SFWRENG 3K04
Assignment 1 Part 2
Documentation

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Contents

1 Requirements

1.1 Welcome Screen

All required aspects of the welcome screen are implemented in the current software revision:

- Register a new user
- Login as an existing user
- Maximum of 10 users stored locally

All requirements will remain in future software revisions.

1.2 User Interface Essential Aspects

All required essential aspects of the user interface have been implemented in the current software revision:

- User interface is capable of utilizing and managing windows for display of text and graphics
- User interface is capable of processing user positioning and input buttons
- User interface is capable of displaying all programmable parameters for review and modification
- User interface is capable of visually indicating when the DCM and the device are communicating
- User interface is capable of visually indicating when a different PACEMAKER device is approached than was previously interrogated

All requirements will remain in future software revisions.

1.3 DCM Utility Functions

1.3.1 About

All required aspects of the About function are implemented in the current software revision:

- Application model number
- Application software revision
- DCM serial number
- Institution name

All requirements will remain in future software revisions.

1.3.2 Set Clock

The Set Clock function is not implemented, but has been allocated a window and a button on the DCM main window. This function will likely be removed in a future revision of the software depending on the feasibility of implementing the feature.

1.3.3 New Patient

The New Patient function is implemented in the current software revision. The function will remain in future software revisions.

1.3.4 Quit

The Quit function is implemented in the current software revision. The function will remain in future software revisions.

1.4 Pacing Mode Interfaces

Interfaces for pacing modes and pacing mode selection for the following pacing modes are implemented in the current software revision:

- AOO
- AAI
- VOO
- VVI

Additional pacing modes will be added to the requirements and implemented in future software revisions including:

- DOO
- AOOR
- VOOR
- AAIR
- VVIR
- DOOR

1.5 Printed Reports

All common requirements for printed reports are implemented in the current software revision:

- Header Information
  - Application model and version number

- Device model and serial number
- DCM serial number
- Date and time of report printing
- Report name

All common requirements for printed reports will remain in future software revisions.

1.5.1 Bradycardia Parameters

The feature is implemented in the current software revision. The feature will remain in future software revisions.

1.5.2 Temporary Parameters

The feature has been allocated a button in the reports window in the current software revision. This feature will likely be removed in a future revision of the software as it is unlikely that a temporary pacing mode is introduced.

1.6 Programmable Parameters

Provisions for storing programmable parameter data have been implemented in the current software revision for the following programmable paramters:

- Lower Rate Limit
- Upper Rate Limit
- Atrial Amplitude
- Atrial Pulse Width
- Atrial Refractory Period (ARP)
- Ventricular Amplitude
- Ventricular Pulse Width
- Ventricular Refractory Period (VRP)

These programmable parameters will remain in future software revisions. Additional programmable parameters will be implemented in future software revisions which will depend on future requirements.

1.7 Real-time Electrograms

The following requirements of real-time electrograms and the displaying of electrograms have been implemented in the current software revision:

- Real-time internal electrograms shall be made available from atrial and ventricular sense/pace leads
- Electrogram viewing
  - The user shall have the option of viewing electrograms on the screen
  - The user shall have the option of selecting which electrograms are viewed
- The system is capable of displaying real-time traces in a scrollable fashion

These features will remain in future software revisions.

Requirements that will be implemented in future software revisions include:

- The DCM shall be capable of printing real time telemetered data
  - will be implemented after serial communication with pacemaker for telemetry has been implemented

Requirements that involve the surface ECG will not be implemented in future requirements due to the lack of a surface ECG on the pacemaker.

1.8 Future Requirements

Future requirements that will be implemented include:

- Serial communication between DCM and Pacemaker
  - Sending programmable parameters to Pacemaker
  - Receiving telemetry data from Pacemaker
- Input validation for safety critical Pacemaker systems operated by DCM

2 Software

2.1 General Design Decisions

The DCM and all its modules were programmed in Python 3. The decision to use Python was largely due to the programmers' familiarity with the Python language and Python libraries that could be used to handle different DCM systems. The release of Python decided was Python 3.7.9; an earlier release was selected to ensure compatibility with potential libraries.

The GUI was designed using PyQt, a Python library for Qt, a widget-toolkit for designing and creating graphical user interfaces. It was initially decided that Python's standard Tkinter package and it's associated tools would be used, however it was later decided that a tool that would allow us to create our user interface graphically instead of programmatically would ease our workflow. The PyQt5 library was ultimately decided upon due to the ability to automatically generate the code for the graphical user interface from design files created using Qt Designer, a tool to graphically design GUI elements for Qt.

Serial communcation between the DCM and Pacemaker and device recognition is handled by the pyserial library due to the programmers' familiarity with the library.

Graphs in the DCM are handled by the PyQtGraph library. The library was chosen due to it's straightforward integration with the PyQt library and it's ability to easily create interactive plots.

2.2 GUI

2.2.1 Welcome Screen

The Welcome Screen is a QStackedWidget,

2.2.1.1 Welcome

QWidget, can't access register/login

Push Button	Function
welcome_ui.reg_btn	welcome_gui.setCurrentIndex(1)
welcome_ui.log_btn	welcome_gui.setCurrentIndex(2)

Table 1: Welcome Screen

2.2.1.2 Register

QWidget, can't access login

2.2.1.3 Login

QWidget, can't access register

Push Button	Function
welcome_ui.reg_back_btn	welcome_gui.setCurrentIndex(0)
welcome_ui.reg_submit_btn	auth.register

Table 2: Register

Push Button	Function
welcome_ui.log_back_btn	welcome_gui.setCurrentIndex(0)
welcome_ui.log_submit_btn	auth.login

Table 3: Login

2.2.2 DCM Main Window

2.2.2.1 Electrograms

UI Element		Function
dcm_ui.about_btn		about_gui.exec_
dcm_ui.parameters_btn		params_gui.exec_
dcm_ui.reports_btn		reports_gui.exec_
dcm_ui.set_clock_btn		set_clock_gui.exec_
dcm_ui.new_patient_btn		conn.register_device
dcm_ui.quit_btn		dcm_gui.close
dcm_ui.pace_box	isChecked()	graphs.pace_show()
	!isChecked()	graphs.pace_hide()
dcm_ui.sense_box	isChecked()	graphs.sense_show()
	!isChecked()	graphs.sense_hide()

Table 4: DCM Main Window

2.2.2.2 Reports

2.2.2.3 Parameters

2.2.2.4 About

2.2.2.5 New Patient

2.2.2.6 Quit

The Quit push button closes the DCM GUI and exits the program.

Push Button	Function
reports_ui.egram_btn	reports.generate_egram(get_pace_mode_params())
reports_ui.brady_btn	reports.generate_brady(get_pace_mode_params())
reports_ui.temp_btn	reports.generate_temp(get_pace_mode_params())

Table 5: DCM Reports

2.3 Handlers

2.3.1 Authentication

2.3.2 Connection

2.3.3 Graphs

2.3.4 Parameters

2.3.5 Reports

3 Testing

3.1 GUI

All testing for the GUI was done manually. Tests for all modules confirmed that their functions were behaving as intended.

3.1.1 Welcome Screen

The push buttons were tested to check if they led to the appropriate GUI elements and called the correct functions.

In the Welcome window, the register and login buttons were pressed, and they lead to the register and login screens respectively.

In the register screen, the back button led the user back to the welcome screen. The text fields allowed user input up to 15 characters with the password field being masked with bullet points. The submit button saved the new user in the credentials file and sent the user to the DCM main window when there were less than 10 users registered. The submit button displayed a popup message telling the user that the maximum of 10 registered users had been reached when there were 10 users registered. The submit button displayed a popup message telling the user to login instead if the username already exists in the credentials file.

In the login screen, the back button led the user back to the welcome screen. The text fields allowed user input up to 15 characters with the password field being masked with bullet points. The submit button sent the user to the DCM main window when the user's credentials were present in the credentials file. The submit button displayed a popup message instructing the user to register the account if the user did not exist in the credentials file. The submit button displayed a popup message telling the user that the password is incorrect if the username existed in the credentials file but the passwords did not match.

3.1.2 DCM Main Window

The push buttons, check boxes, graphs and radio buttons were tested to see if they led to the appropriate GUI elements and called the correct functions.

The pace electrograms were no longer displayed when the pace leads checkbox was unchecked. The pace electrograms were displayed again when the pace leads checkbox was checked. The sense electrograms were no longer displayed when the sense leads checkbox was unchecked. The sense electrograms were displayed again when the sense leads checkbox was checked. The electrogram graphs were scrollable.

The Reports window was opened when the reports button was pressed. The Parameters window was opened when the parameters button was pressed. The About window was opened when the about button was pressed. The Set Clock window was opened when the set clock window was pressed. The new patient button could not be tested in its current implementation as the testers only had access to one pacemaker. The program was exitted when the quit button was pressed.

3.1.3 Reports

The push buttons were tested to check if they called the correct functions.

The "Electrogram" and "Temporary Parameters" buttons did not display anything. The "Bradycardia Parameters" button displayed a popup window showing the necessary header information. The pacing mode selected in the DCM main window and the relevant programmable parameters for the pacing mode were displayed following the header information.

Other functions of the main window could not be accessed while the Reports window was active.

3.1.4 Parameters

The push buttons and the data table were tested to check if they called the correct functions and displayed the intended behaviour.

The only values displayed that could be changed were the ones listed under the "Values" column. All other text could not be modified. Changing the values in the column did not immediately update the parameters file.

The parameters file was updated when the "Confirm changes" button was pressed with modified values in the table.

The reset to defaults button displayed a popup window to confirm if you want to reset all values. The "No" option returned the user to the Parameters window with no changes to the paramaters file. The "Yes" option returned the user to the Parameters window with the values in the parameters file and the values showed in the table being set to their default values.

Other functions of the main window could not be accessed while the Parameters window was active.

3.1.5 About

None of the cells in the table could be selected or modified.

Other functions of the main window could not be accessed while the About window was active.

3.1.6 New Patient

The New Patient functions could not be tested in its current implementation due the testers only having access to one pacemaker.

3.2 Handlers

3.2.1 Authentication

3.2.2 Connection

3.2.3 Graphs

3.2.4 Parameters

3.2.5 Reports