CodeBlue

Verification & Validation Document

Modular Phone App for Cardiac Arrest Detection

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1. Overview

Testing of CodeBlue includes: front-end component testing using Storybook, unit testing with Jest, user-testing of the applications core functionalities, and visual analysis of the CA Detection Algorithm.

2. Test Descriptions

2.1 Functional Requirements

2.1.1 Minimum Viable Product

2.1.1.1 Receives cardiac data wirelessly from a peripheral app

Method	Test case	Result
Manual	Test sending cardiac data from peripheral app	

Table 2.1.1.1 - Stream Heart Rate Data tests

2.1.1.2 Supports Bluetooth connection and communication

Method	Test case	Result
Manual	Scanning for nearby bluetooth devices	Passed
Manual	Discover services and characteristics of connected device	Passed
Manual	Monitor characteristic to receive streamed cardiac data from a 3rd party BLE Peripheral app	Passed
Manual	Disconnecting from device	Passed
Manual	Reading connection state of device and handle connection state changes if device disconnects	Passed

Table 2.1.1.2 - Wireless Connection tests

2.1.1.3 Uses cardiovascular data input to perform cardiac monitoring

Method	Test case	Result
Manual	Healthy cardiac data	Passed - no CA detected

Table 2.1.1.3 - Cardiac monitoring tests

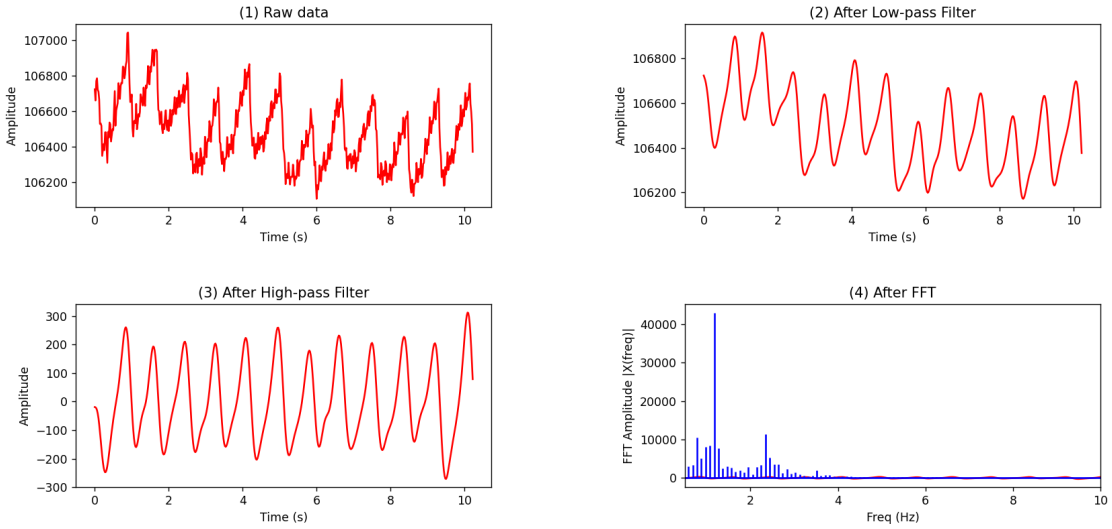

Figure 2.1.1.3.1 - Sample time-frame 1

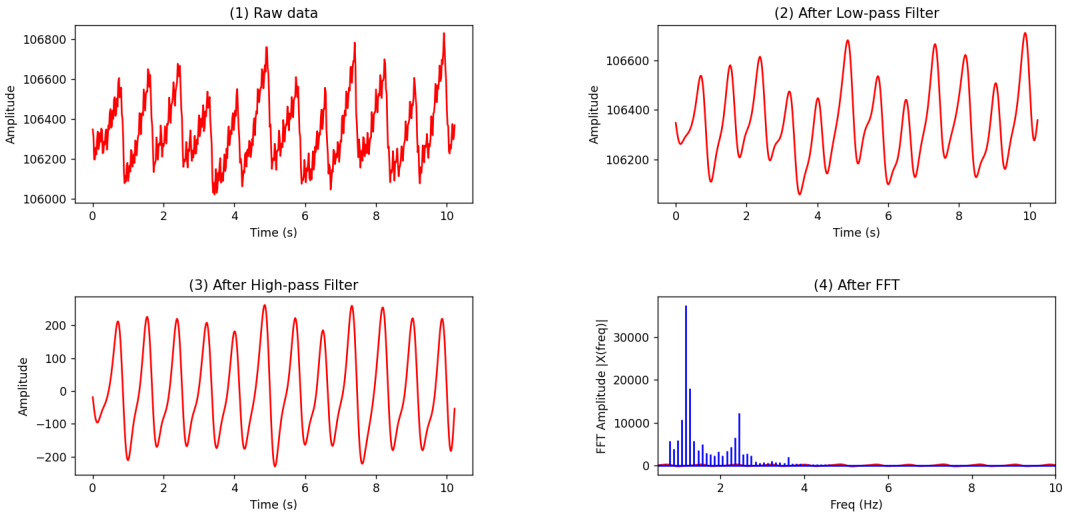

Figure 2.1.1.3.2 - Sample time-frame 2

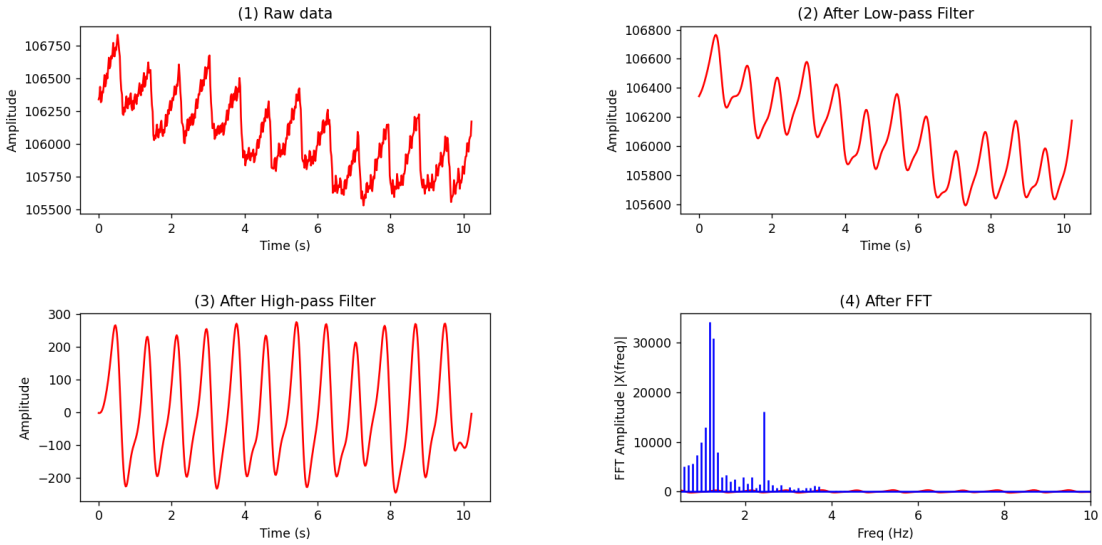

Figure 2.1.1.3.3 - Sample time-frame 3

2.1.1.4 Implements Emergency Procedure that includes calling 911

Method	**Test case**	**Result**
Manual	Phone call placed when timer reaches 0	Passed
Manual	Phone call placed if user clicks “Call 911” before timer reaches 0	Passed
Manual	No phone call if user cancel EP	Passed

Table 2.1.1.4 - Emergency Procedure tests

2.1.1.5 Background processing

Method	**Test case**	**Result**
Manual	Default background mode is MONITOR_HEART	Passed
Manual	Background mode changes to CA_DETECTED when a CA notification is received	Passed
Manual	Background mode changes to CALL_NOW if the user expedites the EMS call	Passed

Manual	Background mode changes to CANCEL_CALL if the user cancels the EMS call	Passed
Manual	Background mode changes to CALL_ENDED when the EMS call is over	Passed

Table 2.1.1.5 - Background processing tests

2.1.1.6 Push notifications trigger EP and can be received in foreground and background mode

Push notifications are made using Firebase Cloud Messaging (FCM) and require manual testing.

Method	**Test case**	**Result**
Manual	Push notifications are successfully received by device with specified id while CodeBlue is open in the foreground	Passed
Manual	Push notifications are successfully received by device with specified id while CodeBlue is open in the background	Passed
Manual	Push notifications are successfully received by device with specified id while CodeBlue is open in the background with phone screen off	Passed
Manual	Push notifications successfully trigger Emergency Protocol procedure	Passed

Table 2.1.1.6 - FCM Notification tests

2.1.1.7 Algorithm server

The node server that is hosted on EC2 to allow the detection algorithm to be called through an API call is unit tested using Jest.

Method	**Test case**	**Result**
Jest	Request body data validation	Passed
Jest	Express server routing is handled correctly	Passed

	and returns success status code	
Jest	Detection algorithm outputs correct response given healthy data	Passed
Jest	Detection algorithm outputs correct response given cardiac arrest data	Passed

Table 2.1.1.7 - Algorithm server tests

2.2 Front-End Testing

2.2.1 Jest

The Jest framework comes with React Native and is used for component, unit, and integration testing.

2.2.2 Component Testing

We are using Storybook to perform visual testing on UI components. For each component or screen file, we create a matching story file which allows each component and their interactions to be rendered when the app is launched in Storybook mode. The app can be launched in Storybook mode to view individual components and screens by setting `const STORYBOOK_START = true;` in `App.tsx`.

2.2.3 Unit Testing

Method	**Test case**	**Result**
Jest	useLocalStorage.ts test suite	Passed with 100% line coverage
Jest	LocalStorageImpl.ts test suite	Passed with 100% line

		coverage
Jest	LocalStorageCache.ts test suite	Passed with 100% line coverage
Jest	formatValidators.ts test suite	Passed with 100% line coverage

Table 2.2.3 - Unit tests

2.2.4 Integration Testing

Method	**Test case**	**Result**
Manual	Go through onboarding flow and verify that the Home screen is shown the next time the app is opened	Passed
Manual	Verify that the “Reset App” modal deletes all locally stored information	Passed

Table 2.2.4 - Integration tests

2.3 Stretch Goals

2.3.1 Confidence Rating

Method	**Test case**	**Result**
-	-	-

Table 2.3.1 - Confidence Rating tests

2.3.2 Hardware Integration

Method	**Test case**	**Result**

Manual	Connect to a 3rd party BLE peripheral app and receive streamed data	Passed

Table 2.3.2 - Hardware Integration tests

2.3.3 Sensor Attachment

Method	**Test case**	**Result**
-	-	-

Table 2.3.3 - Sensor Attachment tests

2.3.4. Pass Information to EMS

Method	**Test case**	**Result**
-	-	-

Table 2.3.4 - Pass Information to EMS tests

2.3.5 Saving User Data

Method	**Test case**	**Result**
Manual	Verify onboarding data is saved locally	Passed
Manual	Verify that editing saved data works	Passed

Table 2.3.5 - Saving User Data tests

2.4 Non-functional Requirements

2.4.1 Fast decision time for CA detection algorithm

Method	**Test case**	**Result**
Manual	Send 10-second dataframe to server	Pass
Manual	Determine if current data frame contains	Pass

	cardiac data outside of healthy range under 10 seconds	

Table 2.4.1 - Decision Time tests

2.4.2 Fast, accurate, and anonymous cardiovascular data streaming

Method	**Test case**	**Result**
Manual	CodeBlue immediately receives data sent over Bluetooth from peripheral app	Passed

Table 2.4.2 - Fast, Accurate, Anonymous Cardiovascular Data tests

2.4.3 Ease of Use

Method	**Test case**	**Result**
Manual	Inspect UI using colour blind simulator on Figma	Passed - adequate contrast

Table 2.4.3 - Ease of Use tests

3. Access to data

CodeBlue unit tests and Storybook components are found in the React Native codebase. Sensor data for the CA detection algorithm is supplied by the client and confidential to the team.

4. References

5. Appendix

A. Contributions

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