SFWRENG 3K04: Software Development

Assignment 2 – Part 3 - Testing

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Group 5: More Life Pacemaker

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Test #1 - DOO

Purpose

To test the DOO behavior from the simulink model. In this case, the atrium and ventricle chambers should beat periodically at a rate of 100 BPM. Since sensing and inhibition features are off, the labview environment should not interfere with the pacemaker beats.

Input

The following parameters are programmed, and the remaining parameters are set to their default values.

p_pacingMode	4	DOO
p_lowerRateLimit	100	BPM

Pre-Program

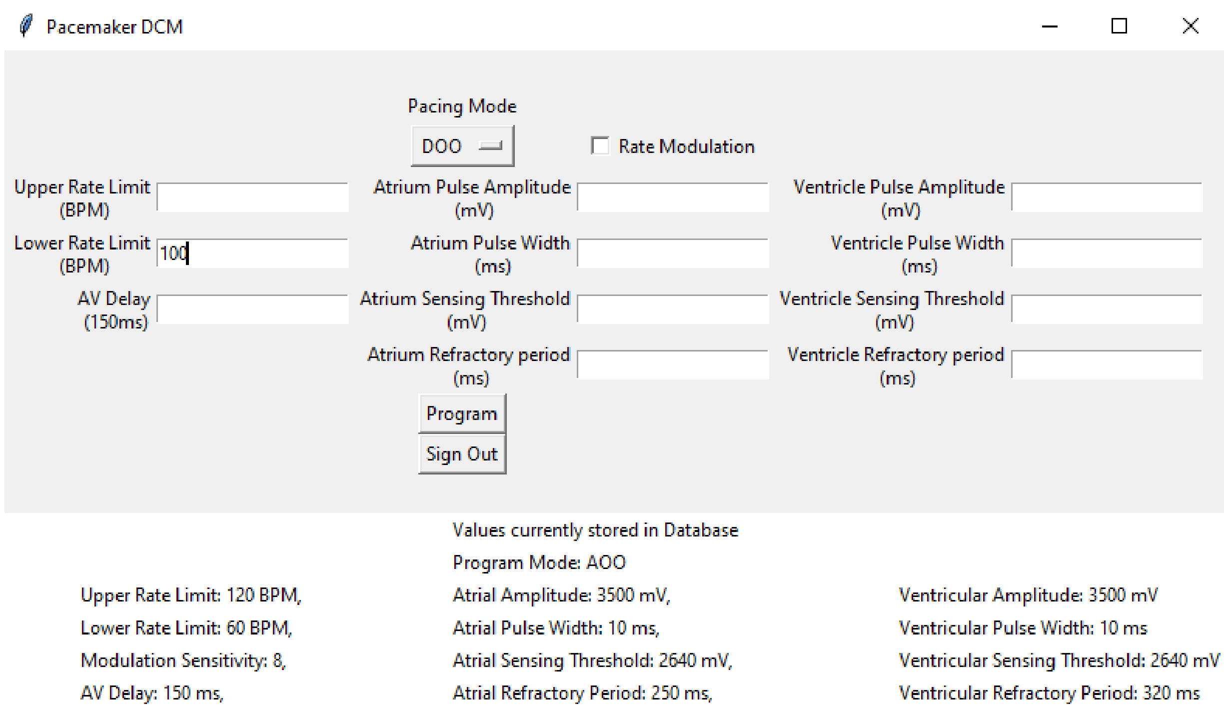

Figure 1: DCM Interface before programming

Post-Program

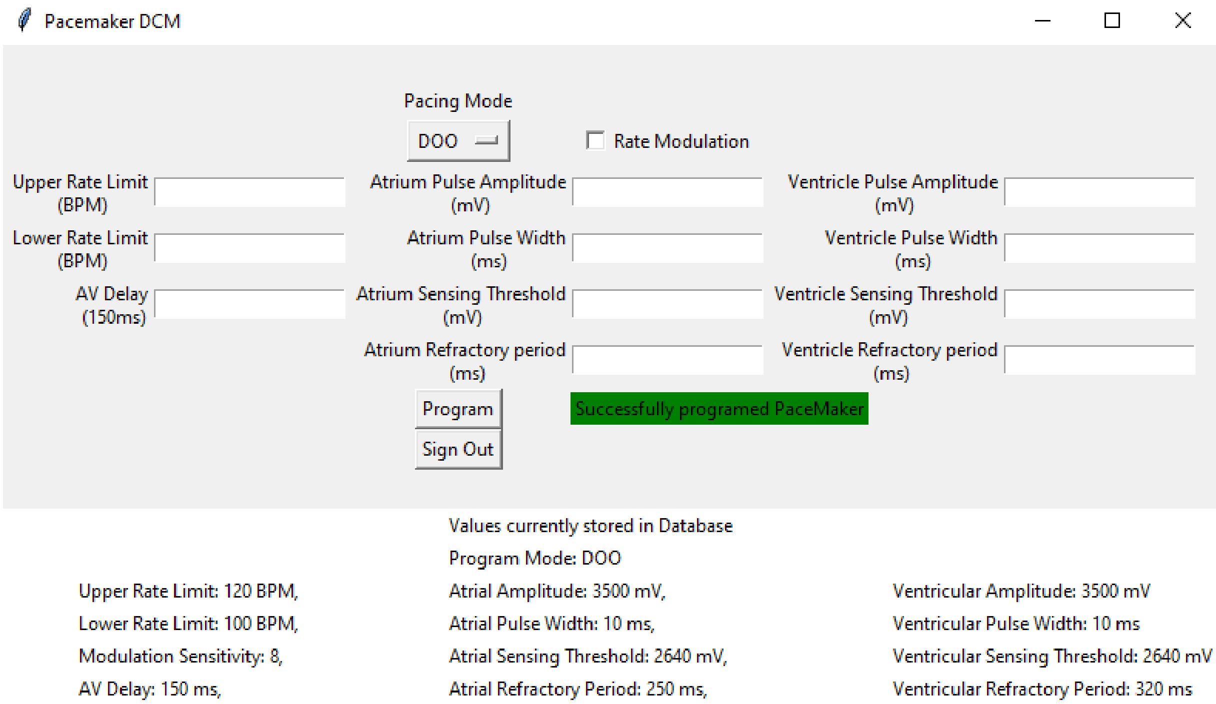

Figure 2: DCM Interface after programming

Expected Output

Pacemaker shall cause the atrium chamber to beat first and soon after 150msec, the ventricle chamber shall beat. In total, for both atrium and ventricle, a hundred beats must be registered in a minute on the oscilloscope.

Actual Output

Figure 3: DOO Oscilloscope View

Wave 1 (Yellow Color)	-	Atrium Pacemaker Model
Wave 2 (Blue Color)	-	Ventricle Pacemaker Model
Wave 3 (Pink Color)	-	Atrium Labview (Artificial) - used for sensing modes
Wave 4 (Green Color)	-	Ventricle Labview (Artificial) - used for sensing modes

It is clearly seen from figure 2 that atrium and ventricle pulsate with a difference of 150ms and the period of atrium/ventricle beats is 600ms = 0.6s (because time scale is 200ms and the difference between two atrium beats is 3*200ms = 600ms).

Now,	1 minute	=	60seconds;
and,	0.6s	=	1 beat
Therefore, multiply by 60s:	60s * 0.6s	=	1beat * 60s
Divide by 0.6s:	60s	=	(60 beats-s) ÷ (0.6s)
	1minute	=	100 beats

Hence, it is proven that the DOO mode generates 100 beats per minute as per the specifications.

Result

Pass

Test #2 - AOO

Purpose

To test the AOO behavior from the simulink model. In this case, only atrium chamber should beat periodically at a rate of 50 BPM. Since sensing and inhibition features are off, the labview environment should not interfere with the pacemaker beats.

Input

The following parameters are programmed, and the remaining parameters are set to their default values.

p_pacingMode	0	AOO
p_lowerRateLimit	50	BPM

Pre-Program

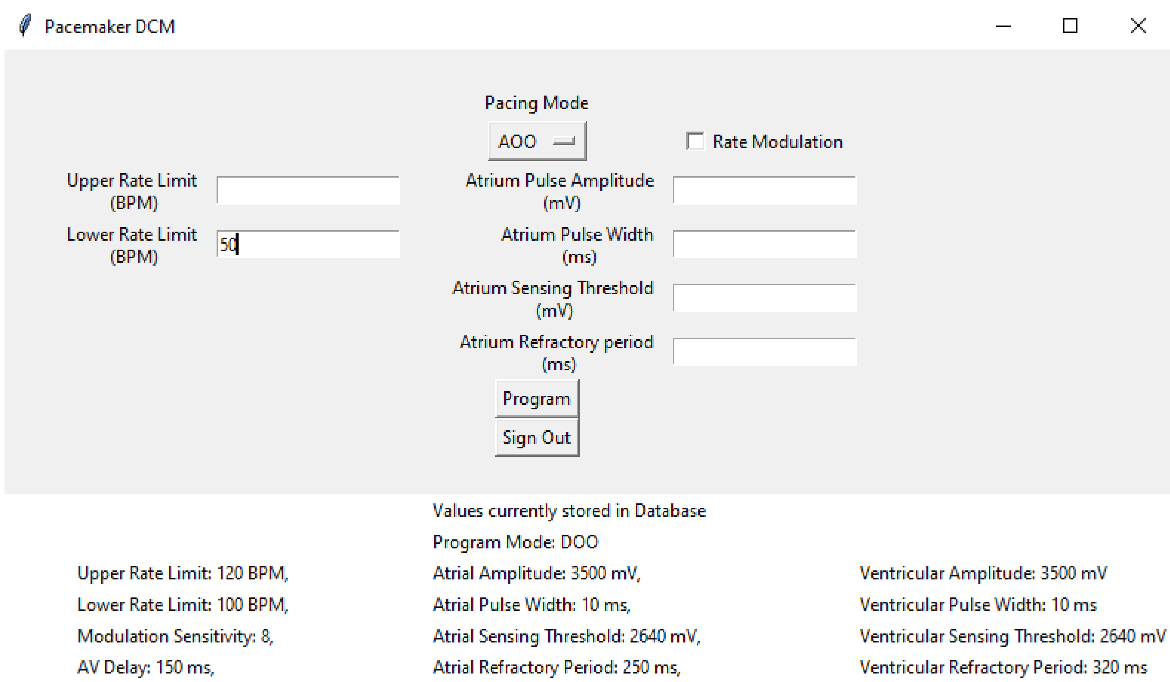

Figure 4: DCM Interface before programming

Post-Program

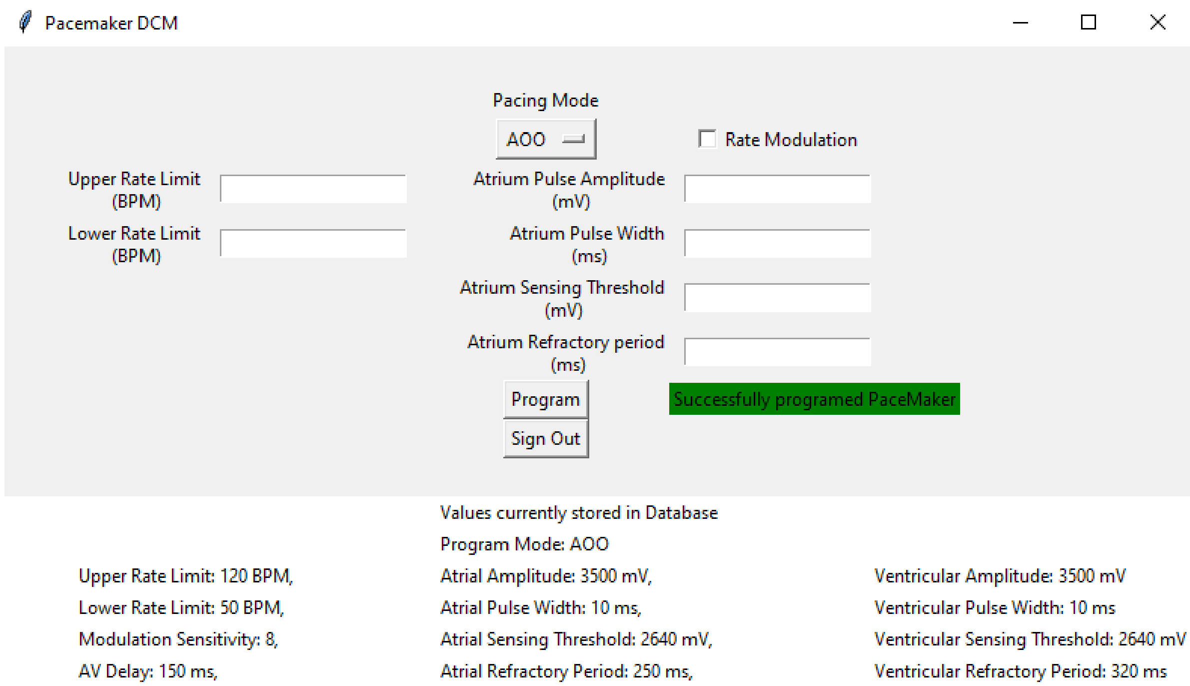

Figure 5: DCM Interface after programming

Expected Output

Pacemaker shall cause the atrium chamber to beat repeatedly with a period of 1200ms and the ventricle chamber should be idle. In total, fifty beats must be registered in a minute on the oscilloscope.

Actual Output

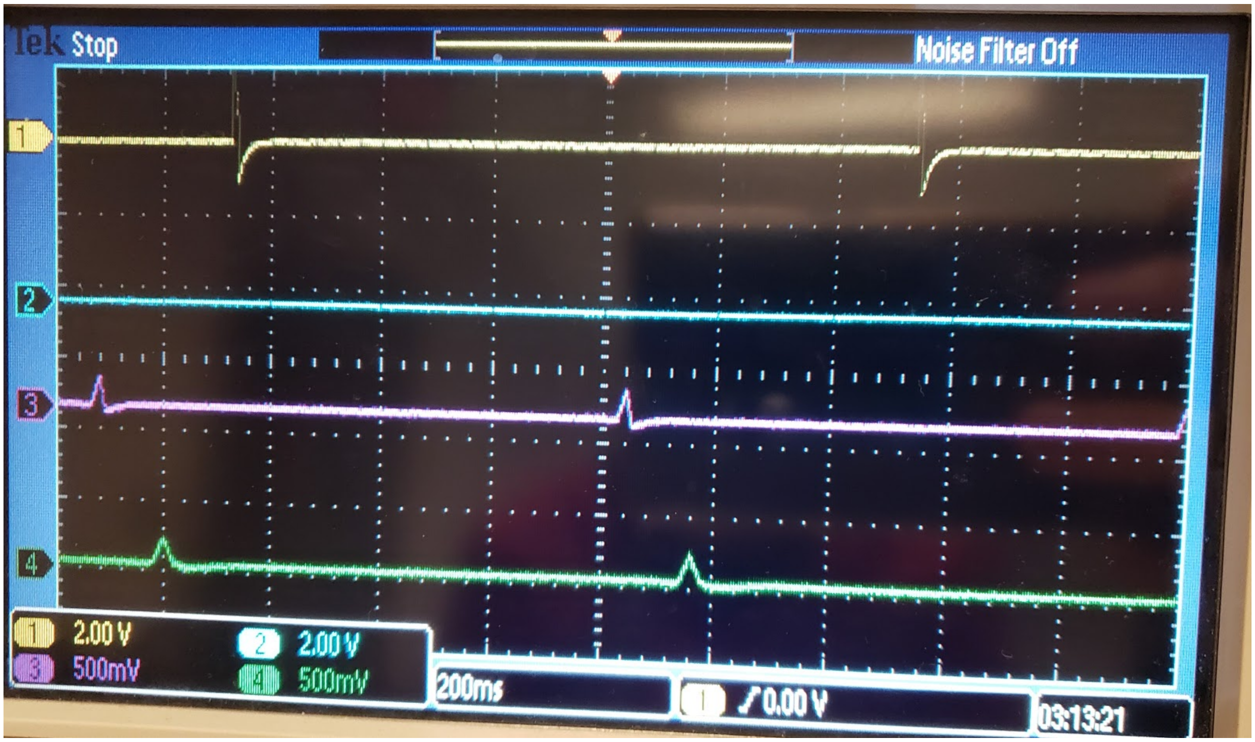

Figure 6: AOO Oscilloscope View

Wave 1 (Yellow Color)	-	Atrium Pacemaker Model
Wave 2 (Blue Color)	-	Ventricle Pacemaker Model
Wave 3 (Pink Color)	-	Atrium Labview (Artificial) - used for sensing modes
Wave 4 (Green Color)	-	Ventricle Labview (Artificial) - used for sensing modes

It is clearly seen from figure 3 that only the atrium pulsates with a period of 1200ms = 1.2s (because time scale is 200ms and the difference between two atrium beats is 6*200ms = 1200ms).

Now,	1 minute	=	60seconds;
and,	1.2s	=	1 beat
Therefore, multiply by 60s:	60s * 1.2s	=	1beat * 60s
Divide by 1.2s:	60s	=	(60 beats-s) ÷(1.2s)
	1minute	=	50 beats

Hence, it is proven that the AOO mode generates 50 beats per minute as per the specifications.

Result

Pass

Test #3 - VOO

Purpose

To test the VOO behavior from the simulink model. In this case, only ventricle chamber should beat periodically at a rate of 80 BPM. Since sensing and inhibition features are off, the labview environment should not interfere with the pacemaker beats.

Input

The following parameters are programmed, and the remaining parameters are set to their default values.

p_pacingMode	1	VOO
p_lowerRateLimit	80	BPM

Pre-Program

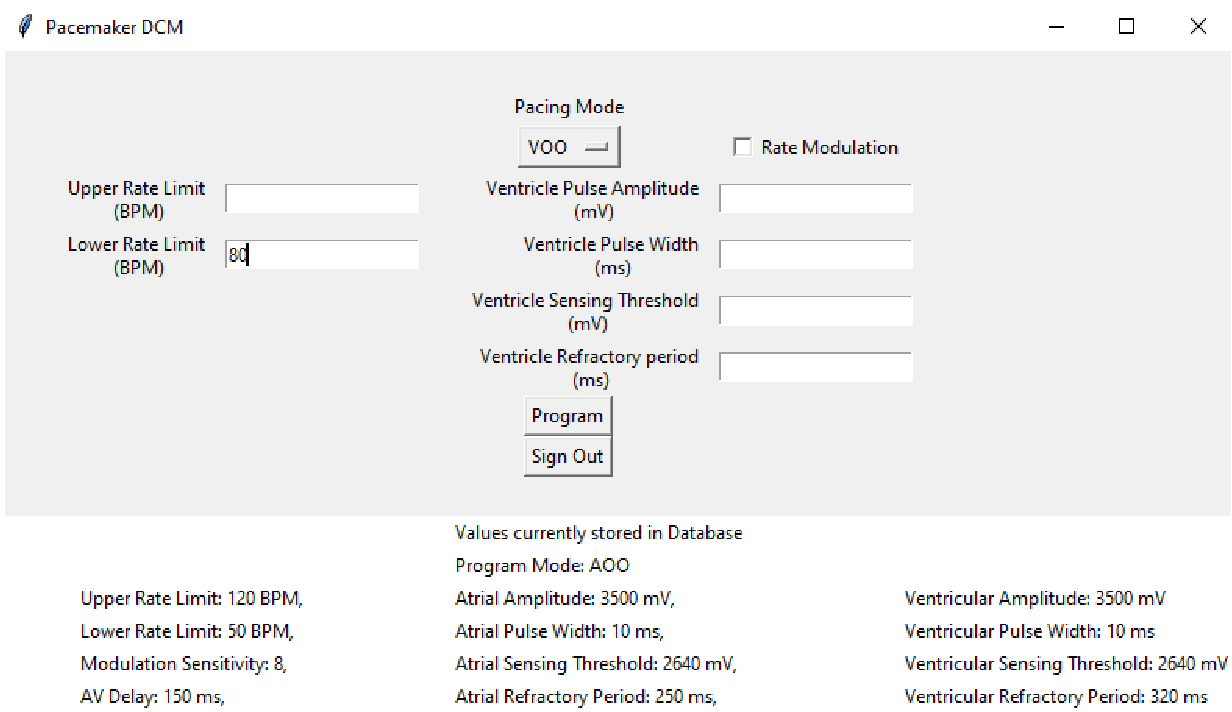

Figure 7: DCM Interface before programming

Post-Program

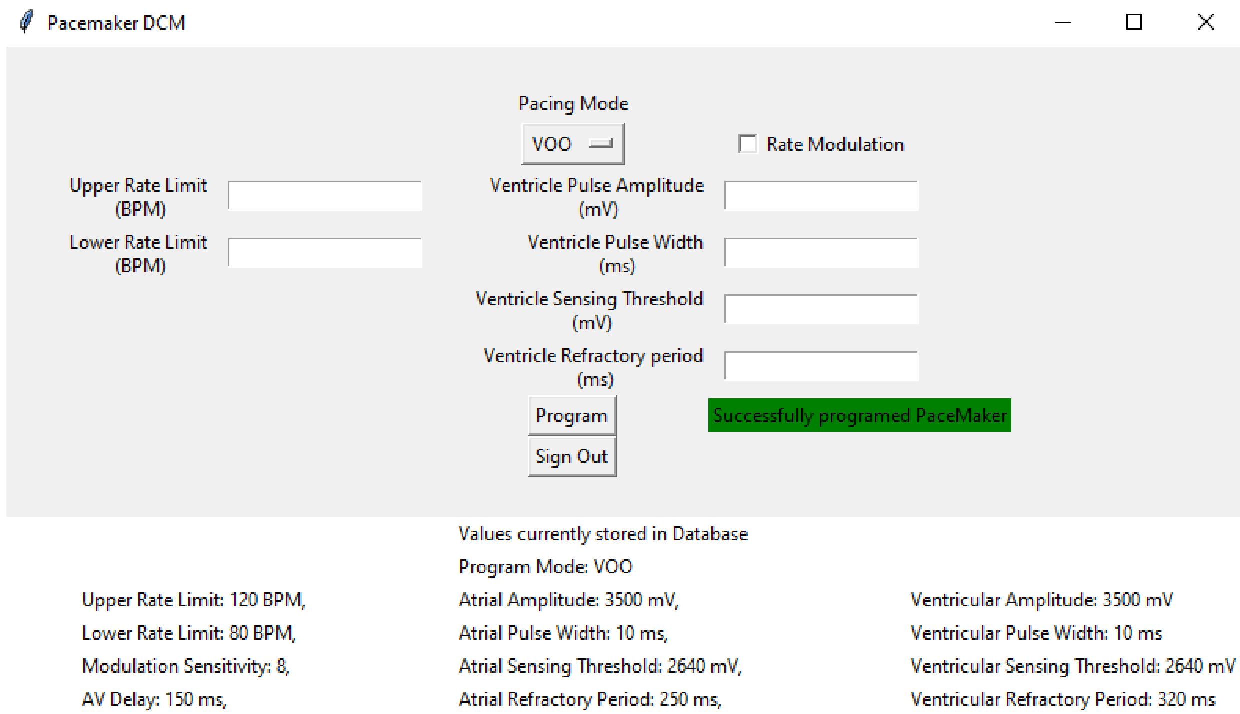

Figure 8: DCM Interface after programming

Expected Output

Pacemaker shall cause the ventricle chamber to beat repeatedly with a period of 750ms and the atrium chamber should be idle. In total, eighty beats must be registered in a minute on the oscilloscope.

Actual Output

Figure 9: VOO Oscilloscope View

Wave 1 (Yellow Color)	-	Atrium Pacemaker Model
Wave 2 (Blue Color)	-	Ventricle Pacemaker Model
Wave 3 (Pink Color)	-	Atrium Labview (Artificial) - used for sensing modes
Wave 4 (Green Color)	-	Ventricle Labview (Artificial) - used for sensing modes

It is clearly seen from figure 4 that only the ventricle chamber pulsates with a period of 750ms = 0.75s (because time scale is 200ms and the difference between two atrium beats is 3.75(approx.)*200ms = 750ms).

Now,	1 minute	=	60seconds;
and,	0.75s	=	1 beat
Therefore, multiply by 60s:	60s * 0.75s	=	1beat * 60s
Divide by 0.75s:	60s	=	(60 beats-s) ÷ (0.75s)
	1minute	=	80 beats

Hence, it is proven that the AOO mode generates 80 beats per minute as per the specifications.

Result

Pass

Correctness Testing of DCM

GUI Testing

Purpose

To test the GUI behaviour of the DCM. We have tested the GUI with test cases derived from the requirements as well as test cases based on the behaviour the program aims to achieve. Completing black box and white box testing is an attempt to locate bugs in the GUI, as well as performing robustness testing to determine that the gui has acceptable error handling protocols.

Drop-down Menu Testing:

Test #	Input	Expected Output	Actual Output	Result
1	Selecting Mode AOO	Mode change label switches to AOO	Mode change label switched to AOO	Pass
2	Selecting Mode AAI	Mode change label switches to AAI	Mode change label switched to AAI	Pass
3	Selecting Mode VOO	Mode change label switches to VOO	Mode change label switched to VOO	Pass
4	Selecting Mode VVI	Mode change label switches to VVI	Mode change label switches to VVI	Pass
5	Selecting Mode DOO	Mode change label switches to DOO	Mode change label switches to DOO	Pass

Repeated test cases with all five modes with rate modulation selected. All tests in rate modulation also passed

Checkbox Testing:

Test #	Input	Expected Output	Actual Output	Result
1	In non-rate modulation state, checking box	Enter rate modulation state and switch to rate modulated mode	Entered rate modulation state and switched to rate modulated mode	Pass
2	In rate modulation state, deselecting checkbox	Enter non-rate modulated state and switch to rate non-rate modulated mode	Entered non-rate modulated state and switched to non-rate modulated mode	Pass

Button Testing:

Test #	Input	Expected Output	Actual Output	Result
1	Press Login Button with valid credentials	Display Programming Screen in current state saved in database for the user	Displayed Programming Screen in current state saved in database for the user	Pass
2	Press Login Button with invalid credentials	Display invalid user input error message	Displayed invalid user input error message	Pass
3	Press New User Button	Display Create New User Screen	Displayed Create New User Screen	Pass
4	Press Create New User Button with valid user input	Display Login Screen	Displayed Login Screen	Pass
5	Press Create New User Button with invalid user input	Display invalid user input error message	Displayed invalid user input error message	Pass

6	Pressed Cancel Button	Display Login Screen	Displayed Login Screen	Pass
7	Press Program Button with correct user input values while connected to Pacemaker	Display Program Screen with up to data values stored in database for user Display successfully programed Pacemaker message	Displayed Program Screen with up to data values stored in database for user Displayed successfully programed Pacemaker message	Pass
8	Press Program Button with correct user input values and not connected to Pacemaker	Display Program Screen with up to data values stored in database for user Display could not program Pacemaker message	Displayed Program Screen with up to data values stored in database for user Display could not program Pacemaker message	Pass
9	Press Program Button with incorrect user input values	Display invalid user input error message under specific user entry fields	Displayed invalid user input error message under specific user entry fields	Pass
10	Press Echo Button while connect to Pacemaker	Display received pacemaker data on Programming Screen	Displayed received pacemaker data on Programming Screen	Pass
11	Press Echo Button while not connected to Pacemaker	Display cannot open serial port error message	Display cannot open serial port error message	Pass
12	Press Sign Out Button	Display Login Screen	Display Login Screen	Pass

User Entry Field Testing:

Test #	Input	Expected Output	Actual Output	Result
1	Valid integer	Complete callback for respective button pressed	Completed callback for respective button pressed	Pass
2	Invalid Character	Display invalid user input error message	Displayed invalid user input error message	Pass

Serial Testing

Purpose

To test that the correct serial data is being sent on the correct COM port with the correct baud rate.

Input

Part 1:

- ‘hello’ converted to a byte array: [0x68, 0x65, 0x6c, 0x6c ,0x6f]

Part 2:

- Default pacemaker parameter settings with start byte, and command byte prepended, and lower rate set to 50 BPM:
  [0x16, 0x55, 0x0, 0x32, 0x78, 0xAC, 0xD, 0xAC, 0xD, 0xA, 0xA, 0x5, 0xA, 0x5, 0xA, 0xFA, 0x0, 0x4, 0x1, 0x96, 0x0, 0x0, 0x8]

Expected Output

Part 1:

- Arduino blinks LED because ‘hello’ is read over serial.

Part 2:

- Pacemaker shall cause the atrium chamber to beat repeatedly with a period of 1200ms and the ventricle chamber should be idle. In total, fifty beats must be registered in a minute on the oscilloscope.

Actual Output

Part 1:

- Arduino blinks LED because ‘hello’ is read over serial.

Part 2:

- Pacemaker causes the atrium chamber to beat repeatedly with a period of 1200ms and the ventricle chamber is idle. In total, fifty beats are registered in a minute on the oscilloscope.

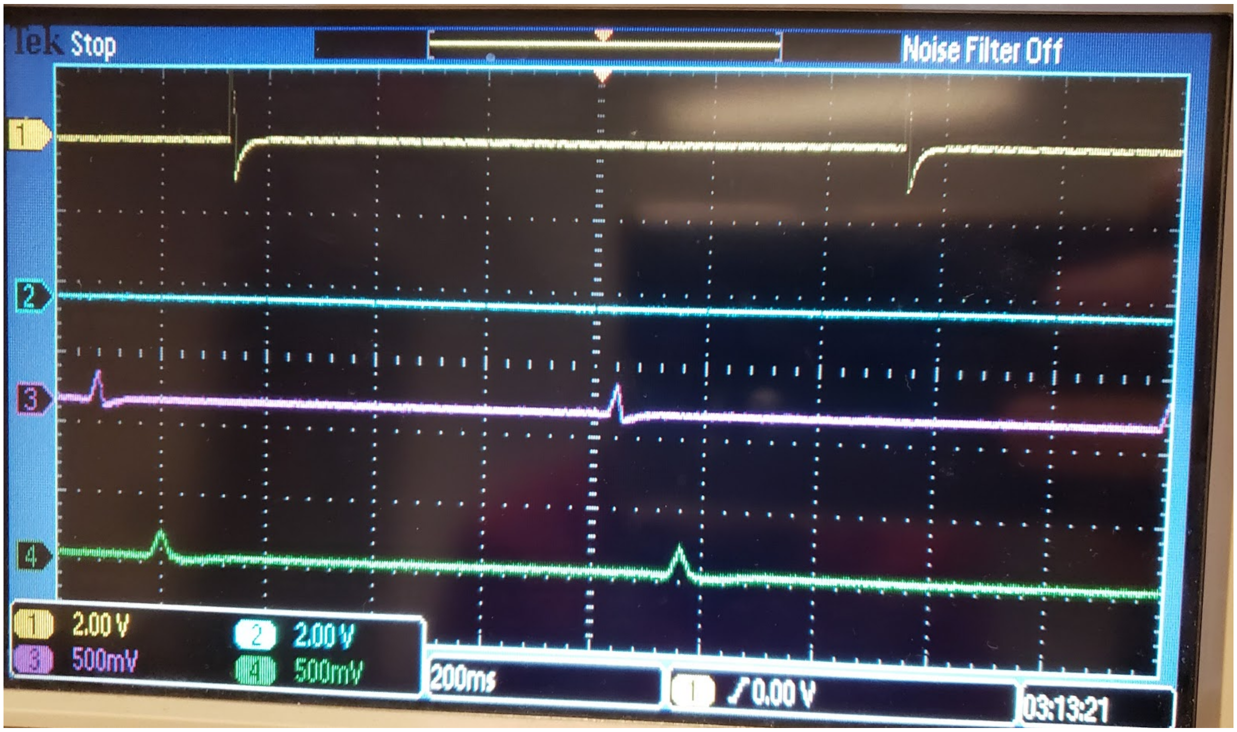

Figure 10: AOO Oscilloscope View of DCM Serial Test

Wave 1 (Yellow) - Atrium Pacemaker Model

It is clearly seen from figure 3 that only the atrium pulsates with a period of 1200ms = 1.2s (because time scale is 200ms and the difference between two atrium beats is 6*200ms = 1200ms).

Result

Part 1:

- Pass

Part 2:

- Pass

Database Testing

Purpose

Black box test to test that the correct data is being stored/retrieved to/from the database.

Input

Create new user with username: test, and password: test.

Expected Output

User is redirected to the main login page, and when the user attempts to login with credentials they are signed in.

Actual Output

User is redirected to the main login page, and when the user attempts to login with credentials they are signed in.

```
SELECT * FROM 'databaseuserdata' LIMIT 0,30
```

Execute

id	username	password	role	data_id
1	Admin	0b4548dfadaf4ad5c8c9ab4bf1fc95247ebf358c1952e026f67fccc7a7c...	UserRole.ADMIN	1
2	test	7c5403109017ab4c703f06013696867ebd120651629f29d79bee28d9...	UserRole.USER	2

Figure 11: User Table in Database Content After User Creation

```
SELECT * FROM 'databaseprogramdata' LIMIT 0,30
```

Execute

id	programMode	lowerRateLimit	upperRateLimit	atrialAmplitude	atrialPulseWidth	atrialSensingThreshold	atrialRefractoryPeriod	ventricularAmplitude	ventri
1	AOO	60	120	3500	10	2640	250	3500	10
2	AOO	60	120	3500	10	2640	250	3500	10
3	AOO	60	120	3500	10	2640	250	3500	10

Figure 12: Parameter Table in Database Content After User Creation

Result

Pass