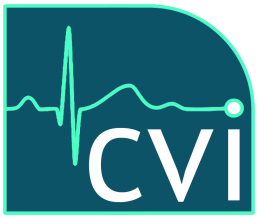

Wireless Auscultation with Decision Support

DATABASE ACCESS AND RELIABILITY SYSTEM INTEGRATION TEST

Prepared By	K. McNiece		
Reviewed By	A. Siddiqui		
Reviewed By	D. Yee		
Approved By	S. Greene		

Document No.	003TS-001-001	Rev: 0

DATE
March 2013

PASS ☐	**PASS** ☐ with deviations listed on p. 3	**FAIL** ☐	**RETEST** ☐

Test ID: DB A&R SIT

Title: Verify Database Access and Reliability SIT

Commencement Date and Time:	Completion Date and Time:
Estimated Duration: 1 Day	Actual Duration:

Project Area: Database

Prerequisites: This test may take place once a preliminary database has been established and the iOS application has developed database interface capability.

I certify that this procedure has been performed according to the procedures detailed herein except as noted, and that the results recorded are accurate and complete.

Tester:	_____	_____	_____
	Name	Signature	Date and Time
Witness:	_____	_____	_____
	Name	Signature	Date and Time

I certify that I have validated the results recorded against the test procedure and the deviations are noted below.

Reviewer:	_____	_____	_____
	Name	Signature	Date and Time

Supporting Documentation:
N/A

Requirements List:
Refer to Prerequisites above.

Scope:
This procedure includes database response time and reliability testing.

Observations

Procedure Overview:
The purpose of this testing procedure is to ensure timely and reliable database access. Prior to the commencement of the test, CVI personnel are to write a testing script for the iOS device interface that will repeatedly push and pull data to and from the database, and record the response times. Data packet sizes are to vary from 50 kB to 10 MB. Response times are to fall within the pass criteria specified below. Speed tests shall be completed manually; endurance reliability testing shall be done by means of the pre-designed script over a set period of time.

Notes:
- One person will be required to complete the testing.
- Use this document to mark the test results. Once the test is complete, remove the test report cover page provided as the last page of this document and staple it to the front of the document.
- Scripting shall be provided at the tester's discretion. Script must be demonstrated to produce reliable results and be included in product documentation.
- Data should be recorded in a recoverable file and attached to test report.
- In this Proof of Concept stage, database reliability is granted some leniency: any failure to adhere to industry standards will be corrected in commercial product.

Deviations / Modifications

Test Case 1 SPEED TESTING

Method: The iOS interface will be configured to transmit and receive data from the database before testing begins. In this test, the tester will manually send and receive packages of varying sizes, ranging from 50 kB to 10 MB, and recording response times and confirm complete and accurate transmission.

Expected Results: Each data package is sent swiftly without error at an average speed of 50 kB/s or greater.

Pass Criteria: No errors are found in transmission of data packages. Each data packet shall transfer with an average speed of 40 kB/s or greater.

Checklist: Data Transfer Speed

Package Number	Package Size (kB)	Transmission Times (s)	Accurate Data Transfer (Tx)?	Accurate Data Transfer (Rx)?	Pass/Fail
1	10		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
2	25		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
3	50		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
4	75		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
5	100		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
6	500		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
7	1000		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
8	5000		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
9	10000		Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )

Test Case 2 RELIABILITY TESTING

Method: The iOS interface will be configured to transmit and receive data to and from the database by means of a tester-written script. The script shall record package size, transmission time, and record successful transmissions. This test will run for seven days; else for as long as time permits. To prevent a buildup of unnecessary data on the servers, the script shall remove data after testing use.

Expected Results: Each data package is sent and received swiftly without error at an average speed of 50 kB/s or greater. All packets are received.

Pass Criteria: 95% of all packets are received. Average transmission speed shall be 40 kB/s or greater.

Checklist: Data Transfer Speed

Package Number	Package Size (kB)	Average Transmission Times (s)	Data Transfer Success Rate (Tx)?	Data Transfer Success Rate (Rx)?	Pass/Fail
1	10				P ( ) / F ( )
2	25				P ( ) / F ( )
3	50				P ( ) / F ( )
4	75				P ( ) / F ( )
5	100				P ( ) / F ( )
6	500				P ( ) / F ( )
7	1000				P ( ) / F ( )
8	5000				P ( ) / F ( )
9	10000				P ( ) / F ( )

Wireless Auscultation with Decision Support

DATABASE ACCESS AND RELIABILITY SYSTEM INTEGRATION TEST

Reference SIT Procedure #: 003TS-00X

Prepared by: _____ _____

Approved by: _____ _____

Name Signature

Document No.	003TS-001	Rev: 0

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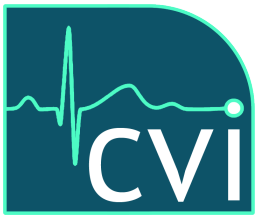
Distribution:

☐ CVI Development Team ☐ ENSC Supervisory Committee ☐

☐ CVI Project Management ☐ ☐



Wireless Auscultation with Decision Support

SOFTWARE FUNCTIONALITY SYSTEM INTEGRATION TEST

Prepared By	K. McNiece		
Reviewed By	D. Yee		
Reviewed By	A. Siddiqui		
Approved By	S. Greene		

Document No.	003TS-002-001	Rev: 0

DATE
March 2013

PASS ☐	PASS ☐ with deviations listed on p. 3	FAIL ☐	RETEST ☐

Test ID: SOFTWARE SIT

Title: Verify Software Functionality

Commencement Date and Time:	Completion Date and Time:
Estimated Duration: 1 Day	Actual Duration:

Project Area: Software GUI and Functionality

Prerequisites: This test may take place once visualization, analytic, and user/patient sharing functionality has been added to the iOS software interface.

I certify that this procedure has been performed according to the procedures detailed herein except as noted, and that the results recorded are accurate and complete.

Tester:	_____	_____	_____
	Name	Signature	Date and Time
Witness:	_____	_____	_____
	Name	Signature	Date and Time

I certify that I have validated the results recorded against the test procedure and the deviations are noted below.

Reviewer:	_____	_____	_____
	Name	Signature	Date and Time

Supporting Documentation:
N/A

Requirements List:
Refer to Prerequisites above.

Scope:
This procedure includes software functionality testing, including basic UI, signal representation, analysis, and sharing capabilities.

Observations

Procedure Overview:
In this test, the tester will test the sharing functionality as well as the signal display and analysis capabilities of the software. For sharing test, the tester will ensure that doctors and medical professionals have access to the records of only their patients, and that when a patient is shared, *only* that patient is shared, and only to the intended recipient.

When testing the signal display and analysis, the tester will be provided with a series of sample signals to display. Certain signals will have anomalies in their heartbeats; the data analytics should pick up this anomaly and point out the location.

Notes:
- One person will be required to complete the testing.
- Use this document to mark the test results. Once the test is complete, remove the test report cover page provided as the last page of this document and staple it to the front of the document.
- Sample signals shall be procured from online medical libraries for the purposes of this test.
- In this Proof of Concept stage, fault detection accuracy is granted some leniency: any failure to adhere to industry standards will be corrected in commercial product.

Deviations / Modifications

Test Case 1 USER INTERFACE

Method: The tester will be provided with the User Interface (UI) map included in the design specification. Navigating the software application, the tester will ensure the UI functionality meets that specified. The tester will then attempt to “break” the software by attempting unconventional user operations.

Expected Results: The user interface behaves as expected and does not perform erratically in extreme cases.

Pass Criteria: The user interface behaves as expected and does not perform erratically in extreme cases.

Checklist: User Interface

Test Number	Test Name	Expected Behaviour?	Notes	Pass/Fail
1	User Interface Behaves Normally	Y ( ) / N ( )		P ( ) / F ( )
2	User Interface is Robust	Y ( ) / N ( )		P ( ) / F ( )

Test Case 2 PATIENT SHARING

Method: The tester will create four sample accounts. Two of these, User A and UserB, shall be configured to have unique patient records; the other two, User C and User D, will have access to no patients. The tester will begin by logging into each of the four accounts and ensuring that each is only able to view the patients they have access to initially.

Next, the tester will log in as User A. The tester will share a patient from User A to both User B and User C. The tester will then sign out of User A and check that User B and User C each have access to the shared patient profile, but no other patient profiles, and that User D still has no patients on record. The tester will then repeat this procedure, sharing from User B to Users A and B.

The tester will then attempt to share a patient from User D. No patients should be shareable, and the appropriate error message should result.

Expected Results: In each sharing transaction, the intended recipients will receive the patient information of *only* the patient shared, and no other users aside from the intended recipients should receive this information. When no patients are available to share, the appropriate error message is returned.

Pass Criteria: The system performs as described above, with no exceptions.

Test A: Sharing Functionality

Test Number	Sender	Recipient	Only Desired Information Sent?	Accessible to Unintended Recipients?	Pass/Fail
1	User A	User B	Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
2	User A	User C	Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
3	User B	User A	Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )
4	User B	User C	Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )

Test B: Sharing From Empty User

Test Number	Sender	Recipient	Information Sent?	Error Message Generated?	Pass/Fail
1	User D	All Users	Y ( ) / N ( )	Y ( ) / N ( )	P ( ) / F ( )

Test Case 3 ANALYTIC TESTING

Method: The tester will be provided with several audio files procured from online medical record databases. These files will be loaded into a patient session and visualised for testing. Prior to the test, each audio file will be analysed by trained personnel to identify any irregularities. The software will run an analysis on these files, and attempt to identify the anomalies. The tester will ensure that all anomalies are caught and all signals are clearly and accurately represented on-screen. In this Proof of Concept device, CVI does not expect to attain an ideal algorithm; therefore not all anomalies must be detected to meet the passing criteria. This shortcoming, if it occurs, will be resolved in the commercial product.

Expected Results: Signals are represented on the screen clearly, and all anomalies are detected.

Pass Criteria: 80% of anomalies are detected. Signal is clear and relatively free of noise.

Checklist: Data Transfer Speed

Signal Number	Signal Displayed Clearly?	Anomalies Detected?	Notes	Pass/Fail
1	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )
2	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )
3	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )
4	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )
5	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )
6	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )
7	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )
8	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )
9	Y ( ) / N ( )	Y ( ) / N ( )		P ( ) / F ( )

Wireless Auscultation with Decision Support

SOFTWARE FUNCTIONALITY SYSTEM INTEGRATION TEST

Reference SIT Procedure #: 003TS-002-001

Prepared by: _____ _____

Approved by: _____ _____

Name Signature

Document No.	003TS-002-001	Rev: 0

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☐ CVI Development Team ☐ ENSC Supervisory Committee ☐

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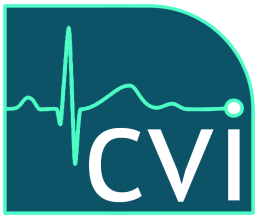

Wireless Auscultation with Decision Support

HARDWARE FUNCTIONALITY SYSTEM INTEGRATION TEST

Prepared By	K. McNiece		
Reviewed By	A. Oudijn		
Reviewed By	A. Siddiqui		
Approved By	S. Greene		

Document No.	003TS-003-001	Rev: 0

DATE
March 2013

PASS ☐	PASS ☐ with deviations listed on p. 3	FAIL ☐	RETEST ☐

Test ID: HARDWARE SIT

Title: Verify Hardware Functionality

Commencement Date and Time:	Completion Date and Time:
Estimated Duration: 2 Days	Actual Duration:

Project Area: Hardware Functionality

Prerequisites: This test has several components. Once an individual hardware system is fabricated for the end product, testing on that sub-system may begin immediately. The final test requires a working database and iOS interface capable of establishing a connection between the Arduino device and the database.

I certify that this procedure has been performed according to the procedures detailed herein except as noted, and that the results recorded are accurate and complete.

Tester: _____ _____ _____
Name Signature Date and Time

Witness: _____ _____ _____
Name Signature Date and Time

I certify that I have validated the results recorded against the test procedure and the deviations are noted below.

Reviewer: _____ _____ _____
Name Signature Date and Time

Supporting Documentation:
N/A

Requirements List:
Refer to Prerequisites above.

Scope:
This procedure describes hardware testing procedures, including analog signal amplification, analog/digital conversion, Signal-to-Noise Ratios (SNRs), and wireless communications.

Observations

Procedure Overview:
In this test, the tester will test the functionality of the analog signal processing circuitry, the analog/digital converter, and the proper storage and transmission of data

Notes:
- One person will be required to complete the testing.
- The tester may use a second person as a test subject for collecting audio data.
- Use this document to mark the test results. Once the test is complete, remove the test report cover page provided as the last page of this document and staple it to the front of the document.
- The functioning Arduino board must be configured before the wireless test takes place, and data must be sent from the registers used to store incoming signal data in the wireless network test.
- In this Proof of Concept stage, database reliability is granted some leniency: any failure to adhere to industry standards will be corrected in commercial product.

Deviations / Modifications

Test Case 1 ANALOG SIGNAL PROCESSING

Method: The tester shall use a test subject or his or her own body to collect an audio signal. The electrical audio signal output shall be collected over a brief time span of several heartbeats using a high-sample rate data collection device. While collecting this data, the tester will simultaneously listen to the audio transmitted through the audio port on high-quality headphones and verify whether the signal is clean and understandable. The Signal-to-Noise Ratio will be estimated based on the data collected. Due to the nature of the device, an accurate calculation may prove difficult, as stethoscopes are prone to picking up environmental noise prior to the signal conversion.

Expected Results: The analog circuitry will produce a clean signal for transmission to the A/D converter, as well as to the headphone jack on the device.

Pass Criteria: The audio signal to the headphones is clear and valuable, and the Signal-to-Noise Ratio estimated from the collected data output shall be greater than 5.

Testing Checklist: Analog Signal Testing

Test Number	Test Name	Notes	Pass/Fail
1	Audio Signal Clarity		P ( ) / F ( )
2	SNR		P ( ) / F ( )

Test Case 2 ANALOG/DIGITAL CONVERSION

Method: The tester will configure the Arduino board to take an analog input to the A/D converter and record the output in a file. The file will then be read by the tester and graphed by the desired means. The tester will compare this digital representation to a direct conversion of an analog signal as generated in Test Case 1.

Expected Results: The digital representation of the signal will match with reasonable accuracy the direct conversion of the analog signal created using the procedure of Test Case 1.

Pass Criteria: The digital conversion of the audio signal from the Arduino board closely matches the analog output from the amplifier circuit. The analog signal is recoverable from the digital signal.

Testing Checklist: Analog-to-Digital Conversion

Test Number	Test Name	Notes	Pass/Fail
1	Digital matches Analog		P ( ) / F ( )
2	Analog recoverable from digital		P ( ) / F ( )

Test Case 3WIRELESS COMMUNICATIONS

Method: The tester will configure the Arduino board to transfer a set of recorded data files from the on-board data storage location to the working database across the wireless network. First the connection must be established through the iOS interface, then the data must be transferred securely to the specified database location and be recoverable in the iOS interface. This is essentially an end-to-end test of product information management capabilities.

Expected Results: The given audio files are recoverable in the iOS interface with no corruption or data loss.

Pass Criteria: All files are transferred correctly with no loss or corruption.

Testing Checklist: Wireless Data Transfer

Test Number	Test Name	Notes	Pass/Fail
1	Data Transfer Completed, Data Recovered		P ( ) / F ( )
2	No Data Loss or Corruption		P ( ) / F ( )

Wireless Auscultation with Decision Support

HARDWARE FUNCTIONALITY SYSTEM INTEGRATION TEST

Reference SIT Procedure #: 003TS-002-001

Prepared by: _____ _____

Approved by: _____ _____

Name Signature

Document No.	003TS-003-001	Rev: 0

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