



MSc Robotics

(Department of Computer Engineering and information)

PDF4431 Robot Manipulation

Virtual Application Development (RoboDK Simulator)

Coursework-1

Part -B

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Aim

The goal of this challenge is to create a work cell in Simulation Software (RoboDK Simulator) that will choose a certain box from an input conveyor and palletize it on a wooden pallet depending on the user's specifications.

List of Illustrations

The initial stage of a food production company that makes nuts (such as peanuts, cashew nuts, and others) is thinking about automating the end-of-the-line task of palletizing using a robot. On those lines, 200gm cashew nut packs and 100gm peanut packets are produced.

The production rate of each line is:

- Peanut - 30 packs / Minute
- Cashew – 15 packs / Minute

Box Dimensions/Weights (Empty box)/ Capacity are:

- Peanut Box – 300mm x 200mm x 105mm (height) | 0.2 Kg | 15 packs/box
- Cashew nut box – 400mm x 400mm x 400mm (height) | 0.5 Kg | 15 packs/box

Space Availability:

- To accommodate the system, the customer can offer a 5×5 -meter shop floor. Conveyors and current conveyor systems can be connected. 6 meters is the ceiling clearance.

Introduction

The business must be aware of the robotized palletizing process's step-by-step flow, tooling required, and cycle time and must present a simulation that focuses on these consumer expectations and detail the fundamental idea in a concise write-up with any appropriate charts, tables, or illustrations.

The Robot System requires the feeding of Cashew and Peanut Box through two separate conveyors. Manual labour is currently employed for both case packing and palletizing. Case packing requires a minimum of four personnel and two individuals in the palletizing area. Justification for conveyor type selection is required. The robot must collect boxes from the conveyor and arrange them on the appropriate Pallets.

Methodology

According to the application, the initial stage was to design the System manually, which was planned as shown in below image:

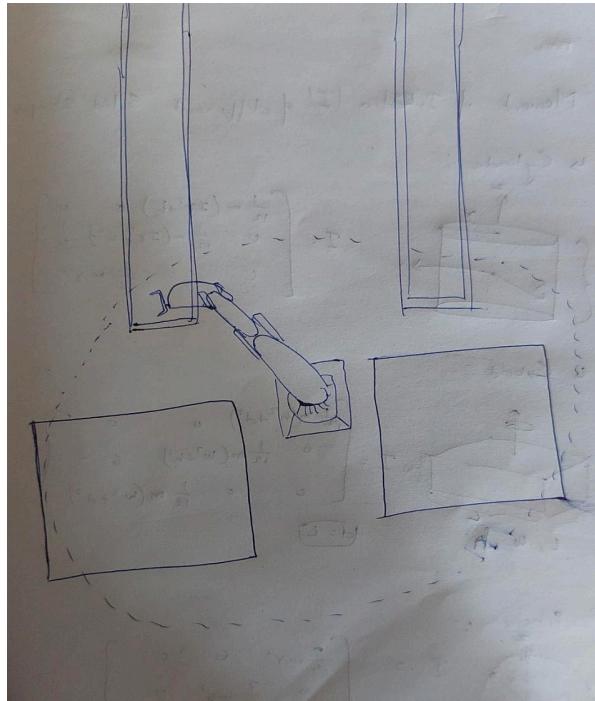


Figure 1 System Design

- The Estimated Reach was approximately 1200mm (1.2 meters).

The Required Box Dimension and Weight has been Calculated for Peanuts and Cashew nuts Boxes:

1. Peanut Box:

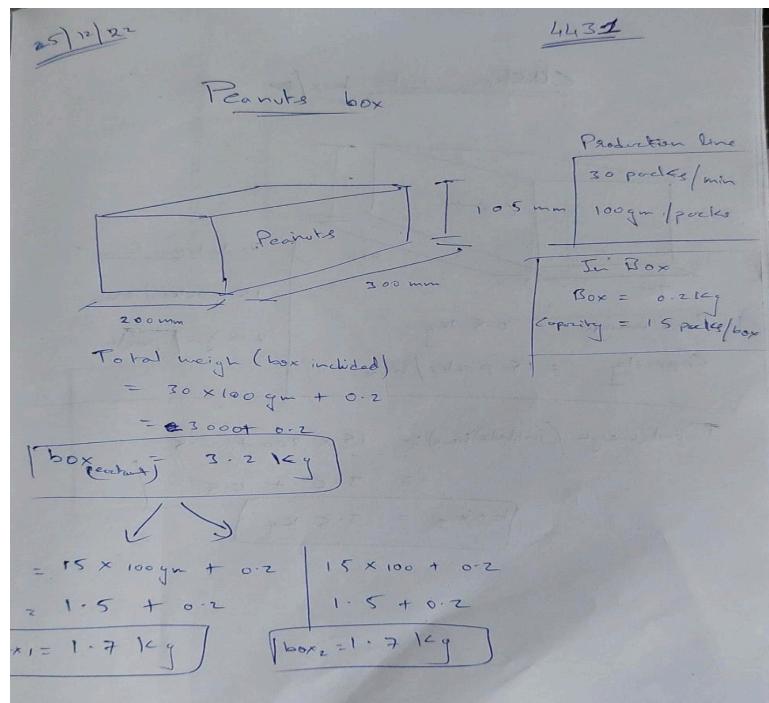


Figure 2 Peanut box Calculations

2. Cashew nuts Box:

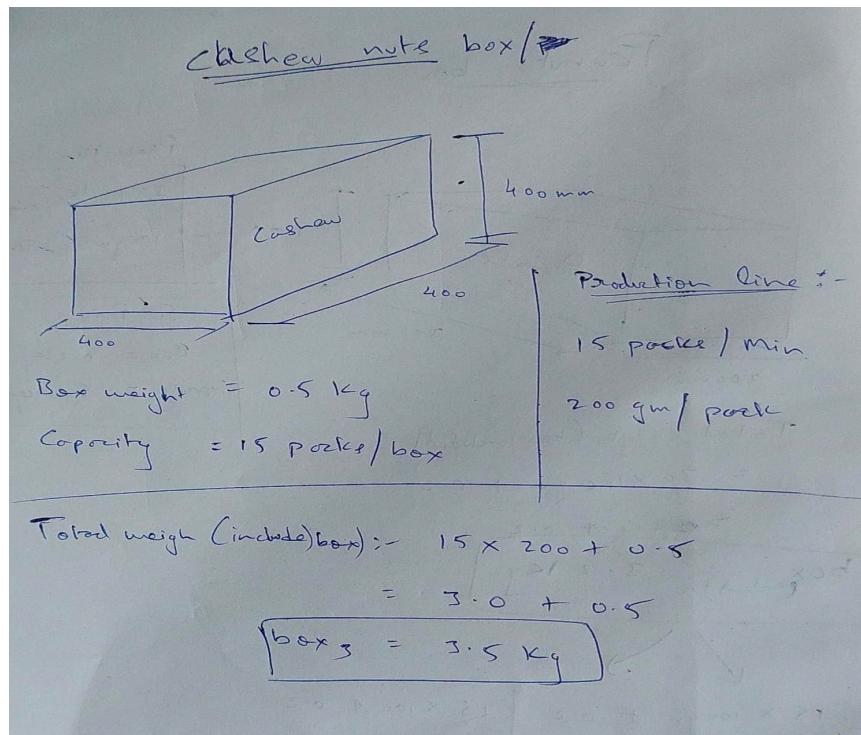


Figure 3 Cashew nut Box Calculations

The final estimated weights of boxes will be determined after computation.

- Peanut box : 1.7Kgs (Including Box)
- Cashew nut box : 3.5 Kgs (Including Box)

By estimating the weights, we can determine that the Payload will be 10 kg and will also include the tool.

As seen in the user requirements the estimated production line will be

- Peanut Conveyor : 2 Boxes/min
- Cashew Conveyor : 1 Box/min

Based on the Dimensions of Boxes, the pallet dimensions are going to

- Peanut Pallet: 800mm x 1200mm
- Cashew Pallet: 1200mm x 1200mm (48 x 48in)

In above Pallet Dimensions, it can arrange:

- Peanut Pallet : 16 Boxes
- Cashew Pallet: 9 boxes

The arrangement of Boxes on Pallet are shown in below image

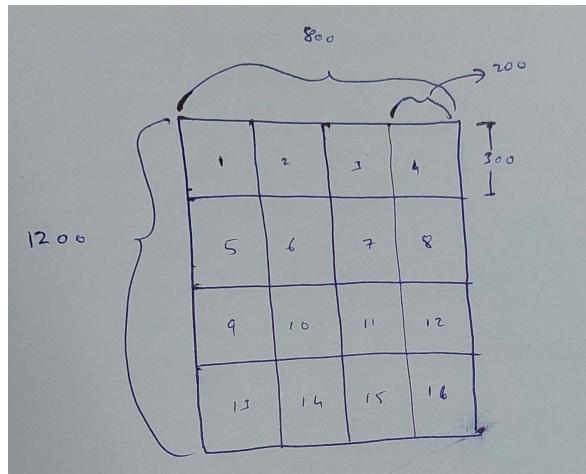


Figure 4 Cashew pallet Arrangement.

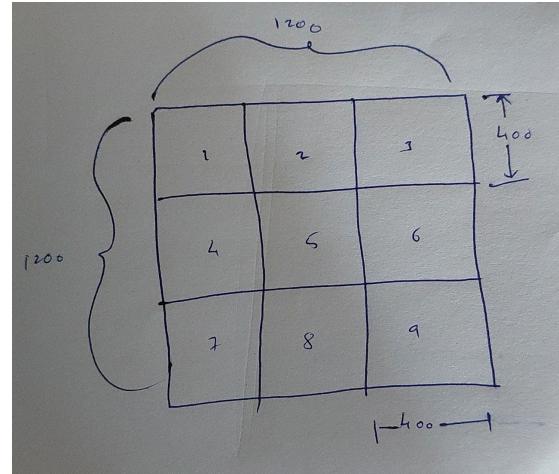
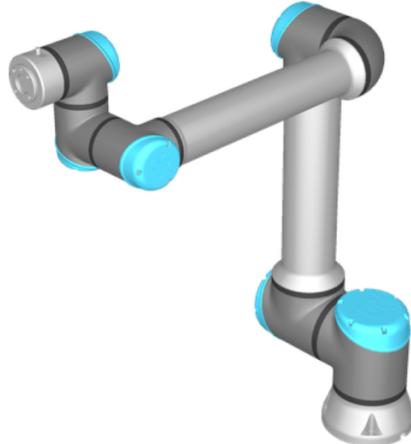


Figure 5 Peanut Pallet Arrangement

Selection of Peripherals

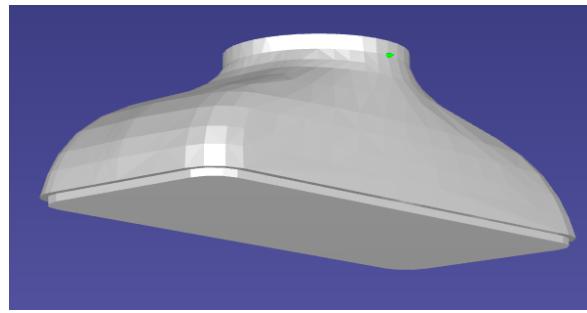
It was quite tough to filter according to the characteristics like Axis, Payload, Reach, Repeatability, Tools, and Robot Mass while choosing a robot. Finally, as seen in the figure below, we have chosen the "UR10e" (Universal Robot) for palletizing:



Robot Specifications:

Axes	6
Payload	10Kg
Reach	1300mm
Repeatability	0.05mm
Robot Mass	29Kg

Vacuumed Tool was used to grab the Box as shown below:



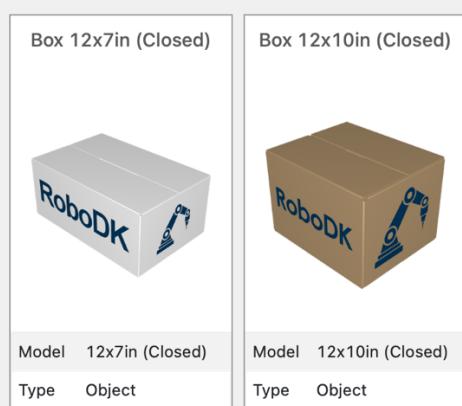
When coming to conveyor we have selected 2m length with 1 axis, as shown in below image

Conveyor Belt (2m)

Specifications

Models	Belt (2m)
Axes	1

For Box, the required/ Exact Dimensions are not available in RoboDK Library, although managed to match the Dimensions by using Scale in RoboDK application.



a. Peanut Box, b. Cahsew Box

Box Specification:

1. Peanut Box 12 x 7in (approx.)
2. Cashew Box 12 x 10in (approx. scaled to 16 x 16in)

For Pallets, the exact Dimensions were available in RoboDK Library, which are

Pallet 1200x800mm



Peanut Pallet.

Pallet 48x48in



Cashew Pallet

The Pedestal for robot was 24in height as shown below

Pedestal H24in (Type 1)

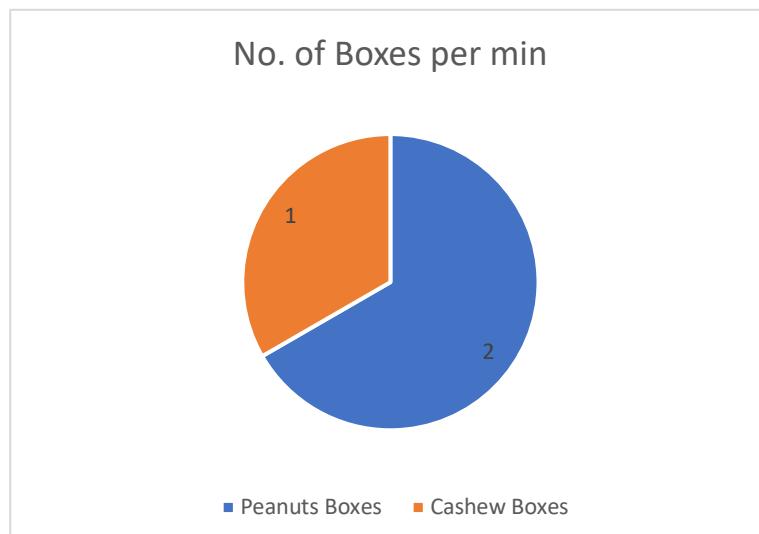


Specifications

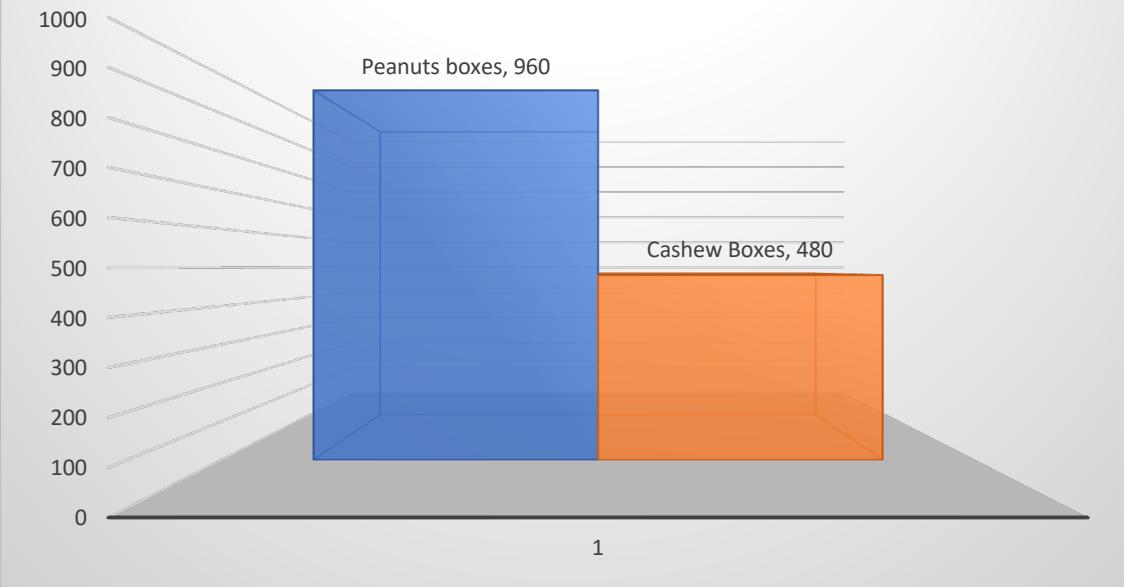
Models	H24in (Type 1)
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Results:

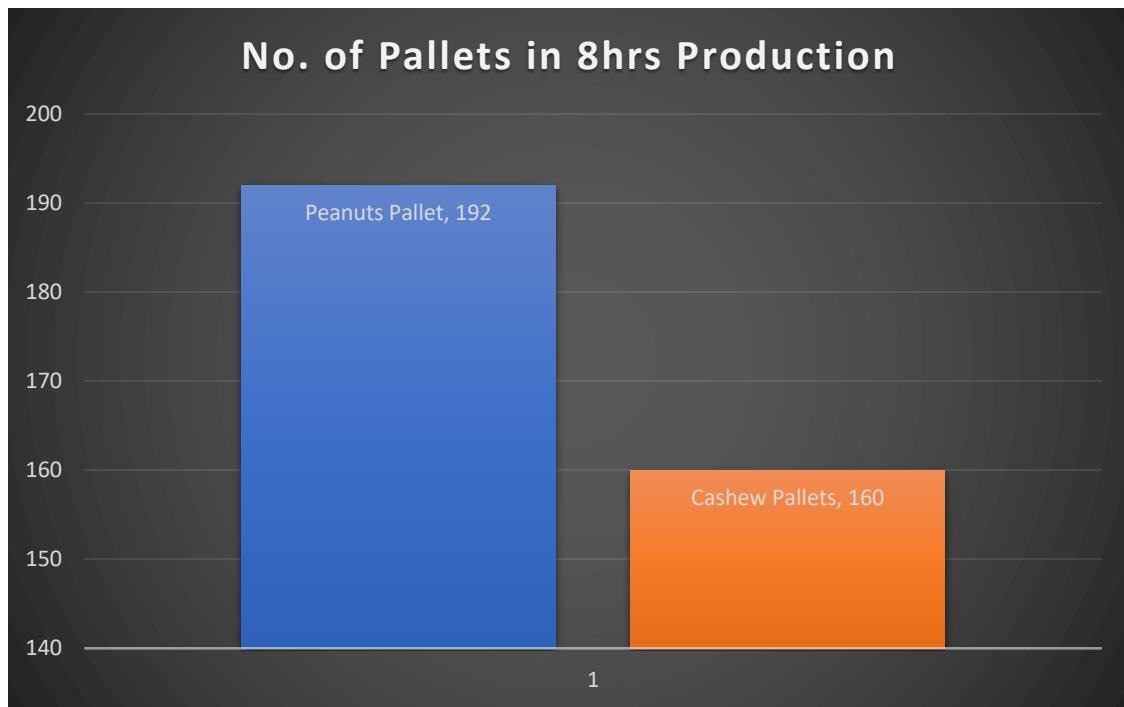
- The Cycle time of the Robot is 8 min 30 sec, for 1 complete layer on each pallet.
- Robot would take 20 sec for each box which is represented in Pie chart below:



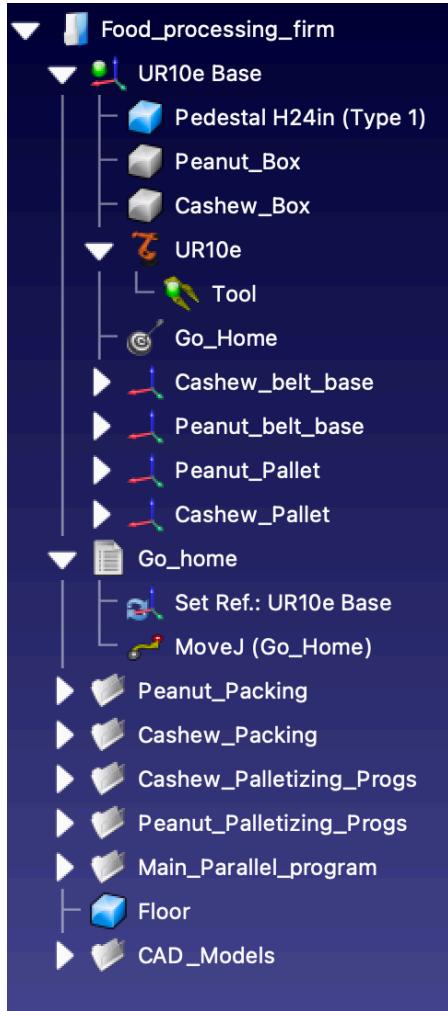
8hrs of In-line Production to Robot



- Considering the line output and Robot cycle time the possible pallets output in shift of 8 hours. Final outcome are shown in chart below:



- Simulation cell tree :



Conclusions

Simulation in RoboDK using the input conveyor and palletization on the wooden pallet in accordance with user requirements were completed successfully. Interpolation techniques, including Joint and Linear, were implemented, along with the pick-and-place application's Approach and Retract features.

Generated a simulation video ([run_main.html](#)) that was uploaded to the appropriate place, displaying the design's layout and major elements. The Simulation is shown in the screenshot below.

