*Problem Specification: MoodFULL – Mood tracking app using facial action coding units and trend analysis.*

**Problem Domain**

The number of people with mental health disorders worldwide has by all estimates been increasing, in the UK for example an estimated 13% in prevalence between 1990 and 2016 and an increase of 31% in the USA (Saloni Dattani, 2021)*.*

Research suggests that understanding emotional triggers helps people regulate their negative behaviours and stops their negative thoughts and feelings from driving their behavioural response (Gross, 1995). More current research suggests that cognitive reappraisal can be used as a memory modification process to reduce negative affect (Samide, 2021). During retrospective reappraisal, a person must reactivate the negative memory, with a potential by-product being that the memory is rendered liable and can be updated.

**How the problem will be addressed**

A mobile application will be designed to record users’ daily emotion via a photo (facial action coding units) and prompt the user for context. With the user’s data, trends will be extrapolated for the user as to whether events are statistically significant and whether certain reasons or locations are frequently present. With statistically significant context and history available to the user, it is possible that the user will be able to perform retrospective reappraisal to reform negative events and to understand triggers affecting their behavioural response.

A mobile application was chosen in order to provide a supplementary service to more formal mental health solutions as provided by relevant health services. This was due to the large penetration of smartphones across all age gaps, studies show that an estimated 82.9% of the UK population has access (Strugar, 2021).

**Proposed System Features for Different Types of User**

The primary function would be to develop a mobile application that is capable of recording users’ emotion with context and provide trends over time. Users will be able to use the ‘automatic detection’ mode which will access the camera and by using facial action coding units will auto detect a user’s emotion. A user will be able to ‘override’ the automatic detection feature or choose a manual input method.

A trend tab would be developed which will allow a user will be able to ‘Group’ their recorded emotions and context into categories for them to be able to be able to manually plot emotions over time. The user will also be able to view their system generated trends as evaluated by the system.

A settings tab will be developed which will allow the user to manage their account, for example, user preferences, personal details and account deletion.

Management and administration will be supported by an administrator backend which will be used to add new information and provide live updates.

**Proposed Interface Elements**

The application will be developed with mobile in mind, using a cross platform approach. Estimates suggest that 72.84% of users are Android based, with 26.34% respectively for IOS (O'Dea, 2021). The user will be greeted with a landing page prompting them to log in or sign up. They will be asked whether they want to use automatic mood detection (camera enabled) or manual entry mood. They will be prompted to select a daily mood input time whilst also being encouraged to submit moods with context as often as possible to build a more detailed trend analysis.

The user’s entry will be stored on a database. Once logged in the user will have three tabs to choose from ‘Record’ ‘Analyse’ and ‘Settings’. The ‘Analyse’ tab will provide graphical analysis of mood over time and any statistically significant events. A user will also be able to populate their own tables using their data extracted from the database. The ‘settings’ tab will allow users to control their account.

**Technology Investigation**

***Front-End Frameworks***

Having review usage statistics of both Android and IOS prevalence it has been decided that a cross platform approach will be undertaken. This decision was based on the ability to roll out an application to both operating systems without generating two code bases which would be necessary if undertaking a ‘native’ development approach.

Flutter has been selected as the development toolset of choice with justifications listed below:

* Open-source framework built in Dart powered by Google
* Popular at present – supported by a large community user base.
* Same UI Business Logic and Code – One codebase looks native on both platforms.
* One codebase allows for faster testing.
* Application will look the same on older IOS and Android versions.
* High performance – flutter application is built directly onto machine code. Removes the need for a Javascript bridge that ReactNative uses.
* Hot -Reload feature – allows developer to make changes to code and see affect in real time speeding up development.
* Enables access to ‘native only’ capabilities by using platform channels.

***Backend Frameworks:***

As user data will need to be stored in order to facilitate log in, authentication and trend analysis a database will need to be implemented. The database that has been selected is Firebase. Justifications have been listed below:

* Part of the Google Ecosystem
* Authentication – firebase offers many authentication methods
* Realtime database – Firebase is a NoSQL database that synchronises in real time which makes the data available to the app in event of connection loss.
* Cloud based makes the database scalable depending on user base.
* Firebase is Google proprietary and integrates seamlessly with Flutter.
* Extensive premade API’s and UI’s make setup easy and fast.
* Push notifications – used to automatically feed information to the app without reloading.
* Can handle up to 1 million current connections.

***Facial Recognition***

As the app will harness mood detection via facial recognition methods it is necessary to implement an algorithm to predict a user’s emotion. Tensor flow has been selected as the machine learning framework, rather than building a model from scratch it has been decided to perform transfer learning’ on a model that has been built for image recognition (Inception v3 image classifier – Developed by Google). The justification for this has been listed below:

* Tensor flow is part of the Google ecosystem and easy to integrate into Flutter.
* Train the top layer of the model for a specific task rather than building every layer.
* The model is a complex network, by only training the top layer we save several days of computation time.
* The Inception v3 model was built as an image classifier model achieving best in class results. Lower levels that will not be changed provide beneficial in mood detection.
* Inception v3 can be imported via API to Tensor flow models which are easily imported in flutter applications.
* The paper published by Xiao-Ling Xia et al. (Xiao-Ling Xia, 2017) showed using this technique on the CK+ dataset they were able to achieve accuracy of 97%.

**Progress Planner**

Throughout the project I will be employing the Agile methodology. The iterative model used in Agile allows for movement backwards and forwards and reduces the risk of systems and features being implemented incorrectly and not detected until the testing stage. Being the single team member the odds of implementing incorrectly and not being detected is of greater risk. Agile provides more flexibility around requirements and features, which allows for quicker adjustment than more traditional project management methodologies. See figure [1] for a Gannt chart reflecting the proposed timeline.

# Bibliography

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Figure - Gannt chart of project timeline