DEVELOPMENT OF AN INTEGRATED INTELLIGENT BUILDING CONTROL SYSTEM THROUGH AN AUTOMATED SCENARIO BASED APPROACH

Narasinghage Don Gihan Dilmika Senarath

188768X

Thesis Submitted in Partial Fulfillment of the Requirements for the Master of Science in Building Services Engineering

Department of Mechanical Engineering

University of Moratuwa

Sri Lanka

January 2024

DECLARATION OF THE CANDIDATE AND THE SUPERVISOR

I declare that this is my own work, and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text. Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: Date: 05 Jan 24

The above candidate has
supervision.

Signature of the supervisor:

ABSTRACT

Integrated Building Control Systems (IBCS) may consist of public address and pipe music systems (PAPMS), elevator management systems, fire/life protection and detection systems, CCTV systems, access control systems, and building energy management systems (IBCS). So, the Integrated Intelligent Building control system has a major influence on energy efficiency, indoor environmental variables/parameters, analysis & survey, health and safety. It is well acknowledged that an Integrated Intelligent Building control system may improve a building's environmental and economic performance. Basically, automated high-rise buildings can regulate /control its inside environment parameters using a computer in view of improved cost effective energy usage, building users satisfaction, safety, and productivity. Energy, Safety and comfort management, as the principal function of a high rice defence building control system, seeks to resolve the tension between increasing user wellbeing including safety and lowering building operating costs. This thesis presents a novel method for Intelligent Building Control systems that use an intelligent facility manager to autonomously regulate the building environment. This thesis discusses the present problems facing when constructing the Integrated Building Control System and further explains available and required facilities and the importance of acquiring information from sensors through common architecture with a common protocol (Communication language). Further, this describes how Building Control System architecture (including all required facilities) utilizes its sensory data to understand and identify exciting/ real time situations from the behaviour /scenario of persons and systems whilst always providing a fast, safe response to any situation. Finally, this report shows how deep can utilize this system for early warning and firefighting of high-rise defense building

Keywords: Building Automation, Facility Management, Defence Building

ACKNOWLEDGEMENT

This is my thesis as a student of MSc/PG Diploma in Building Services Engineering. I thought I was very lucky to have a golden opportunity to select intake 5. So having this golden opportunity extremely I got good knowledge of Building Services Engineering aspects. Sometimes I felt little bit of difficulty to understand some points, but my colleagues and well-resourced lecturers helped me to overcome such difficulties.

First of all, I would like to thank Dr. MMID Manthilake (Initial Course Coordinator & Senior Lecturer -MSc/PG Diploma in Building Services Engineering), Dr. M. Anusha Wijewardane (Present Course Coordinator & Senior Lecturer -MSc/PG Diploma in Building Services Engineering), Dr. RACP Ranasinghe (Senior Lecturer -MSc/PG Diploma in Building Services Engineering), Eng. Prasanna Narangoda (Lecturer and MEP Manager at World Trade Center based in Colombo) including all other lecturers who contribute their valuable time and energy to upgrade our theoretical and practical knowledge. Further, I like to extend my sincere gratitude to my supervisor Prof. Asanka S. Rodrigo (Professor-Department of Electrical Engineering, University of Moratuwa-Sri Lanka) for guiding me throughout this report. Apart from my supervisor, I am very thankful to Dr. MMID Manthilake and Dr. M. Anusha Wijewardane for their continuous guidance and motivation throughout this thesis and the course.

I also like to thank to the Commander of the NAVY – Sri Lanka, the Director Project Management Unit (PMU) – Defence Head Quarters Complex project, the Director General Coast Guard and all officers in Sri Lanka Navy to be kind for giving this opportunity to me. Further, I like to thank Capt Wetthasinghe (PM -Electrical/ ICT), Brig. P Wimalasiri (Director Procurement-DHQC Project) and Cdr IT Jayashantha for the support provided. My special thank goes to all the staff of the University of Moratuwa-Sri Lanka including Ms. Sandeepani (Secretary -MSc/PG Diploma in Building Services Engineering) for coordinating activities & giving help to succeed my thesis.

I wish to extend my sincere thanks to Mr. Tharanga (Manager of VS Information Systems (Pvt) Ltd. Mr. Dinesh Bandara (Manager Pre Sales – ICT), Eng. B.W.N. Rupasinghe (Director MEPI – CECB), Eng. Nilusha Mahawaththa (Systems Engineer – CECB), Eng. S.A.P Maduwantha (Systems Engineer – CECB), Eng. Manuka Roshan (Electrical Engineer – CECB) Mr. H.D Wedisinghe (Network Designer -CECB) , Mr. Shiron Cader (Engineer transmission Planning & Development), Mr. Chandana Bandara (Engineer), & Mr. Buddhika Many thanks go to Other Specialists, Engineers and all other staff of the relevant divisions for their support, guidance and assistance.

I am grateful to my mother, father and my beloved wife for their support, guidance and assistance throughout my life.

NGDGD SENARATH

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
AHU	Air Handling Units
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BACS	Building Automation And Control Systems
BCS	Building Control Systems
BEMS	Building Energy Management Systems
BMS	Building Management System
CEA	Central Environmental Authority
CNP	Control Network Protocol
DGI	Daylight Glare Index
DGP	Day Light Glare Probability
EHS	European Home Systems Protocol
HBES	Home and Building Electronic Systems
HTTP	Hypertext Transfer Protocol
HVAC	Heating Ventilation and Air Conditioning
IBCS	Integrated Building Control Systems
IEC	International Electrotechnical Commission
IIBCS	Integrated Intelligent Building Control Systems
IoT	Internet of Things
IP	Internet Protocol
ISA	National Standardizing Associations
ISO	International Organization for Standardization
NEA	National Environmental Act
NGO	Non Government Organization
OSI	Open Systems Interconnection
PAPMS	Public Address and Pipe Music System
PICS	Protocol Implementation Conformance Statement
PIR	passive infrared Detectors
PL	Power Line
PMV	Predicted Mean Vote

PPD	Predicted Percentage Of Dissatisfied
SCADA	Supervisory Control And Data Acquisition
TCP	Transmission Control Protocol
WHO	World Health Organization