

Contents

General Index	xvii
List of Figures	xxiii
List of Tables	xxx
I Foundation	1
1 Introduction	2
1.1 Motivation	3
1.2 Aims and Objectives	4
1.2.1 Aims	4
1.2.2 Objectives	4
1.3 Thesis Outline	5
1.4 Related Research Activities	6
1.4.1 Publications in Journals	7
1.4.2 Publications in Conferences	7

1.4.3 Research Project	8
2 State of the Art	9
2.1 Autonomy	9
2.2 Automated Planning	11
2.2.1 Planning Models and Modelling Languages	11
2.2.2 The PDDL Representation and Versions	14
2.2.3 Planning Systems	19
2.3 Plan Execution Monitoring	23
2.4 Survival of the Agent, Failures and Opportunities	25
2.5 Knowledge Representation	31
2.5.1 Knowledge Representation Forms	32
2.5.2 Ontologies	34
2.5.3 Ontologies and Autonomous Agents	35
2.5.4 Ontologies and Planning	38
2.6 Additional Prevalent Challenges in State-of-the-Art and the Thesis' Re- sponsive Strategies	41
2.6.1 Additional Prevalent Challenges from the State-of-the-Art	41
2.6.2 The Author's Approach to the Challenges	42
II Contributions	45
3 System Architecture	46
3.1 Problem Formalisation	47
3.1.1 Planning Formalisation	48
3.1.2 Knowledge Formalisation	50

3.2 Problem Description	51
3.3 Method Description	53
3.4 Framework Overview	56
3.5 Chapter Summary	59
4 An Intelligent System for Execution Simulation in a Dynamic Environment	60
4.1 Background	61
4.2 Design Decisions	63
4.2.1 Bespoke vs Off-the-shelf	63
4.2.2 Single-agent vs Multi-agent Re/Planning and Execution	66
4.3 System Architecture	67
4.4 Planning Module	70
4.5 Simulator	72
4.5.1 Timed Event Simulation: the Timeline	73
4.5.2 Plan Execution Simulation	75
4.5.3 Reformulating the Planning Problem	76
4.5.4 Monitoring Preferences and State Trajectory Constraints	79
4.5.5 Graphical User Interface	81
4.6 Conclusion	83
5 Context-aware Knowledge Acquisition for Planning Applications	85
5.1 Introduction	88
5.2 Background	91

5.3 Overview of the Approach	93
5.4 Context-aware Knowledge Acquisition for Planning Applications using Ontologies	97
5.5 Ontology-based operations.	103
5.5.1 Preliminary OWL Ontological Representation.	103
5.5.2 Augmentation of Classes using ConceptNet	104
5.5.3 Vector Space Model Similarity Measure	106
5.5.4 Extended OWL representation.	107
5.5.5 A Tailored Semantic Similarity Measure for planning dynamics	107
5.6 Selecting the Ontology with the Highest Semantic Insight	111
5.6.1 Alignment with neighbourhood constraint.	113
5.7 Discussion and Future Work.	114
5.8 Conclusion	116
6 Plan Commitment Repair	117
6.1 Introduction	120
6.2 Related Work.	123
6.3 Plan Commitment.	128
6.3.1 Plan Commitment as a Distance	130
6.3.2 The Value of Plan Commitment	134
6.4 Plan Repair through Plan Commitment	144
6.4.1 Working Scheme of C-TFLAP.	146
6.4.2 Heuristic Evaluation Directed by the Commitment Distance	148
6.4.3 Two Queues based Search	149
6.5 Experimental Evaluation and Discussion	153
6.5.1 Setup of Experiments	153

6.5.2	Brief Description of the Test Domains	154
6.5.3	The Experiments	155
6.5.4	Discussion	158
6.6	Extensibility and Future Work	170
6.7	Conclusion	175
III	Conclusions and Future Work	177
7	Conclusions and Future Work	178
7.1	Introduction	178
7.2	Conclusions	180
7.2.1	Brief Summary of the Proposed Approach	181
7.2.2	Brief Summary of the Thesis Contributions	182
7.3	Future Lines of Research	184
IV	Appendices	188
Appendices		189
A	Appendix Case Study: Tourist Assistant	190
A.1	Planning Module	191
A.1.1	Initial State	191
A.1.2	Goals and Preferences	192
A.1.3	Actions	193
A.2	Valencia Tour	197

A.3 Conclusion	202
B Appendix Case Study: Context-aware Knowledge Acquisition for Planning Applications	204
B.1 A Repairing Agency Application	205
B.1.1 The Planning Task	205
B.1.2 Execution Simulation and Context-aware Knowledge Acquisition	208
B.2 A Tourist Assistant Application	217
B.2.1 The Planning Task	217
B.2.2 Execution Simulation and Context-aware Knowledge Acquisition	223
B.3 Conclusion	228
C Appendix Case Study: Assisted Living Homes	230
C.1 Introduction	231
C.2 Related Work.	234
C.3 Concept Design of the AL Environment	235
C.4 Planning Task of the AL Concept Design	237
C.5 Proposed methodology	239
C.6 System details	243
C.6.1 Stress Detection and Emotions Recognition.	243
C.6.2 Semantic Knowledge Augmentation and Types Learning	247
C.6.3 Learning objects	250
C.6.4 Planning, Acting, Failure Detection, and Monitoring	251
C.7 Validation	253
C.7.1 Validity of Behaviour of the System.	253
C.7.2 Validation of Stress Detection	258

C.7.3 Validation of Emotions Recognition	259
C.7.4 Validation of Objects Classification	260
C.8 Discussion.	262
C.9 Conclusion	265
References	267
Acronyms	303