

AN EXPLORATION OF USABILITY AND BIG DATA ANALYSIS OF ANDROID INERTIAL MEASUREMENT FOR GAIT ANALYSIS

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Abstract

Parkinson's disease (PD) is a condition which affects one in 500 people. This disease progressively damages parts of the brain over the time leading to wide range of both physical and psychological symptoms. The diagnostic tools currently available require a specialist using lab based equipment. This project looks at the feasibility of using an Android smartphone's Inertial Measurement Units (IMU) to provide a cheaper and more accessible alternative.

Introduction

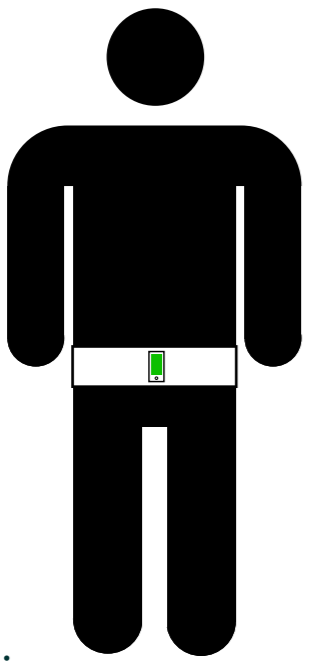
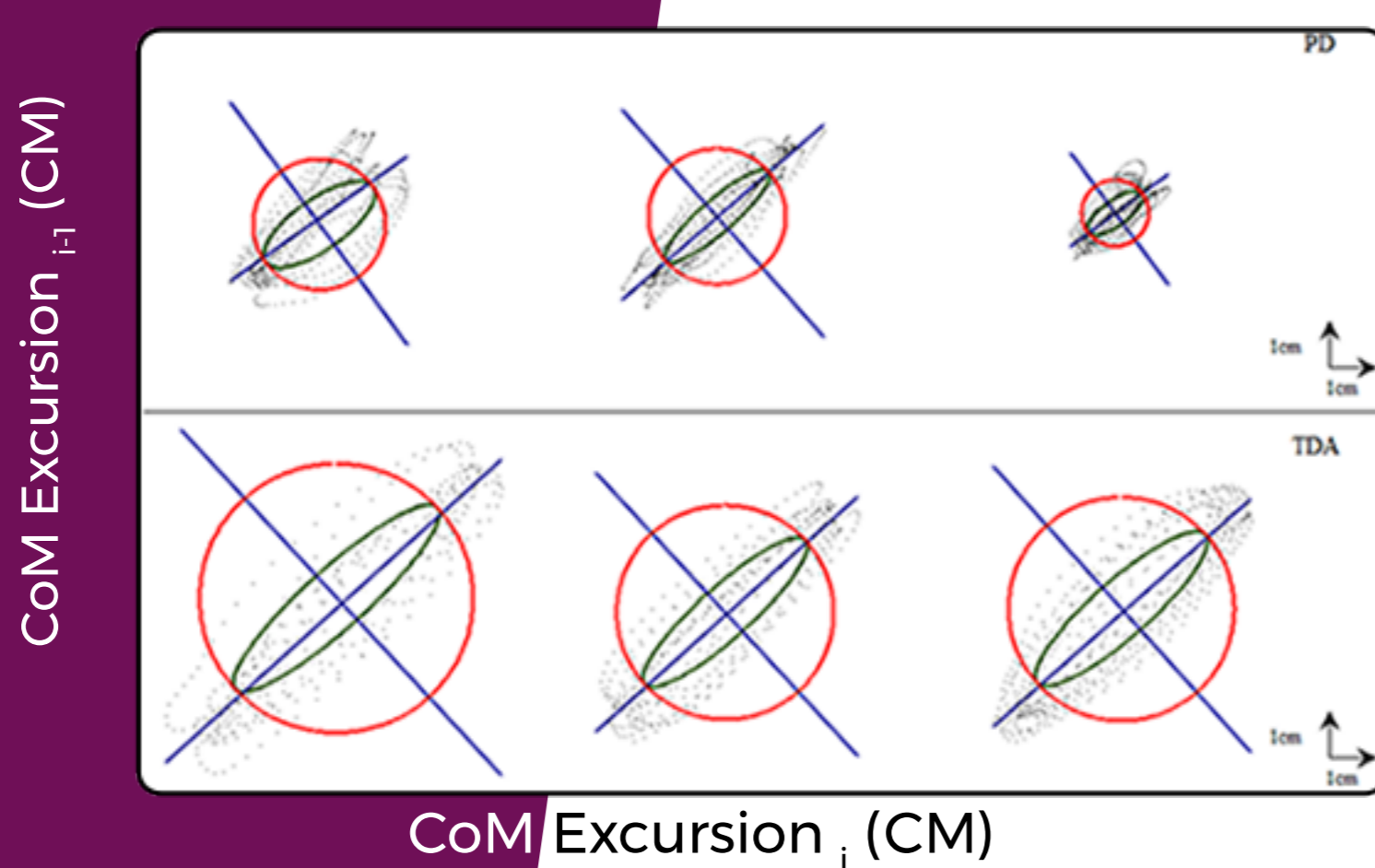


Fig. 1:
How the
application is worn

Gait analysis is most commonly used to help clinicians track advances or decline of a subject's condition rather than to be used as a diagnostic tool. Although recent research has shown that plotting a person's gait (Fig. 2) with a Micro Electric Mechanical System (MEMS) can be used as a diagnostic tool for those with Parkinson's [2]. The aim of this project is to replicate these results using an Android smartphone's IMU (which is worn as in Fig. 1) while providing a high level of usability and accessibility with the ability to upload these results to a centralised server.

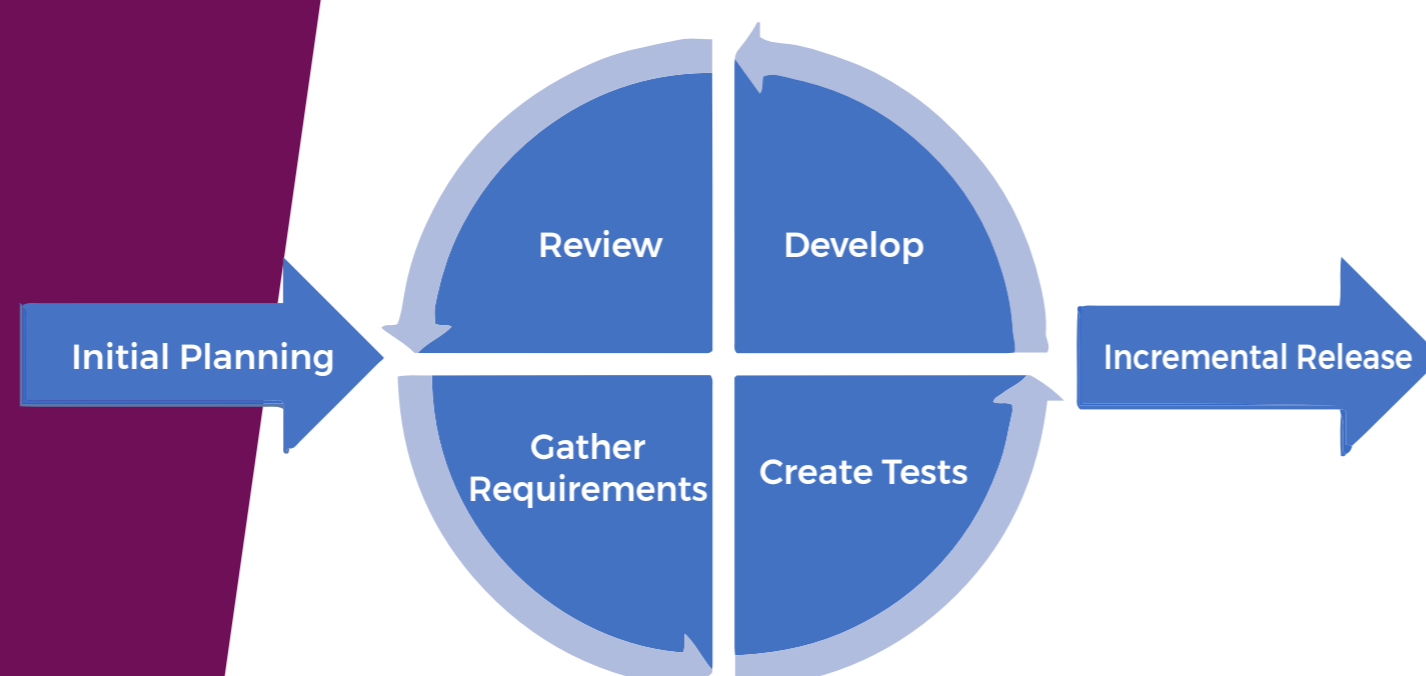
Fig. 2: Phase plot analysis [2]. Top 3 show participants with PD. Bottom row are typically developed adults.



Methods

An Agile software development methodology which allows for 'incremental and iterative changes on an ongoing basis' [2] was used in conjunction with user-centred design (UCD) and test-driven development (TDD). TDD required that at the start of each sprint (a repeatable work cycle) the requirements were turned into test cases. Development within that sprint would then need to pass these test cases. Once the test cases had been passed there could be an iterative release allowing for new requirements to be gathered going into the next sprint cycle. An example of this software development methodology can be seen in Fig. 3.

Fig. 3:
The agile
development
methodology
used



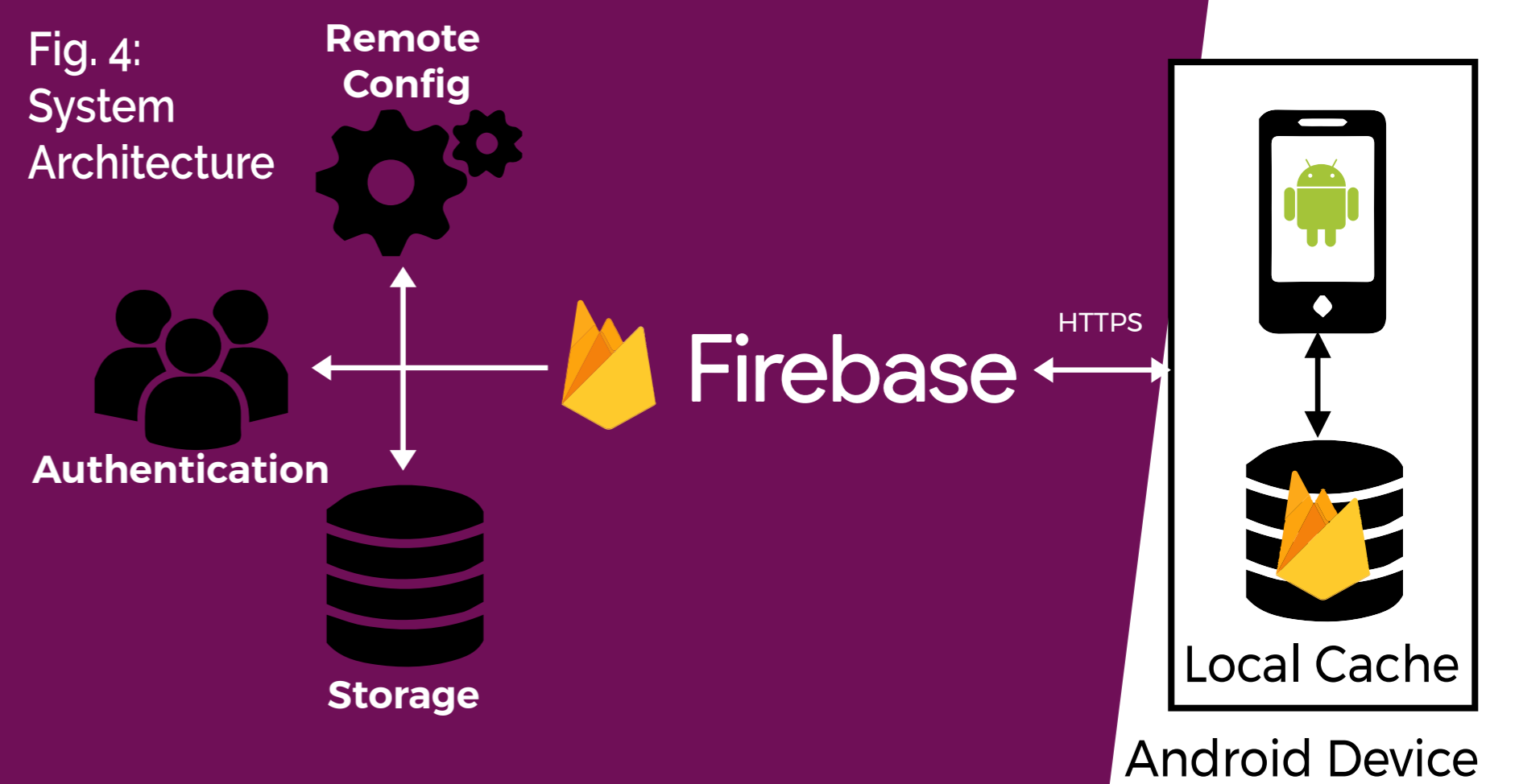
Big Data

To ensure the application was more widely accessible than its predecessors, usability was a key factor in its development including the sharing and storage of the captured data. Thus a centralised cloud server would be required to accommodate this. Because of the confidential nature of the data it was important to comply with the Data Protection Act [4] by ensuring encryption on the device and during transfer.

Firebase (Fig. 4), which is a Software-as-a-Service by Google [5] provides this functionality, as well as many other useful features, a few of which have been outlined below.

- Authentication - Secure account creation, logging in and out
- Storage - Cloud storage for mass amounts
- Remote Config - Remote changes to all instances without the user needing to update their device

Fig. 4:
System
Architecture



Heuristic Evaluation

A heuristic evaluation is an informal usability inspection method for software that helps to identify usability problems in the user interface [3].

The evaluation consisted of five evaluators, which has been shown to uncover most usability problems [6], scored ten heuristics on a scale of 0 to 4. Each evaluator received the same information and instructions before they began. The evaluation helped to uncover usability issues within the application such as misleading buttons.

Conclusion

- It was shown that a usable and accessible Android application can capture the required IMU data required to perform phase plot analysis.
- It was shown that it is possible to securely process and upload this data to a cloud server where it can be analysed by researchers at Oxford Brookes Faculty of Health and Life Sciences.
- However, due to time & ethical limitations it was not possible to validate the data captured with results from the MEMS.

References

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