

ÉCOLE NATIONALE SUPÉRIEURE DES MINES DE  
SAINT-ÉTIENNE

MASTER'S 1 REPORT

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# Implementation of a robot behavior learning simulator

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in the*

Set of Intelligent Robots Project  
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## Declaration of Authorship

I, Kushagra Singh BISEN, declare that this thesis titled, “Implementation of a robot behavior learning simulator” and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

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Date:

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*“Thanks to my solid academic training, today I can write hundreds of words on virtually any topic without possessing a shred of information, which is how I got a good job in journalism.”*

Dave Barry



ÉCOLE NATIONALE SUPÉRIEURE DES MINES DE SAINT-ÉTIENNE

# *Abstract*

Faculty Name

Institu Henri Fayol, IT and Intelligent Systems department

Master's 1 in Cyber-Physical and Social Systems

**Implementation of a robot behavior learning simulator**

by Kushagra Singh BISEN

The Thesis Abstract is written here (and usually kept to just this page). The page is kept centered vertically so can expand into the blank space above the title too...





## *Acknowledgements*

The acknowledgments and the people to thank go here, don't forget to include your project advisor...



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# List of Abbreviations

**LAH** List Abbreviations **Here**  
**WSF** What (it) Stands For



# Physical Constants

Speed of Light  $c_0 = 2.997\,924\,58 \times 10^8 \text{ m s}^{-1}$  (exact)



# List of Symbols

$a$	distance	m
$P$	power	W (J s <sup>-1</sup> )
$\omega$	angular frequency	rad



*For/Dedicated to/To my...*





## Chapter 1

# Context

### 1.1 Introduction

The work is based on an Industry 4.0 scenario, which is a cyber-physical environment consisting of various different actors and objects involved. The different actors involved are either stationary or mobile. Moreover, complexity of the environment increases when we account for heterogeneous actors with various decision making capabilities. Robots with various manufacturers present various transform frames, different software and sensors. Due to the heterogeneous nature of the robots involved, we can not depend on information we receive from the robot, as this particular information will differ from a robot to other based upon it's configuration. The problem is solved by creating a digital twin which records the information of the environment as well as the robot. The simulator notes the state of the robot and obstacles it surrounds as it passes through the obstacle grid.

#### 1.1.1 Motivation

The structure of a dynamic Industry 4.0 environment is highly volatile, the structure is defined through a stationary frame that has been declared before. The decision making capabilities of the robot to navigate the environment while avoiding obstacles and other robots can have a great impact on the performance and the utility of the environment.



## **Chapter 2**

# **Technologies Implemented**

### **2.1 Introduction**



## Appendix A

# Frequently Asked Questions

### A.1 How do I change the colors of links?

The color of links can be changed to your liking using:

```
\hypersetup{urlcolor=red}, or  
\hypersetup{citecolor=green}, or  
\hypersetup{allcolor=blue}.
```

If you want to completely hide the links, you can use:

```
\hypersetup{allcolors=.}, or even better:  
\hypersetup{hidelinks}.
```

If you want to have obvious links in the PDF but not the printed text, use:

```
\hypersetup{colorlinks=false}.
```