# Table of Content

PREFACE........................................................................................................................................... v
EDITOR............................................................................................................................................... vi

**SECTION 1: INTELLIGENT CONTROL SYSTEM ................................................................. 5**

Chapter 1 ........................................................................................................................................ 6
*Working Principle and Operating Mode of Atomic Force Microscopy*
Iskandar Al-Thani Mahmood

Chapter 2 ......................................................................................................................................... 13
*Design and Development of controller of Active Power Filter for Industrial Usage part 1*
M.M.Rashid\(^1\), N.A.Ramin\(^2\) and Zahurul\(^2\)

Chapter 3 ....................................................................................................................................... 21
*Design and Development of controller of Active Power Filter for Industrial Usage part 2*
M.M.Rashid\(^1\), N.A.Ramin\(^3\) and Zahurul \(^2\)

Chapter 4 ....................................................................................................................................... 30
*Design and Implementation of Instant Noodles Vending Machine*
M.M.Rashid

Chapter 5 ....................................................................................................................................... 39
*Development of Intelligent Belt Conveyor System (Part 1)*
M. M. Rashid, Faruok Alliays

Chapter 6 ....................................................................................................................................... 45
*Development of Intelligent Belt Conveyor System*
M.M.Rashid, Faruk, M J E Salami

Chapter 7 ....................................................................................................................................... 50
*Anti Skid Control System, A Tutorial*
M. J. E. Salami, A. M. Aibinu, A. F. Salami and Mohd Sofian Bin Basrah

Chapter 8 ....................................................................................................................................... 54
*Design and Prototyping of Inertia Wheel*

Chapter 9 ....................................................................................................................................... 62
*Control of Automatic Drilling Machine by PLC*
Md Mozasser Rahman, Najiah Md Zain @Abdul Rahman and Mohd Syazwan Bin Jamil

Chapter 10 ..................................................................................................................................... 74
*Automatic Storage and Retrieval System*
Abdul Kadir Abdul Jabar Abdul Kadir, M. J. E. Salami and A. M. Aibinu

Chapter 11 ..................................................................................................................................... 80
*Control of Unmanned Underwater Vehicle*
Raisuddin Khan\(^1\),\(^2\), Faried Hasbullah\(^2\) and Masum Billah\(^3\),\(^e\)

Chapter 12 ..................................................................................................................................... 85
Adaptive Sliding Mode Control for 3dof Helicopter
Mostafa A. Hamood¹, Rini Akmeiawati²

Chapter 13 ........................................................................................................................................... 93

Backstepping Control of an Autonomous Quadrotor
Norafizah Abas¹, Rini Akmeiawati²

Chapter 14 ........................................................................................................................................... 103

Piezoelectric Tube Scanner in Atomic Force Microscope
Iskandar Al-Thani Mahmood

SECTION II: INTELLIGENT CONTROL SYSTEM DESIGN ................................................................. 111

Chapter 15 ........................................................................................................................................... 112

A Review on Control of Two-Wheeled Wheelchair System
Salmiah Ahmad¹, M. O. Tokhi²

Chapter 16 ........................................................................................................................................... 121

A Smart Car Surveillance System using Programmable Logic Controller (PLC)
Siti Fauziah Tohao and Mohammad Zafran Haja Mohideen

Chapter 17 ........................................................................................................................................... 128

Design of Controller for Elevator Group Using Fuzzy Logic Part 1
M.M.Rashid, Azhar

Chapter 18 ........................................................................................................................................... 133

Design of Controller for Elevator Group Using Fuzzy Logic Controller Part 2
M.M.Rashid, Azhar

Chapter 19 ........................................................................................................................................... 139

Fuzzy Logic-based Intelligent Control of Flexible Link Manipulator
Ismaila B. Tijani and Rini Akmeiawati

Chapter 20 ........................................................................................................................................... 148

EEG based robot control
A. Khorshidtalab and M. J. E. Salami

Chapter 21 ........................................................................................................................................... 158

Visual-Based Intelligent Solar Tracking System
Rini Akmeiawati*, Samir A. Abdul Kareem, Riza Muhida

SECTION III: INTELLIGENT SYSTEM DESIGN ............................................................................... 172

Chapter 22 ........................................................................................................................................... 173

Intelligent Air-conditioning System
Amir A. Shafie, Raisuddin Khan, H. Al-haieaid M. Ebrahim

Chapter 23 ........................................................................................................................................... 179

An Intelligent Car Surveillance System: Design and Tools Selection
Siti Fauziah Toha’ and Mohammad Zafran Haja Mohideen

Chapter 24 ........................................................................................................................................... 185

Automatic Pipe Bursting Monitoring System
M. J. E Salami, Syed Ahmed @ Hla Moe Win
Chapter 37 ............................................................................................................................... 292
Kernel PCA – An Introduction
Hamza Baali¹,², Momoh-Jimoh Eyiomika Salami³,², Rini Akmelawati³,²

Chapter 38 ............................................................................................................................... 297
System Modelling of a Twin rotor System: Time and Frequency Domain Analysis
Siti Fauziah Toha¹ and M. O. Tokhi²,³

Chapter 39 ............................................................................................................................... 304
System Identification Technique for a Helicopter Using Genetic Algorithms
Siti Fauziah Toha¹,² and M. O. Tokhi²,³

Chapter 40 ............................................................................................................................... 311
Advanced Noise Removal Techniques for the Detection of EMG Signal
Md. Rezwanul Ahsan¹,², Muhammad Ibn Ibrahimy³,² and Othman Omran Khalifa³,²

Chapter 41 ............................................................................................................................... 322
Active suspension system: Part 1 - Mathematical Modelling
Aiman O. Bajaber¹, Asan G. A. Muthalif³, Ayman S.I. Elzubair³

Chapter 42 ............................................................................................................................... 327
Active Suspension System: Part 2 - Controller Design and Simulation
Aiman S.I. Elzubair¹, Asan G. A. Muthalif³, Aiman O. Bajaber³

Chapter 43 ............................................................................................................................... 332
Book Shelving Robotics
M. J. E. Salami¹,², Mohd Farid Md Alias³,², Nurul Izzah Sidek³,², Mohamed Mousa³,²

Chapter 44 ............................................................................................................................... 337
Model Structure and Random Input for System Identification Technique for Flexible Manipulating System
Siti Fauziah Toha¹,² and M. O. Tokhi²,³

Chapter 45 ............................................................................................................................... 344
Fault Tree Analysis, A case study of a simple Line Following Robot
Abiodun Musa Aibinu, Haaris Ahmad Quadri, Mu Ham Mach A Mine, Almehmadi Tarig Saeed S. And Hamide Roehimah

Chapter 46 .................................................................................................................................. 351
Review of Malaysian Traffic Summon and Payment system
A. M. Aibinu, Sharifah Nadiah bt Syed Mohammad, Wan Nur Faezah bin Wan Azmi
Chapter 10
Automatic Storage and Retrieval System

Abdul Kadir Abdul Jabar Abdul Kadir, M. J. E. Salami and A. M. Abinu
Intelligent Mechatronics System Research Group
Department of Mechatronics Engineering, International Islamic University Malaysia.
P O. Box 10 50728, Kuala Lumpur, Malaysia
E-mail : maibinu@iium.edu.my

10.1 Introduction
The topic of relative capabilities of the human and the machines has been in the literature for over 4 decades, but the topic was an idle one in the early years because machines were absolutely poor competitors of human functions. That is not the case today. The digital computers, and the field of artificial intelligence and robotics nurtured by it, have developed machines that are competitors with some human’s functions; the topic is no longer idle. The 21st century is indeed the era of the powerful working machines. Artificial intelligence is a discipline that develops machines which simulate functions that we associate with intelligent human behavior. Some references and scholars defines industrial robots as “reprogrammable, multi-functional manipulators designed to move parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks.” [1].

Introduction of new automation has shifted human role to monitoring exception handler, and manager of automated resources. But only some of these anticipated benefits of automation have, in fact, materialized- primarily those related to the improved precision and economy of operations- i.e., those aspects of system operation that do not involve much interaction between human and machine [2]. Other expectations were not met, and unanticipated difficulties were observed. These problems are primarily associated with the fact that even highly automated systems still require operator involvement and therefore communication and coordination between human and machine. It is a primary object of the present project to provide an automatic intelligent mail- processing device with full function. The operations thereof are completely computerized and adapted to cooperate with peripheral equipments such as RFID (Radio Frequency Identification) readers and tags, remote controlled robot, and key board assembly, etc. beside the mail receiving operation, the present device can sort the mails according to its destination and type, which enables the post officers to easily identify the location of a particular mail at the mail storage as well as trace any missing or lost mails.

The present project relates to the post office retrieving and restoring system that performs, in succession, the task of quickly identifying then retrieving individual mails desired by post office staff from among many mails arranged on the mail conveyor at the post office, and then sorting them in mail storage locations according to its destination and type one at a time, securely placing each mail in its proper section location. This project also relates to an intelligent automatic post office system incorporating such a robotic arm in a configuration that is fully compatible with the existing mail stores most commonly used in post offices today.