

Dedication

To those who have enlightened our lives in all aspects, father and mother. to those whom whatever I say or do I still owe them, my wife and son to those who paved the path for my career , my education march and to those whom even I can't find the words to say how I am so grateful, I proudly dedicate this humble .

Acknowledgment

After thank of ALLAH (s.w.t) for everything and for guidance and strengthening which without them, this work couldn't have been done, I would like to thank Dr: Abdurasoul Jabar Alzubaidi for his great effort that he has done for helping me in the accomplishment of this Research as well as his continuous encouragement and patience through all the aspect and phases of this research also I would like to thank my family for their assistance and good guidance, you have my gratitude.

TABLE OF CONTENTS

Dedication	I
Acknowledgment	II
Table of contents	III
List of Figures	VI
List of tables	IX
Abbreviations	X
Abstract	XIV
المستخلص	XV

Chapter One: Introduction

1.1 Background.....	1
1.2 Problem Statement.....	2
1.3 Proposed solution.....	2
1.4 Methodology	3
1.5 Objectives	3
1.6 Research Outline	4

Chapter Two: Overview

2. Introduction.....	5
2.1 Control System.	5
2.1.1 The Process	6
2.1.2 Manual Control Operation	7
2.1.3 Automation	8
2.1.4 Automated System Building Blocks.....	8
2.2 The PLC	10
2.2.1 PLC Architecture.....	13
2.2.2 Program Scan.....	14
2.2.3 PLC Programming Languages.....	16
2.3 SCADA System	17

2.3.1 SCADA system performers	17
2.3.2 Why SCADA.....	18
2.3.3 FEATURE OF SCADA.....	18
2.3.4 SCADA Architecture.....	19
2.4 Previous Studies.....	19

Chapter Three: Simulation Hardware Devices

3.1 The project description.....	21
3.2 System Description.....	21
3.3 The Central Processing Unit (CPU)	22
3. 4 The power supply module.....	25
3.5 The I/O section	27
3.6 The IM 365 (Overview)	29
3.7 HMI [Human Machine Interface].....	30
3.7.1 HMI (USAGE).....	30
3.7.2 Siemens HMI Family.....	30
3.7.3 PC Adapter USB.....	30
3.7.4 Functions	31
3.8 SCADA SYSTEM ARTICHTURE	31
3.8.1 SIMATIC S7-300 Architecture	31
3.8.2 WINCC flexible system overview.....	33
3.8.3 WINCC flexible engineering system.....	33
3.8.4 WINCC flexible Run time.....	34
3.8.5 WINCC flexible option.....	34
3.9 Field devices.....	34
3.9 .1 Basic Measurement System.....	34
3.9.2 Level Measurement.....	35
3.9 .3 Flow Measurement	36

3.9. 4 Pump	37
3.9 .5 Motor Operated Valve	37

Chapter Four: Software

4 introduction	38
4.1 SIMATIC MANAGER.....	38
4.2 WINCC Flexible2008.....	40
4.3 System Configuration.....	41
4.3.1 Software Planning and configuration	43
4.3.2 I Software implementation and module test	45
4.3.3 Software Testing and commissioning	47
4.3.4 Software Operation and maintenance.....	49
4.4 Process Description	50
4.4 .1 Level and pressure monitoring	50
4.4 .2 Flow monitoring	51
4.4.3 Graphic View.....	51
4.5 Simulation	51

Chapter Five: Result & Discussion

5.1 Result	53
5.2 Discussion	55

Chapter Six: Conclusion&Recommendations

6.1 Conclusion	58
6.2 Recommendations	59
References	60
Appendices.....	62

LIST OF FIGURES

Figure 2.1	Control systems functional view.....	6
Figure 2.2	Water flow tank process	7
Figure 2.3	Manual control systems	7
Figure 2.4	Closed-loop controls.....	9
Figure 2.5	Programmable logic controller.....	10
Figure 2.6	Relay- and PLC-based control panels..	11
Figure 2.7	Relationships between the inputs and outputs	12
Figure 2.8	Control program can be displayed in a monitor in real time	12
Figure 2.9	Typical PLC input/output (I/O) system connections	14
Figure 2.10	PLC program scan cycle	15
Figure 2.11	Standards IEC 61131 languages associated with PLC.....	16
Figure 2.12	typical SCADA hardware architecture.....	19
Figure 3.1	ALSAHAFA pumping station	21
Figure 3.2a	Sections of a PLC processor module.....	22
Figure 3.3	PLC power supply	24
Figure 3.4	Wiring diagram of PS 307; 10 A	26
Figure 3.5	block diagram of PS 307; 10A.....	26
Figure 3.6	Rack-based I/O section	27
Figure 3.7	16xdc24v, /0.5A I/O modules.....	28
Figure (3.8)	IM configuration	29
Figure 3.9	the HMI	30
Figure 3.9	PC adapter for downloading and uploading.....	31
Figure 3.10	SCADA structure	31
Figure 3.11	Siemens PLC s7-300 architecture.....	31
Figure 3.12	SIMATIC S7-300: The modular controller.....	33

Figure 3-13 Instrument block diagram	34
Figure 3.14 Level Transmitter.....	36
Figure 3.15 Function and system design	36
Figure 3.16 proline prosonic flow 91 W ultra sonic flow meter	36
Figure 3.17 Pump	37
Figure 3.18 Motor Operated Valves	37
Figure 4.1 the steps of the plant creation	38
Figure 4.2 supporting of s7 for all project phases.....	39
Figure 4.3 the necessary software packages.....	40
Figure 4.4 WINCC flexible panel chosen in the research.....	41
Figure 4.5 the research data.....	42
Figure 4.6 s7-300 software hierarchal.....	43
Figure 4.7 start programming of a project	43
Figure 4.8 H.W configurations for ALSAHAFa pumping station.....	44
Figure 4.9 H.W Process assigning each module.....	45
Figure 4.10 Project cross reference data.....	46
Figure 4.11 WINCC flexible throughout SIMATIC manager	47
Figure 4.12 loading the programming	48
Figure 4.13 how to archive data	49
Figure 4.14 the project system graphic	51
Figure 4.15 Simulation of the ALSAHAFa pumping station.....	52

LIST OF TABLES

Table 5.1 Inputs	53
Table 5.2 Outputs	54
Table 5.3 Output Alarming	55

ABBREVIATIONS

A/D	Analog to Digital Converter
AI	Analog Input
AO	Analog Output
MPI	Multi Point Interface
Bar	barometer unit of atmospheric pressure measurement
Bps	Bits per second
CAN	Control Area Network or Control and Automation Network
CIP	Common Industrial Protocol
CPU	Central Processing Unit
D/A	Digital to Analog Converter
DC or dc	Direct current
DI	Digital Input
DO	Digital Output
DP	Distributed peripheral
FBD	Function Block Diagram
HMI	Human Machine Interface
IEC	International Electro technical Commission
IEEE	Institute of Electrical and Electronic Engineers (US)
IL	Instruction List
IP	Internet Protocol
ISO	International Organization for Standardization

IT	Information Technology (as in IT manager or IT department)
LAD	Ladder Diagram
LED	Light Emitting Diode
mA or ma	mill amperes
MB	mega-Byte
Mbs, mbps	Mega Bits per Second
MOV	Motor Operated Valve
MSB	Most Significant Bit
MV	Manipulated variable
PC	Personal Computer
PID	Proportional Integral and Derivative
PL	Program list
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
TIA	Totally integrated package
PS	Power Supply
PS	Process Station
PV	Process variable
OPC	Open Platform Communications
OS	Operator Station
RAM	Random access memory
ROM	Read only memory

SFC	Sequential Function Chart
ST	Structured Text
TCP/IP	Transmission control Protocol / Internet Protocol
TON	Timer on Delay
WINCC	Windows Control Center
KSWC	Khartoum State Water Cooperation

Abstract

This research presents the simulation of an automation system of ALSAHFAFA pumping station to control of the parameters in a plant such as: level-pump pressure-flow in and out of the tank and the operation of the pumps. The research addresses the problems of conventional control for such parameter since the autonomous control helps and participates in improvement of the level of efficiency. The software code is developed using both SIMATIC MANAGER S7-300 for PLC while WINCC flexible_2008 (SCADA) is used as simulator of the system. The purpose of the research is to replace the manual system being used in the station, compare the time, and manpower requirement for both the existing system with the proposed automated system and also the operator can monitor the functionality of the entire building on the SCADA screen, and alarm reports assist in location faults, which contributes to a significant increase in maintenance efficiency.

المستخلص

هذا البحث يناقش ويتناول عملية محاكاة لنظام تحكم ألي للمتغيرات المتعلقة بمحطة مياه الصحافة للضح التابعة لهيئة مياه ولاية الخرطوم مثل (مستوي الماء في الخزان – ضغط الطلمبات- التدفق الداخل والخارج وتشغيل الطلمبات).. ويعالج هذا البحث مشكلة التحكم التقليدي المستخدم للتحكم في هذه المتغيرات حيث ان التحكم الالي يساعد ويساهم في رفع مستوي الكفاءة. في البداية تم تطوير البرمجيات باستخدام برامج SIMATIC MANAGER S7-300 للتحكم المنطقي القابل للبرمجة PLC بينما استخدم WINCC Flexible 2008 كبرنامج للاسكادا للعرض والمحاكاة. وكان الغرض من هذا البحث استبدال النظام اليدوي الذي يستخدم في المحطة بالمقارنة مع النظام الاتوماتيكي من حيث الزمن والحاجة الي الايدي العاملة, وايضا يستطيع المشغل استعراض الوظائف الداخلية المضمنة في شاشة الاسكادا, وتقارير الانذارات التي تساعد في تحديد مكان العطل والذي بدوره يساهم بقدر كبير في رفع كفاءة الصيانة.