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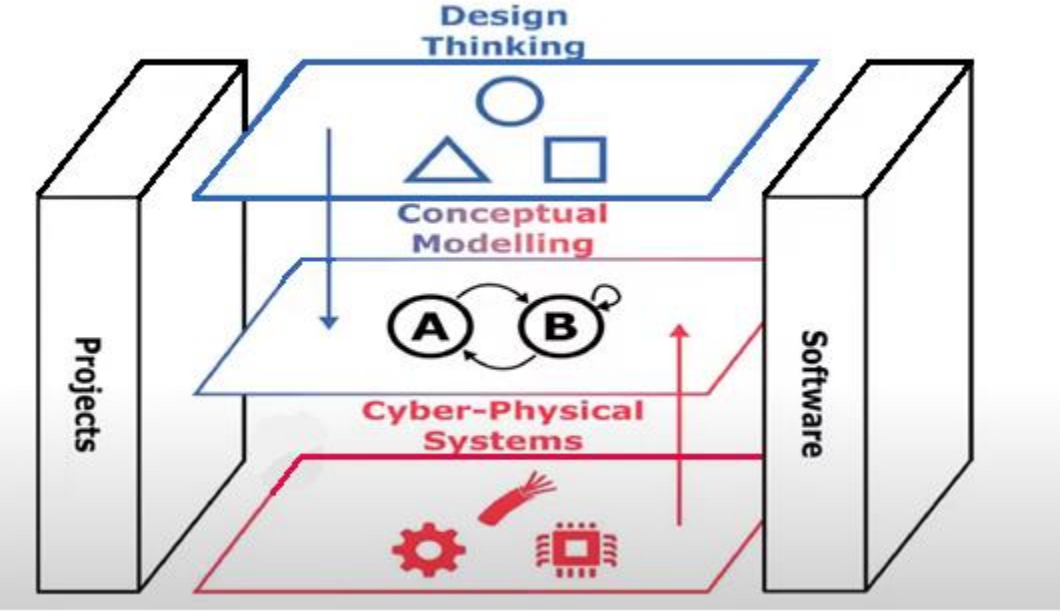
AUTOMATION OF ASSEMBLY LINES ASSISTED BY A ROBOTIC ARM AND A MOBILE ROBOT

Balteș Octavian-Isaia
Lucian Blaga University of Sibiu
octavian.baltes@gmail.com

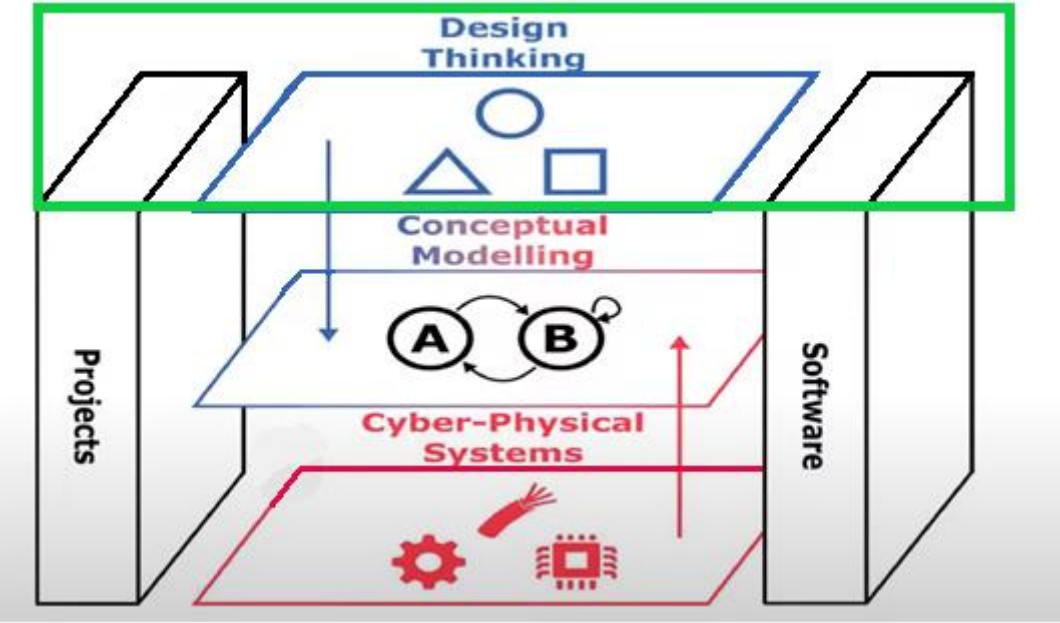
Objectives

- Simulation of assembly line automation using modeling languages.
- Handling a robotic arm and a mBot.
- Creating the model to solve the problem.
- Writing the code to solve the problem.
- Prototype to simulate the AGVs in logistic processes.

The 3 main approaches suggested by OMiLAB



1. Design Thinking



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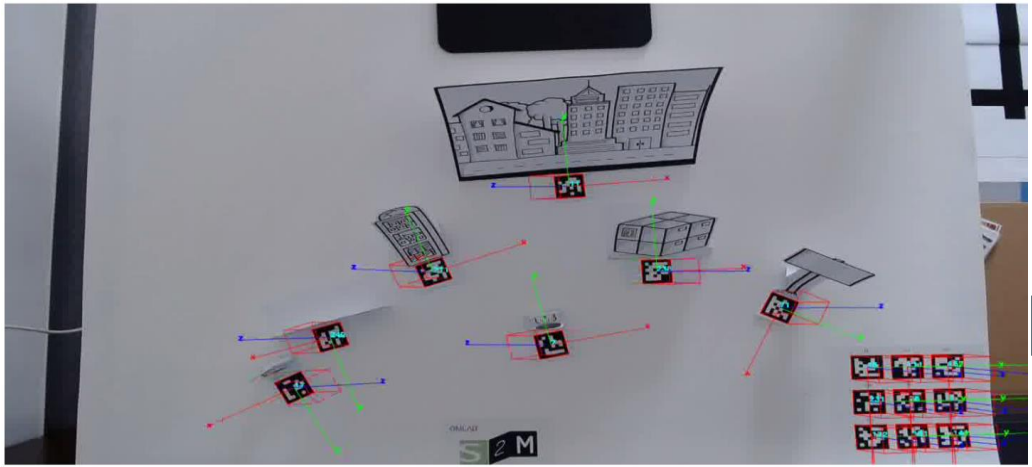

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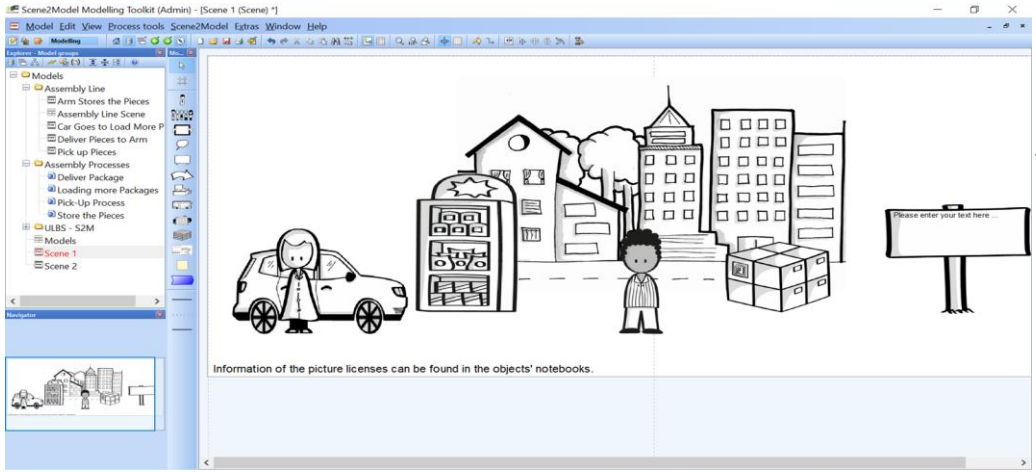
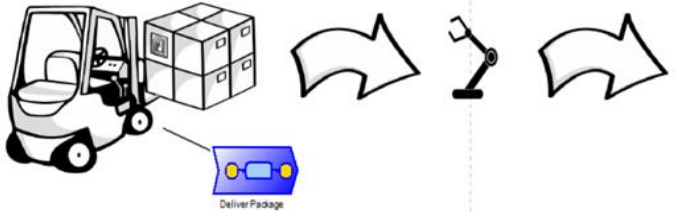


S2M
Scene2Model

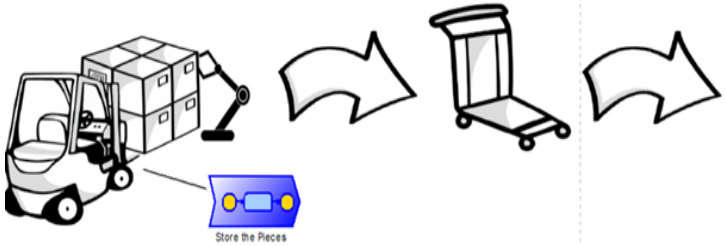
Scene 1 - Pick-up

Scene 2 - Deliver

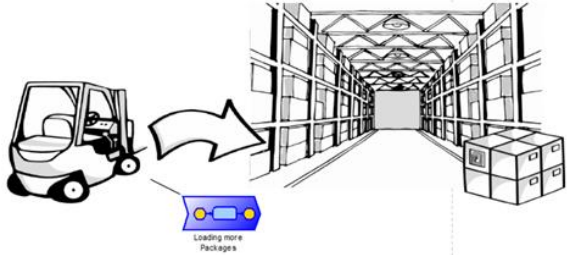


Scene2Model

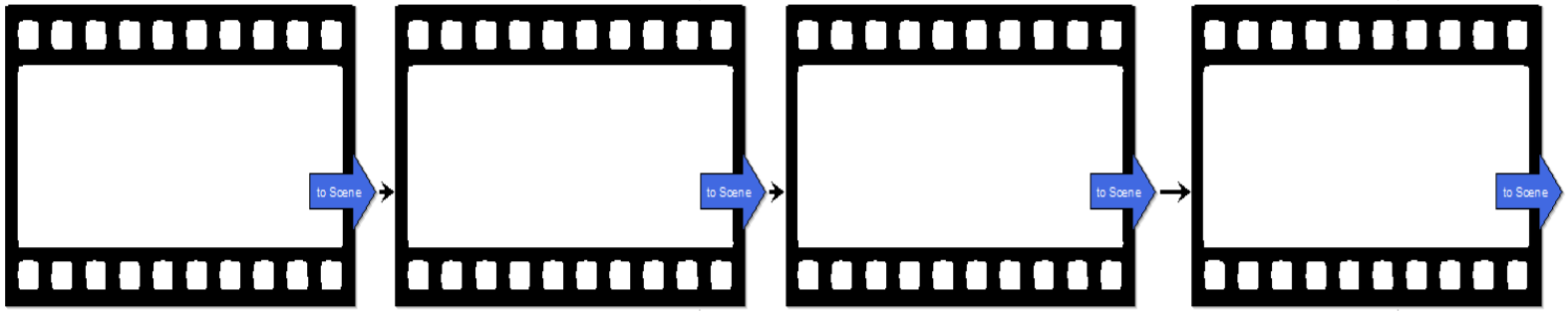
Scene 3 - Store



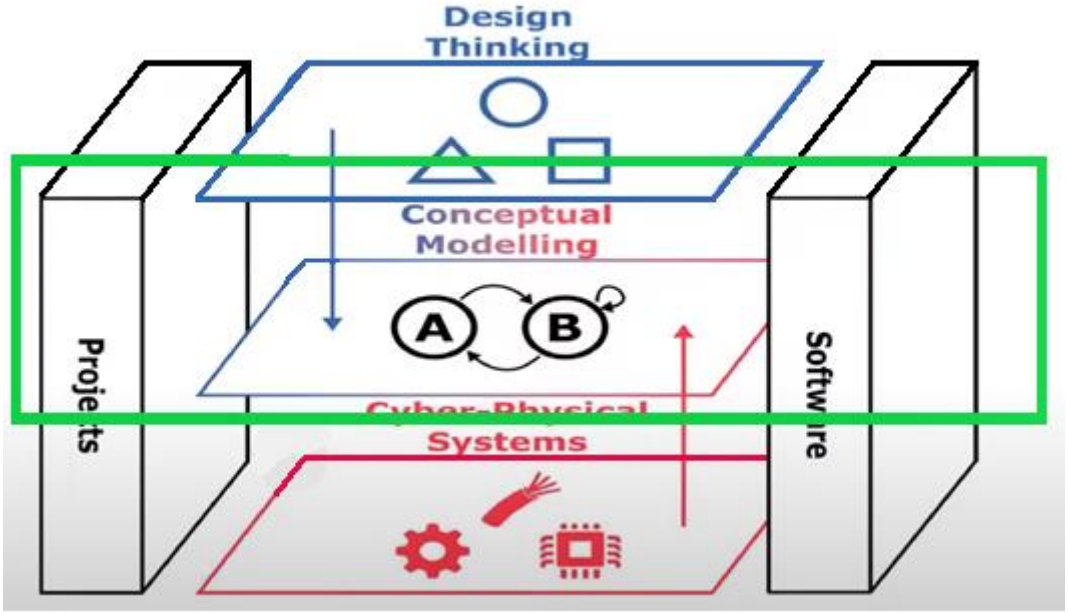
Scene 4 - Reload

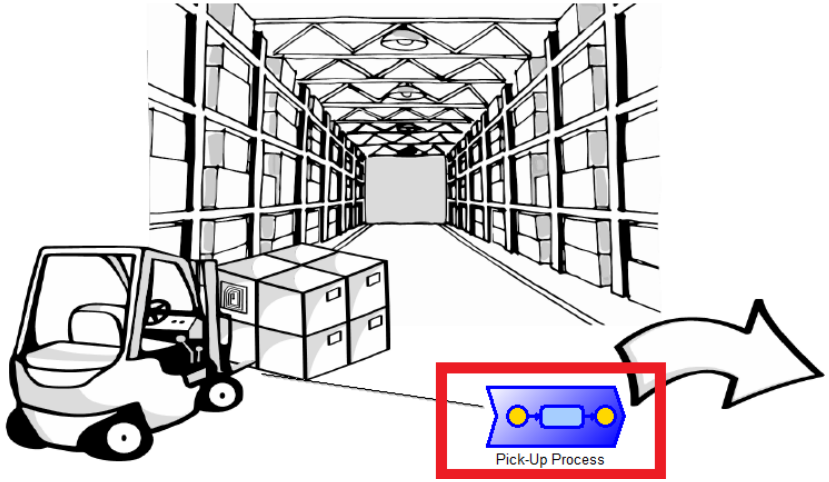


Storyboard


to Scene
to Scene
to Scene
to Scene
Pick up Pieces
Deliver Pieces to Arm
Arm Stores the Pieces
Car Goes to Load More Pieces

2. Conceptual Modelling





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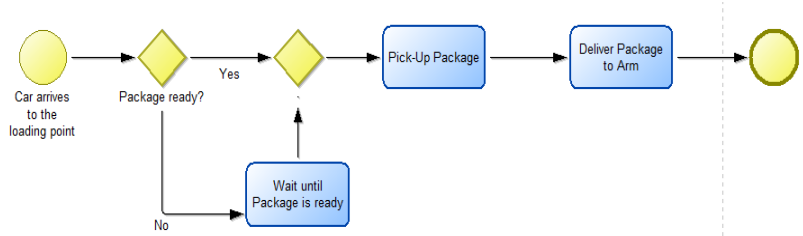
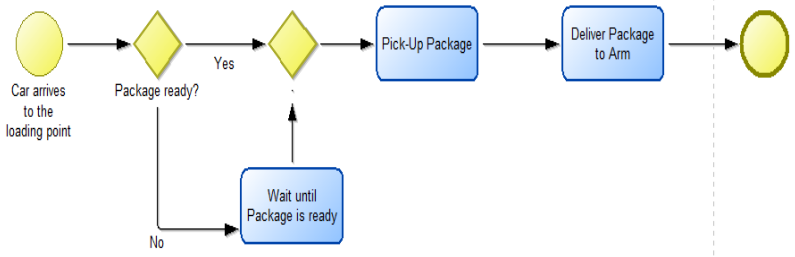
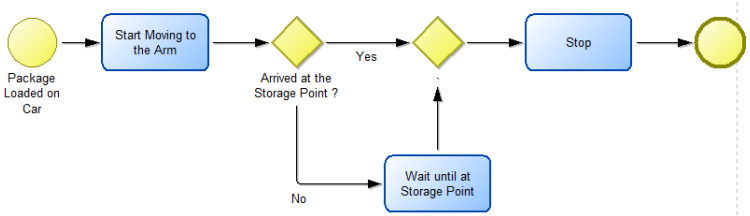


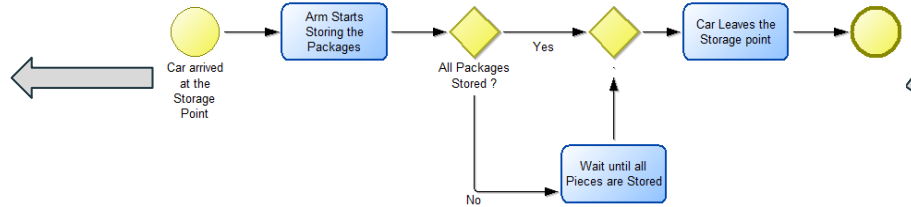
Scene 1 - Pick-up



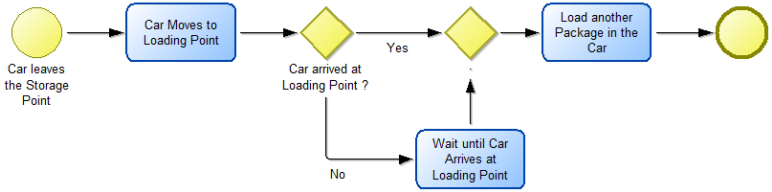
Scene 2 - Deliver



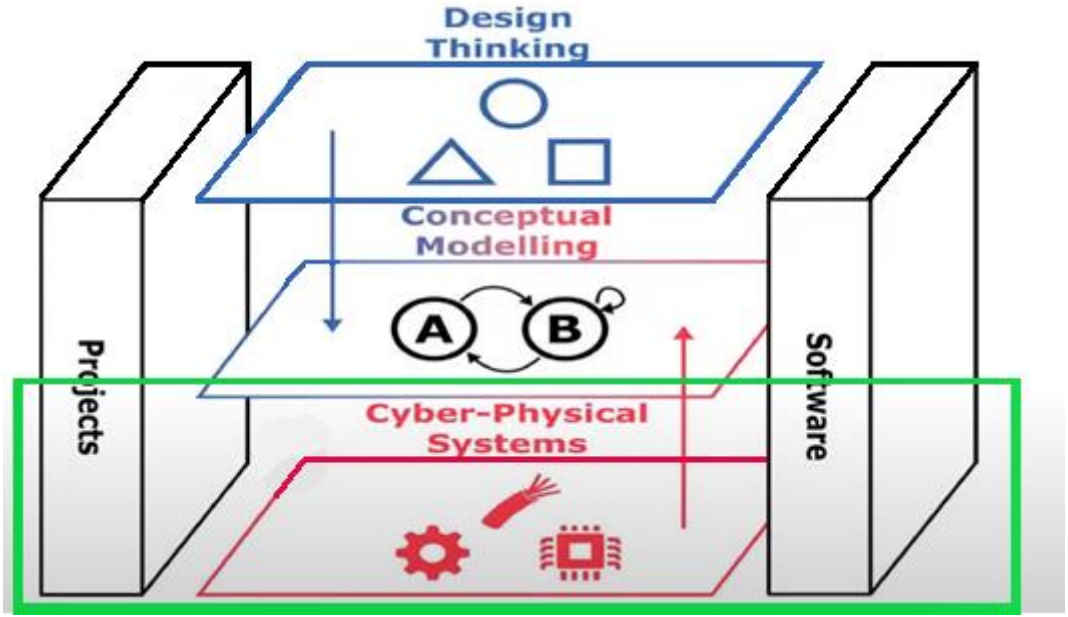
Scene 3 - Store



Scene 4 - Reload



3. Cyber-Physical System



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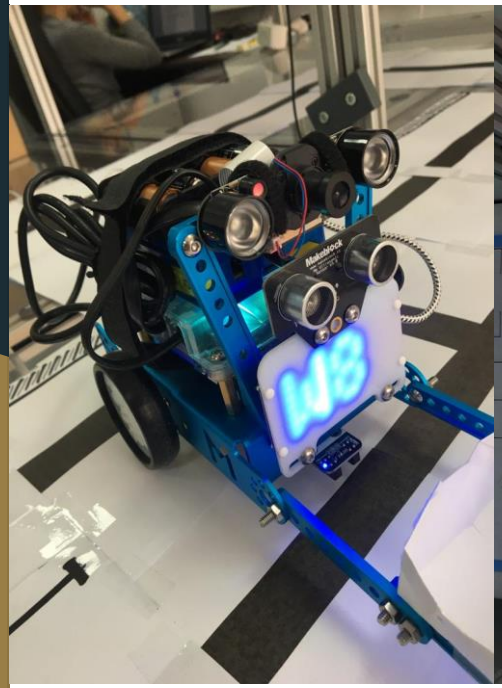
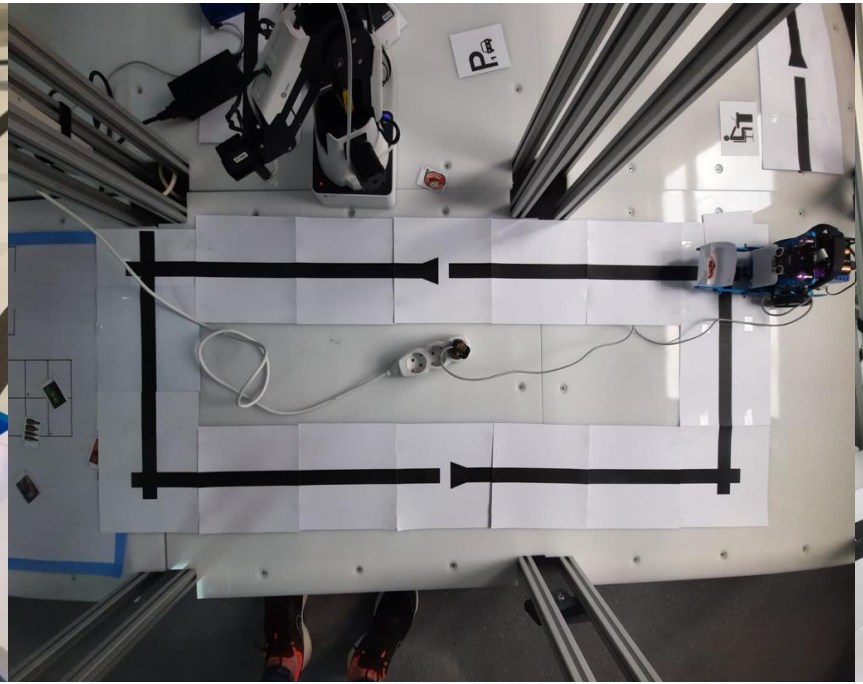
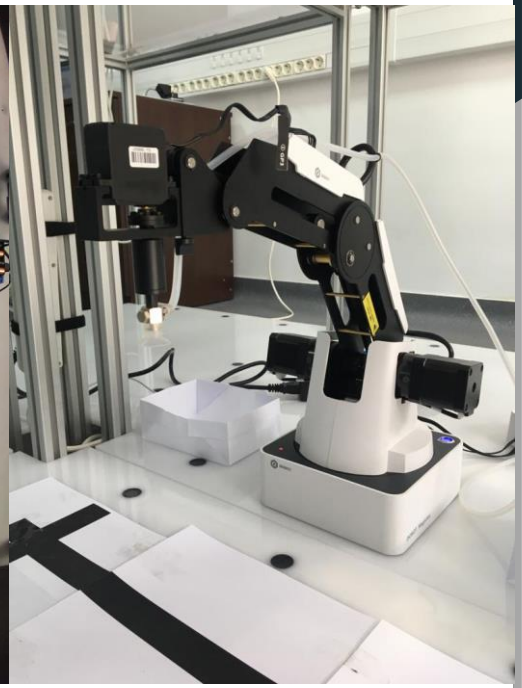

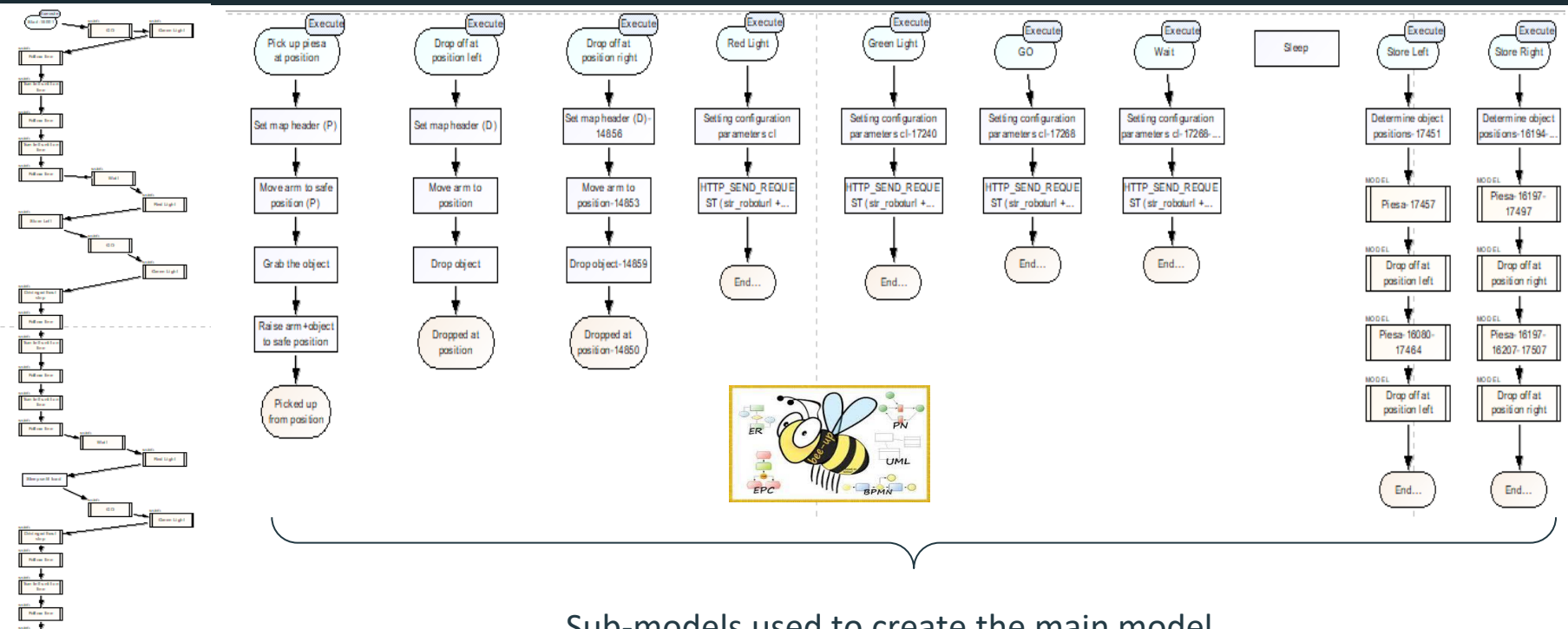

Sub-models used to create the main model.

The complete model of the application.

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MODEL

Drop off at position left

Execute

Drop off at position left

Required Variables:

	Variable name	Variable type	Default value
1	str_roboturl	string	"http://10.14.10.253:8080/dobot/api/operation/"
2	xPos	any	10
3	yPos	any	211
4	zPos	any	30

Set map header (D)

Operation code:

```
map_headers := {"Content-Type": "application/json"}
```

Move arm to position

Operation code:

```
HTTP_SEND_REQUEST (str_roboturl + "moveToPosition?x=" + STR xPos +
"&y=" + STR yPos+"&z=" + STR zPos) str_method:("POST") map_reqheaders:
(map_headers) str_reqbody:("") val_respcode:val_httpcode
map_respheaders:map_respheaders str_respbody:str_respbody
```

Drop object

Operation code:

```
HTTP_SEND_REQUEST (str_roboturl + "turnOffSuctionCup")
str_method:("POST") map_reqheaders:(map_headers)
str_reqbody:("") val_respcode:val_httpcode
map_respheaders:map_respheaders str_respbody:str_respbody
```

Dropped at position

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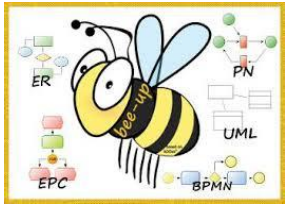

Conclusions and further developments

I believe that this type of project has wide applicability and can be successful in industrial companies.

From a software point of view, I used Bee-Up as a tool for the CPS part and the Flowchart as a working method, and for the Design Thinking and Conceptual Modeling parts I used Scene2Model.

In the future, I want to make the robotic arm smarter, attaching a camera so that the parts are separated based on QR codes. Apart from the automation problem, I want to make a project in which the arm is used as a 3D printer.

As for the mBot, I want to attach at least 2 proximity sensors so that it can move alone on an obstacle course.

References

- Dimitris Karagiannis, Heinrich C. Mayr, John Mylopoulos – “Domain-Specific Conceptual Modeling”
- Bee-Up Tool : https://austria.omilab.org/psm/content/bee-up/info
- Scene2Model Tool : https://austria.omilab.org/psm/content/scene2model/info
- ADOxx : https://www.adoxx.org/live/home
- OMiLAB Approach : https://www.omilab.org/assets/docs/OMiLAB%20Laboratory%20Layout_DRAFT.pdf

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Thank you for your attention !

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