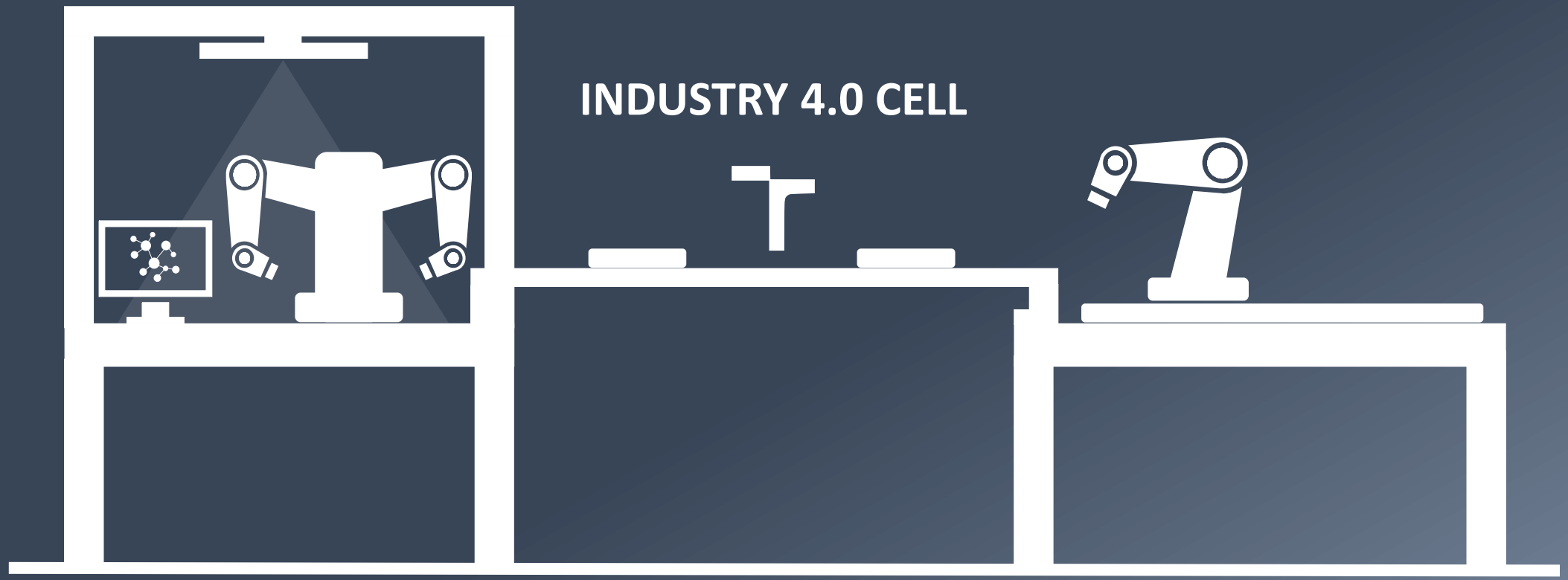

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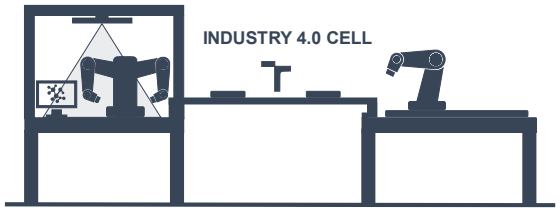
El Bestos Muchachos Teamos: Automated Medical Laboratory

Čermák, Jozefovič, Jukić

NETME Centre



FACULTY OF MECHANICAL ENGINEERING institute of automation and computer science

Brno, 2023

Content

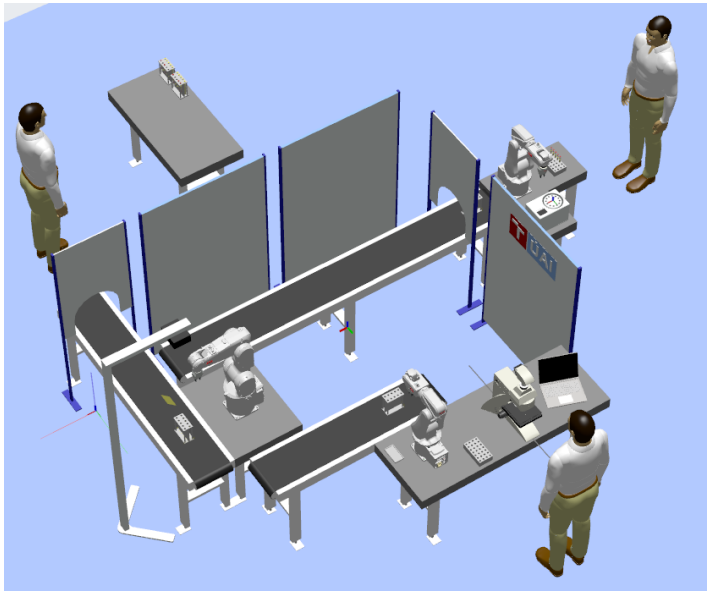
1. Definition of the Problem, Related Work, etc.
2. Development Tools, Methods, etc.
3. Design and Implementation of a Functional Solution
4. Experiments and Results
5. Conclusion and Future Work

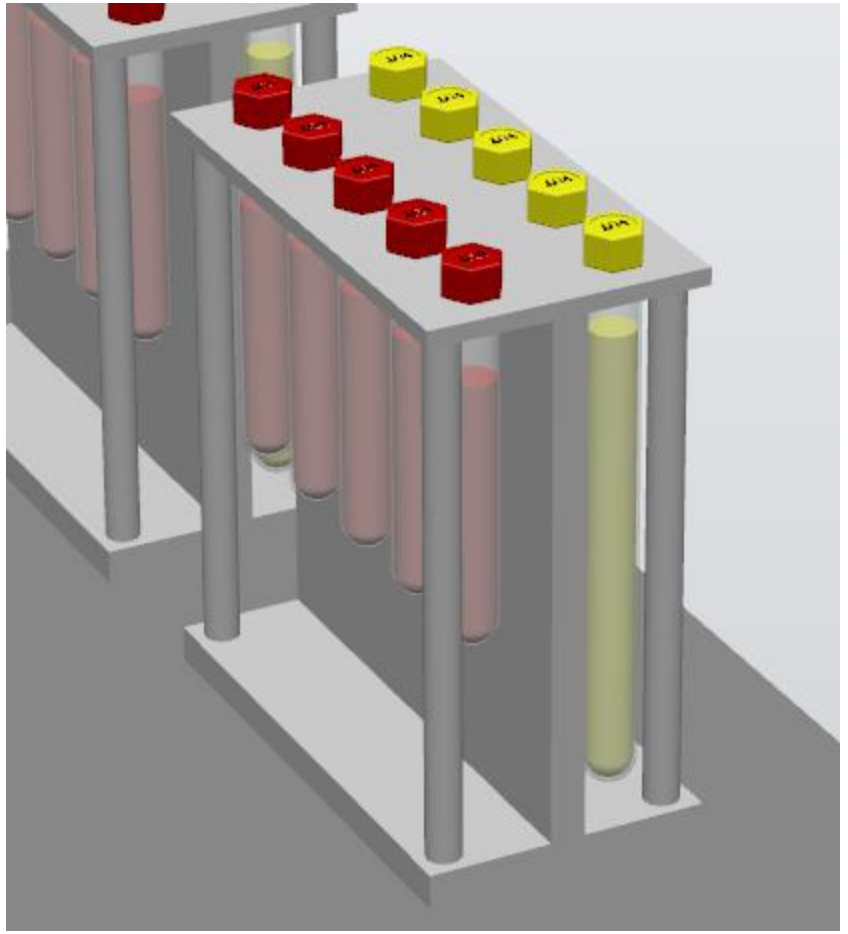
Definition of the Problem

Definition of the Problem: Summary

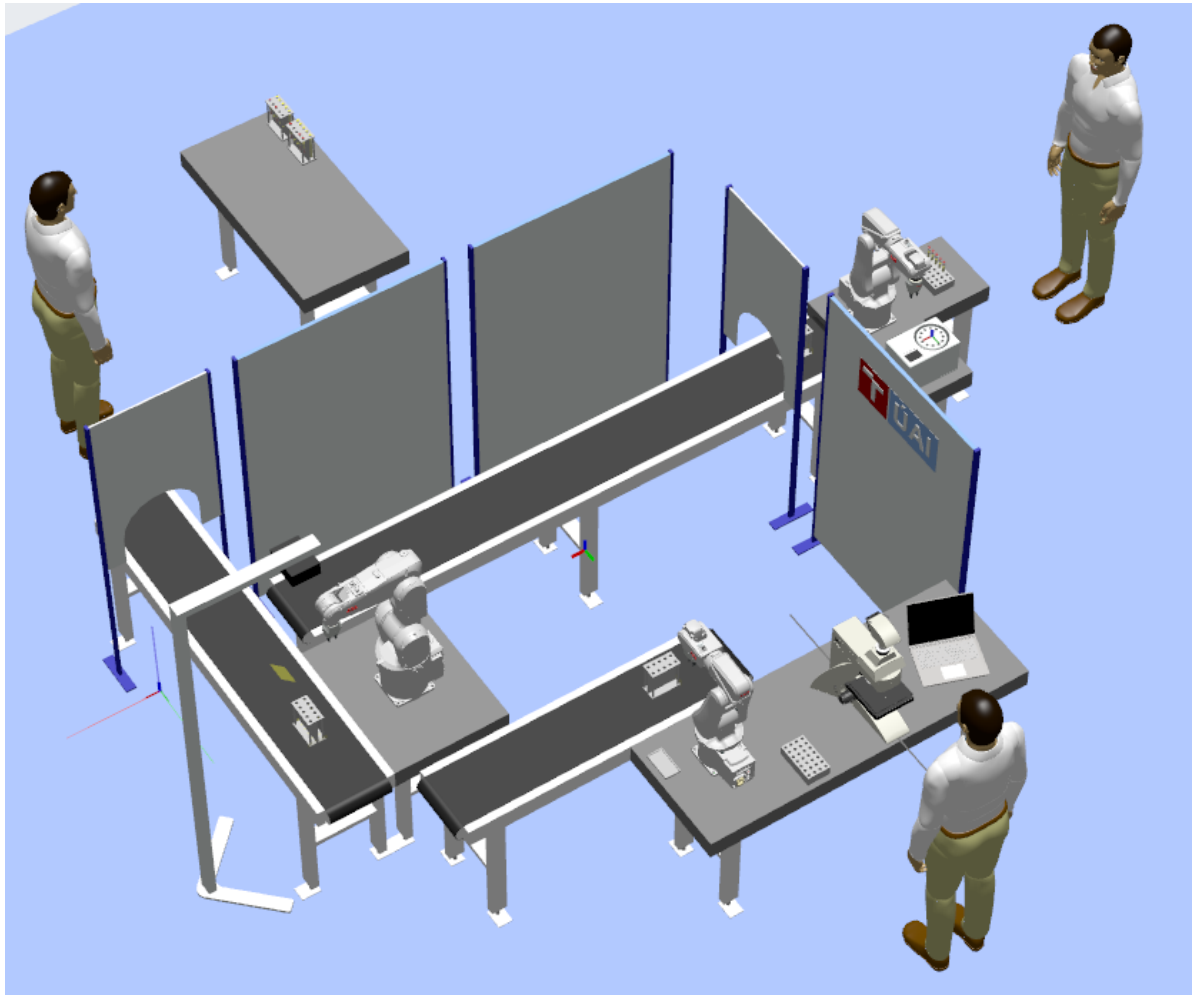
Our project is about sorting and dealing with test tubes

- Blood and urine
- Different operation, different goals
- → Automated Medical Laboratory





Definition of the Problem: Summary



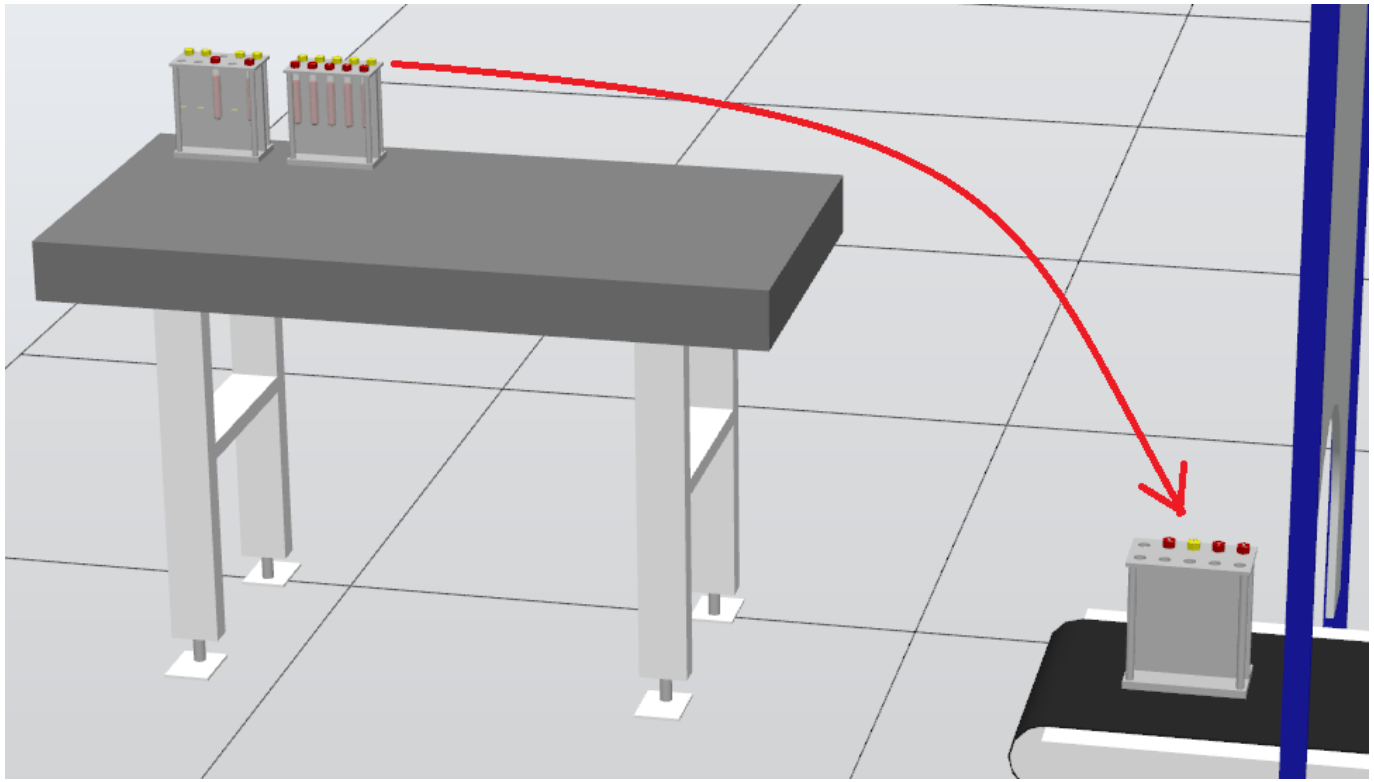
Development Tools and Methods

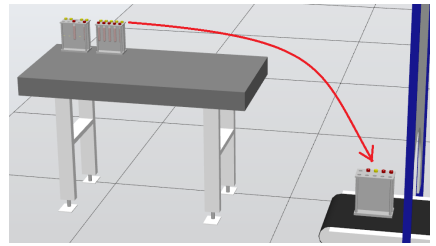
Robot Studio

- RobotWare 6.15.01
- 2x Robot IRB 120, 1x Robot IRB 1200
- 3x ABB Smart Gripper

Random Generator

- Random test tubes are inserted onto the conveyor





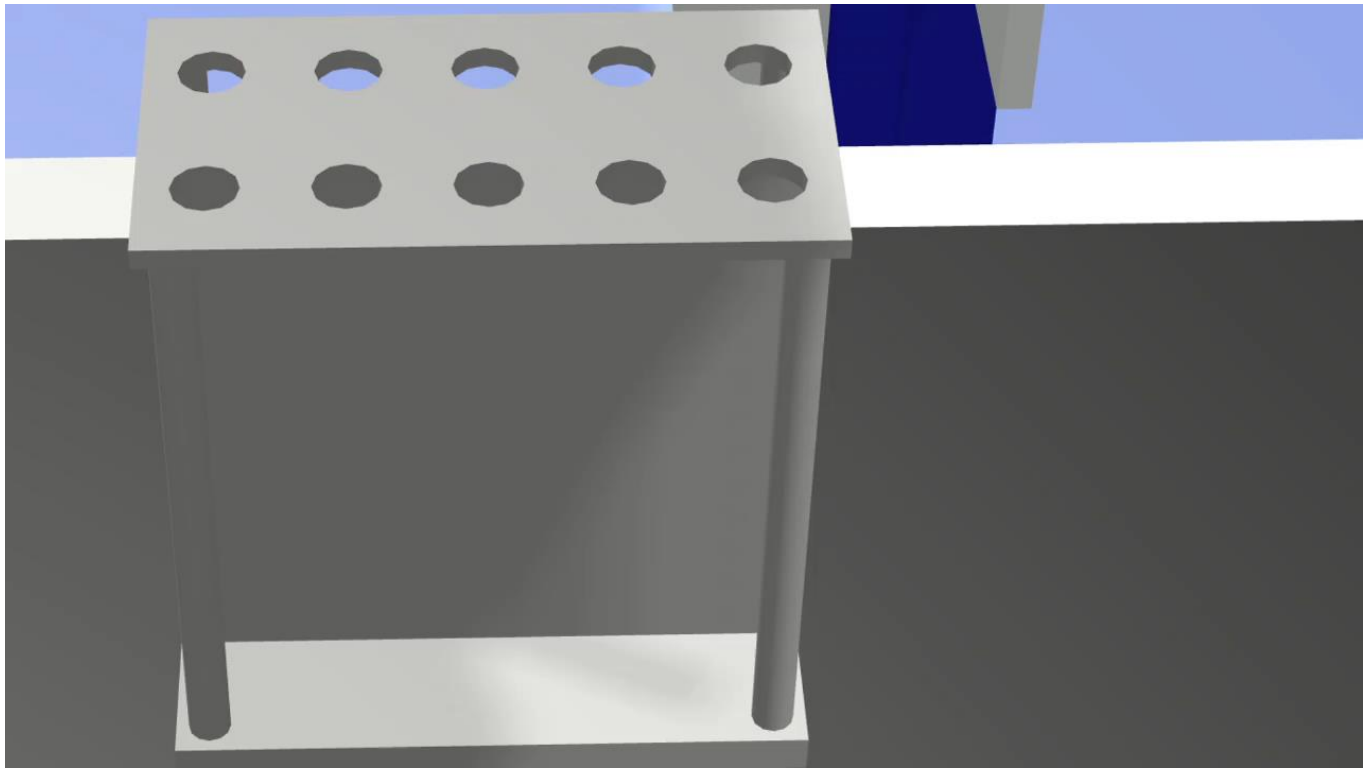
Random Generator

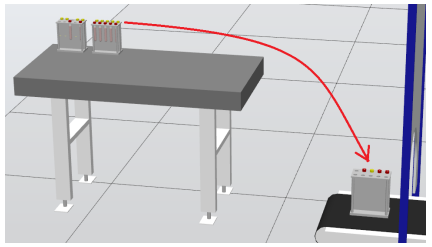
- Rapid script

```
PROC place_tube()
    FOR i FROM 1 TO 5 DO
        x := Rand(\SeedEachNTime:=10)/RAND_MAX;
        IF x > 0.66 THEN
            place_blood i;
        ELSEIF x < 0.66 AND x > 0.33 THEN
            place_urine i;
        ENDIF
```

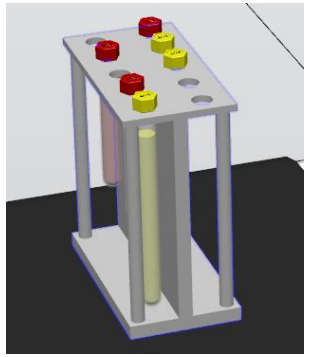
Random Generator

- Result

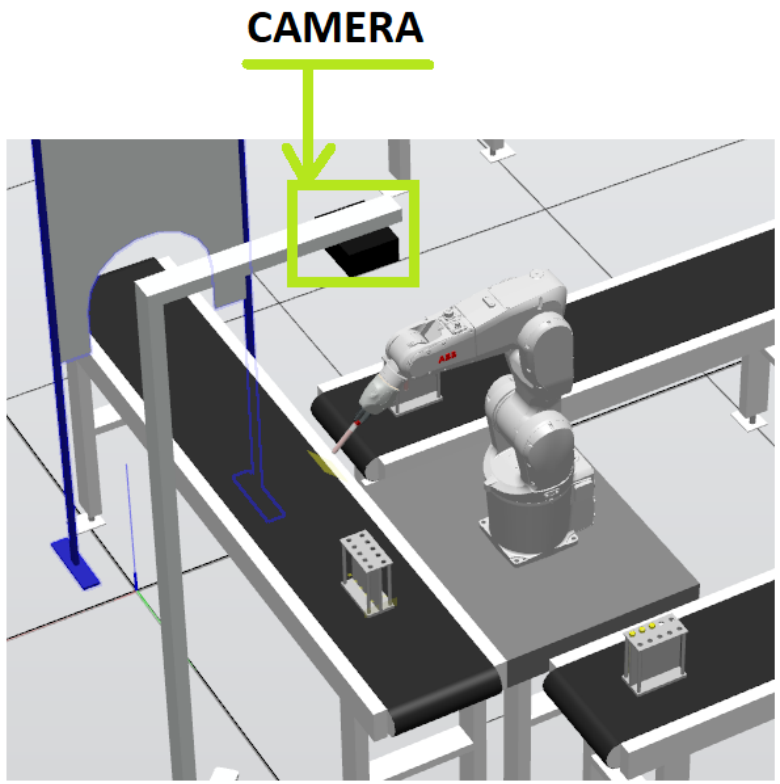


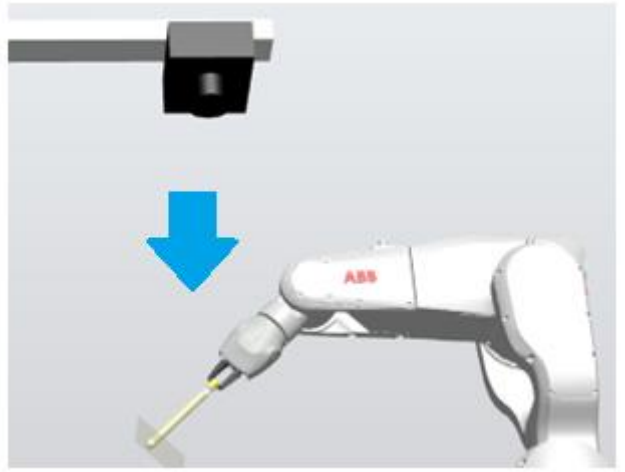


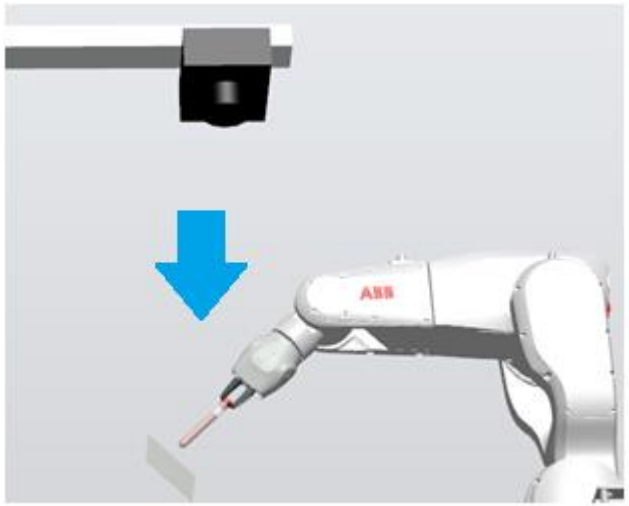
```
PROC place_tube()
    FOR i FROM 1 TO 5 DO
        x := Rand(\SeedEachNTime:=10)/RAND_MAX;
        IF x > 0.66 THEN
            place_blood i;
        ELSEIF x < 0.66 AND x > 0.33 THEN
            place_urine i;
        ENDIF
```



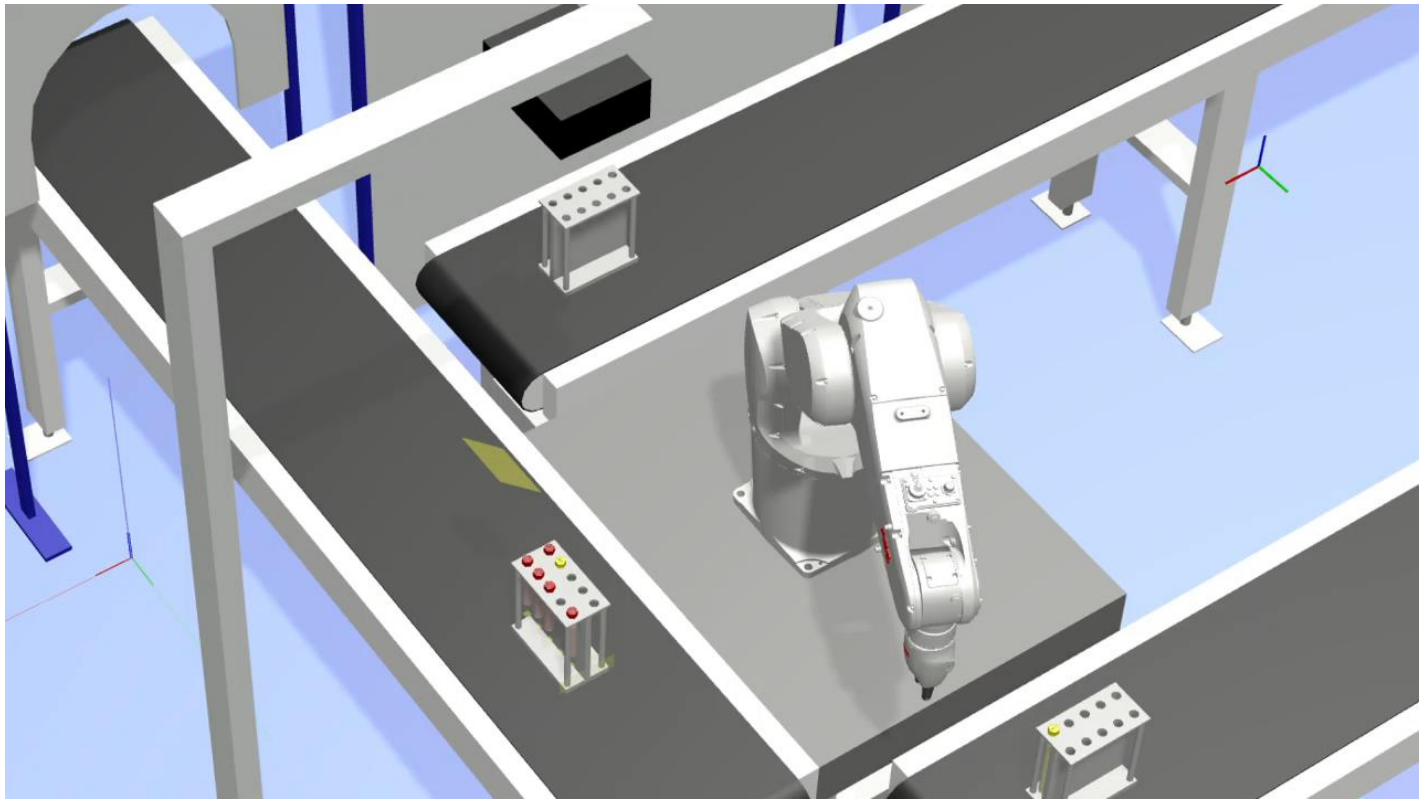
Camera Scanning Simulation

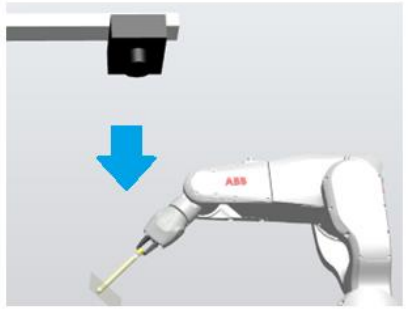


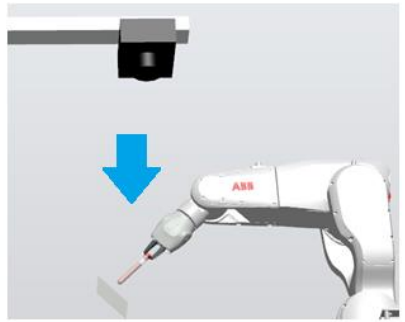




Camera Scanning Simulation



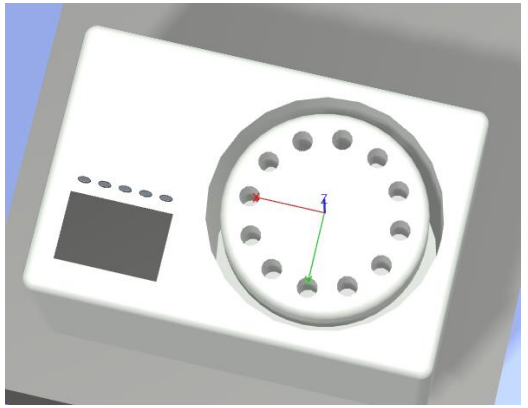


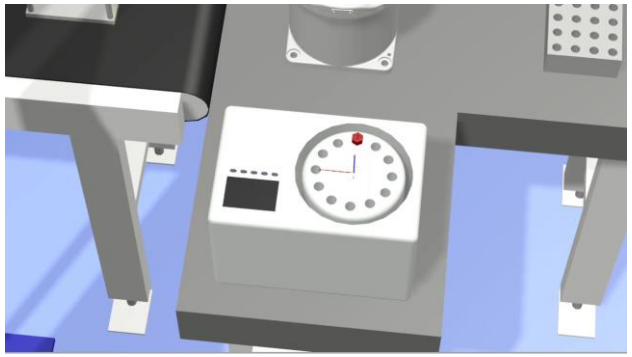


Centrifuge blood separation

- Red Blood Cells
- White Blood Cells
- Blood Plasma

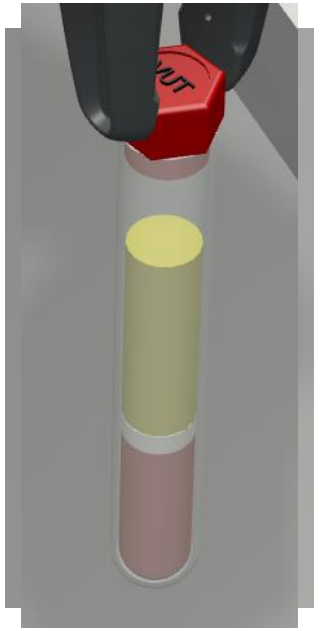
```
CASE 20:
    !EXPECTED ROTATION OF CENTRIFUGE
    SetDO DO_ROTATE_CENT,1;
    WaitTime 4;
    SetDO DO_ROTATE_CENT,0;
    PulseDO DO_CENTRIFUGE_HOME;
    PulseDO DO_HIDE_BLOOD;
    cent_sequence := 30;
```





Rotator
Properties
Object (Centrifuge_holder)
CenterPoint ([0,00 0,00 0,00] mm)
Axis ([0,00 0,00 1000,00] ...)
Speed (180,00 deg/s)
Reference (Object)
ReferenceObject (Frame_2)
I/O Signals
Execute (0)

Hide_10	
Properties	
Object (Content_Blood_101)	
I/O Signals	
Execute (0)	Executed (0)



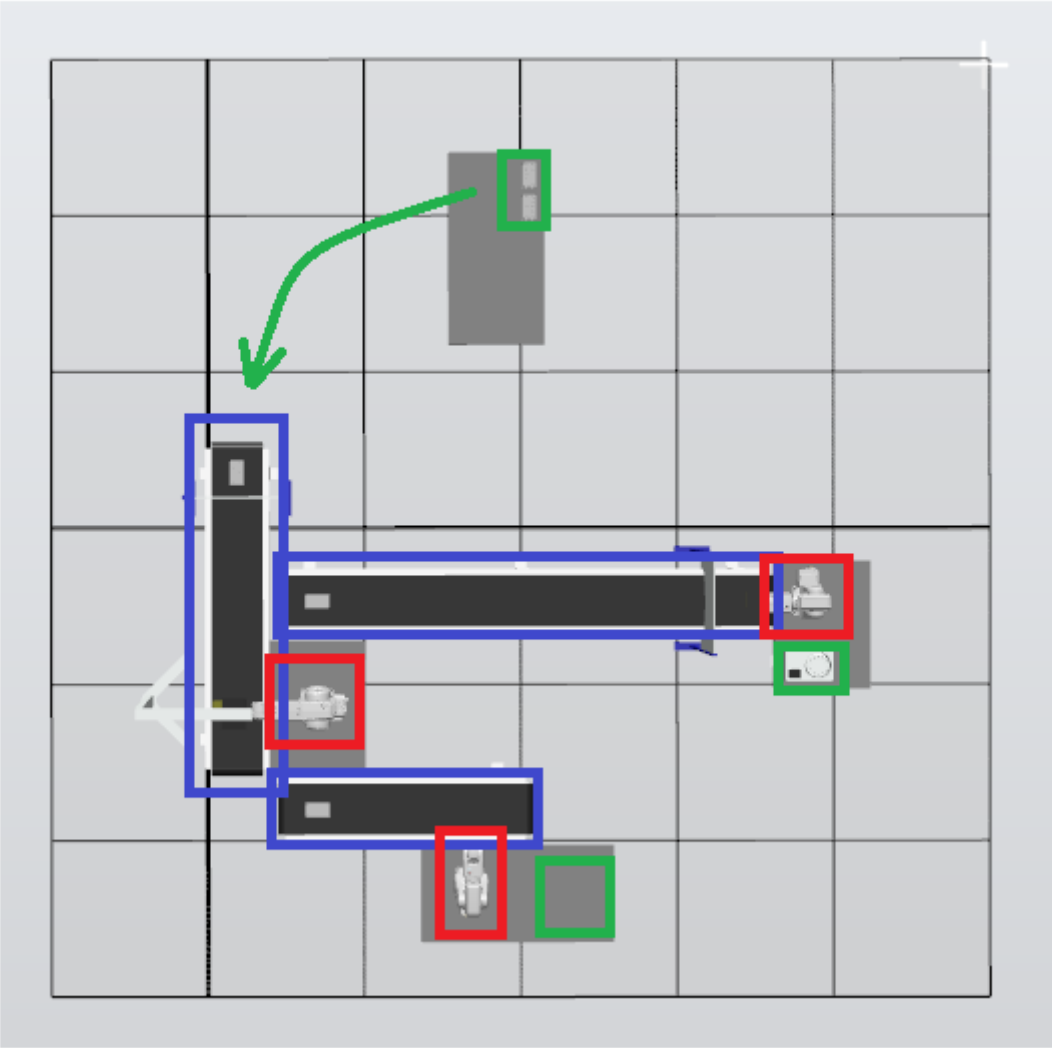
Design and Implementation of Functional Solution

Design and Implementation of Functional Solution

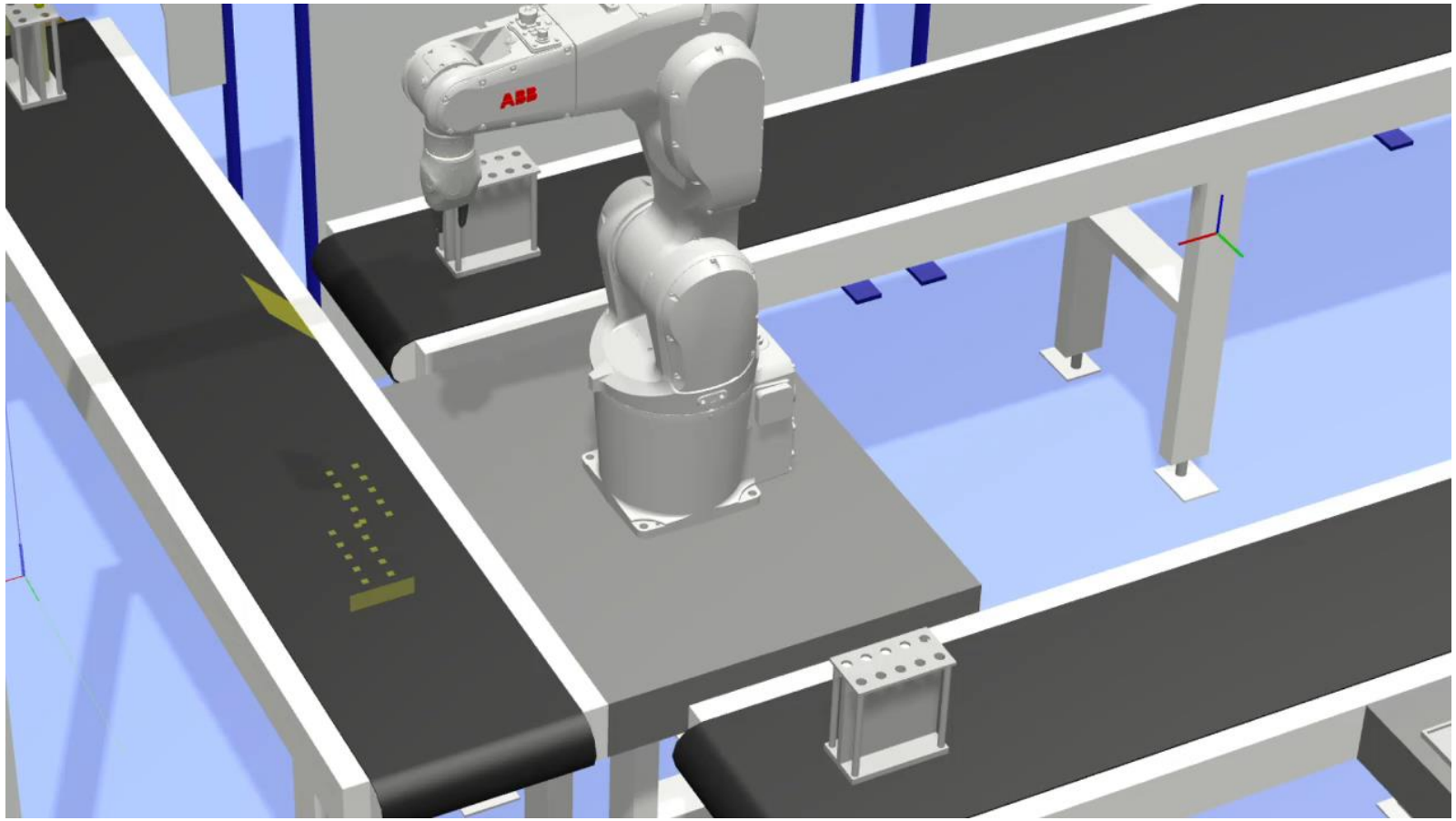
Blue … Conveyors

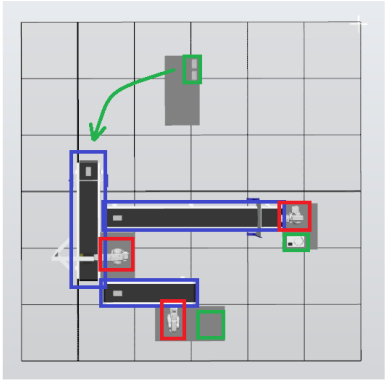
Red … Robots

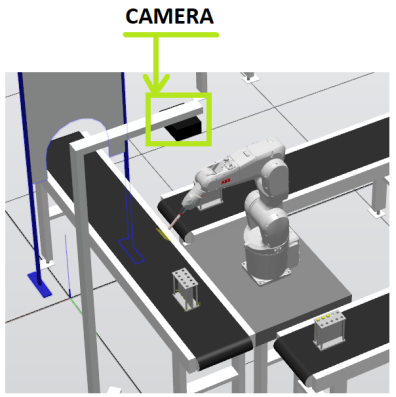
Green … Centrifuge, Microscop and starting Base-point



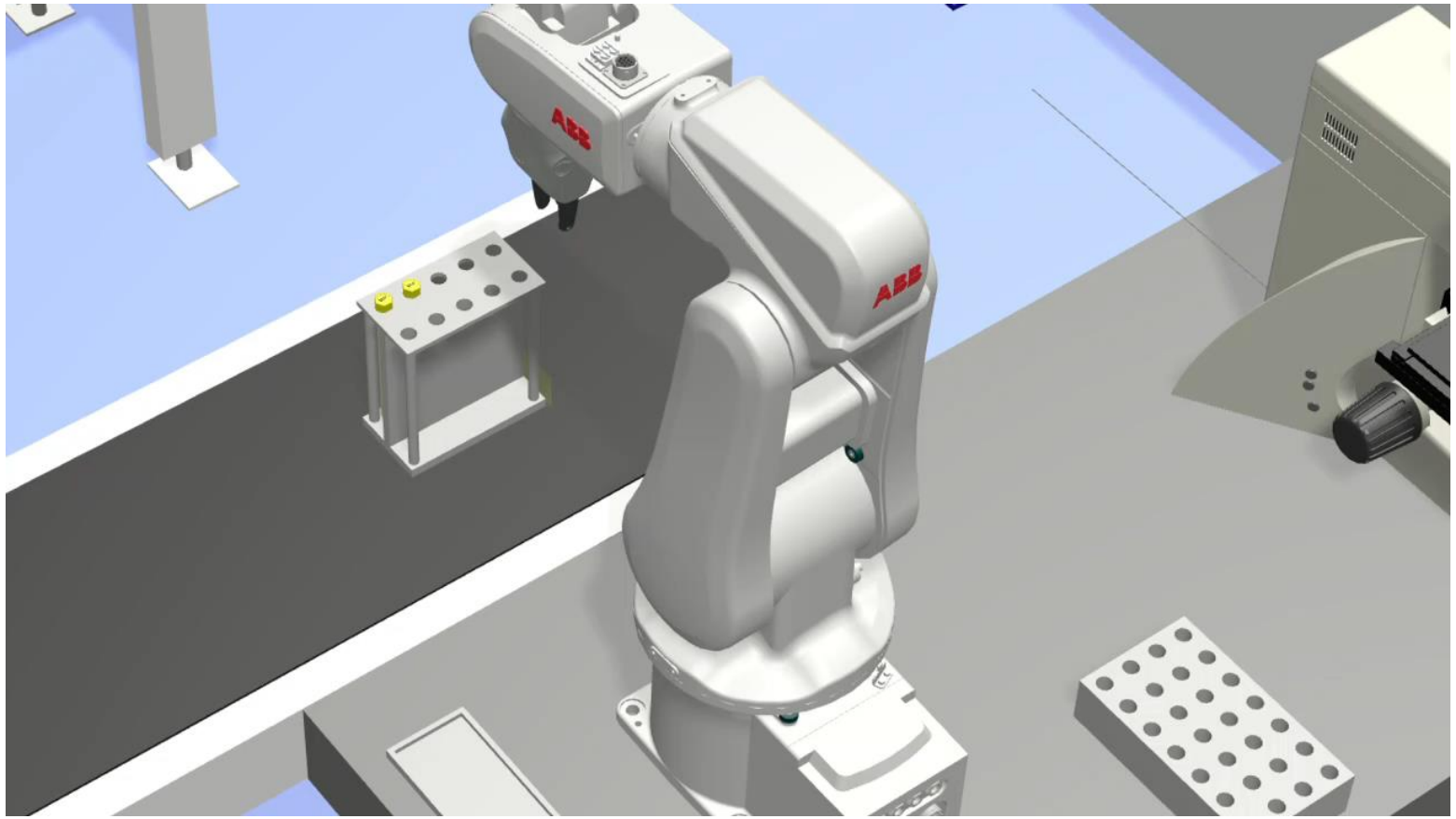
Camera

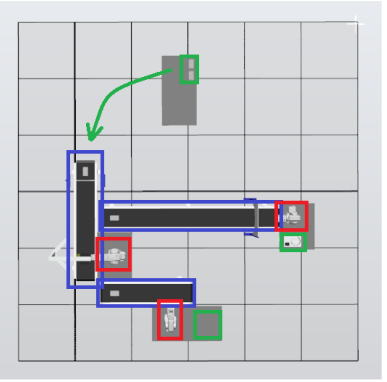


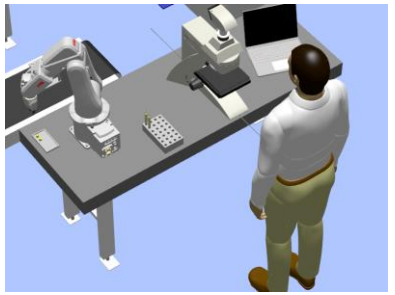




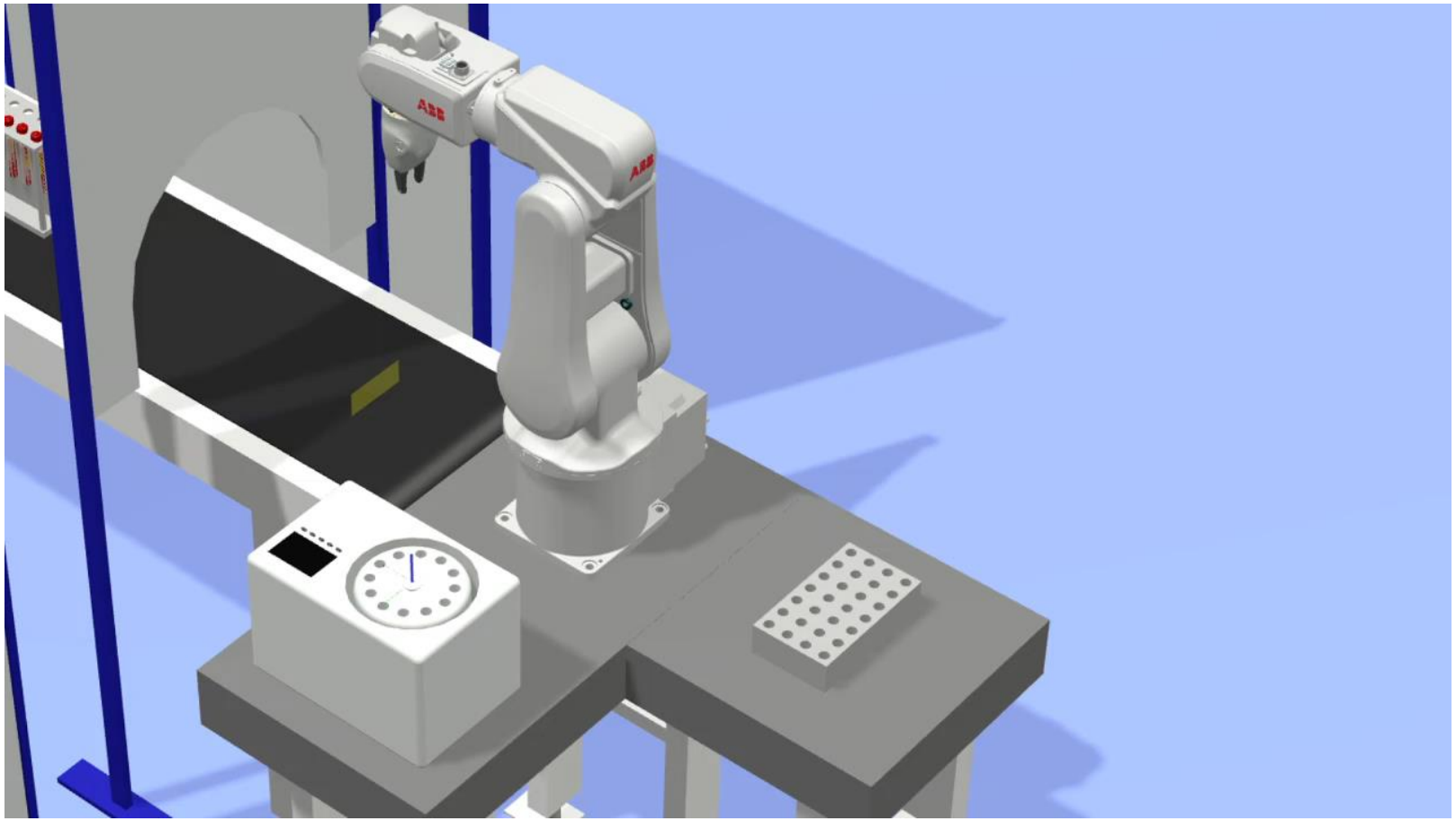
Microscop

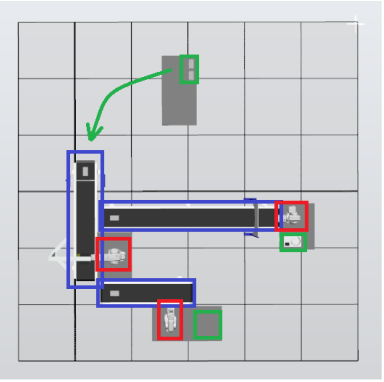


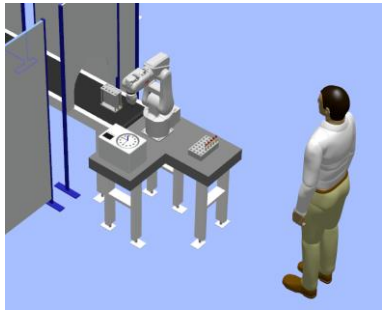




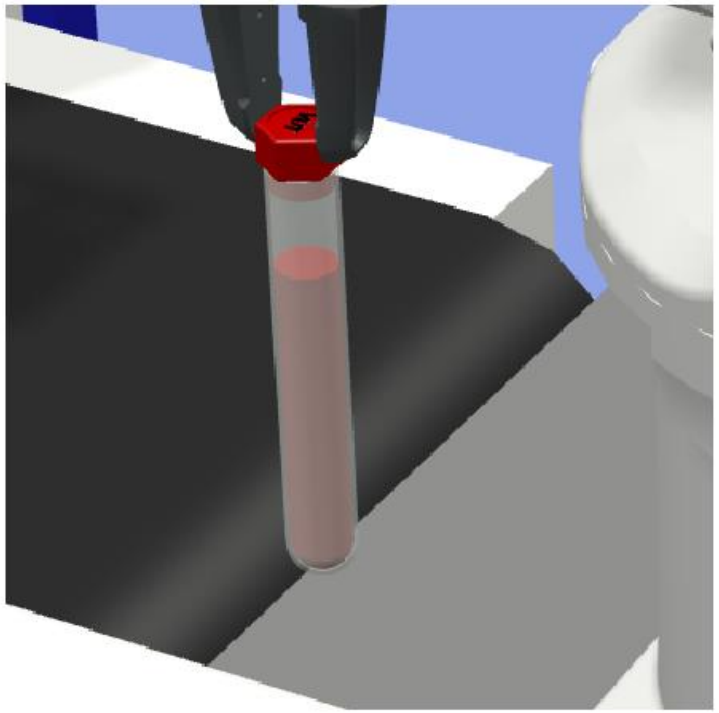
Centrifuge







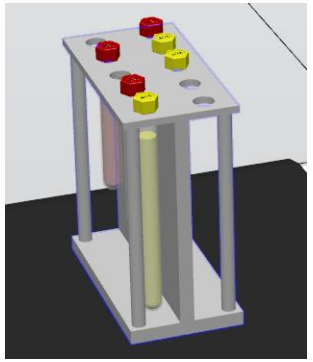
Design and Implementation of Functional Solution

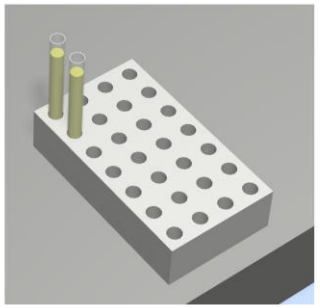


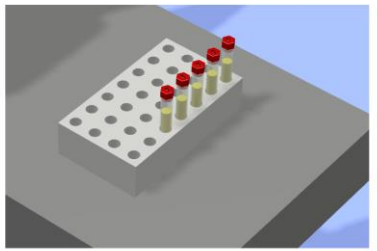
Experiments and Results

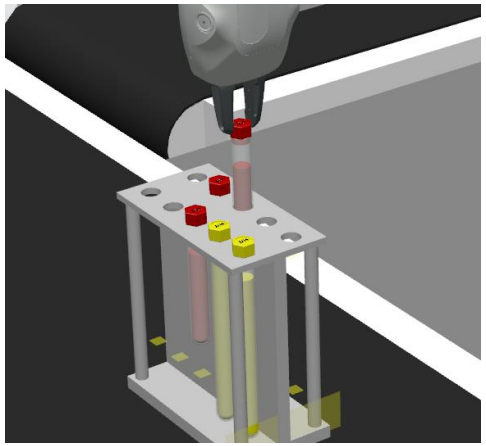
Does It Work ?

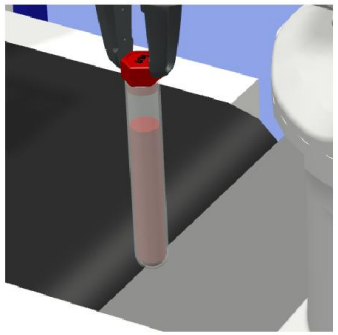
- ✓ Random Generator
- ✓ All test tubes reach their final positions
- ✓ Smooth and correct Robot arm movements
- ✓ Centrifuge spins and Blood changes Colour

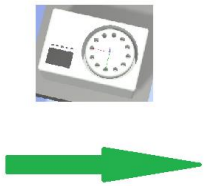












Conclusion and Future Work

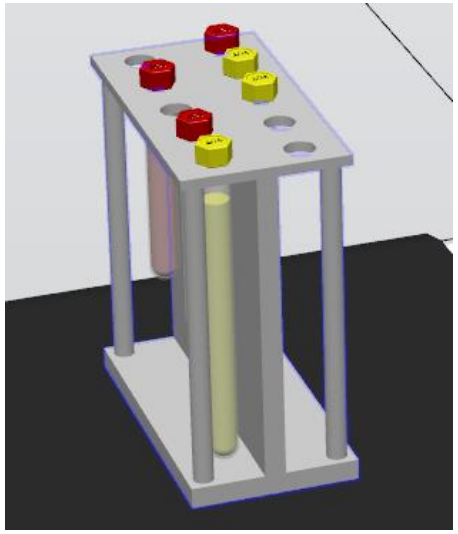
Future Work

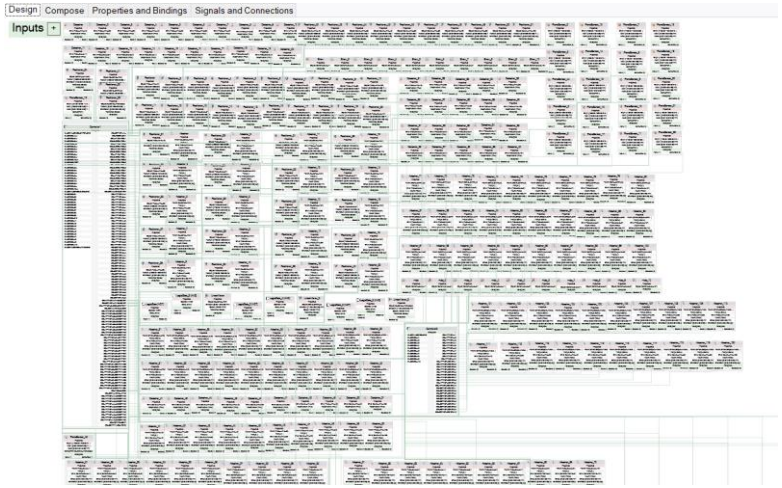
- Join the Competition
- Use ROS with real Camera
- Put it into a Virtual Reality
- Make it real
- ***… And Patrik will add like 30 or 40 commands for better feeling***

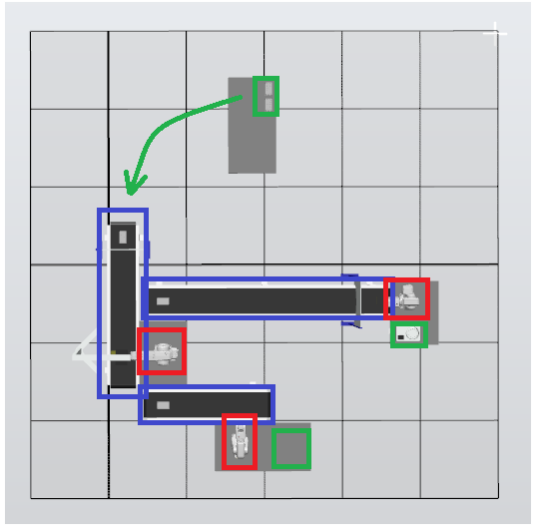
ROS

What have we learned

- New skills in Robot Studio
- Teamwork
- Solving complex task

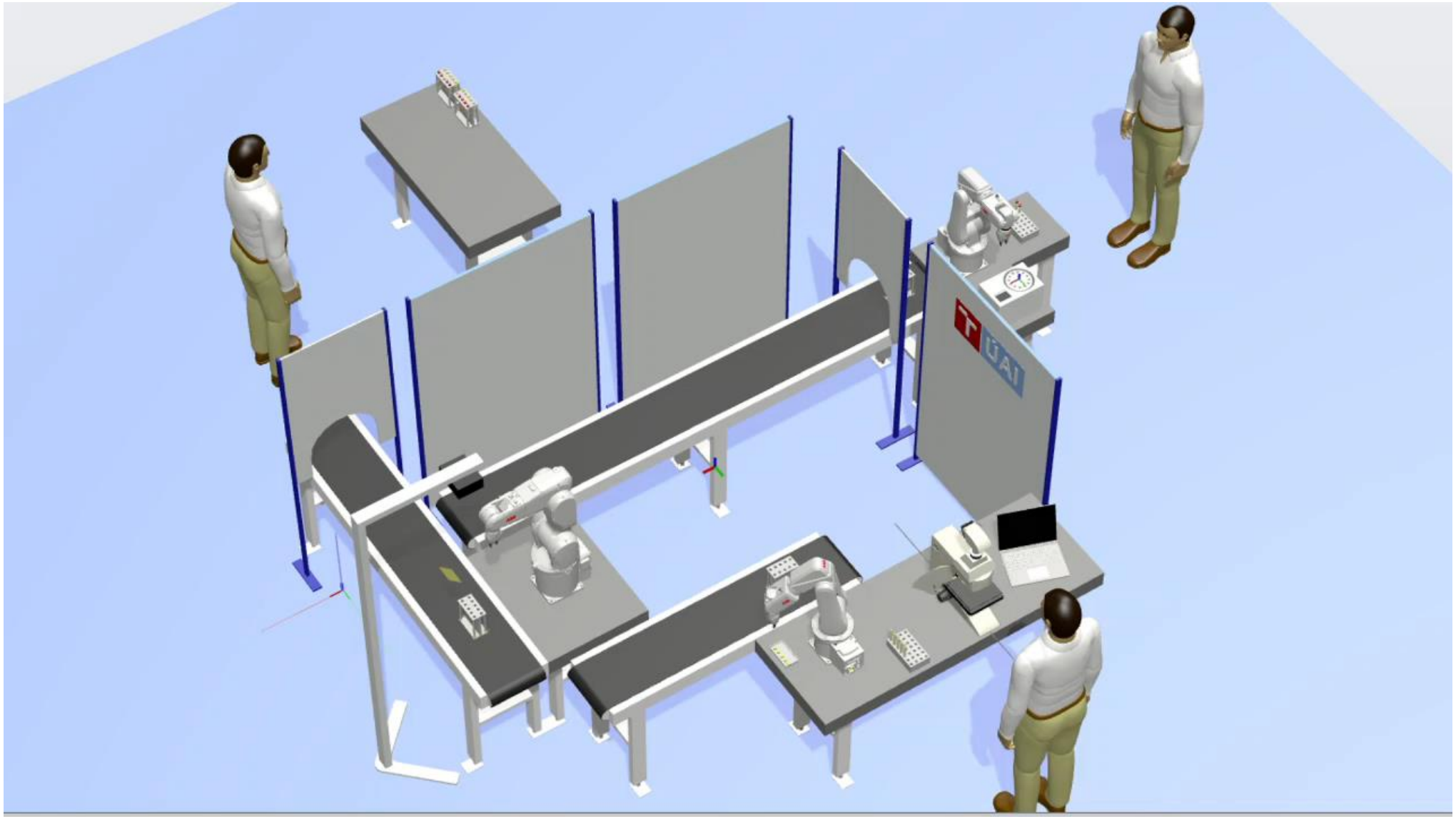






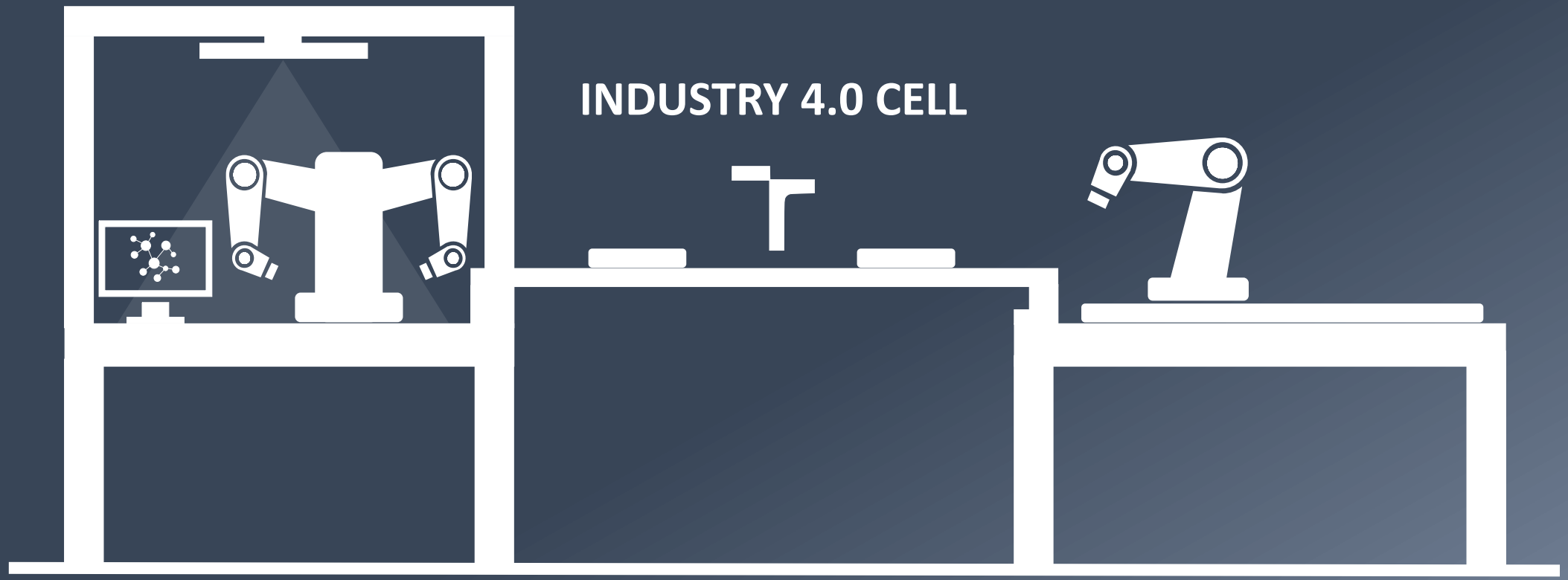
Conclusion and Future Work: Video

Video



Thank You!

Questions?



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