FYP Project Proposal Form 2018/2019.

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Programme Code: DT228/TU856	
Project Title: Calculating User Experience with Facial Expression Recognition	

Summary (approx 200 words)

The goal of this project is 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.

Existing solutions to usability testing use questionnaires, audio recordings, screen recordings and recordings of the participant through the webcam. This project is going to build on top of that and use machine learning to automatically detect the user's emotions and display the data to the developers for further analysis. The project might also verbally interact with the user as they are completing the tasks set by the developer to understand what they are struggling with. 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.

Once the data is collected by the application that is running locally on the machine, it is uploaded to a server where it can be viewed and analyzed online and be accessible from anywhere. Two applications will be created, the first is for the developer (web application) where they set tasks and analyze data. The other will run locally on the machine the testing user will use and will provide test instructions for completing use cases and collects data.

Background (and References)

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]

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]

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]

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]

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]

References
[1] Landowska, Agnieszka. (2015). Towards Emotion Acquisition in IT Usability Evaluation Context. ResearchGate [Internet]. 2015 [cited 2020 Oct 15]; Available from: https://www.researchgate.net/publication/301454217_Towards_Emotion_Acquisition_in_IT_Usability_Evaluation_Context

[2] Connor Esterwood. Facial Recognition & Journey Mapping for Improved Usability Testing [Internet]. Medium; 2018 [cited 2020 Oct 15]. Available from: https://medium.com/@cesterwo/facial-recognition-journey-mapping-for-improved-usability-testing-37269a50b71f

[3] Halder, Rituparna & Sengupta, Sushmit & Pal, Arnab & Ghosh, Sudipta & Kundu, Debashish. (2016). Real Time Facial Emotion Recognition based on Image Processing and Machine Learning. International Journal of Computer Applications. ResearchGate [Internet]. 2016 [cited 2020 Oct 15]; Available from:
https://www.researchgate.net/publication/301335563_Real_Time_Facial_Emotion_Recognition_based_on_Image_Processing_and_Machine_Learning

[4] Bastien, J.. (2009). Usability testing: A review of some methodological and technical aspects of the method. International journal of medical informatics. ResearchGate [Internet]. 2020 [cited 2020 Oct 15]; Available from:
https://www.researchgate.net/publication/24256512_Usability_testing_A_review_of_some_methodological_and_technical_aspects_of_the_method

[5] Gaurav Sharma. Real Time Facial Expression Recognition - Data Driven Investor - Medium [Internet]. Medium. Data Driven Investor; 2018 [cited 2020 Oct 15]. Available from:
https://medium.com/datadriveninvestor/real-time-facial-expression-recognition-f860dacfeb6a

Proposed Approach

The approach is to have two applications. One application, let us name it *monitoring app* will run locally on the computer and will be used by the person testing an application. Monitoring app will give the testing user instructions (test cases) to complete and will track the user's facial expressions. *Monitoring app* will also include questionnaire and surveys for the testing user to fill out. Once the usability testing is complete the data will be uploaded to the cloud.

The other app, let us name it *developer's website* will be a website where the developer can login and create the tests they want to conduct. There the developer will specify the instructions for the tester and set up surveys and questionnaires for the tester to fill out. The *developer's website* is also where the data will be displayed in various forms for analysis. One of the visual ways the data will be presented will be a journey map that will show the stages the testing user completed and their emotions at certain points. The developer can also view the whole recording of both the user and their actions on screen side by side. A thing to consider regarding uploading entire videos and screen captures of the test to be later viewed on a webpage is storage capacity and scalability. This will have to be researched.

The application is designed for when the developer/evaluator and testing user are in person, and the testing user is performing the tests with the developer/evaluator equipment which might include using two cameras for increased accuracy. However, remote testing will also be explored.

Depending on how fast the development of this project progresses, more features could be added such as converting the testing user's speech to text and performing sentiment analysis on that text.

There are three main areas to my approach:
- Design and research
- Implementation
- Testing / Maintenance

Design and Research
- Machine Learning is a new area for me, so I am going to have to do a lot of research into facial recognition and image classification. This includes research on the dataset.
- I will have to research hosting the application and all the related components such as the database in order to ensure the app runs efficiently and is robust.
- The frontend will have to be designed in such a way that the user finds it intuitive and easy to use. Research will have to be done in that regard.
- Research has been done on existing solutions and these will be further investigated to improve design.
- The various widgets for displaying the test data will be researched.

Implementation
- The facial expression recognition will be implemented first, this will be done in Python.
- The local testing app will be implemented next with placeholder data that will be obtained from the cloud in the future.
- Once the testing app is implemented the website for the developer will be created next. The GUI will be basic, and the priority will be to get the functionality working first.
- The register/login and managing of tests will be implemented and a way to sync the testing app and the website.
- Once data is transferrable from the testing app to the cloud and the website will have access to the data the priority is going to be displaying it.
- Once the backend and frontend are fully complete the application will be deployed.

Testing & Maintenance
- The application will undergo unit testing, integration testing to ensure everything is working before it is finally deployed live. The application will be tested before and after it is deployed live.

- The usability of various websites will be tested using the application. I intend to test as many websites and with as many people of various degrees of tech savviness as possible to collect data.
- The data will be analysed by people who are familiar with technology and are in the field of software development/testing to see if they like application and the design.
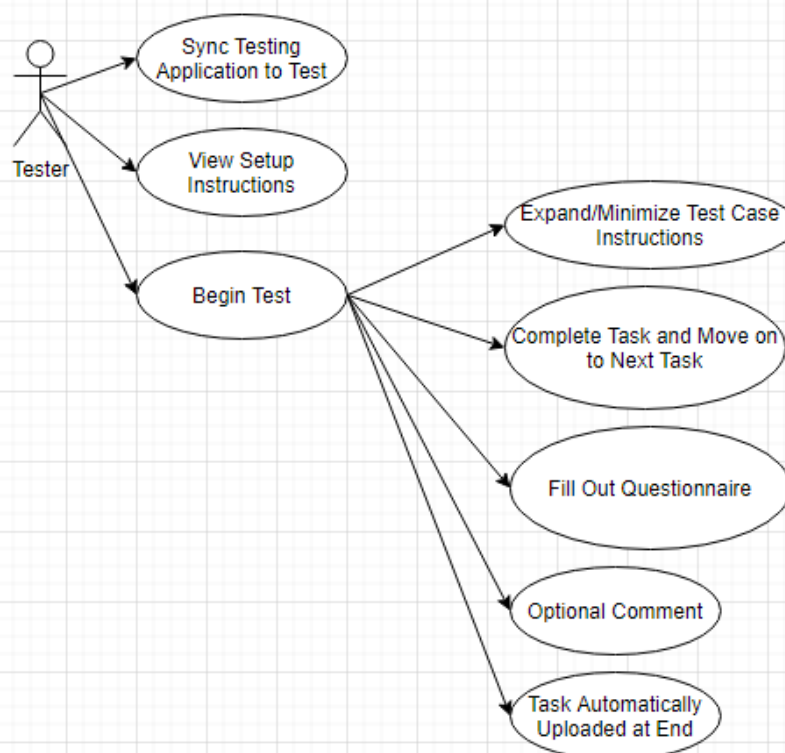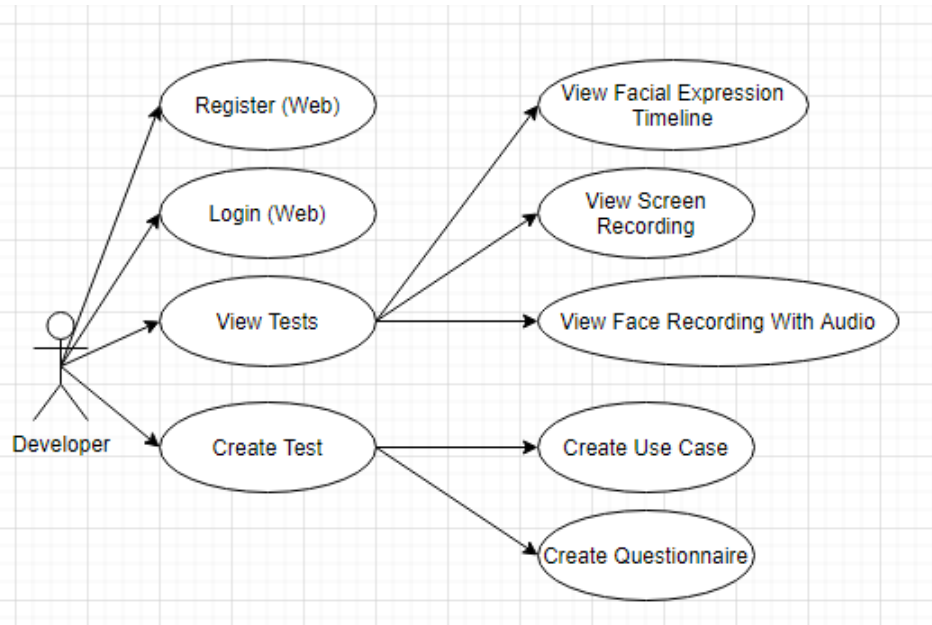
Deliverables
A project dissertation
A web app that will be launched
A windows application to be launched
Interim Report

Technical Requirements
PC/Laptop
Database hosting
Web hosting
Camera

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Project Reviews – Please include reviews of two of LAST 2 years projects from either DT228, DT282 or DT211C.

Project 1
Title: Sentiment and Mood Interpreter for Logging Emotions

Student: Christine Fahy

Description (brief):
The project investigates the methods of recording and tracking moods to help people with their mental health. The application records moods through three different methods; a diary entry, facial recognition and emojis. The user can then view their records in a 'timeline' style panel. They can also view summary reports on the data they have recorded.

What is complex in this project?
The complexity in this project came from having different ways of recording mood. One of the ways involving machine learning which is quite complex. The project was also said to have a "huge learning curve with both technical and soft skills".

What technical architecture was used?
Python, OpenCV, wxPython, TextBlob API

Explain key strengths and weaknesses of this project, as you see it.
The project had a simple UI which I understand to be one of the strengths and research was done on usability heuristics (Neilsen's Heuristics).

The classifier was picking up on micro expressions from the person's face which I personally found interesting and think is one of the strengths of the project.

The weakness in this project is that only negative and neutral moods were detected from the user's facial expression when typing a diary entry. This is because people tend to bow their head when they are typing.

Project 2
Title: Detecting Bot Twitter Accounts using Machine Learning

Student: Brendan Tierney

Description (brief):
This project is for the purpose of detecting and evaluating whether a Twitter account is a bot. This project uses machine learning models to identify a Twitter bot accounts. These bot accounts can be harmful as they have, for example, circulated fake news stories without being verified.

What is complex in this project?
This project is complex because it uses various machine learning models to more accurately identify a bot account. There is a user model, tweet model, sentiment model and a timing model. Another form of complexity comes from testing different machine learning algorithms to see which one performs best. The project also faces other challenges such as the accuracy of the dataset and the speed of the application.

What technical architecture was used?
Django framework, also including front-end technologies such as JavaScript, Bootstrap, HTML, and CSS. MySQL database. Twitter API

Explain key strengths and weaknesses of this project, as you see it.
The key strength of this project is the vast amount of research that has been done into each area. The challenges and problems were identified, and a solution was proposed. The project implements features that the existing applications lack which is detecting the followers of an account.

The weakness of the project was that the follows of a user were not processed and identified fast enough in some cases because of the constraint imposed by the Twitter API.

Proposal Sign off:

Student Signature:	**Date:**
Lecturer Signature:	**Date:**