

MILESTONE 2 - IMPLEMENTATION

CIS 441/541 - PACEMAKER

GROUP 2

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CODE DESCRIPTION :

We have two .cpp files, namely, the heart and pacemaker. The heart.cpp code deals with modelling a dysfunctional heart and the three modes of the heart - random, manual and test. This code also runs test cases to ensure proper working of the system. The pacemaker.cpp code deals with generating Apace and Vpace signals at the correct instants of time in accordance with the four modes - normal, manual, sleep and exercise.

We have modelled one mbed board to function as the heart and the other to function as the pacemaker.

1. Heart :

All the parameters such as AVI, PVARP, VRP, URI, LRI etc are initialised with the values given in the specifications. The function sendAsignal() is used to generate Asignal in a random manner. This is accomplished by using the rand() function. The function sendVsignal() works in a similar fashion to generate Vsignal. The function manualMode_() allows the user to press 'a'/'A' or 'v'/'V' to generate Asignal or Vsignal manually. Pressing 'e'/'E' exits the manual mode. This function is called when the user presses 'm'/'M' for the heart to function in the manual mode.

The function testMode_() deals with the various test cases used to determine the correct functioning of the pacemaker. This verifies that the atrial and ventricular signals are received at the proper instants of time for the correct functioning of the heart.

In the main() method, five threads are generated - asense, vsense, apace, vpace and test. The user is allowed to enter characters to switch between the three modes of the heart. Pressing 'm'/'M' enters the manual mode, pressing 'r'/'R' enters the random mode and pressing 't'/'T' enters the test mode.

2. Pacemaker :

All the parameters such as AVI, PVARP, VRP, URI, LRI etc are initialised with the values given in the specifications. The function `ObservationInterval()` is responsible for counting heartbeats in the interval of time as specified by the user. This function allows the user to enter any interval of time; otherwise, a default observation interval of 10s is considered. Once the average heart rate is calculated, it is displayed on the LCD along with the details of the mode in which the pacemaker is currently running. The function `pacemakerThread()` is used while creating a thread called `pacemaker` in the `main()` of the code. This function monitors the reception of `Asignal` and `Vsignal`, and glows the respective LEDs.

When `pvarpmax` has elapsed and no `Asignal` has been detected, this function generates an `Apace` signal. Similarly, when `avimax` has elapsed and no `Vsignal` has been detected, this function generates an `Vpace` signal. It takes into consideration timing constraints with respect to `URI`, `AVI` and `PVARP`. When any event occurs, a trace is generated on the serial port where the event and timestamp are recorded. In `modeSwitchFunctionality()`, the user is allowed to enter characters that allows the heart to switch modes. This is done by using a switch case.

In `main()`, three threads - `pacemaker`, `buzzer` and `modeswitch` are created to model the functionalities of the pacemaker and to allow the user to switch between modes of the pacemaker.

HARDWARE CONNECTIONS :

CONNECTIONS BETWEEN LCD AND PACEMAKER MBED :

Pin number	TextLCD pins	mbed pins
1	GND	0V
2	VCC	3.3V
3	VO	0V, via 1k resistor
4	RS	p15
5	RW	0V
6	E	p16
7	D0	not connected
8	D1	not connected
9	D2	not connected
10	D3	not connected
11	D4	p17
12	D5	p18
13	D6	p19
14	D7	p20

The LCD is connected to the mbed that represents the pacemaker using the pin connections as shown above.

CONNECTIONS BETWEEN PACEMAKER MBED AND LEDs :

There are two sets of LEDs - One represents the pacing signals being given to the heart. The other glows whenever there is an A signal and V signal received from the heart mbed.

Pin 12 is connected to a red LED that represents Apace. It glows whenever this signal is generated.

Pin 13 is connected to a green LED that represents Vspace. It glows whenever this signal is generated.

Pin 10 is connected to a red LED that represents A signal. It glows whenever this signal is received.

Pin 11 is connected to a green LED that represents V signal. It glows whenever this signal is received.

CONNECTIONS BETWEEN HEART MBED AND PACEMAKER MBED :

Pin 5 (DigitalOut) of heart mbed is connected to pin 5(DigitalIn) of pacemaker mbed. This connection represents A signal.

Pin 6(DigitalOut) of heart mbed is connected to pin 6(DigitalIn) of pacemaker mbed. This connection represents V signal.

Pin 7(DigitalIn) of heart mbed is connected to pin 7(DigitalOut) of pacemaker mbed. This connection represents Apace.

Pin 8(DigitalIn) of heart mbed is connected to pin 8(DigitalOut) of pacemaker mbed. This connection represents Vspace.

Pin 21 of heart mbed is connected to pin 21(DigitalOut) of pacemaker mbed for synchronization during the functioning of test mode. This is used to receive and send a ready signal.

Pin 22 of heart mbed is connected to pin 22 of pacemaker mbed. This sends and receives an acknowledgement signal.

Pin 23 of heart mbed is connected to pin 23 of pacemaker mbed. This is to model the feedback from the SA Node to the pacemaker as an acknowledgement of a valid/useful Apace.

Pin 24 of heart mbed is connected to pin 24 of pacemaker mbed. This is to model the feedback from the VA Node to the pacemaker as an acknowledgement of a valid/useful Vspace.

CONNECTIONS BETWEEN PACEMAKER MBED AND BUZZER :

Pin 25 of the pacemaker mbed is connected to the buzzer, which is used to model a failure of the pacemaker.