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:
IIUM Press
International Islamic University Malaysia

First Edition, 2011
© IIUM Press, IIUM

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 :
IIUM 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

Chapter	Title & Author	Page No
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

Chapter Title & Author Page No

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

Chapter | Title & Author | Page No

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 4

SCADA SYSTEM FOR ELECTRICAL DISTRIBUTION SYSTEM

Musse Mohamud Ahmed and Soo Wai Lian

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

Chapter 4 deals with SCADA history overview and in order to upgrade the existing one to better one and SCADA research to distribution system in Malaysia.

4.1 SCADA History

In 1997, a switching gear tripped at the Sultan Salehuddin Abdul Aziz power station in Klang, caused load shedding from Kuala Lumpur to Johor Baharu [1]. At that time, TNB was not equipped to deal with unexpected crisis. In order to improve the quality of service to consumers, TNB has installed Supervisory Control and Data Acquisition System/Data Automation (SCADA/DA) programmed in the distribution network in stages from 1998 to 2004 [2].

SCADA is a process control system that enables a site operator to monitor and control processes that are distributed among various remote sites. The IEEE Std C37.1-1994 specification for the electric power industry defines SCADA systems as "a system operating with coded signals over communication channels so as to provide control of remote terminal unit (RTU) equipment" [3].

SCADA began in the early sixties as an electronic system operating as input and output (I/O) transmissions between a master station and a remote station. The master stations would receive data through a telemetry network and then store the data on mainframe computers. In the early seventies, Distributed Control Systems (DCS) were developed to control separate remote subsystems and in the eighties, with the development of the microcomputer, process control could be distributed among remote sites. Further development enabled the DCS to use Programmable Logic Controllers (PLC), which have the ability to control sites without taking direction from a master. In the late nineties, SCADA systems were built with DCS capabilities and systems were customized based on certain proprietary control features built in by the designers. Now with the Internet being utilized more as a communication tool, SCADA and telemetry systems are used automated software with certain portals to download information or control a process. Good SCADA systems today not only control processes but are also used for measuring, forecasting, billing, analyzing and planning.

Historically, SCADA system has consisted of four components which are the supervisory system, remote terminal units, a communication network, and field instruments.