

Contents

List of Contributors xv

Preface xix

Profile of Editors xxvii

Acknowledgments xxx

1 Dynamic Key-based Biometric End-User Authentication Proposal for IoT in Industry 4.0 1

Subhash Mondal, Swapnoy Banerjee, Soumodipto Halder, and Diganta Sengupta

- 1.1 Introduction 1
- 1.2 Literature Review 2
- 1.3 Proposed Framework 5
 - 1.3.1 Enrolment Phase 5
 - 1.3.2 Authentication Phase 7
 - 1.3.2.1 Pre-processing 7
 - 1.3.2.2 Minutiae Extraction and False Minutiae Removal 12
 - 1.3.2.3 Key Generation from extracted Minutiae points 13
 - 1.3.2.4 Encrypting the Biometric Fingerprint Image Using AES 14
- 1.4 Comparative Analysis 18
- 1.5 Conclusion 19
- References 19

2 Decision Support Methodology for Scheduling Orders in Additive Manufacturing 25

Juan Jesús Tello Rodríguez and Lopez-I Fernando

- 2.1 Introduction 25
- 2.2 The Additive Manufacturing Process 26
- 2.3 Some Background 28
- 2.4 Proposed Approach 30

2.4.1	A Mathematical Model for the Initial Printing Scheduling	32
2.4.1.1	Considerations	32
2.4.1.2	Sets	32
2.4.2	Parameters	33
2.4.2.1	Orders	33
2.4.2.2	Parts	33
2.4.2.3	Printing Machines	33
2.4.2.4	Process	33
2.4.3	Decision Variables	33
2.4.4	Optimization Criteria	33
2.4.5	Constrains	34
2.5	Results	35
2.5.1	Orders	35
2.6	Conclusions	39
	References	39
3	Significance of Consuming 5G-Built Artificial Intelligence in Smart Cities	43
	<i>Y. Bevish Jinila, Cinthia Joy, J. Joshua Thomas, and S. Prayla Shyry</i>	
3.1	Introduction	43
3.2	Background and Related Work	47
3.3	Challenges in Smart Cities	49
3.3.1	Data Acquisition	49
3.3.2	Data Analysis	50
3.3.3	Data Security and Privacy	50
3.3.4	Data Dissemination	50
3.4	Need for AI and Data Analytics	50
3.5	Applications of AI in Smart Cities	51
3.5.1	Road Condition Monitoring	51
3.5.2	Driver Behavior Monitoring	52
3.5.3	AI-Enabled Automatic Parking	53
3.5.4	Waste Management	53
3.5.5	Smart Governance	53
3.5.6	Smart Healthcare	54
3.5.7	Smart Grid	54
3.5.8	Smart Agriculture	55
3.6	AI-based Modeling for Smart Cities	55
3.6.1	Smart Cities Deployment Model	55
3.6.2	AI-Based Predictive Analytics	57
3.6.3	Pre-processing	58
3.6.4	Feature Selection	58

3.6.5	Artificial Intelligence Model	58
3.7	Conclusion	60
	References	60

4 Neural Network Approach to Segmentation of Economic Infrastructure Objects on High-Resolution Satellite Images 63

Vladimir A. Kozub, Alexander B. Murynin, Igor S. Litvinchev, Ivan A. Matveev, and Pandian Vasant

4.1	Introduction	63
4.2	Methodology for Constructing a Digital Terrain Model	64
4.3	Image Segmentation Problem	65
4.4	Segmentation Quality Assessment	67
4.5	Existing Segmentation Methods and Algorithms	68
4.6	Classical Methods	69
4.7	Neural Network Methods	72
4.7.1	Semantic Segmentation of Objects in Satellite Images	74
4.8	Segmentation with Neural Networks	76
4.9	Convolutional Neural Networks	79
4.10	Batch Normalization	83
4.11	Residual Blocks	84
4.12	Training of Neural Networks	85
4.13	Loss Functions	85
4.14	Optimization	86
4.15	Numerical Experiments	88
4.16	Description of the Training Set	88
4.17	Class Analysis	90
4.18	Augmentation	90
4.19	NN Architecture	92
4.20	Training and Results	93
4.21	Conclusion	97
	Acknowledgments	97
	References	97

5 The Impact of Data Security on the Internet of Things 101

Joshua E. Chukwuere and Boitumelo Molefe

5.1	Introduction	101
5.2	Background of the Study	102
5.3	Problem Statement	103
5.4	Research Questions	103
5.5	Literature Review	103

5.5.1	The Data Security on IoT	103
5.5.2	The Security Threats and Awareness of Data Security on IoT	105
5.5.3	The Different Ways to Assist with Keeping Your IoT Device Safer from Security Threats	105
5.6	Research Methodology	106
5.6.1	Population and Sampling	106
5.6.2	Data Collection	107
5.6.3	Reliability and Validity	108
5.7	Chapter Results and Discussions	108
5.7.1	The Demographic Information	109
5.7.1.1	Age, Ethnic Group, and Ownership of a Smart Device	109
5.7.2	Awareness of Users About Data Security of the Internet of Things	109
5.7.3	The Security Threats that are Affecting the Internet of Things Devices	111
5.7.3.1	The Architecture of IoT Devices	112
5.7.3.2	The botnets Attack	112
5.7.4	The Effects of Security Threats on IoT Devices that are Affecting Users	112
5.7.4.1	The Slowness or Malfunctioning of the IoT Device	112
5.7.4.2	The Trust of Users on IoT	113
5.7.4.3	The Safety of Users	113
5.7.4.4	The Guaranteed Duration of IoT Devices	114
5.7.5	Different Ways to Assist with Keeping IoT Smart Devices Safer from Security Threats	114
5.7.5.1	The Change Default Passwords	114
5.7.5.2	The Easy or Common Passwords	114
5.7.5.3	On the Importance of Reading Privacy Policies	114
5.7.5.4	The Bluetooth and Wi-Fi of IoT Devices	115
5.7.5.5	The VPN on IoT	115
5.7.5.6	The Physical Restriction	115
5.7.5.7	Two-Factor Authentication	116
5.7.5.8	The Biometric Authentication	116
5.8	Answers to the Chapter Questions	116
5.8.1	Objective 1: Awareness on Users About Data Security of Internet of Things (IoT)	116
5.8.2	Objective 2: Determine the Security Threats that are Involved in the Internet of Things (IoT)	117
5.8.3	Objective 3: The Effects of Security Threats on IoT Devices that are Affecting Users	117
5.8.4	Objective 4: Different Ways to Assist with Keeping IoT Devices Safer from Security Threats	117

5.8.5	Other Descriptive Analysis (Mean)	118
5.8.5.1	Mean 1 – Awareness on Users About Data Security on IoT	118
5.8.5.2	The Effects of Security Threats on IoT Devices that are Affecting Users	118
5.8.5.3	Different Ways to Assist with Keeping an IoT Device Safer	122
5.9	Chapter Recommendations	122
5.10	Conclusion	122
	References	124

6 Sustainable Renewable Energy and Waste Management on Weathering Corporate Pollution

Choo K. Chin and Deng H. Xiang

6.1	Introduction	129
6.2	Literature Review	131
6.2.1	Energy Efficiency	135
6.2.2	Waste Minimization	136
6.2.3	Water Consumption	137
6.2.4	Eco-Procurement	137
6.2.5	Communication	138
6.2.6	Awareness	138
6.2.7	Sustainable and Renewable Energy Development	138
6.3	Conceptual Framework	139
6.4	Conclusion	139
6.4.1	Energy Efficiency	140
6.4.2	Waste Minimization	140
6.4.3	Water Consumption	140
6.4.4	Eco-Procurement	141
6.4.5	Communication	141
6.4.6	Sustainable and Renewable Energy Development	141
	Acknowledgment	142
	References	142

7 Adam Adaptive Optimization Method for Neural Network Models Regression in Image Recognition Tasks

Denis Y. Nartsev, Alexander N. Gneushev, and Ivan A. Matveev

7.1	Introduction	147
7.2	Problem Statement	149
7.3	Modifications of the Adam Optimization Method for Training a Regression Model	151
7.4	Computational Experiments	155
7.4.1	Model for Evaluating the Eye Image Blurring Degree	155

7.4.2	Facial Rotation Angle Estimation Model	158
7.5	Conclusion	160
	Acknowledgments	161
	References	161

8 **Application of Integer Programming in Allocating Energy Resources in Rural Africa** 165

Elias Manopo

8.1	Introduction	165
8.1.1	Applications of the QAP	165
8.2	Quadratic Assignment Problem Formulation	166
8.2.1	Koopmans–Beckmann Formulation	166
8.3	Current Linearization Technique	167
8.3.1	The General Quadratic Binary Problem	167
8.3.2	Linearizing the Quadratic Binary Problem	169
8.3.2.1	Variable Substitution	169
8.3.2.2	Justification	169
8.3.3	Number of Variables and Constraints in the Linearized Model	170
8.3.4	Linearized Quadratic Binary Problem	171
8.3.5	Reducing the Number of Extra Constraints in the Linear Model	171
8.3.6	The General Binary Linear (BLP) Model	171
8.3.6.1	Convex Quadratic Programming Model	172
8.3.6.2	Transforming Binary Linear Programming (BLP) Into a Convex/Concave Quadratic Programming Problem	172
8.3.6.3	Equivalence	173
8.4	Algorithm	174
8.4.1	Making the Model Linear	175
8.5	Conclusions	176
	References	176

9 **Feasibility of Drones as the Next Step in Innovative Solution for Emerging Society** 179

Sadia S. Ali, Rajbir Kaur, and Haidar Abbas

9.1	Introduction	179
9.1.1	Technology and Business	181
9.1.2	Technological Revolution of the Twenty-first Century	181
9.2	An Overview of Drone Technology and Its Future Prospects in Indian Market	182
9.2.1	Utilities	183
9.2.1.1	Delivery	183
9.2.1.2	Media/Photography	183

9.2.1.3	Agriculture	184
9.2.1.4	Contingency and Disaster Management Scenarios	184
9.2.1.5	Civil and Military Services: Search and Rescue, Surveillance, Weather, and Traffic Monitoring, Firefighting	185
9.2.2	Complexities Involved	185
9.2.3	Drones in Indian Business Scenario	186
9.3	Literature Review	187
9.3.1	Absorption and Diffusion of New Technology	188
9.3.2	Leadership for Innovation	188
9.3.3	Social and Economic Environment	189
9.3.4	Customer Perceptions	190
9.3.5	Alliances with Other National and International Organizations	190
9.3.6	Other Influencers	191
9.4	Methodology	191
9.5	Discussion	193
9.5.1	Market Module	195
9.5.2	Technology Module	196
9.5.3	Commercial Module	198
9.6	Conclusions	199
	References	200

10	Designing a Distribution Network for a Soda Company: Formulation and Efficient Solution Procedure	209
	<i>Isidro Soria-Arguello, Rafael Torres-Esobar, and Pandian Vasant</i>	
10.1	Introduction	209
10.2	New Distribution System	211
10.3	The Mathematical Model to Design the Distribution Network	214
10.4	Solution Technique	216
10.4.1	Lagrangian Relaxation	216
10.4.2	Methods for Finding the Value of Lagrange Multipliers	216
10.4.3	Selecting the Solution Method	216
10.4.4	Used Notation	217
10.4.5	Proposed Relaxations of the Distribution Model	218
10.4.5.1	Relaxation 1	218
10.4.5.2	Relaxation 2	219
10.4.6	Selection of the Best Lagrangian Relaxation	219
10.5	Heuristic Algorithm to Restore Feasibility	220
10.6	Numerical Analysis	222
10.6.1	Scenario 2020	223
10.6.2	Scenario 2021	224
10.6.3	Scenario 2022	225

10.6.4	Scenario 2023	226
10.7	Conclusions	228
	References	228

11 Machine Learning and MCDM Approach to Characterize Student Attrition in Higher Education 231

Arrieta-M Luisa F and Lopez-I Fernando

11.1	Introduction	231
11.1.1	Background	232
11.2	Proposed Approach	233
11.3	Case Study	234
11.3.1	Intelligent Phase	234
11.3.2	Design Phase	235
11.3.3	Choice Phase	236
11.4	Results	238
11.5	Conclusion	240
	References	240

12 A Concise Review on Recent Optimization and Deep Learning Applications in Blockchain Technology 243

Timothy Ganesan, Irraivan Elamvazuthi, Pandian Vasant, and J. Joshua Thomas

12.1	Background	243
12.2	Computational Optimization Frameworks	246
12.3	Internet of Things (IoT) Systems	248
12.4	Smart Grids Data Systems	250
12.5	Supply Chain Management	252
12.6	Healthcare Data Management Systems	255
12.7	Outlook	257
	References	258

13 Inventory Routing Problem with Fuzzy Demand and Deliveries with Priority 267

Paulina A. Avila-Torres and Nancy M. Arratia-Martinez

13.1	Introduction	267
13.2	Problem Description	270
13.3	Mathematical Formulation	273
13.4	Computational Experiments	275
13.4.1	Numerical Example	276
13.4.1.1	The Inventory Routing Problem Under Certainty	279

- 13.4.1.2 The Inventory Routing Problem Under Uncertainty in the Consumption Rate of Product 279
- 13.5 Conclusions and Future Work 280
- References 281

14 Comparison of Defuzzification Methods for Project Selection 283

Nancy M. Arratia-Martinez, Paulina A. Avila-Torres, and Lopez-I Fernando

- 14.1 Introduction 283
- 14.2 Problem Description 286
- 14.3 Mathematical Model 286
- 14.3.1 Sets and Parameters 287
- 14.3.2 Decision Variables 287
- 14.3.3 Objective Functions 287
- 14.4 Constraints 288
- 14.5 Methods of Defuzzification and Solution Algorithm 289
- 14.5.1 k -Preference Method 289
- 14.5.2 Integral Value 291
- 14.5.3 SAUGMECON Algorithm 291
- 14.6 Results 292
- 14.6.1 Results of k -Preference Method 292
- 14.6.2 Results of Integral Value Method 295
- 14.7 Conclusions 299
- References 300

15 Re-Identification-Based Models for Multiple Object Tracking 303

Alexey D. Grigorev, Alexander N. Gneushev, and Igor S. Litvinchev

- 15.1 Introduction 303
- 15.2 Multiple Object Tracking Problem 305
- 15.3 Decomposition of Tracking into Filtering and Assignment Tasks 306
- 15.4 Cost Matrix Adjustment in Assignment Problem Based on Re-Identification with Pre-Filtering of Descriptors by Quality 310
- 15.5 Computational Experiments 313
- 15.6 Conclusion 315
- Acknowledgments 315
- References 316

Index 319