research paper since the results were being tested. Despite the lack of results the research is still valuable to my project. [[3]](https://www.researchgate.net/publication/301335563_Real_Time_Facial_Emotion_Recognition_based_on_Image_Processing_and_Machine_Learning)

Bastien (2009) reviewed some methodologies and the technical aspects of the methods of usability testing. They looked at user-based evaluation and explored questions such as how many users have to be tested. The topics that have been selected were considered relevant for evaluating applications in the field of medical and health care informatics. They also explored remote usability evaluation where the test participant(s) and the evaluators are not in the same room. This research paper gave me insight into usability testing which is very relevant in my project and remote testing will be considered. [[4]](https://www.researchgate.net/publication/24256512_Usability_testing_A_review_of_some_methodological_and_technical_aspects_of_the_method)

Gaurav (2018) wrote a case study that discussed real-time facial expression recognition. It gave me great insight into the implementation of real-time facial expression recognition. The case study looks at the development process which includes the problem and constraints, the dataset, processing of data and training the algorithm. The case study is practical and very valuable in understanding the development process. [[5]](https://medium.com/datadriveninvestor/real-time-facial-expression-recognition-f860dacfeb6a)

## 2.2. Alternative Existing Solutions to Your Problem

### 2.2.1 UserZoom Go

### 2.2.2 UserTesting

### 2.2.3 Loop11

## 2.3. Technologies Research

### 2.3.1 Machine Learning

#### 2.3.1.1 Convolutional Neural Networks (CNNs)

#### 2.3.1.2 VGG Model

#### 2.3.1.3 Support Vector Machines (SVM)

#### 2.3.1.4 Bag of Visual Words (BOVW)

### 2.3.2 Dataset Research

#### 2.3.2.1 JAFFE (The Japanese Female Facial Expression (JAFFE)

#### 2.3.2.2 Emotic (Emotions In Context)

#### 2.3.2.3 FEC (Goole Facial Expression)

#### 2.3.2.4 FER2013 (Facial Expression Recognition Dataset 2013)

#### 2.3.2.5 AffectNet

#### 2.3.2.6 FacesDB

### 2.3.3 Programming Languages

#### 2.3.3.1 Python

#### 2.3.3.2 Java

#### 2.3.3.3 JavaScript

### 2.3.4 Python Libraries

#### 2.3.4.1 Numpy

#### 2.3.4.2 Pandas

#### 2.3.4.3 MatPlotLib

#### 2.3.4.4 Scikit-Learn

#### 2.3.4.5 Tensorflow & Keras API

#### 2.3.4.6 FastAI

#### 2.3.4.7 OpenCV

## 2.4. Domain Specific Research

### 2.4.1 Usability Testing

### 2.4.2 Video Uploading

#### 2.4.2.1 SwiftStack

#### 2.4.2.2 StreamingVideoProvider

#### 2.4.2.3 Vimeo

#### 2.4.2.4 Muvi

#### 2.4.2.5 AWS

### 2.4.3 Website Hosting

#### 2.4.3.1 Tomcat

#### 2.4.3.2 Google Firebase

## 2.5. Existing Final Year Projects

## 2.6. Conclusions

# **3. Prototype Design**

**As least 6 pages, but as many as you like (but lots of diagrams, which count towards the page total).**

## 3.1 Introduction

## 3.2. Software Methodology

## 3.3. Overview of System

Include a diagram

## 3.4. Front-End

Including screen prototypes and Use Cases

## 3.5. Middle-Tier

## 3.6. Back-End

Including ERDs, and maybe ISDs

## 3.7. Conclusions

# **4. Prototype Development**

**As least 2 pages, but as many as you like (but lots of code samples).**

## 4.1. Introduction

## 4.2. Prototype Development

## 4.3. Front-End

## 4.4. Middle-Tier

## 4.5. Back-End

## 4.6. Conclusions

# **5. Testing and Evaluation**

**As least 2 pages, but as many as you like**

## 5.1. Introduction

## 5.2. Plan for Testing

## 5.3. Plan for Evaluation

## 5.4. Conclusions

# **6. Issues and Future Work**

**As least 5 pages, but as many as you like**

## 6.1. Introduction

## 6.2. Issues and Risks

## 6.3. Plans and Future Work

### 6.3.1. GANTT Chart

# Bibliography