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**King’s College London**

**An Improvement Detection Model of Occluded Objects for Robotic Arm Based on YOLO v8**

**Submitted by:**

**Haoyi Zhang**

**k23046882**

**Project Report Submitted in Partial Fulfillment of the Requirements of the MSc Project Module**

**Engineering Department**

**Supervised by:**

**Prof./Dr. Shan Luo**

**London**

**August/2024**

# Abstract

Generally, the abstract has 5-12 sentences, about 150-200 words. The tone is general and informative. Construct your abstract by answering the following questions and merging the answers in a single paragraph.

Why is the problem important? Give readers the context for the project, and the main reason(s) for undertaking the project. (1-2 sentences)

What does the problem attempt to solve? What central questions does the project address? What is its scope? What is the main argument, thesis, or claim? (1-2 sentences)

**What** **was** **done** to address the problem and **how**? Describe the research design and methodology. Specify models or approaches used. Describe the general experimental set up used to obtain the types of evidence reported. (1-2 sentences)

**What** did the project **yield** or reveal? What are the key findings of the study and how the results answered the research questions? (1-2 sentences)

**What** are the implications of the results and what are their **value?** What are the general takeaways? (1-2 sentences)

**Any limiting assumptions?** (1 sentence)

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# List of Symbols

|  |  |  |
| --- | --- | --- |
| **Acronyms** |  | |
| AC | Ant colony | |
| CP | Constraint programming | |
| CVRP | Capacitated vehicle routing problem | |
| GA | Genetic algorithm | |
|  |  | |
| **Notation** |  | |
|  | Set of *n* clients augmented by the depot | |
|  | Global best position of all particles in the swarm | |
|  | A very large positive number | |
|  | Depot | |
|  | Client *i* | |
| **Parameters** |  | |
|  | Depot | |
|  | Maximum number of vehicles in VRPMTW | |
|  | Number of clients | |
|  |  | |
| **Decision Variables for MIP** | |  |
|  | equals 1 if client *i* immediately precedes client *j* on the route of vehicle *k* and 0 otherwise | |
|  | Time vehicle *k* leaves the depot | |

# Acknowledgement

Thank whomever you wish if you wish or simply remove. (Most likely not needed for the project proposal.)

**Chapter 1**

# Introduction

## Background

Intelligent robotic arms can achieve the functions of detecting objects, picking and placing the objects for users, which has been widely used in the automotive factory, manufactory, and logistics factory. In terms of the robotic arms, one of the most important task is to make sure the detection accuracy, otherwise it will grasp wrong objects or miss grasping objects, which may cause poor products quality to factories or wrong dispatching problems for logistics. In this paper, we proposed a detection model for robotics arm based on YOLO v8 focusing on improving the detection accuracy for robotics arms to avoid grasping error due to poor detection.

## 1.2 Problem Statement

The intelligent robotic arms are being used in different areas nowadays, and people are looking forward they perform well in different situations. In this case there are two problems that a robotic arm need to face with. One is the detection accuracy during a complex background like target objects being occluded by other objects, and another one is the adaptability of the detection model to any devices, which means the detection model need to be small enough. (cite sources to make problems a real one) To address this problems, xxxxxx has xxxx

There are a lot of intelligent robotic arms are being used in manufactories and logistics. When a detection error occurs, it may make robotic arms to wrong grasping or miss grasping leading to big problems like poor product quality and wrong dispatching, which will decrease the reputation of the companies. For example,(real-life cases) . Vice versa, if a robotic arm has a very good detection accuracy, it will improve its robustness and makes production better quality and increase production speed for saving time to check the production again.

There are some researchers focusing on improving the detection accuracy and published some papers about this. For example(cite papers) However, most of them are focusing on improving the accuracy when occlusion occurs in people detecting or vehicles detecting. There is not a lot researchers focusing on improve the accuracy in the intelligent robotic arms area. The detector not only needs to have a good detection accuracy when target being occluded but also need to have a small volume. A good detector will push the development of intelligent robotic arms and make factories more automatic to accelerate the production and earn more profits.

## 1.3 Proposed Model

This paragraph gives a glimpse on how you modeled (be it physical, mathematical, chemical, simulation, experimentally based, etc.) the problem, states all assumptions you made, and justifies the validity of these assumptions. It specifies whether the problem or model was new and highlights differences from the literature.

## 1.4 Solution Approach, Exciting Outcomes, and Contribution

This is a three-paragraph section.

* The first paragraph explains how you solved the problem and states how your method advanced the state of the art, its strengths and weaknesses, i.e., its limitations.
* The second paragraph presents how you assess the success of your methods (experimental set up, using existing data, generating your own data and how, writing codes, design of your experiment, etc.), and explains why this is the best way to assess your method.
* The third paragraph states the spectacular results you obtained in this project and explains how these results change/impact the science/engineering?

## 1.4 Outline

This project report is organized as follows. Chapter 2 reviews the literature on XXXXXXX. Chapter 3 defines the problem and models it as XXXXXXXXXXX. Chapter 4 describes XXXXsolution approach and methodologyXXXXX. Chapter 5 presents the experimental set and results. Chapter 6 discusses the engineering issues resulting from this research. Finally, Chapter 7 summarizes the research and provides potential future extensions.

**Chapter 2**

# Literature Review

## 2.1 Introduction

This chapter presents a sample of the most pertinent literature related to your problem. Section 2.X surveys methods applied to your problem and its variants whereas Section 2.3 highlights the contributions.

## 2.2 Reviewed Literature

You should review about 10-15 papers. Categorize them. Write a good paragraph about each reference clearly stating the problem it solves, how similar or different it is from yours, their experimental set up and their findings. You can have subheadings to categorize the literature by problem type or solution technique. Before you submit your report, make sure you have updated this section so that it includes any recent papers.

### 2.2.1 Related Problem variants

Alba and Dorronsoro (2004) propose three variants of a cellular GA (cGA), a subclass of GA where each client has five neighbors: itself, its north, south, east and west closest neighbors. XXXXXXXX

Gendreau et al. (1994) apply a multiple restart tabu search for CVRP. Their tabu search explores the generalized insertion algorithm (GENI) and the unstringing stringing routines (US) of Gendreau et al. (1992). GENI is an iterative algorithm that

### 2.2.2 Existing Solution Techniques

Chang and Chen (2007) use a GA to solve VRPTW. Their GA defines the solution as a chromosome whose genes correspond to the routes of the vehicles.

**2.3 Research Gap**

Present a table that lists what has been done and how it is similar/different from your problem/method or how your method extends existing work. See Table 2.1.

If the method you used was never applied to your problem, then Table 2.1 should clearly show that. If it has been used before, clearly state what is new.

Table 2.1: Insights in characteristics of existing distributed flow shop scheduling

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**Chapter 3**

# Problem Statement

## 3.1 Introduction

This paragraph briefly and concisely describes your problem in simple words. It may add a sentence about your model.

## 3.2 Problem Definition

This section defines your problem using the appropriate Engineering/technical language and notation. It must

* help the reader understand where the project comes from;
* set the foundation of the project;
* communicate the purpose, relevance and significance of the project; and
* rely on a literature review and on documentation of the need.

This section presents the main notation within a narrative of the problem. Anyone who reads this section should be able to understand your problem. State the hypotheses you are testing.

## 3.3 XXXXXX Model

Present your model(s), detailing all their elements and justifying your choice of the specific model. Use Figures or equations or other illustration tools. Clearly define your decision variables, objectives, constraints. Explain each equation and its role.

## 

**Chapter 4**

# Methodology

## 4.1 Introduction

A detailed description of the method you used to solve the problem you formulated.

## 4.2 XXXX

Explain in detail the procedure you used to test your hypothesis and achieve your goals.

Give an accurate and complete account of what you did, which algorithms or simulations or experiments you performed. If you used someone else’s code, please indicate whether you made any changes to it and whether you had their permission to use it, or provide appropriate referencing to their work.

This section must

* be self-contained;
* list and justify all assumptions;
* explain rationale for approach;
* be comprehensible by a non-specialist;
* be detailed enough for a specialist;
* enable reproducibility of method -contains detailed information-; and should
* include subheadings.

**Chapter 5**

# Experimental Results

## 4.1 Introduction

This paragraph states the objectives of your experiments and includes an outline of the chapter.

## 5.2 Experimental Set Up

This section states how you collected or generated your data, the sources of any benchmark data, the experimental design set up, the computing environment (machine used, computer coding language, libraries, etc.). Refer to lecture notes of June 2024. Mention that your raw data is in Appendix A, while explaining any assumptions made during measurements and ensuring clear labeling of the raw data and results. Reproducibility of experiments is key in science!

Explain how you benchmark your results (against exact methods, heuristic methods, nature, other chemical/physical experiments, etc.). Validation and comparison are key in science!

## 5.3 Results

Section 5.3 reports the results in the most useful way. Refer to lecture slides on how to best present the results. Present the results in a story like manner, tie them together. Give an unbiased clear statement of your observations and findings.

* Only include information that is relevant to your research problem and hypotheses.
* Use one table or figure per research question.
* A table may be used to present results for more than one question.
* State the research hypotheses/question for which the table/figure is presented. Then, present the evidence (table, figure). Finally, comment on the evidence.

## 5.4 Discussion

Section 5.4 discusses the associations and trends your data reveals.

* Do the results support the hypotheses of the project?
* Are the drawn associations logical?

# Chapter 6

# Professional and Ethical Issues

**6.1: Introduction**

This chapter allows you to demonstrate awareness of your responsibilities as an Engineer and the social, environmental, and ethical context of your work. It is not the same as the ethical approval required for your research method. The introduction explains how your project accounts for environmental, ethical, social, and economic concerns.

**6.2: PESTEL Analysis**

Demonstrate how your designed solution for a complex engineering problem has some originality while it meets a combination of societal, user, business, and customer needs over the entire life of the product or process. Use PESTEL Analysis.

Discuss how your solution(s):

* adopts a holistic approach to the mitigation of security, health and safety risks,
* accounts for diversity, inclusion,
* minimizes adverse cultural, societal, and environmental,
* considers commercial matters,
* abides to codes of practice and industry standards.

Use the following questions as a guideline:

* Why does your project exist? What is the high-level purpose?
* Who is your project for? Who is it not for/excluded?
* Who benefits? Who does not benefit or does not have access?
* What are the key enablers for your project to make it a reality?
* What are the barriers to implementation?
* What are the potential positive impacts of your project (direct and indirect)?
* What are the potential negative impacts of your project (direct and indirect)?
* How does your project account for human behaviour and acceptance?
* How will this impact your project outcome?
* How could your project change behaviour (positive/negative)?
* What are the potential risks of someone misusing your outcome?

**6.3: Ethical Considerations**

How does your solution meet the following?

* **Respect for life, law, the environment and public good** includes cybersecurity and minimisation of adverse effects for own and succeeding generations
* **Data Protection**

**6.4: Inclusive Engineering Outcomes**

Answer the following question.

* Does your solution produce engineering outcomes that consider the perspectives of all stakeholders?
* Does your solution avoid the inclusion of bias and discrimination?
* Does your solution consider future needs and trends?
* Does your solution make outcomes equally accessible to all?
* Does your solution meet any United Nations Sustainable Development Goals?

**6.5: Conclusion**

This paragraph should

* reflect your understanding of the wider Professional responsibilities of Engineers,
* expand the traditional PESTEL analysis to include ethical and inclusive approaches to Engineering, and
* explain how your research supports the UN Sustainable Development Goals.

If your project scope is very specific, abstract a few levels to address these issues in your report.

**Chapter 5**

# Conclusion

The conclusion chapter has at least 1 paragraph and at most 2 paragraphs. The first paragraph is a five-sentence summary (one sentence per bullet point), nicely tied together.

* What problem did the project address and what hypotheses were targeted?
* How was the problem modelled and what makes this model the most appropriate one?
* What approach was applied to verify the hypotheses?
* What was the experimental set up and what were the exciting results obtained?
* What are the implications of your findings?

The second paragraph discusses two points:

* Limitations: which aspects were not tackled? How do these limitations impact the findings and applicability of the results?
* Future extensions of this work.

If the second paragraph is too short, it can be merged with the first.

# References

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Larsen, J. (1999). Parallelization of the vehicle routing problem with time windows (Doctoral dissertation). *Technical University of Denmark, Lyngby, Denmark*.

**Appendix A**

**Raw Data**

**A.1: Computer Code**

Make sure you comment your code.

**A.2: Raw Data**

Make sure your data is clearly labelled.

**A.3: Details Results**

Present these in form of clearly labelled tables.

**A.4: Ethical Approval (if needed)**