Assignment 05

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Assignment

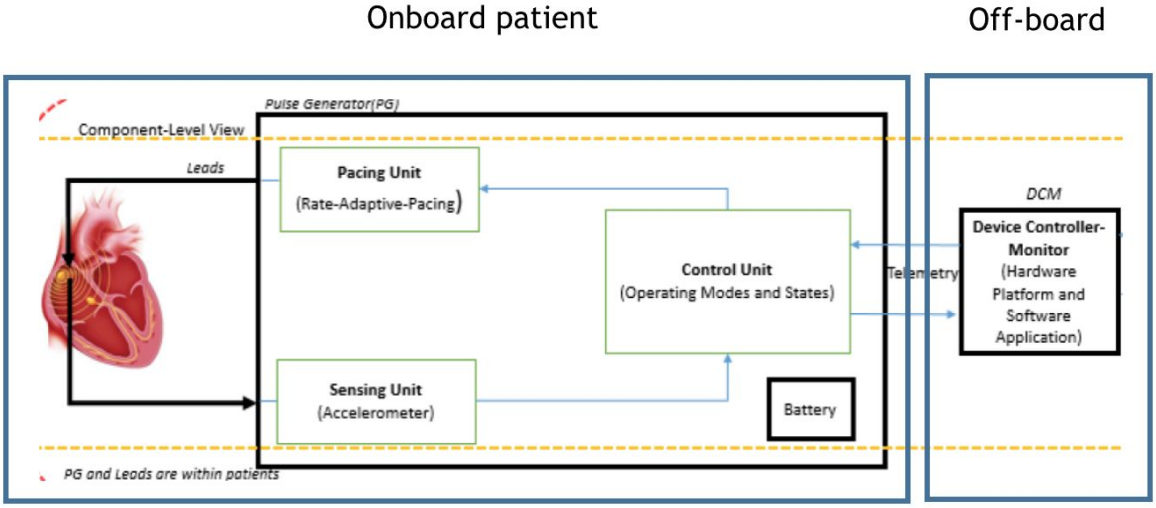
Describe, in a narrative, at least 3 design decisions you have made in previous assignments. Why did you decide on the action that you took? What were the alternatives that you considered but did not select?

Description

In previous assignments, I used Feedback Control Loop including nominal and error models, and three design tactics to refine my pacemaker design.

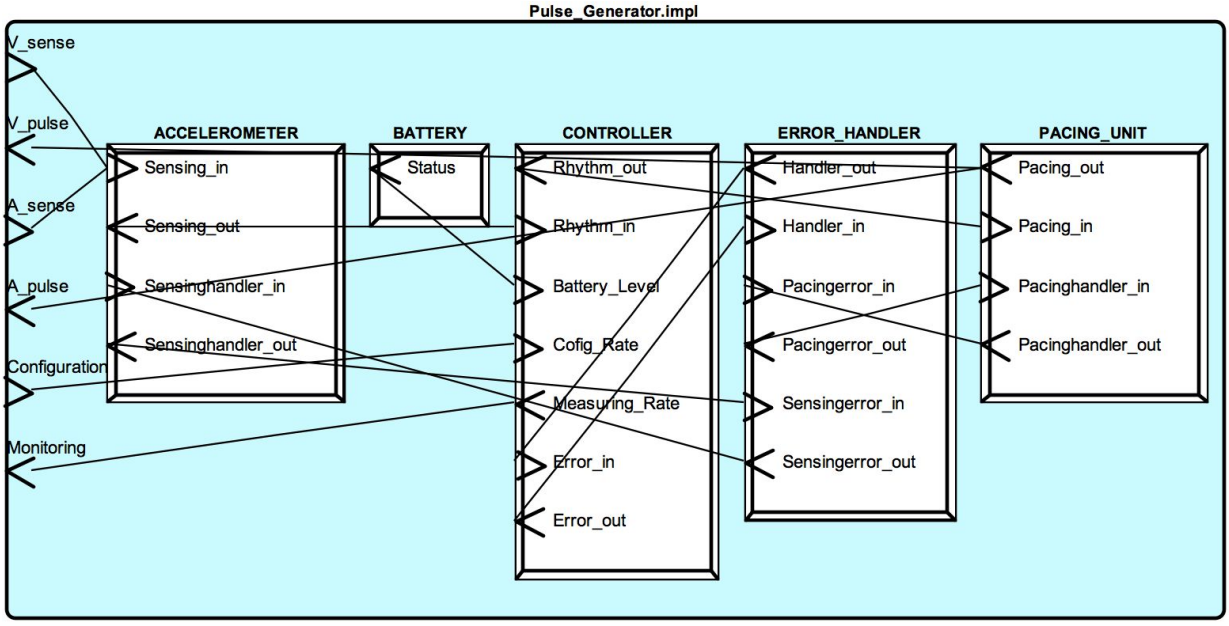
Tactic 1: Splitting

The pacemaker system is decomposed into 2 subsystems: Pulse Generator system and Device Controller Monitor system. Distributed architecture techniques require synchronization. This is a closed system so no need to translate between systems. In this way, the testability of maintainability, hardware independence□ of portability and efficiency have been improved in the pacemaker system.



Besides, the Accelerometer module in previous Pulse Generator system is divided into four modules, including Controller, Accelerometer, Error Handler, and Pacing Unit. Each module is responsible for respective functions after modification. In this way, the error tolerance□ of reliability, software independence of portability and performance of system have been improved dramatically. There is also a feedback control loop forming inside the Pulse Generator.

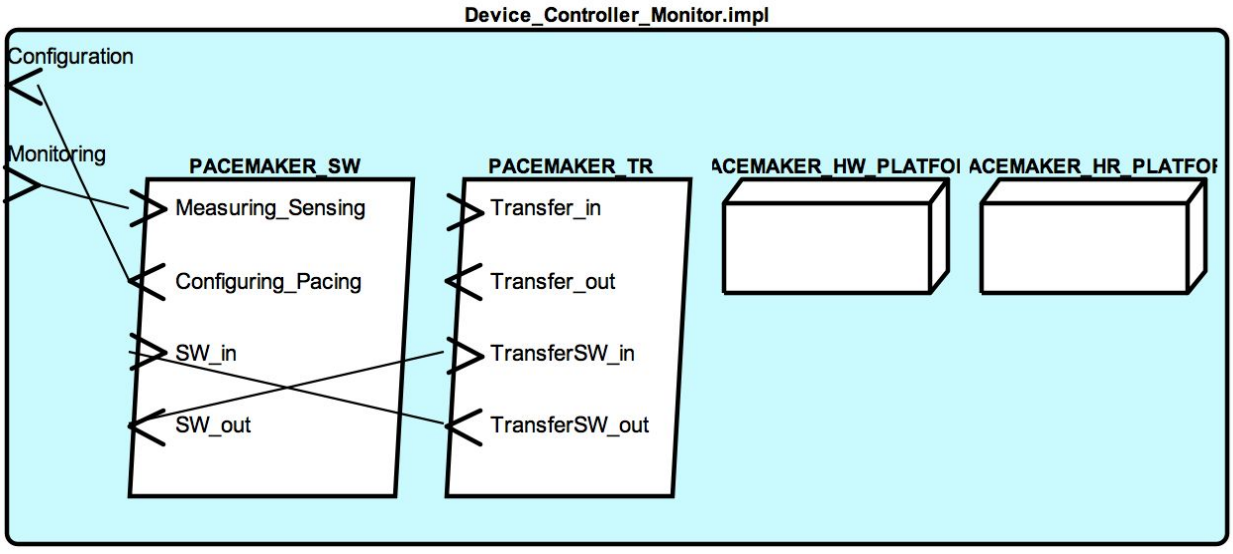
After refinement：

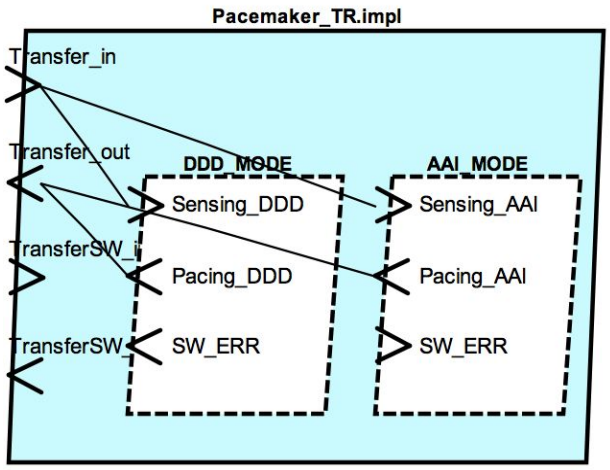


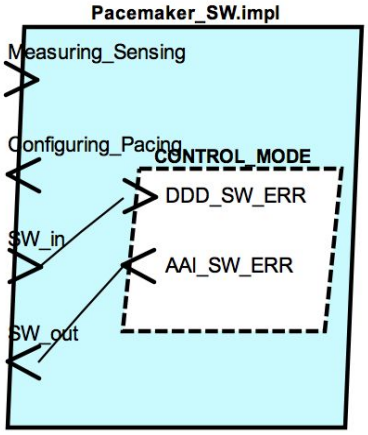
Tactic 2: Intermediary

The process Pacemaker_TR is added as an intermediary between process Pacemaker_SW and general operating modes for better expansibility and performance. Control Mode is separated from general operating modes, because it determines switching of modes and judging of errors. In this way, not only the expandability and testability of maintainability, but also the interoperability of functionality have been improved in the Device Controller Monitor system.

After refinement：





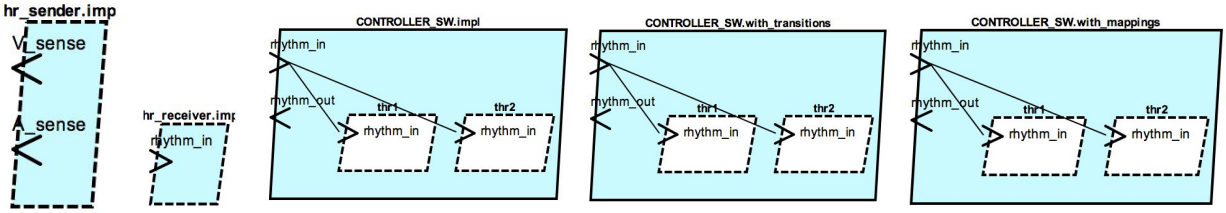


I considered tactic Encapsulation as an alternative of Intermediary, but I didn't select it. A major reason is that an efficient interface of process Pacemaker_SW is needed in tactic Encapsulation, but I didn't know how to create an interface between process and threads which include DDD Mode, AAI Mode and any other operating modes. So I chose tactic Intermediary to create another process Pacemaker_TR for transition.

Tactic 3: Augmenting

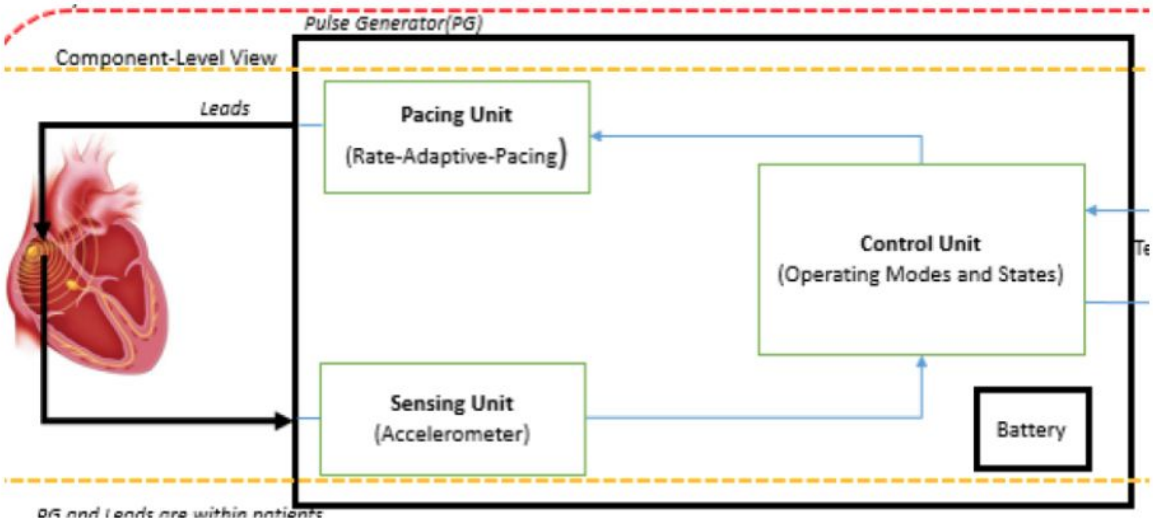
Two additional threads and three additional processes are added to the system in order to implement a feedback control loop including nominal and error flows. Also, a pacemaker_HR _Platform is added to the Device Controller Monitor system because of the new Pacemaker_TR process. In this way, the completeness, correctness and compatibility of functionality in the entire pacemaker system have been improved.

After refinement：



Feedback Control Loop

Instead of the previous design, a feedback control loop is added into the Pulse Generator system, including nominal and error model and identifying the controller, sensors, actuators, controlled process. Control unit is a finite state machine that controls timing and strength of pulse. Actuators/Pacing Unit uses leads to actuate the heart when needed. In Sensing Unit, the same leads are used to administer shock.



In this way, no matter how quick the heart rate changes, we can sense these current values and determine if it is necessary to generate a pulse or change the operating modes of pacemaker. The frequency and magnitude of Pulse are chosen by controller. If sampling misses a beat, may pulse too soon. If sampling reads in between beats, the software may deduce the wrong magnitude.