ReFrESH Design Notebook

v1.0

Yanzhe Cui

Richard Voyles

Collaborative Robotics Laboratory

Purdue University

Acronyms Used in Document

STD: State Transition Diagram

DFD: Data Flow Diagram

FC: Flow Chart



Bubble 1 – Run

STD of “Run”



DFD of “Run”



Bubble 2 – Performance Analysis

STD of “Performance Analysis”



Note:

1. The first bubble of above STD, launch/shut down Evaluators should be concurrence with the launch/shut down Modules (the last bubble in Run STD).
2. The last bubble of above STD, “determine function/non-function reason” means that there is a mechanism to distinguish the functional and non-functional faults in the system when the performance of current configuration is unacceptable.

Bubble 2 – Performance Analysis (Continue)

DFD of “Performance Analysis”



Note:

1. Each module’s Evaluator consists of two kinds of output ports to Decider: non-functional and functional ports. Each kind of them are output to the Monitor bubble.
2. The Monitor bubble of STD consists of two parts: monitoring non-functional and functional performance of current configuration.
3. Non-functional port(s) of Evaluator outputs its mother module’s non-functional characteristics, such as “the power consumption”, “the FPGA area usage”; functional ports outputs its mother module’s functional characteristics, but it depends on the specific module, such as FrameGrabber module “the number of continues FF”, SSD “the error of template matching”.
4. To determine the reason of unacceptable performance, system resource is also needed, such as the left over power and the communication link.

Bubble 3 – Non-functional Analysis

FC of “Non-functional Analysis”



Bubble 3 – Non-functional Analysis (Continue)

Note:

1. Assumption: there is not this kind of situation that multiple (≥ 2) non-functional problems happened at the same time. It means that only one non-functional problem in the system. For example, it may be the problem of power, or communication, or sensors/actuators; but it’s not both power and communication or all of them. In the future, we will add more complexities.
2. “Start” trigged by the flag obtained from result in Bubble 2 DFD.
3. In current design, to do the non-functional analysis, we assume that four situations are considered: power, communication link, sensors and actuators. The check process is in the sequence of power 🡪 communication 🡪 sensors/actuators.
4. Based on the different non-functional reasons, different generate node configuration methods are called from ReFrESH STD Bubble 6.

Bubble 4 – Generate Node Configurations

FC of “Generate Node Configurations”



Bubble 4 – Generate Node Configurations (Continue)

Note: The following “Start” DFD shows the process of how to generate the Configuration Pool.

DFD of “Start” in the above FC



Note: In the Configuration Pool, all configuration candidates are already satisfy non-functional requirements, such as (1) the summation of all modules power usage on one node should be less than the overall left power on that node; (2) the communication link among nodes are good; (3) sensors are characteristic similar, for example, serial camera or USB camera, though they have different interface, but both of them produce the same size and format data, so switch them does not affect the next module that needs image data.

Bubble 5 – Calibration Analysis

Background: What’s the calibration?

The calibration process consists of placing the DUT (device under test) into configurations where the inertial input stimuli for the sensor is known (? What is the stimuli for camera sensor?), thus allowing us to determine the actual error in each measurement.

I got stuck in this bubble! Question:

1. How to do calibration analysis?
2. Can we have a calibration target? Such as for camera, we point to a specific place (fixed place: a part of robot body) that can detect the fixed target to know the error; or for IMU, move the IMU holder to a specific angle?
3. What is calibration sufficient/insufficient?

Bubble 6 – Generate Calibration Options

Bubble 7 – Identify Source of Degradation

Bubble 8 – Generate Module Configurations

Bubble 9 – Eliminate Non-feasible Configurations

Bubble 10 – Estimation

STD of “Estimation”



Bubble 11 – Re-generate