▦ Master's Thesis Submission

**Hochschule
Bonn-Rhein-Sieg**
University of Applied Sciences

**PROJECT SUBMISSION FORM
Master's Program in
Autonomous Systems**

A. Student information

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2. Study info	Enrollment number	Started program
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B. Project information

1. Project type	R&D	Thesis	Report dated (dd. mm. yyyy)
	☐	☒	15.04.2025

3. Project duration	From	To
	01.10.2024	15.04.2025

4. Project info	Title
	Forklift and Human Pose Estimation for Safety and Risk Analysis in Industrial Environments

Abstract

Ensuring safety in environments where humans and heavy machinery, such as forklifts, share space is critically important. This research investigates pose recognition models for human and forklift detection, focusing on enhancing dataset quality and optimizing detection algorithms aimed at boosting safety compliance within industrial settings and minimizing workplace incidents. We perform a comparative analysis of YOLO based pose estimation frameworks, assessing their ability to deliver real-time monitoring and risk assessment. A significant portion of the project is allocated to developing techniques for generating high-quality synthetic data for scenarios where real-life data collection is challenging. Experimental evaluations in real images of industrial environments are carried out to confirm the system's efficiency, accuracy, and effectiveness in detecting safety risks. While heavier models provided better accuracy in keypoint estimation, such as the Nano version, were 30-43\% faster in detection of Human and Forklift poses. mAP@[.50:.95] scores of 0.68-0.8 were acheived for Humans and more than 0.98 for Fprklift across models. This work also investigated the advantage of incorporatig synthetic data into the dataset. The models were able to predict more instances and robustness in pose estimation on the test set.

5. Supervisors	1st supervisor's name	1st supervisor's affiliation
	Prof. Dr.-Ing. Sebastian Houben	
	2nd supervisor's name	2nd supervisor's affiliation
	Prof. Dr. Paul G. Plöger	
	3rd supervisor's/advisor's name	3rd supervisor's/advisor's affiliation
	Msc. Ayan Roy Chowdhury	
	4th supervisor's/advisor's name	4th supervisor's/advisor's affiliation

C. Agreement

1. Candidate	Date (dd. mm. yyyy)	Signature
	15.04.2025	*Aniruddha Pal*

Please ensure that the items listed below are complete before submission to the department office:
☐ **A hard copy of the report/thesis per supervisor (in the case of a thesis, copies should be signed and dated)**

These additional items, listed below, are required when submitting a MASTER'S THESIS:
☐ **One additional signed and dated hardcopy of the thesis**
☐ **For each hard copy (there should be number of supervisors + 1 copies), a CD/DVD containing:**
　☐ **The thesis in pdf format**
　☐ **Any software that you have produced**
　☐ **A document containing your name, supervisors' names, thesis title and abstract. If applicable,**
　　include the name of the company with whom the thesis was written
☐ **An additional CD as above**
☐ **One copy of your transcripts (Notenspiegel)**

I agree to the use of my project's title for MAS advertising and media purposes: x̶ Yes　☐ No