

ELECTRICAL AUTOMATION SYSTEMS TOWARDS INTELLIGENT AND ENERGY EFFICIENCY APPLICATIONS

Musse Mohamud Ahmed



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

ELECTRICAL AUTOMATION SYSTEMS
TOWARDS
INTELLIGENT AND ENERGY EFFICIENCY
APPLICATIONS

Musse Mohamud Ahmed

Electrical and Computer Engineering Department,
The Faculty of Engineering, IIUM



IIUM Press

Published by:
IUM Press
International Islamic University Malaysia

First Edition, 2011
© IUM Press, IUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

ISBN: 978-967-418-170-3

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

CONTENTS OF THE BOOK

<u>Chapter</u>	<u>Title & Author</u>	<u>Page No</u>
PART I: ELECTRICAL DISTRIBUTION AUTOMATION SYSTEMS		
CHAPTER 1:	ELECTRICAL DISTRIBUTION SYSTEM Musse Mohamud Ahmed and Soo Wai Lian	2
CHAPTER 2:	ELECTRIC DISTRIBUTION EQUIPMENT FAULTS..... Musse Mohamud Ahmed and Soo Wai Lian	6
CHAPTER 3:	FAULTS FROM TRADITIONAL TO AUTOMATION TECHNIQUES..... Musse Mohamud Ahmed and Soo Wai Lian	15
CHAPTER 4:	SCADA SYSTEM FOR ELECTRICAL DISTRIBUTION SYSTEM..... Musse Mohamud Ahmed and Soo Wai Lian	22
CHAPTER 5:	SCADA SOFTWARE DEVELOPMENT–INDUSOFT CASE STUDY..... Musse Mohamud Ahmed and Soo Wai Lian	25
CHAPTER 6:	PROTECTION SYSTEM FOR ELECTRICAL DISTRIBUTION..... Musse Mohamud Ahmed and Soo Wai Lian	37
CHAPTER 7:	RELAYS..... Musse Mohamud Ahmed and Soo Wai Lian	43
CHAPTER 8:	REMOTE TERMINAL UNIT (RTU)..... Musse Mohamud Ahmed and Soo Wai Lian	49
CHAPTER 9:	INTELLIGENT AUTOMATION SYSTEM: AUTOMATION HARDWARE DEVELOPMENT Musse Mohamud Ahmed and Soo Wai Lian	60
CHAPTER 10:	SCHEMATIC DIAGRAMS OF AUTOMATED SUBSTATION PANELS..... Musse Mohamud Ahmed and Soo Wai Lian	69
CHAPTER 11:	SOFTWARE AUTOMATION DEVELOPMENT Musse Mohamud Ahmed and Soo Wai Lian	78
CHAPTER 12:	DEVELOPMENT OF MODBUS TCP/IP SETTING Musse Mohamud Ahmed and Soo Wai Lian	87
CHAPTER 13:	POWER LINE CARRIER COMMUNICATION SYSTEM..... Musse Mohamud Ahmed and Soo Wai Lian	96
CHAPTER 14:	WIRELESS COMMUNICATIONS FOR ELECTRIC SYSTEM AUTOMATION..... Othman O. Khalifa and Musse Mohamud Ahmed	103
CHAPTER 15:	DEVELOPMENT OF AUTOMATION SYSTEM FOR SMALL/MEDIUM	

SCALE BIOMASS BASED RENEWABLE POWER PLANTS	108
Musse Mohamud Ahmed and Sheroz Khan	

<u>Chapter</u>	<u>Title & Author</u>	<u>Page No</u>
----------------	---------------------------	----------------

PART II: INTELLIGENT SYSTEMS USING COMMUNICATION AND ELECTRONICS SYSTEMS

CHAPTER 16:	MODELING OF LOW VOLTAGE POWER LINE FOR DATA COMMUNICATION: SIMULATION RESULTS	118
	Amar Hazwani Binti Radzi, Wisatawati Darwis Harahap, Sheroz Khan, Musse Mohamud Ahmed and Khaizuran Abdullah	
CHAPTER 17:	LOW VOLTAGE POWERLINE ANALYSIS AND SIMULATION RESULTS.....	125
	Amar Hazwani Binti Radzi, Wisawati Darwis Harahap, Sheroz Khan, Musse Mohamud Ahmed and Khaizuran Abdullah.	
CHAPTER 18:	ZIGBEE APPLICATIONS TO WIRELESS COMMUNICATION SYSTEMS	133
	Hikma Shabani, Musse Mohamud Ahmed, Sheroz Khan and Rashid A. Saeed	
CHAPTER 19:	MODELING OF AN ENVIRONMENT FRIENDLY HYBRID ELECTRIC VEHICLE (HEV).....	138
	Musse Mohamud Ahmed, M. Habib Ullah, Teddy S. Gunawan, M. Raihan Sharif and Riza Muhida	
CHAPTER 20:	PIC 16F877A FOR HYBRID VEHICLE CONTROLLER	144
	Musse Mohamud Ahmed, M. Habib Ullah, Teddy S. Gunawan, M. Raihan Sharif, and Riza Muhida	
CHAPTER 21:	FPGA-BASED HARDWARE MODELING OF LIGHT RAIL TRANSIT FARE CARD CONTROLLER	155
	Musse Mohamud Ahmed, M. Raihan Sharif and M. Habib Ullah	
CHAPTER 22:	DEVELOPMENT OF A METHOD TO MAINTAIN TEMPERATURE AND HUMIDITY IN AN OPEN COMPOUND RESTAURANT	166
	M. Raihan Sharif and M. Habib Ullah, Musse Mohamud Ahmed	

PART III: ENERGY EFFICIENCY APPLICATIONS TO ELECTRIC MOTORS AND FAN MOTORS

CHAPTER 23:	ELECTRIC MOTOR	176
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	
CHAPTER 24:	LOSSES OF ELECTRIC MOTORS	180
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	
CHAPTER 25:	ELECTRIC MOTOR EFFICIENCY	185
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi	

and Che Fazilah Bt Fathil

CHAPTER 26:	ENERGY EFFICIENCY IMPLEMENTATION OF PERMANENT MAGNET SYNCHRONOUS MOTOR.....	191
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	

<u>Chapter</u>	<u>Title & Author</u>	<u>Page No</u>
CHAPTER 27:	ENERGY CALCULATIONS.....	195
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	
CHAPTER 28:	MODELING, RESULT AND ANALYSIS	203
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	
CHAPTER 29:	AIR BLOWING EQUIPMENT	210
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 30:	ENERGY USAGE IN MALAYSIA.....	214
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 31:	FAN MOTOR EFFICIENCY REQUIREMENT.....	217
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 32:	APPLICATION OF FAN MOTOR ENEGY EFFICIENCY.....	220
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 33:	FAN EFFICIENCY GRADE (FEG) DEVELOPMENT STAGES.....	223
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 34:	FEG AND FMEG PRACTICAL CONSIDERATIONS - FAN SELECTIONS GUIDE	227
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 35:	RESULTS AND DISCUSSIONS.....	232
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	

CHAPTER 10

SCHEMATIC DIAGRAMS OF AUTOMATED SUBSTATION PANELS

Musse Mohamud Ahmed and Soo Wai Lian

*Department of Electrical and Computer Engineering, Faculty of Engineering
International Islamic University Malaysia*

10.1 Introduction

Chapter 10 discusses about the schematic/wiring diagrams of the substation panels. Automation system has been developed on these two panels. The automation consists of remote terminal unit, digital input/out devices, serial communication, communication system, operating switches, relays and others. Figure 10.1 shows the service substation panel schematic diagram. 415V power supply is supplied to the service substation panel. MK2200 relays are connected to I-7042 module (RTU Controller) as digital input signal. MK2200 relay is connected to the current transformers to provide protection to feeders and perform readings for the current values. In this chapter, all hardware parts connected to both service and customer stations are presented in schematic diagram form. All wiring diagrams of the hardware components are presented in this chapter. Figures 10.1 to 10.6 depict the wiring diagrams of hardware components installed to the two substation panels. These panels were fabricated to represent service substation at the utility distribution substation side while customer substation represent the last substation at the customer side. The hardware fabrication part has been planned, studied, developed, implemented and integrated to the software part in order to develop total distribution automation system at the customer side automation system. Service substation panel has also been developed and connected to the customer substation panel.