

50

LB/DON/06/09

13

DCS 05/05

DISTRIBUTED MANAGEMENT SYSTEM FOR UNMANAGED UPS

by

Malinda Punchimudiyanse

058271

LIBRARY
UNIVERSITY OF MORATUWA, SRI LANKA
MORATUWA

This dissertation was submitted to the

Department of Computer Science and Engineering of the University of Moratuwa

in partial fulfillment of the requirements for the Degree of

Master of Science specializing in Computer Networks

University of Moratuwa



92281

Department of Computer Science and Engineering

University of Moratuwa - Sri Lanka

March 2007

92281

004 "07"
004 (043)

TH

92281

DECLARATION

Malinda Punchimudiyanse
No : 205, Mandawila,
Angoda
Sri Lanka

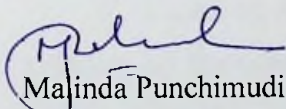
The University of Moratuwa Sri Lanka,
Katubedda, Moratuwa
Sri Lanka

Dear Sir / Madam

In accordance with the requirements of the Degree of Master of Computer Science in Specialization of Computer Networks, I wish to present the following thesis entitled "Distributed Management System for Unmanaged UPS" to fulfill my Master's research project. This work was performed under the supervision of Mrs. Vishaka Nanayakkara (Head of Department of Computer Science and Engineering, University of Moratuwa).

I declare that the work submitted in this thesis is my own, except as acknowledged in the Text and footnotes, and has not been previously submitted in part or as whole to any other university or institution.

Yours sincerely,



Malinda Punchimudiyanse
058271

Certification of Research Supervisor

I hereby certify the work presented in the dissertation is a work carried out by Malinda Punchimudiyanse under my supervision.

UOM Verified Signature

Mrs. Vishaka Nanayakkara
Research Supervisor

Date 07/03/07

ABSTRACT

DISTRIBUTED MANAGEMENT SYSTEM FOR UNMANAGED UPS

by Malinda Punchimudiyanse

Supervisor : Mrs. Vishaka Nanayakkara,

Department of Computer Science and Engineering - University of Moratuwa

Information and communication networks have transformed the world to a global village. A typical distributed local area network often consists of one or more network distribution cabinets powered by uninterrupted power supplies of various capacities ranging from 400VA to 2 KVA. Maintaining high availability at correct time is the key issue faced by technical personnel involved in network maintenance today.

The research project "Distributed Management System for Unmanaged UPS" is intended to provide effective monitoring of environment and timely notifications of status or interruptions to background services such as electricity and temperature control of the distributed network locations by a remote unit installed in each remote location. The status of the remote location is sent back to a central software module through Ethernet network then to appropriate technical personnel for necessary actions.

The research project utilizes embedded electronic device and sensors with some custom programmed or pre programmed intelligence to monitor and control equipment at the remote network locations. An embedded device named TINI "Tini InterNet Interfaces" [1], [8] is used in order to monitor the status of UPS using smart/ non smart serial protocol of the UPS via its serial port to measure the electrical stability of remote location, and uses a temperature sensor to get feedback on temperature status of the remote location. Immediate evasive actions also triggered automatically in temperature increases without intervention from technical personnel.

A central software module with real time status monitor is used to integrate status logging and alerting on behalf of remote units. SMS and Intercom alerts are used as alerting mechanisms with specified / customized thresholds, messages suiting to each remote network location and alerted only to personal intended to attend to specific location.

TABLE OF CONTENTS

Chapter 1 - Introduction	1
1.1 Background & Motivation	1
1.2 Definition of Problem & Scope of Project.....	2
1.3 The Aim of Project	4
1.4 Objectives	4
1.5 Organization of Literature Review	5
1.6 Layout of Thesis	6
Chapter 2 - Proposed System Design With Theoretical & Technological Background.....	7
2.1 Feasibility Analysis	7
2.2 Functional Requirements of System	9
2.3 Proposed Design of the System	10
2.4 Central Unit	16
2.5 Proposed Integration Mechanism of Remote unit and Central unit.....	17
Chapter 3 – System Implementation	18
3.1 Key Technologies Explored in Research project.....	18
3.2 Setting up Overall Development Environment and Hardware	19
3.3 Technologies Behind Remote Unit and Initial Configuration of Unit.....	22
3.4 Functional Implementation of Remote unit	33
3.5 Functional Implementation of Central System	41
3.6 Overall Integration within Central Unit and Database Structure	52
3.7 Integration of Remote Unit with Central Unit	54

Chapter 4 – System Testing and Evaluation	55
4.1 Setting up Testing Environment and Assumptions Made	55
4.2 Testing and Evaluation Methodology	56
4.3 Scenario Based Testing	58
4.4 System Test and Statistics on Actual Environment.....	64
4.5 Evaluation	65
 Chapter 5 - Conclusion	 66
5.1 Conclusion	66
5.2 Further work	67
 References	 68
 Appendices.....	 71
A - Complete Screen and Source code for Central unit	
B - Detailed information on SMART UPS protocols	
C - Circuitry Used in Remote Controlling Equipment	
D - Souce Code for Remote Unit	
E - Assembling/Loading Firmware and Initialization Process to TINI Evaluation Kit	

LIST OF FIGURES

Number	Page
Figure 1.1 – Typical Network connectivity and operation	3
Figure 1.2 – Disconnection due to power outages and Isolation	3
Figure 2.1 – Standalone approach	7
Figure 2.2 – Client / Server approach	8
Figure 2.3 – Proposed system Design	11
Figure 2.4 – TINI evaluation board [2]	15
Figure 2.5 – Functional layout of the Central unit	16
Figure 3.1 – Initial cabling setup for loading firmware to remote unit [8]	21
Figure 3.2 – TINIIs400 verification module with TINIm400 module inserted[2]	22
Figure 3.3 – DSTINIm400 module [2]	23
Figure 3.4 – TINI Software Architecture [3]	24
Figure 3.5 – Functional description of power source to TINI	26
Figure 3.6 – Standard 5V regulator circuit [15]	27
Figure 3.7 – Sample network configuration of a network settings in TINI	30
Figure 3.8 – List of Available commands in TINI Operating System	31
Figure 3.9 – Cabling / functional model of remote unit	33
Figure 3.10 – Cable pin out of APC serial cable [18]	36
Figure 3.11 – DS1920-F5 i-button [5]	38
Figure 3.12 – Remote Control Circuit used to Control Fans in Prototype system	39
Figure 3.13 – Messaging done in various modules of remote unit java code	40
Figure 3.14 – Alert Threshold configuration Screen	44
Figure 3.15 – Status information display based on device id	46
Figure 3.16 – Contact registration page with customization based on location	47
Figure 3.17 – Reference Libraries used in Prototype system	48

Figure 3.18 – Screen for remote control of equipment	50
Figure 3.19 – The statistics report generation screen	51
Figure 3.20 – Menu system used in Central unit	52
Figure 3.21 – The Access Database Structure of Central Unit	53
Figure 4.1 – Test environment Cabling setup	55
Figure 4.2 – Short power failure	58
Figure 4.3 – Normal Status of a Remote Device	59
Figure 4.4 – Status display of registered module	60
Figure 4.5 – SMS message notifying Power increase in remote location	60
Figure 4.6 – A power failure that goes over grace period no alert	61
Figure 4.7 – SMS Alert received notifying power failure	62
Figure 4.8 – Actual Deployment Setup of prototype system	63

LIST OF TABLES

Number	Page
Table 2.1 – Summary of microcontrollers and evaluation boards	13
Table 3.1 – Few sample status codes of APC smart serial protocol [18]	34
Table 3.2 – APC Smart Protocol Alerts information [18]	35
Table 3.3 – System events, triggers, alerts and thresholds	43
Table 4.1 – Remote unit function Test	56
Table 4.2 – Central unit function test	57
Table 4.3 – Statistics on actual deployment	64

ACKNOWLEDGEMENTS

I wish to acknowledge my research supervisor Mrs. Vishaka Nanayakkara who had a unique way of encouraging me on making this project a success, sitting and discussing problems and guiding me amidst really busy schedule of her as MSc Coordinator, Head of Computer Science Department of University of Moratuwa.

My sincere thanks must go to Mr. Prabhath Dehigaspitiyage, Director / Information Technology of The Open University of Sri Lanka for allowing me to do my research project and granting me permission to deploy the system on running campus network.

I also wish to thank my parents Mr. P.M. Jayasena, Mrs. Somalatha Cooray, and loving brother Mr. Hemantha Punchimudiyanse for their great moral support to have ease of my mind to be engaged in research project.

Finally I wish to thank all my friends and colleagues in my work place who have encouraged me and supported me on various ways in making this research project a reality.

GLOSSARY

- OUSL - The Open University of Sri Lanka
- TINI - Tini InterNet Interfaces
- ICT - Information and Communication Technology
- IT - Information Technology
- PC - Personal Computer
- SMS - Short Message Service
- UPS - Uninterrupted Power Supply
- TCP / IP - Transmission Control Protocol / Internet Protocol
- RAM - Random Access Memory
- UDP - User Datagram Protocol
- JDK - Java Development Kit
- SDK - Software Development Kit
- TFTP - Trivial File Transfer Protocol
- HTTP - Hyper Text Transfer Protocol
- APC - American Power Conversion

