University Of Maryland

ENPM809B RWA-4

Topic: Build a whole kit- Architecture Description

Report By: Group 7

1 Architecture

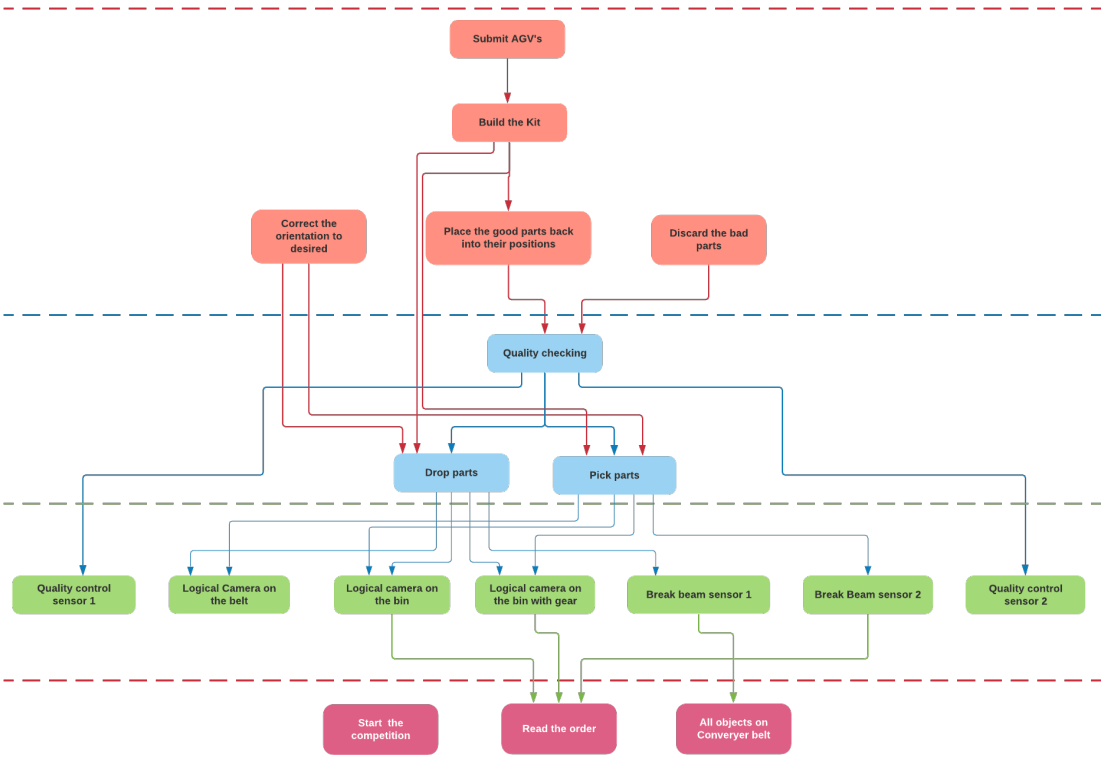

Figure 1: Architecture

The Architecture is of Hybrid Control type. In our approach, both thinking and acting works in parallel and all the tasks are classified into several layers. We preferred this architecture as we want to make our system perceive the environment, understand, act and reiterate to accomplish our goal with perfection. The entire architecture can be divided into 4 broad levels - Initialization, Sensing, Planning and Acting.

1. The Initialization takes care of all the system initialization tasks like, starting the environment, starting the competition, reading the orders, setting up the robotics arms.

2. The Sensing level subscribes to all the sensors and keeps track of all the movements/changes in environment.

3. Our planning level, working with the sensing level, plans the sub-processes like quality checking, picking up the parts, dropping the parts in specified poses. This Planning level also takes care of avoiding collisions with the environment while planning the sub-processes.

4. Actions are performed based on the responses from performing sub-processes. These actions are the decisions that are taken in by the planning level. This involves tasks like discarding

the faulty parts, retaining the good parts, building the kit, correcting the pose to match the requirements if needed, and submit the kit with AGV.

This architecture is similar to 4D/RCS structure and we believe it can work well, providing the top levels components sufficient reliability.

2 Flow Chart

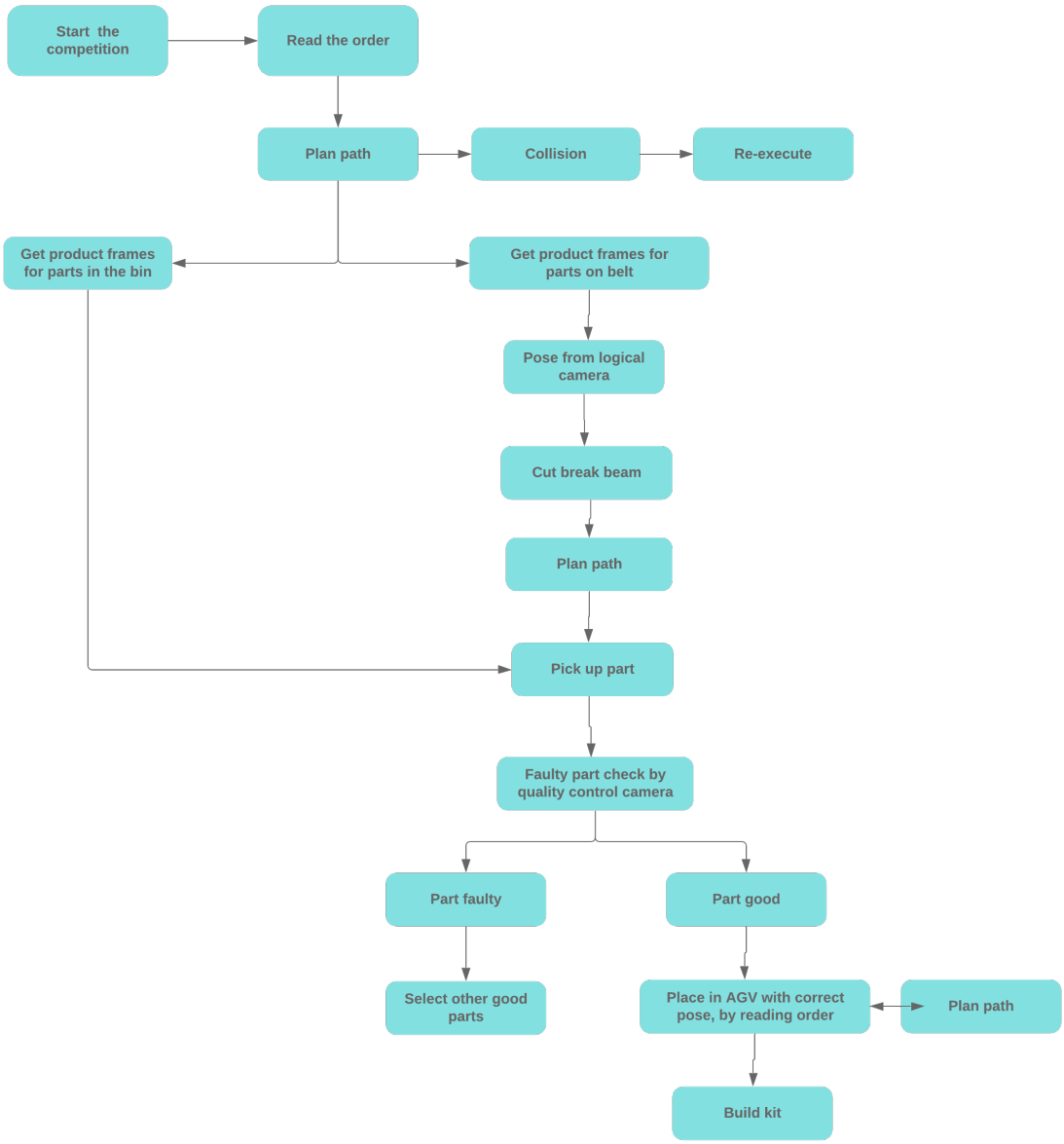

Figure 2: Flow chart of our approach

The flow chart gives a detailed explanation of how the task of building the whole kit has been implemented in the ARIAC environment. The task is to build a kit consisting of parts which are included in the order (a set of shipments). For this we need to read the order, know where the part is, pick

up the part and place it in the tray. This process completes one order. The parts in the order can be found either in the bin or on the conveyor belt. As mentioned in the problem statement, the piston rod part can only be found on the conveyor belt whereas the gear part can be found both on the conveyor belt and the bin. For solving this task we use 3 sensors namely - logical camera, break beam sensor and the quality control sensor (fault detector).

Location of sensors in the environment:

1. Logical Camera 1: Placed above the conveyor belt at a reasonable distance from the ARM1.
2. Logical Camera 2: Placed above one of the empty bins.
3. Logical Camera 3: Placed above one of the bins with parts at a reasonable distance from the ARM2.
4. Break Beam Sensor 1: Placed on the conveyor belt in such a way that every part moving on the belt breaks the beam before entering the scope of Logical Camera 1.
5. Break Beam Sensor 2: Placed on the conveyor belt in such a way that every part moving on the belt breaks the beam after exiting the scope of Logical Camera 1.
6. Quality Control Sensor 1: This is located on the AGV1 to detect the faulty parts.
7. Quality Control Sensor 2: This is located on the AGV2 to detect the faulty parts.

All the actions are executed using the OSRF GEAR interface. The environment is initialised and the competition is started. The orders along with the shipment details are read using the topic *ariac/orders*. Next, the flow proceeds to locate the parts to be picked up which can either be on the conveyor belt or in the bin. The order is used to extract the names of the parts to be picked. The two arms (ARM1 and ARM2) are used to pick up parts from the conveyor belt and the bin respectively. If the order consists of piston rods then ARM1 picks it up from the conveyor belt. simultaneously, If the order consists of gear parts then ARM2 picks them up from the bin. Once the order is read, the desired product is searched using the logical cameras.

The logical camera 3 reads the poses of gear parts in the bin. The ARM2 pickups the gear parts from the bin and performs quality check using the quality control sensor 2. Our path planner makes sure that the arm does not collide with any other objects in the environment. The path planner considers way points to create a reference trajectory to avoid collision conditions On the same lines, if the order consists of a piston rod part, the logical camera 1 above the conveyor belt is activated and the product details of the incoming parts is read to match it with the order. The break beam sensor 1 and break beam sensor 2 are used along with the logical camera 2 so as to capture only one product at a time. If the incoming product matches the product in the order, the break beam sensor is used as a counter (to make sure the right part is picked up). As soon as the break beam counter is activated for the desired part (using the correct count), the ARM1 (in its home position) is activated to pick up the part. The break beam sensor is kept at a distance from the ARM1 such that the time between the break beam activation for the desired part and the picking up action is correct for the part to be picked up.

Once any of the two arms pick up a part, the part is also checked for quality assurance. The arm plans a path to place it in the AGV tray to check for quality. ARM1 uses the AGV1 to perform the quality check whereas ARM2 uses the AGV2 to perform the quality check. This approach also

guarantees the collision avoidance between arms. The quality control sensor placed on the AGV reports the pose of the part if it is faulty else it won't. If the part is found to be faulty, it is simply discarded. If the part is not found to be faulty, it is placed in one of the bins or in their original locations in case of gear parts. The process of faulty checks is finished when all the desired parts in good condition are in either of the bins. The Kit building is then started based on which AGV tray the kit needs to be built in. The desired poses for the Kit building are obtained from the order and any necessary corrections in orientation/position are taken care while placing the parts in the tray. This AGV tray now serves as the final kit with all the parts listed in the order. The kit is now built and ready to be shipped!