Swissport X - Airport operator and reinforcement agent

About (What's the problem?)

"Swissport need a developed human-machine interface to ensure communication between the airport operator and the reinforcement agent."

We developed a System that recognises the tasks performed by employees and identifies potential delays, including the reasons for them.

This information will be automatically relayed to the supervisor, enabling more efficient decision making and proactive problem solving.

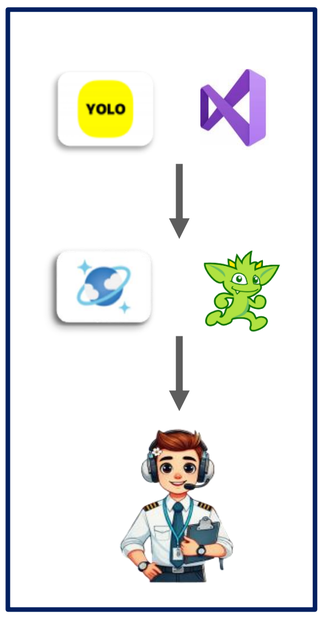
Methodology (How to solve it?)

With machine automation on **Studio Visual Code**, including the "**Yolov3**" and "**Deepsort**" algorithm, we can accurately identify and track objects and employees in motion.

A grid was added to structure the camera view into specific Sectors. With the defined rules in the Knowledge Graph, we can track the start and end of each task based on the employee's position.
Implementation of a Knowledge Graph with the Application "**CosmoDB**" to define standardised tasks, rules and task dependencies.

With the implementation of the "**Gremlin API**" its possible to combine the tracking of employees and their position with the structure of the Knowledge Graph.

If a worker takes longer than the standardised time set by the rules, a notification is sent to the **supervisor** in the control tower.



1. Machine Automation

1. Processes the video to recognise people, vehicles, aircraft and other objects

```
def initialize_deepsort_tracker():
return DeepSort(max_age=30, nn_budget=200,
max_iou_distance=0.7,
nms_max_overlap=1.0,
max_cosine_distance=0.4)
```

2. Create the fields where the tasks are executed

```
for field_id, (x_min, y_min, x_max, y_max) in
fields.items(): cv2.rectangle(frame_resized,
(x_min, y_min), (x_max, y_max), (255, 0, 0), 2)
cv2.putText(frame_resized, f"{field_id}", (x_min + 5,
y_min + 20),
cv2.FONT_HERSHEY_SIMPLEX, 0.6, (255, 0, 0), 2)
```

3. Save the time spent by employees within the field

```
track_field_times = defaultdict(lambda:
{"field_id": None, "enter_time": None,
"total_time": 0})
```

4. Calculate the current time in the current field

```
if track_field_times[track.track_id]["enter_time"]:
time_in_field = current_time -
track_field_times[track.track_id]["enter_time"]
cv2.putText(frame_resized, f"Time:
{time_in_field:.2f}s", (int(ltrb[0]), int(ltrb[1]) + 30),
cv2.FONT_HERSHEY_SIMPLEX, 0.6, (255, 255,
255), 2)
```

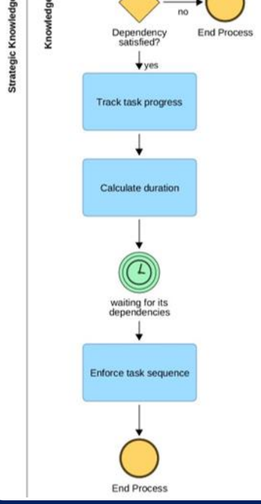
5. Show the frame

```
try:
cv2.imshow("YOLOv5 + DeepSort Tracking",
frame_resized)
except Exception as e:
print(f"Error by showing the frames": {str(e)}")
break
```

6. end the frame pressing q

```
if cv2.waitKey(1) & 0xFF == ord('q'):
break
```

2. Knowledge Engineering



Detect People in Sectors

A camera detects people and determines their presence in specific sectors.

For each person, a vertex gets created and associated with the detected Sector.

Evaluate Task Rules

Check if the required number of people are in the correct sector(s).

Verify all dependency tasks (via depends_on edges) are completed.

If both conditions are met the Start Time gets set and Status gets Updated to "InProgress"

Track Task Progress

When the required conditions are no longer met (e.g., people leave the sector), mark the task as Completed. The End Time property gets set and the Duration of the task is calculated

Enforce Task Sequence

Use task dependencies to ensure proper execution order:

A task can only start if all its dependencies (connected via depends_on edges) are completed.

3. Innovative Solutions

- Real-time monitoring and automatic escalation
- Fully automated analysis system
- Explainable AI (Causal AI) for delay reasoning
- Enhanced labor utilization
- Scalable across multiple locations worldwide
- Long-term cost savings

4. Benefits

- **Increased Employee Motivation and Engagement:** Due to the high interpretability of the system, employees understand how their work contributes to overall performance and why delays occur.
- **Responsibility and Proactive Problem-Solving:** Employees can better comprehend delays and their causes. The ability to actively contribute to improving workflows strengthens employees' trust in the company and promotes a culture of accountability.
- **Improved Company Image:** distinguishes the company from competitors, and makes it an attractive employer and business partner
- **Long-Term Value Growth:** Trust in the technology and positive market perception create a solid foundation for future growth

5. Sales

- **Increased Operational Efficiency**: The system automates task tracking and delay identification, improving overall operational performance.
- **Cost Savings**: Long-term reduction in labor costs through automation
- **Proactive Problem Solving**: Real-time notifications allow supervisors to address potential delays before they impact operations.
- **Scalable Solution**: The system can be easily implemented across multiple global locations, ensuring wide applicability.
- **Competitive Advantage**: Leveraging advanced AI technology
- **24/7 IT- Support**
- **Total Investment**: CHF 1'250'000
  (CHF 30,000 per year (for ongoing maintenance, support and updates)

Author affiliation and references:
1. FHNW - School of Business, Riggenbachstrasse 16, Olten 4600, Switzerland
2. Claudio Vinci, Chiara Mamie, Jan Steiner, Sujani Ragumar, Robin Meier
3. Image Source: Chat GPT, Google