

Sudan University of Science and Technology

College of Graduate Studies

Use of SCADA system for remote monitoring of Khartoum state water corporation

استخدام نظام اسكادا للمراقبة عن بعد لهيئة مياه ولاية الخرطوم

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of M.Sc. in Mechatronics Engineering

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صدق الله العظيم

(سورة الرحمن)

DEDICATION

This work is dedicated to My parents

ACKNOWLEDGEMENT

I would like to thank all my parents, my brother, my sisters and my friends. Special thanks are due to my Supervisor, Dr.ALAAELDEEN AWOUDA, zeta automation systems training center and all persons who supported me in preparing this research.

ABSTRACT

The Supervisory Control and Data Acquisition (SCADA) system monitors and controls many applications such as:

(Water distribution network including water reticulation, pump stations , Public utilities, including electrical power generation, oil and gas pipelines, and water and sewage treatment plants).

The SCADA system provide reliable and efficient water supply services across (enabling us to monitor and control the entire network from one location, saving time and resources and Minimizing risk of human error).

The main objective of this research to design SCADA system for remote monitoring of Khartoum state water corporation and collecting data from soba station.

الملخص

تستخدم انظمة مراقبة التحكم ونظام اكتساب البيانات في العديد من التطبيقات على سبيل المثال

(شبكة مضخات المياه متضمنة مد شبكات المياه ومجطات الضخ وفي المرافق العامة مثلا في محطات توليد الكهرباء وحقول النفط والغاز و محطات معالجة المياه والصرف الصحي).

وتعمل انظمة مراقبة التحكم ونظام اكتساب البيانات بموثوقية وفعالية عالية في امداد المياه والصرف الصحي اذ تقوم ب(تمكننا من رصد ومراقبة الشبكة بالكامل من مكان واحد و توفير الوقت والموارد وتقليل احتمالات الخطأ البشري).

الهدف الرئيس من هذا البحث هو تصميم انظمة مراقبة التحكم ونظام اكتساب البيانات لرئاسة هيئة مياه ولاية الخرطوم للحصول على البيانات من محطة سوبا.

Table of Contents					
الآية	i				
DEDICATION	ii				
ACKNOWLEDGEMENT	iii				
ABSTRACT	iv				
الملخص	V				
List of Figures	viii				
List of Tables	xi				
List of Abbreviation	xii				
CHAPTER ONE: INTRODUCTION					
1.1 Overview	1				
1.2 Problem Statement	2				
1.3 Proposed Solution	2				
1.4 Research Objectives	2				
1.5 Scope	2				
1.6 Methodology	3				
1.7Thesis Layout	3				
CHAPTER TWO: THEORETICAL BACKGROUND	J				
2.1 Previous studies of SCADA systems	4				
2.2Programmable Logic Controllers	5				
2.2.1 PLC Internal Architecture					
2.2.2 Operation Principles	6				
2.2.3 PLC Programming	8				

2.2.4 PLC Advantages	9				
2.3 SCADA System	10				
2.3.1 SCADA System Capacities	11				
2.4 Siemens network Automation Step7 Control Center (SINAUT ST7cc)	11				
2.5 DSL Router	15				
CHAPTER THREE : DESIGN AND IMPLEMENTATION SYSTEM					
3.1 Background of Soba Station's Operation	17				
3.2 Configuration of Siemens Network Automation Step 7 Control Center	23				
CHAPTER FOUR: RESULTS AND DISCUSSION					
4.1 The Result of Implementation	46				
4.1.1 Intake Process	46				
CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS					
5.1 Conclusions	50				
5.2 Recommendations	50				
References	51				

List of Figures	
Figure (2.1): PLC Internal Architecture	6
Figure (2.2) PLC Scanning	7
Figure (2.3): PLC Input/output Interface	8
Figure (2.4): PLC Programming Languages	9
Figure (2.5): SCADA Systems	11
Figure (2.6): Node Station of TIM 3V-IE Advanced Module	14
Figure (2.7): Node Station of TIM 4R-IE Module	15
Figure (3.1): Intake Process of Soba Station	17
Figure (3.2): Sedimentation Process of Soba Station	18
Figure (3.3): Clari-Flocarator Process of Soba Station	19
Figure (3.4): Filters Process of Soba Station	20
Figure (3.5): Lifting Pump Process of Soba Station	21
Figure (3.6): Three Stations of Hardware Configuration	24
Figure (3.7): Pc Station Configuration	24
Figure (3.8): Master TIM Station Configuration	25
Figure (3.9): DSL Station Configuration	25
Figure (3.10): Industrial Ethernet Configuration	27
Figure (3.11): Setting of IE General (Pc Station)	27
Figure (3.12): Setting of keepalives (Pc Station)	28

Figure (3.13): Setting of Ethernet Interface 2 (TIM4-IE) Connect With PC						
Figure (3.14): Setting of Ethernet Interface 1(TIM4-IE) Connect with DSL	29					
Figure (3.15): Setting of Keepalives (Master TIM)	29					
Figure (3.16): Setting Time of Ethernet 2 (Master TIM)	30					
Figure (3.17): Setting Time of Ethernet 1(Master TIM)	30					
Figure (3.18): Setting of Ethernet Interface DSL Station	31					
Figure (3.19): Setting of Keepalives DSL Station	31`					
Figure (3.20): Setting Time of Ethernet 1 DSL Station	32					
Figure (3.21) Connection Configuration	33					
Figure (3.22) Subscriber Administration	34					
Figure (3.23) MSC Master Properties	34					
Figure (3.24) Binary and Analog Data	35					
Figure (3.25) Preparation of Digital Transmit Data	35					
Figure (3.26) Preparation of Analog Transmit Data	36					
Figure (3.27) Pc Station Configuration	36					
Figure (3.28) Commutation Setting	37					
Figure (3.29): Global Setting (Computer)	38					
Figure (3.30): Global Setting (Activate Parameter)	38					
Figure (3.31): Setting of local IPs, Access Point and Subscriber Number	39					
Figure (3.32): Received Digital Data	39					

Figure (3.33): Received Analog Data	40
Figure (3.34): Computer Properties	41
Figure (3.35): Setting of ST7 Serve	41
Figure (3.36): Generation Tags to WINCC	42
Figure (3.37): Generation Tags in ST7	42
Figure (4.1): Default of Pump_1	44
Figure (4.2): Running of Pump_1	44
Figure (4.3): Default of Electrical Motor_V127	45
Figure (4.4): Running of Electrical Motor V_127	45
Figure (4.5): Default of Level Sensor _21	46
Figure (4.6): Running of Level Sensor _21	46
Figure (4.7): Default of Pressure Meter 1	47
Figure (4.8): Running of Pressure Meter 1	47

List of Tables	
Table (3.1): The Components of Soba Station Process	22
Table (3.2): Hardware and Software Components Used	45
Table (4.1): Actual Value of Device Using in The Process from Soba Station	48
Table (4.2): Some of Input Module Using in Implementation	49

List of Abbreviation							
SCADA	Supervisory Control and Data Acquisition	1					
KSWC	Khartoum State Water Corporation	1					
PLC	Programmable logic Controllers	2					
DSL	Digital Subscriber Line	2					
WINCC	Windows Control Center	2					
SINAUT	Siemens Network Automation	2					
CPU	Central Processing Unit	6					
LAD	Ladder Diagrams	8					
IL	Instruction List	8					
FBD	Function Block Diagram	8					
ST	Structured Text	8					
SFC	Sequential Function Charts	8					
SQL	Structured Query Language	10					
MTU	Master Terminal Unit	11					
HMI	Human-Machine Interface	11					
MTU	Master Terminal Unit	11					
I/O	INPUT/OUTPUT	12					
ST7cc	Step 7 Control Center	13					
GPRS	General Packet Radio Service	13					
MSC	Micro Switching Centre	15					
TIM	Telecontrol Interface Module	16					
WAN	Wide Area Network	16					
PC	Personal Computer	16					

S7-300	STEP 7 300	16
S7-400	STEP 7 400	16
LAN	Local Wide Area Network	18

CHAPTER ONE INTRODUCTION

1.1 Overview:

The Supervisory Control and Data Acquisition (SCADA)system monitors and controls many industrial applications such as:

- 1. water distribution network including water reticulation and pump stations
- 2. sewage collection and treatment network
- 3. Gathering real-time data, monitoring equipment and controlling processes in industrial facilities.
- 4. Public utilities, including chemical plants, electrical power generation, oil and gas pipelines, and water and sewage treatment plants.

The SCADA system is critical to provide reliable and efficient water supply and sewage treatment services across an area of more than 5700 square kilo meters, by:

- enabling us to monitor and control the entire network from one location
- saving time and resources
- Minimizing risk of human error.

The control center had been configured for authorized users at Khartoum state water corporation (KSWC) center, for remote monitoring of water plant, communications, and system diagnostics. The WINCC software also provides real-time information on reservoirs water level, flow values, water pressure and other mission-critical data, as well as reporting. The main station is Soba water treatment pumps station. The customer wanted a user-friendly system, with advanced and reliable communication. They also needed a system that could issue targeted urgent alerts, as well as on-demand summary reports of system activity the solution, with total system monitor, can be expanded and modified to meet changing of Khartoum state water corporation needs.

1.2 Problem Statement:

Problem of this research no data exchange between the center of Khartoum state water corporation (KSWC)and soba station. The Khartoum state water corporationfinds problems in obtaining information from the Soba station it is difficult to check daily reports, status and know the important data in soba station (output flow rate, PH, output pressure, TUR and...... etc.).

1.3Proposed Solution:

Design and implement a remote monitoring center for Khartoum state Water Corporation with SOBA water treatment pumps stationto Logging of all data and statuses and to know all data in soba station (output flow rate, PH, output pressure and etc.). This research will depend on software program (WINCC and SINAUT ST7cc) to solve the main problem.

1.4Research Objectives:

The main objective of this research design SCADA systemWINCC and SINAUT ST7cc for remote monitoring of Khartoum state Water Corporationto achieve of this objective:

- Proposed control system using PLC.
- Proposed monitoring system using SCADA WINCC.
- Proposed communication media DSL.
- Simulation practices and implementation.

1.5 Scope

Collecting data from soba station to Khartoum state Water Corporation (KSWC)usingSINAUT ST7cc and WINCC.

1.6Methodology

The methodology is: -

- ✓ Configuration of SIMATIC ST7.
- ✓ Setting up WINCC then configuration.
- ✓ Installing the system hardware DSL router in the center.
- ✓ Setting up SINAUT ST7cc then configuration.

1.7Thesis Layout

This thesis consists of five chapters:

Chapter Onegives an introduction, and problem statement. It also presents the objectives and methodology of this study.

Chapter TwoTheoretical backgroundofPLC, SCADA system, DSL and SINAUT ST7cc

Chapter three deals with the design and Implementation system. It gives the simulation of collecting data from soba station to the center of Khartoum state Water Corporation using PLC, SCADA WINCC and SINAUT ST7cc.

Chapter fourthe resultsand discussion

Chapter fiveconclusions and recommendations.

CHAPTER TWO

THEORETICAL BACKGROUND

2.1 previous studies of SCADA systems: -

- In 2010 Mr.binqin and mr.dongyan were designed remote SCADA system of secondary pressurization pump station uses a PLC controller, through the friendly human machine interface to control and monitor. The designed system shows that the control system has high degree of automation, and stable and reliable performance, largely reducing the acquisition time and meeting the control requirements [1], [2].
- In 2012 mr.xin ma was designed the SCADA system for longnan water corporation it is include (master terminal unit (MTU)-communication system (CS)-two class dispatch center and RTU and the SCADA designed based on Ethernet. [3], [4].
- In 2014 mr. Adrian Korodi, and mr.IoanSilea were designed Specifying and Tendering of Automation and SCADA Systems: Case Study for Waste Water Treatment Plants providing a set of information that has to be contained by an adequate technical documentation for automation and SCADA works. [5], [6]
- in 2010 mr. Amir Firoozshahi was designed Intelligent and Innovative Monitoring of Water Treatment Plant in Large Gas Refinery the Monitoring System has been successfully designed, installed, commissioned and started up. All features accessed. Operators are working by this system easily and satisfied.
 [7], [8]

2.2 Programmable Logic Controllers (PLC)

Programmable logic controllers, also called programmable controllers orPLCs, are solid-state members of the computer family, using integrated circuits instead of electromechanical devices to implement control functions. They are capable of storing instructions, such as sequencing, timing, counting, arithmetic, data manipulation, and communication, to controlindustrial machines and processes.

Programmable controllers have many definitions. However, PLCs can be thought of in simple terms as industrial computers with specially designed architecture in both their central units (the PLC itself) and their interfacing circuitry to field devices (input/output connections to the real world).

PLCs have the great advantage that the same basic controller can be used with a wide range of control systems. To modify a control system and the rules that are to be used, all that is necessary is for an operator to key in a different set of instructions. There is no need to rewire. The result is a flexible, cost effective, system which can be used with control systems which vary quite widely in their nature and complexity.[9]

2.2.1 PLCInternal Architecture

Thebasic internal architecture of a PLC consists of acentral processing unit (CPU) containing the system microprocessor, memory, and input/output circuitry, as shown in Figure (2.1). The CPU controls and processes all the operations within the PLC. It is supplied with a clock with a frequency of typically between 1 and 8 MHz This frequency determines the operating speed of the PLC and provides the timing and synchronization for all elements in the system.

The information within the PLC is carried by means of digital signals. The CPU uses the data bus for sending data between the constituent elements, the address

bus to send the addresses of locations for accessing stored data and the control bus for signals relating to internal control actions. The system bus is used for communications between the input/output ports and the input/output unit. [10]



Figure (2.1): PLCInternalArchitecture

2.2.2Operation Principles

The input/ output (I/O) system is physically connected to the field devices that are encountered in the machine or that are used in the control of a process. These field devices may be discrete or analog input/output devices, such as limit switches, pressure transducers, push buttons, motor starters, solenoids, etc. The I/O interfaces provide the connection between the CPU and the information providers (inputs) and controllable devices (outputs). During its operation, the CPU completes three processes:

- **Reads**or accepts the input data from the field devices via the input interfaces.
- **Executes**or performs, the control program stored in the memory system.
- Writesor updates the output devices via the output interfaces. This process of sequentially reading the inputs, executing the program in memory, and updating the outputs is known as scanning as shown as figure (2.2) illustrates a graphic representation of a scan. [1]



Figure (2.2):PLC Scanning

The input/output system forms the interface by which field devices are connected to the controller as shown as figure (2.3). The main purpose of the interface is to condition the various signals received from or sent to external field devices. Incoming signals from sensors (e.g., push buttons, limit switches, analog sensors, selector switches, and thumbwheel switches) are wired to terminals on the input interfaces.

Devices that will be controlled, like motor starters, solenoid valves, pilot lights, and position valves, are connected to the terminals of the output interfaces. The system power supply provides all the voltages required for the proper operation of the various central processing unit sections. [1]



Figure (2.3): PLC Input/outputInterface

2.2.3 PLCProgramming

Programs for microprocessor-based systems have to be loaded into themin machine code, this being a sequence of binary code numbers to represent the program instructions. PLCs are intended to be used by engineers without any great knowledge of programming, this is a means of writing programs which can then be converted into machine code by some software for use by the PLC microprocessor, and this method of writing programs became adopted by most PLCmanufacturers.

The standard, published in 1993, is IEC 1131-3 (International ElectroTechnical Commission), the IEC 1131-3 programming languages are ladder diagrams (LAD), instruction list (IL), sequential function charts (SFC), structured text (ST), and function block diagram (FBD), as shown in Figure (2.4).Ladder

diagrams a very commonly used method of programming PLCs is based on the use of ladder diagrams. Writing a program is then equivalent to drawing a switching circuit. The ladder diagram consists of two vertical lines representing the power rails. Circuits are connected as horizontal lines, i.e. the rungs of the ladder, between these two verticals. [12]



Figure (2.4): PLC ProgrammingLanguages

2.2.4 PLC Advantages

- Flexibility: One single Programmable Logic Controller can easily run many machines.
- **Correcting Errors:** In old days, with wired relay-type panels, any program alterations required time for rewiring of panels and devices. With PLC control, any change in circuit design or sequence is as simple

as retyping the logic. Correcting errors in PLC is extremely short and cost effective.

- **Space Efficient:** Today's Programmable Logic Control memory is getting bigger and bigger this means that we can generate more and more contacts, coils, timers, sequencers, counters and so on. We can have thousands of contact timers and counters in a single PLC.
- Low Cost: Prices of Programmable Logic Controllers vary from few hundreds to few thousand dollars.
- **Testing:** A Programmable Logic Control program can be tested and evaluated in a lab.
- Visual Observation: When running a PLC program a visual operation can be seen on the screen. Hence troubleshooting a circuit is really quick, easy and simple.[8]

2.3 SCADASystem

SCADA IS (Supervisory Control and Data Acquisition). SCADA is a system that collects information from sensors and from the components of the Control System, and sends the data to the main Computer for the purpose of: Management, supervision, Control and MonitoringSCADA System is invented in order to allow the Operator to control this net or even more complicated networks through his computer. And informs the Operatorwhether the circuits are normal or not.

The system will warn/alert of any problem in any circuit. In fact, SCADA System. Is more developed than that: It allows the computer to review and display the received data, draw graphs (curves) to explain the data values within a certain period of time. Also, it compiles the information and outline it the form of Report. [13]



Figure (2.5):SCADA Systems

2.3.1 SCADA System Capacities

- 1. Adding more control buttons for the pages to do one or more jobs.
- 2. Design of indicators to show the working situation and the current condition at the station.
- 3. Display of text messages or drawing to show the state of the workflow or the warning.
- 4. Send orders from the keyboard to deal with all pages or with one single page.
- 5. Monitoring & Control to display all alerts in different forms.
- 6. To exchange information available at the station with another site of work.
- 7. Control of the Quality of Production.[14]

2.4 Siemens network Automation Step7 Control Center (SINAUT ST7cc).

SINAUT ST7cc is the tele-control system based on SIMATIC ST7, consists Oftwo independent systems:

•SINAUT MICRO

Tele-control system for monitoring and controlling distributed plants using DSL on the basis of SIMATIC S7-200 and WinCC flexible or WinCC explorer as a

result of its bidirectional communications capability, SINAUT micro can handle simple tele-control tasks.

•SINAUT ST7cc

Versatile tele-control system based on SIMATIC S7-300,S7-400 and for fully automatic monitoring and control of process terminals which exchange data with oneor more control centers or with each other via a WAN or overEthernet. Configuration is carried out using STEP 7.SINAUT ST7 is a tele-control system based on SIMATIC S7(S7-300 and S7-400)for fully-automatic monitoring and control of process terminalswhich exchange data with one or more control centers or witheach other via a wide range of WAN media.

The modular design and the support of a huge variety of networkforms and operating modes including IP-based networks permitthe design of flexible network structures that can also contain redundantlinks.By using all forms of transmission media, the networks canbe optimally adapted to the respective local conditions.The SINAUT ST7cc system is based on SIMATIC S7 systemsS7-300, S7-400. It supplements these systems with the specific SINAUT hardwareand software components listed below.

• Hardware Components

- 1. TIM communications modules.
- 2. DSL

• Software Components

SINAUT ST7cc Engineering Software. [16]

• TIM Communications Modules

The central component of the SINAUT ST7cc hardware is the Tele-control Interface Module (TIM). It is used by the S7 CPU or control center PC for data exchange via the relevant SINAUT network, optionally with the SINAUT ST7. The TIM is housed in an S7-300 enclosure and is available in two basic versions:

1. TIM 3V-IE/TIM 3V-IE Advanced Module

The TIM 3V-IE is a SINAUT communication module for the SIMATIC S7-300. It has anRS232 port, to which an appropriate external modem can beConnected for data transmission via a conventional WAN. In the case of the TIM 3V-IE,SINAUT communication can be processed alternately via one of the two interfaces, while in the TIM 3V-IE advanced both interfacescan be operated simultaneously.

When used in a node station, TIM 3V-IE Advanced can, for example,Exchange data over its RS232 interface over a radio network with the lower-level stations. It is then connected to the control center over a fiber-optic cable. In this configuration, data can be exchanged between each of the SINAUT stations regardless of which network they are situated in order to disconnect the networks, the connection in the control center can be made via a TIM 4R-IE or, as in the example, directly to the Ethernet interface of the PC as shown figure (2.7).[16]

• Benefits Of TIM 3V-IE/TIM 3V-IE Advanced

- 1. Flexible option for connection to any IP-based WAN.
- For universal use with S7-300, S7-400, C7 compact controlSystem and control center PC
- 3. Simplified maintenance through replacement of modules without PG.
- 4. Reliable storage of important data.
- Remote programming and remote diagnostics (PC routing) in Parallel with data transmission via the WAN or IP-connection Saves time and money.



Figure (2.6): Node StationofTIM 3V-IE Advanced Module

2. TIM 4R-IE Module

The TIM 4R-IE has two RS232/RS485 interfaces for SINAUT data transmission via conventional WANs and additionally two RJ45 interfaces for connection to IP-based networks (WAN or LAN). This TIM can be used as a communications processor ina SIMATIC S7-300.but is particularly suitable as a SINAUT communications processor for a SIMATIC S7 400 or the control console PC (SINAUT ST7cc or ST7sc). It is then connected without S7-300 CPU a standalone device via one of the two Ethernet interfaces to the S7-400 or the PC.

In a node station with a SIMATIC S7-400 the TIM 4R-IE is connected to the S7-400 via one of its two Ethernet interfaces and can, for example, exchange data by radio with the subordinate stations via an RS232/RS485 interface. It is then connected to the control center via the second Ethernet interface. In this configuration, data can be exchanged between all of the SINAUT stations regardless of which network they are situated as shown figure (2.9). [16]

• Benefits of TIM 4R-IE

- 1. Flexible connection capability to up to four SINAUT networks
- 2. For universal use with S7-400 and control center PC as well as with S7-300.
- Compact module with 4 WAN interfaces saves installation Space in the rack and cabinet
- 4. Reliable storage of important data.



Figure (2.7):Node Station of TIM 4R-IE Module

2.5 DSL Router

The DSL router must be able to handle the Port Forwarding property. With Port Forwarding the router waits for data packages at a configured port and forwards them to a certain port in the internal network. For the MSC protocol any port (starting from port 1025) can be used which will be forwarded to the MSC Server via Port Forwarding.

MSC (Micro Switching Centre) is Ethernet based proprietary protocol which has been developed for cost-effective VPN networks in Telecontrol Systems. Theauthentication of the MSC client at the MSC server takesplace with the username and password and the net data are encoded via a pre-shared key. The connection is initiated by the MSC client. [17]

CHAPTER THREE

DESIGN AND IMPLEMENTATION SYSTEM

3.1Background of Soba Station's Operation

Soba station has included five processes:

- 1. Intake process.
- 2. Sedimentation process.
- 3. Clari-floracator process.
- 4. Filters process.
- 5. Lifting pump process

Three pumps are used in the intake process before the operation electrical valve (V127-V128) must be close after pumps are working we open the electrical valve (V127-V128) and the water go through flow meter and pressure meter to check the outlet of flow and pressure also we use level sensor to check the sea level as shown figure (3.1).



Figure (3.1): Intake Process of Soba Station

In the sedimentation process all water come to tank then distributing to two tanks through electrical valve(V138 and V140) and add chemical material and mixing together by mixer using electrical motor (other motor is standby). There are two outlets in two tanks one for mud go through electrical valve (V139 and V141) interval (min) and duration (sec). We use also flow meter (flow meter 24 and flow meter 25) other for water goes to clari-flocarator as shown figure (3.2).



Figure (3.2): Sedimentation Process of Soba Station

In the clari-flocarator process collecting the water then distributing to three tanks and add chemical material and mixing together using electrical motor 10 (motor 4, motor and motor 16) and mixers (mixer 5. mixer6,mixer11,mixer12, mixer17 and mixer18). After that there are two outlets in three tanks one for mud go through electrical valve (V122, V124 and V126) and other for water goes to Filters process as shown figure (3.3).



Figure (3.3):Clari-FlocaratorProcessof Soba Station

In filters process, there are five filters using level sensor to check the level in the filter and six electrical valves (inlet, outlet, air, water, mud and mixing)after that the water goes to last process lifting pump as shown figure (3.4).



Figure (3.4): Filters Process of Soba Station

In the lifting pumps process the water goes to four small tanks then collecting in one tank using level sensor to check the tank level. After that lifting water by (pump4&pump5) another pump is standby. The water goes through flow meter 23 and pressure meter 2 to check the final outlet of flow and pressure as shown figure (3.5).



Figure (3.5): Lifting Pump Process of Soba Station

NO	Process	components	Code
		Valves	V127-V129
		Level sensor	Level sensor 21
1	Intake	Flow meter	Flow meter 22
		Pump	Pump 1- pump 3
		Pressure meter	Pressure meter 1
		Motor	Motor 22– motor 25
2	Sedimentation	Valves	V138-V141
	Sedimentation	Flow meter	Flow meter 24- flow meter 25
		Level sensor	Level sensor 24- level sensor 25
3		Motor	Motor 1 – motor 21
	Clari-flocarator	Valves	V121-V126
	Clair-Hocarator	Flow meter	Flow meter 21
		Valves	V1-V120
		Level sensor	Level sensor 1- level sensor 20
4	Filter	Flow meter	Flow meter 1- flow meter 20
		Valves	V130-V137
		Level sensor	Level sensor 22- level sensor 23
5	Lifting pump	Flow meter	Flow meter 23
		Pump	Pump 4- pump 6
		Pressure meter	Pressure meter 2

Table (3.1):The Components of Soba StationProcess

3.2Configuration of Siemens Network Automation Step 7Control Center:

- Steps of configuration:
- 1. SIMATIC ST7 hardware Configuration.
- 2. Network Configuration.
- 3. ST7cc configuration.
- 4. ST7ccconfig.
- 5. SCADA configuration.

1. SIMATIC ST7 Hardware Configuration:

The hardware is going to be configured with the tool hardwareconfiguration. The stations are inserting first subsequently the configuration of each station takes place.as shown below steps of configuration:

First Step: insert three stations (01_ST7cc station, MasterTIM station And 03_ station (DSL)) as shown figure (3.6)

Second Step: configuration of 01_ST7cc station and download it to PLC as shown figure (3.7).

Third Step: configuration of MASTER TIM station and download it to PLC as shown figure (3.8).

FourthStep: configuration of DSL 03_station and download it to PLC as shown figure (3.9).



Figure (3.6): Three Stations of Hardware Configuration



Figure (3.7):PcStationConfiguration

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🖘 (0) UR						<u>F</u> ind:	nt
2					=	Profile:	Standard
					·		PROFIBUS DP PROFIDES PA PROFINET IO SIMATIC 300 SIMATIC 400 SIMATIC HMI Station SIMATIC PC Based Control 300/400 SIMATIC PC Station
(0) UR							
Slot Drder number	Firmware MPI add	ress I address	Q address	Comment			
2					_		
3							

Figure (3.8): Master TIM Station Configuration

(0)) UR										Drafiler	
1		PS 307 2	A							100	Fluine.	Standard
2		CPU 31	5-2 PI	I/DP							Ξ₩Р	ROFIBUS DP
X1	Ĩ	MPI/DP									E B F	ROFIBUS-PA
X2	T T	PN-10									⊞ 📅 F	ROFINET IO
X21	P1R	Port 1						1			🕀 🔢 S	IMATIC 300
X21	P2 R	Port 2									🗄 🔝 S	IMATIC 400
3											🕀 🛄 S	IMATIC HMI Station
4		D016xD0	24V/0	.5A							🗄 🔝 S	IMATIC PC Based Control 300/400
5		DI16xDC	24V								🗄 🖳 S	IMATIC PC Station
6		AI4/AO2	:8/8Bit	2								
7	H.F.	TIM 3V-IE	Advar	nced								
-	1.00											
										τ.		
•					111					۲		
	_									_		
(=) (0) UR											
	_		_		1	i.	1			-7		
Slot	Module	e	0	Fi., 1	1 I.	. Q.	. Comment		 			
1	PS 307 2	A	6ES7		_							
2	CPU 31	5-2 PN/I	6ES7	V3.22			SINAUT # 2					
XT	MFI/DP		-	2	° 20	4,7						
12	FNHO				20	46						
121	Fort 1				20	45				11		
1/21	Fort 2				A	44						
3		2016/210102	05.0.7		-	0.0						
4	DUTEXDU	247/0.54	bES/		-	4	5					
5	UII5XDC	24V	bt5/	6 8	U	11						

Figure (3.9): DSL Station configuration

2. Network Configuration:

The networks are going to be configured then MSC master and clients are going to be defined it uses for check the connection between two devices as shown below steps of configuration:

First Step: insert two industrial Ethernet (local and MSC network). Local network is use to connect between 01_ST7cc and MasterTIM other one MSC network is use to connect between 03_station (DSL) and MasterTIM as shown figure (3.10)

Second Step: setting of IE general of 01_ST7cc station as shown figure (3.11)

ThirdStep: setting of keepalives of 01_ST7ccstation as shown figure (3.12)

Four Step: setting of Ethernet interface 2 of TIM4-IE connect with PC as shown figure (3.13)

FifthStep: setting of Ethernets interface 1 of TIM4-IE connect with DSL station as shown figure (3.14)

SixthStep: setting of keepalives of Master TIM as shown figure (3.15)

SeventhStep: setting of time service of Ethernet2 of Master TIM as shown figure (3.16)

EighthStep: setting of time service of Ethernet 1 of Master TIM as shown figure (3.17)

NinthStep: setting of Ethernet interface of TIM3-IE advanced of 03_Station (DSL) as shown figure (3.18)

TenthStep: setting of keepalives of 03_Station (DSL)as shown figure (3.19)

EleventhStep: setting of time service of Ethernet 1of 03_Station (DSL) as shown figure (3.20)

TwelfthStep: save and compile.

🚼 NetPro - [sobastation (Network) C.\Program Files)\s7proj\sobastat]		
Retwork Edit Insert PLC View Options Window Help		_ 6
<u>i i i i i i i i i i i i i i i i i i i </u>		
MPI(1) 1		
MPI ²²		Eind: Mt d
		Selection of the network
01_ST7cc MasterTIM		E - ROFIBUS-PA
Appio IE ation Genera TM 4R-IE		
		E- Stations
2		1.25
local		
Industrial Ethernet		
MSC Network		
Industrial Ethernet	-1	
03_Station(DSL)		

Figure (3.10): Industrial Ethernet Configuration

Gateway C Do not use router C Use router Address:
New
Properties Delete

Figure (3.11):Setting of IE General (PcStation)

operties - IE General		2.0
General Options PROFINET Diagnostics		
Send Keepalives for Connections		
Interval [s] (0=off)	10	
Connection Establishment Monitoring		
Timeout [s]	10	

Figure (3.12):Setting of Keepalives (PcStation)

Set MAC addr	ress / use ISO protocol		
P address: Subnet mask: Subnet	192.168.4.3 255.255.255.0	Gateway C Do not use router C Use router Address:	
not networke	ed		New
Iocal MSC Network			Properties
			Delete

Figure (3.13): Setting of Ethernet Interface 2 (TIM4-IE)Connect with PC

Set MAC address / use ISO protocol	
P address: 192.168.2.2 Subnet mask: 255.255.255.0 © Use Addr	ay not use router router ress: 192.168.2.1
Subnet: not networked	New
MSC Network	Properties
	Delete

Figure (3.14): Setting of Ethernet Interface 1(TIM4-IE)Connect with DSL

nienace	State	Info			
themet 1 themet 2	connected to 'MSC' connected to 'local'	Network' addres addres	s = 192.168.2.2 s = 192.168.4.3		
VAN 1	-	No net	work node configured		
VAN 2	1000	No net	work node configured		
<u> </u>	Ethernet 1	Properties	·		
Send kee	epalives for connection	s - Interval [s] (0-6	5535, 0 = off):	120	
Keepaliv	e monitoring time [s] (U-	255, U = use detau	ultsj:	110	
Connecti	on mode:		MSC master	•	
Send cor	nditional messages as b	locks:			
				0	

Figure (3.15):Setting ofKeepalives (MasterTIM)

nterface Sta 7-300-Backplane themet 1	e Info - No synchronization - Synchronized every	r 6 hours.	
Synchronization cycle: Synchronization master Hour scheme [hr]: Minute scheme [min]: Time of day [hr/min]:	minute scheme no 1 1 1 1	s T Start time: Second scheme [s]:	00:00 -

Figure (3.16):Setting Time of Ethernet2 (MasterTIM)

7-300-Backpl	ane -	No synchronization.		
themet 2	-	Synchronized every	minute.	
Synchronizatio Synchronizatio Hour scheme Minute schem Time of day [h	on cycle: on master: [hr]: e [min]: ır/min]:	hour scheme yes • 6 • 1 •	▼ Start time: Second scheme [s]:	00:00 -

Figure (3.17):Setting Timeof Ethernet 1(MasterTIM)

Set MAC address / us	e ISO protocol		
P address: 192 Subnet mask: 255	.168.1.2 .255.255.0	Gateway C Do not use route C Use router Address: 192	er .168.1.1
Subnet: not networked local			New
MSC Network			Properties
			Delete

Figure (3.18): Setting of Ethernet Interface DSL Station

Internace State	Info	102 100 1 2		
VAN 1	ed to MISC Network add	network node configured		
		,		
Ethernet	1 Proper	ties		
Send keepalives for	connections - Interval [s] (0-65535, 0 = off):	120	
Keepalive monitoring	g time [s] (0-255, 0 = use de	efaults):	10	
Connection mode:		MSC station		
Send conditional me	essages as blocks:			
			-	

Figure (3.19): Setting of KeepalivesDSL Station

Interface State 57-300-Backplane	Info - No synchronization. - Synchronized every 6 hours.	
Synchronization cycle: Synchronization master: Hour scheme [hr]: Minute scheme [min]: Time of day [hr/min]:	hour scheme no 6 • 5 • 5 • 5 • 5 • 5 • 5 • • • • • • • • • • • • •	00:00 •

Figure (3.20):Setting Time of Ethernet 1 DSL Station

3. SINAUT ST7cc Configuration: (Preparation of Transmit Data)

The connections are going to be configured, the subscriber numbers are going to be changed and MSC parameters are going to be set as shown below steps of configuration:

First Step: setting of connection configuration as shown figure (3.21)

Second Step: save it then select subscriber administration as shown figure (3.22)

Third Step: fixed IP from provider for (router TIM4) and select MSC port (port 1025) the select ok after that save for the setting Preparations of all transmit data from 03_station (DSL) to Master TIM (Digital or analog data) as shown figure (3.23)

Four Step: select the digital and analog data as shown figure (3.24)

FifthStep: preparation digital transmit data as shown figure (3.25)

SixthStep: preparationanalog transmit data as shown figure (3.26)

SeventhStep: setting of station configuration Then select import station for (PC is PC station) then ok as shown figure (3.27)

Eighth Step: commutation setting (for check IP of IE general) as shown figure (3.28)



Figure (3.21) Connection Configuration

📆 SINAUT ST7 : Configuration - Project 'sobastation', Path 'C:\Program Files\Sir	emens\Step7\s7proj	sobastat	No. of Concession, Name				
Project Edit SINAUT View Extras Help							
🖆 🔨 🦮 🖬 🖨 🗴 🖻 💡 🌘 🜒 🚦							
€ Subscriber administration *							
Subscriber types:	Last change of conne	ection configuration:	30/10/16 22.0	8.10 Selecte	d CPUs: 0		
E-Stall SINAUT subscribers	Subscriber no.	Subscriber type	Module	Station	SINAUT connected	SINAUT library	
- 🖏 Redundant H-CPUs	01	Application	Application	01_ST7cc	yes	1. 81 M .	
	2	CPU 315-2PN/DP	CPU 315-2 PN/DP	03_Station(DSL)	yes		
🗈 📸 TIMs with TD7onTIM	101	SINAUT TIM	TIM 4R-IE	MasterTIM	yes		
	103	SINAUT TIM	TIM 3V-IE Advanced	03_Station(DSL)	yes	TD7 library / TIM	

Figure (3.22) Subscriber Administration

Internet Access		
Name of the Internet router: (max. 128 characters)	C	+
IP address of DNS server 1	0 . 0 . 0 . 0	
IP address of DNS server 2	0.0.0	
Fixed IP address of the router:	10 . 209 . 77 . 2	
MSC port of TIM:	1025 [1024 - 65535]	
Options for partners in GPRS network -		
Monitoring time (min):	10 [0 - 65535]	
Collect data volume:		
Transport protocol UDP:	Г	
οκ	Cancel He	eln

Figure (3.23) MSCMaster Properties

Object name	Object description	J
🕤 WatchDog	Supervision of the CPU-TIM-Connection.	ſ
😙 Partner Status	Shows the connection status for up to 8 SINAUT subscribers.	
🕤 Op Input Monitor	Shows the status of operator inputs.	
SmServiceCenter	SMSC access data object	
Sms01_S	ST7 SMS object: send 1 SMS text, incl. 1 value (optional), to an individual phone.	
😙 Dat 12D_S	ST7 Data-object, send max. 12 double words with any information.	I
Dat 12D_R	ST7 Data-object, receive max. 12 double words with any information.	1
Bin04B_S	ST7 Binary-information object, send 4 bytes status/binary information.	
😙 Bin04B_R	ST7 Binary-information object, receive 4 bytes status/binary information.	
Ana04W_S	ST7 Analog-value-object, send 4 analog values (16 bit valuein the INT format).	
😙 Ana04W_R	ST7 Analog-value-object, receive 4 analog values (16 bit value in the INT format).	
😙 Mean04W_S	ST7 Mean-value-object, send 4 mean values (16 bit value in the INT format).	I
😙 Mean04W_R	ST7 Mean-value-object, receive 4 mean values (16 bit value in the INT format).	1
Cnt01D_S	ST7 Counter-value-object, send 1 counter value (32 bit SINAUT format).	I
Cnt01D_R	ST7 Counter-value-object, receive 1 counter value (32 bit SINAUT format).	1
Cnt04D_S	ST7 Counter-value-object, send 4 counter values (32 bit SINAUT format).	I
Cnt04D_R	ST7 Counter-value-object, receive 4 counter values (32 bit SINAUT format).	
Cmd01B_S	ST7 Command-object, send 1 byte commands (1-out-of-8).	1
😙 Cmd01B_R	ST7 Command-object, receive 1 byte commands (1-out-of-8).	
Set01W_S	ST7 Setpoint-object, send 1 setpoint (16 bit) and receive current on-site setpoint.	
Set01W_R	ST7 Setpoint-object, receive 1 setpoint (16 bit) and send current on-site setpoint.	
😙 Par12D_S	ST7 Parameter-object, send max. 12 double words with parameters and receive current on-site parameter	8
😙 Par12D_R	ST7 Parameter-object, receive max. 12 double words with parameters and send current on-site parameter	
Par12r1D R	ST7cc Parameter object receive max 12 parameters at 1 double word each able to reply on-site parameters at 1 double word each able to reply on site parameters at 1 double word each able to reply on site parameters at 1 double word each able to reply on site parameters at 1 double word each able to reply on site parameters at 1 double word each able to reply on site parameters at 1 double word each able to reply on site parameters at 1 double word each able to reply on site parameters at 1 double word each able to reply on site parameters at 1 double word each able to reply on site parameters at 1 double word	10

Figure (3.24) Binary and AnalogData



Figure (3.25) Preparation of Digital Transmit Data

Subscriber administration *	
Subscriber types:	Last change of connection configuration: 30/10/16 22.08.10 Selected CPUs: 0
	Channel name Channel type Input addr. Output addr.
📕 📲 Redundant H-CPUs	No AnalogInput 1 Analog value send P#M 8.0 WORD 1
Redundant ST7cc/ST7sc	Analoginput 2 Analog value send P#I 10.0 WORD 1
E-🛱 TIMs with TD7onTIM	Analoghput 3 Analog value send P#M 12.0 WORD 1
All Destination Subscribers 103 / 03_Station(DSL) 1 / Bin04B_S 2 / Ana04W_S 	De Analoginput_4 Analog value send P#M 14.0 WORD 1
-	Channel name: AnalogInput_1 Channel type: Analog value send Channel active: Send trigger Input address
	Send at change of: 270 Memory area: C DB @ Memory C Input
	Time trigger
	Active: 1
	Hour: Minute: Time of day: Image: Minute: Address (Byte): 8
	Hour: Minute: Second Time scheme: Image: Second Image: Second Unipolar analog value: Image: Second
	Trigger signal Smoothing factor:
	Active: Fault suppression time: 0 s
	Memory area: C DB C Memory C Input

Figure (3.26) Preparation of Analog Transmit Data

tation:	SIMATIC PC Stati	on(1)	Mode:	RUN	I_P		
Index	Name	Туре	Ring	Status	Run/Stop	Conn	
1	Application	Application		125	0	(\$)	
2	IE General	IE General			0		
3							
4							=
5							
6							
7							
8							-
9							
10							
11							
12							
13							
14							
15							
16							
17					1		
	Add	Edit		Delete		Ring ON	
Stat	ion Name	Import Station			Dis	sable Static	'n

Figure (3.27) Pc Station Configuration

File Language Help	
SIMATIC NET configuration Access points	
Modules Access points	?
Access point Interface parameter assignment Module	
MICROWIN	
S7ONLINE TCP/IP -> Realtek PCIe GBE Famil Realtek PCIe GBE Famil	
> CP_SM_1:	
CP_L2_1:	
▶ CP_L2_2:	
CP_PN_1:	
CP_H1_1: TCP/IP -> Realtek PCIe GBE Famil Realtek PCIe GBE Famil	
> MPI	
DPSONLINE	
FWL_LOAD	

Figure (3.28) Commutation Setting

4. ST7cc Config (Preparation Received Data)

First Step: global setting to check the name and IP address as shown figure (3.29)

Second Step: project setting for activate parameter as shown figure (3.30)

ThirdStep: setting local IP, access point and subscriber number as shown figure (3.31)

FourthStep: preparation of all received digital data as shown figure (3.32)

Fifth Step: preparation of all received analog data as shown figure (3.33)

cc - Global settings		
omputer Project La	nguage	
Server 1		
Computer name:	CONTROLROOM	
IP address:	192.168.4.2	
Server 2		
Computer name:		
IP address:		
	Add server information to system	
Modifying C:\Progra Modifying C:\Progra Calling RcChkF C	mData\SIEMENS\ST7cc\base\hosts (mData\SIEMENS\ST7cc\base\hostname K	ЭК э ОК
OK		Canad
UK		Lancel

Figure (3.29):Global Setting (Computer)

omputer 10je		
Information —		
Project opene	ed in ST7ccConfig:	
E:\ZETA TF	AINING\farahzeta\ST7_PROJECT.XML	
Project activa	ated for ST7cc Runtime:	
E:\ZETA TF	AINING\farahzeta\ST7_PROJECT.XML	
Modifying C:\	ProgramData\SIEMENS\ST7cc\base\ss_config OK	

Figure (3.30):Global Setting (Activate Parameter)

Gerver 1 Computer name: COI Gubscriber number: 1	VTROLROO Server 2 Computer nam Subscriber nur	e:
Add Communication p	artner er no., Local ID and Access communication partner:	
Subscriber no.:	Local ID: S7 connection_1 Access Point: CP_H1_1:	Cancel
New Edit		Delete

Figure (3.31):Setting of local IPs, Access Point and Subscriber Number

🕒 Library		Partner	2	Partner name	Subscriber2		
SinautSystem							
3 2 Subscriber2		Object	1	Variable	1		
⊟- <u>0a</u> 1 Bin048_S					,		
🕀 📴 1 intake_V127		 Details Tunica 	l/Variable —				
		e e ano r y pro a				_	_
🕀 😡 2 intake.V128		Group name	intake_			Internal W	/inCC·Variable 📃
🕀 📴 3 intake.V129							
🕒 📴 4 intake.pump1		Location					
🕀 📴 5 intake.pump2				_		-	
🖻 📴 6 intake.pump3		Byte index	0	Bit index	0	Length	1
🖻 📴 7 lifting_pump.pump4							
😑 📴 8 lifting_pump.pump5		Attribute name	e V127			Type S	Sub type 1
🖻 📴 9 lifting_pump.pump6			,				.)
🖶 💼 📴 10 lifting_pump.V130							
🔁 📴 11 lifting_pump.V131		- Message block	details				
🔁 📴 12 lifting_pump.V132				_		-	
🖻 📴 13 lifting_pump.V133	=	Message	496	Trigger	U	ld	×
🖻 📴 14 lifting_pump.V134							
😑 📴 15 lifting_pump.V135				Class	Error	l ype	Alarm
😑 📴 16 lifting_pump.V136							
		Message text	allarm1vah	/e127			
🕀 😡 18 sidementation.motor_22							
🕀 😡 19 sedimentation.motor23			Comment				
🕀 😡 20 sedimentation.motor24							
🕀 📴 21 sedmentation.motor25		Apply					
22 sedimentation.V138		changes					
23 sedimentation.V139							
- 😡 24 sedimentation.V140		Undo					
25 sedimentation.V141		changes					
26 clari-flocarator.V121							
27 clari-flocarator.V122							
28 clari-flocarator.V123							
📗 💷 29 clańdłocatator V124							

Figure (3.32):Received Digital Data

File Edit Admin View ?	
Lbrary OSinauSystem S2Subscribe2 Bro48_S ZAna04W_S	Pather 2 Pather name Subscriber2 Object 2 Variable 1 Details Typical / Variable
Eren Innake_FT Len STOc:intake_PH Eren 2 intake_TUR Frem 2 intake_trun	Group name intake_ Internal WinCC-Variable IT
Browner Althing_pump.PH Browner Althing_pump.PH Browner Althing Pump.PH Browner Althing Pump	Byte index 0 Bit index 0 Length 16 Attribute name PH Type M Sub type 1
erion 6 Analew S erion 7 Analew S	- Parameter block details
	Block type M LL raw 0 UL raw 27000
	Compression MOM Interv.length Oh Interv.start Om
	Apply changes Undo changes

Figure (3.33):Received Analog Data

5. SCADA Configuration:

First Step: setting of startups of computer properties (alarm logging, tag logging and graphic runtime) as shown figure (3.34)

Second Step: ST7 server from tag management as shown figure (3.35)

Third Step: generation of all tags from WINCC (edit then select complete WINCC generation) as shown figure (3.36)

Fourth Step: generation tags to WINCCas shown figure (3.37)

General	Startup	Parameters	Graphics Runtime	Runtime		
WinCC	Runtime	Start Up Order	-			
Glo	bal Script	Runtime				
🔽 Ala	rm Loggin	g Runtime				
V lag	g Logging	Runtime				
Gra	pont nunui phics Rur	ntime				
Me	ssage Sec	quence Repor	t /SEQPROT			
Use Use	er Archive					
					1	Edit
8 .						
Addition	nal Tasks.	/Applications:				
						Add
					ſ	Remove
						TIGHTOTO
					1	I l=
						Up
						Down
						Edit
1						
Sequ	ence of V	vinCC tasks th	at are started when	the WinCC proje	ct is activated	

Figure (3.34):Computer Properties

Tag Management	« []	ST7 server				F	ind	
- III Tag Management		Name	Data Type	Length	Format adaptation	Connection	Group	Address
🗄 🍄 Internal tags	1	clari-flocarator_flow-meter21	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	clari-flocarator	2_5_0_3
- I, SIMATIC S7 Protocol Suite	2	clari-flocarator_motor1	Binary Tag	1		Subscriber2	clari-flocarator	2_1_0_32
- II MPI	3	clari-flocarator_motor2	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_1
NewConnection 1	4	clari-flocarator_motor3	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_2
PROFIBUS	5	clari-flocarator_motor4	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_3
	6	clari-flocarator_motor5	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_4
II Slot PLC	7	clari-flocarator_motor6	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_5
П ТСР/ГР	8	clari-flocarator_motor7	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_6
	9	clari-flocarator_motor8	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_7
To do at int Fals and A	10	clari-flocarator_motor9	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_8
	11	clari-flocarator_motor10	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_9
	12	clari-flocarator_motor11	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_10
II Soft PLC	13	clari-flocarator_motor12	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_11
B- , st7	14	clari-flocarator_motor13	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_12
⊟- III ST7 server	15	clari-flocarator_motor14	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_13
🗈 🕬 SinautSystem	16	clari-flocarator_motor15	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_14
	17	clari-flocarator_motor16	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_15
💀 Structure tags	18	clari-flocarator_motor17	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_16
E- 😚 VALVE	19	clari-flocarator_motor18	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_17
	20	clari-flocarator_motor19	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_18
	21	clari-flocarator_motor20	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_19
	22	clari-flocarator_motor21	Binary Tag	1		Subscriber2	clari-flocarator	2_4_0_20
	23	clari-flocarator_V121	Binary Tag	1		Subscriber2	clari-flocarator	2_1_0_26
	24	clari-flocarator_V122	Binary Tag	1		Subscriber2	clari-flocarator	2_1_0_27
	25	clari-flocarator_V123	Binary Tag	1		Subscriber2	clari-flocarator	2_1_0_28
	26	clari-flocarator_V124	Binary Tag	1		Subscriber2	clari-flocarator	2_1_0_29

Figure (3.35):setting of ST7 Server

Ec	dit Admin View ?	
	New Station New Local TIM Insert Subscriber Tree	
i 🖂	Complete WinCC Generation	
-	Search	
 	Create the project picture-typic Create the technical picture-typ	als
	Project Settings	F2
	Global Settings	F3

Figure (3.36):Generation Tags to WINCC

WnCC Configuration Studio								
File Edit View Help								
Tag Management	*	II ST7 server					Find	
⊒- <mark>∭</mark> Tag Management		Name	Data Type	Length	Format adaptation	Connection	Group	Address
🗉 🍄 Internal tags		67 intakeV127	Binary Tag	1		Subscriber2	intake_	2_1_0_1
- L SIMATIC S7 Protocol Suite		68 intake_flow-meter	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2		2_5_0_1
- II MPI		69 intake_pump1	Binary Tag	1		Subscriber2		2_1_0_4
NewConnection 1		70 intake_pump2	Binary Tag	1		Subscriber2		2_1_0_5
		71 intake_pump3	Binary Tag	1		Subscriber2		2_1_0_6
Industrial Ethernet		72 intake_temp	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2		2_2_0_3
		73 intake_TUR	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2		2_2_0_2
I TOP ID		74 intake_V128	Binary Tag	1		Subscriber2		2_1_0_2
ILP/IP PROFIBUS (II) Industrial Ethernet (II) Named Connections Soft PLC Soft PLC Soft PLC Soft Structure SinautSystem SinautSystem		75 intake_V129	Binary Tag	1		Subscriber2		2_1_0_3
		76 lifiting_pump_V131	Binary Tag	1		Subscriber2	lifiting_pump	2_1_0_11
		77 lifting_pumpchlorine_	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	lifting_pump_	2_3_0_3
		78 lifting_pump_level-sensor22	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	lifting_pump_	2_7_0_1
		79 lifting_pump_level-sensor23	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	lifting_pump_	2_7_0_2
		80 lifting_pumptemp	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	lifting_pump_	2_3_0_2
		81 lifting_pump_flow-meter23	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	lifting_pump	2_6_0_4
		82 lifting_pump_PH	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	lifting_pump	2_2_0_4
		83 lifting_pump_pressure-meter2	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	lifting_pump	2_7_0_3
		84 lifting_pump_pump4	Binary Tag	1		Subscriber2	lifting_pump	2_1_0_7
		85 lifting_pump_pump5	Binary Tag	1		Subscriber2	lifting_pump	2_1_0_8
		86 lifting_pump_pump6	Binary Tag	1		Subscriber2	lifting_pump	2_1_0_9
		87 lifting_pump_TUR	Floating-point number 64-bit IEEE	8	DoubleToDouble	Subscriber2	lifting_pump	2_3_0_1
		88 lifting_pump_V130	Binary Tag	1		Subscriber2	lifting_pump	2_1_0_10
		89 lifting_pump_V132	Binary Tag	1		Subscriber2	lifting_pump	2_1_0_12
		90 lifting nump V133	Binary Tag	1		Subscriber2	lifting nump	2 1 0 13

Figure (3.37):GenerationTags in ST7

Table (3.2): Hardware and Software Components Used

No	Item	Code		
1	TIM4R-IE	6NH7800-4BA00		
2	TIM 3V-IEAdvanced	6NH7800-3CA00		
3	РС			
4	Power supplyPS3075A	6ES7307-1EA00-0AA0		
5	S7-CPU315PN/DP	6ES7313-5BF03-0AB0		
6	MicroMemoryCard	6ES7953-8LF11-0AA0		
7	Digital input module	DI16Xdc24V/0.5A		
8	Ethernet cable			
9	Digital output module	DO16Xdc24V/0.5A		
10	Analogue input	AI4/AO2Xb/8bit		
	SINAUTST7			
11	Engineering Software	6NH7997-0CA50-0AA0		
	Edition 09/2009			
12	SINAUTST7cc V2.7	6NH7997-7CA15-0AA1		
13	STEP 7 V5.4 SP5	6ES7810-4CC08-0YA5		
14	SIMATIC NETPC			
	software Edition 2006	0UK1/04-1LW04-3AAU		
15	SIMATIC	CANCOOL IDMOC OANO		
15	WINCCV7.2 SP2	0AV0501-1BW00-2AAU		

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 The Result of Implementation

Intake Process

≻ The status of Pump_1

When the soft starter of pump $_1$ is stopping, the pump cannot be working so the result of pump_1 is default indicated by red color. See the figure (4.1)



Figure (4.1):Default of Pump_1

If the soft starter of pump _1 is starting, the pump can be working so the result of pump_1 is running indicated by green color. See figure (4.2)



Figure (4.2):Running of Pump_1

> The status of electrical motor (V_127)

When the contactor of electrical motor (V_127) in the intake process is de-energize the auxiliary contact usually is normal open so the result of (V_127) is default indicated by red color. See figure (4.3)



Figure (4.3): Default of Electrical Motor_V127

if the contactor of electrical motor (V_127) in the intake processes energize the auxiliary contact usually is normal open will change to normal close so the result of (V_127) is running indicated by green color. see figure (4.4)



Figure (4.4): Running of Electrical Motor V_127

\succ The status of level sensor_21

The minimum value of level sensor_21 = 3.5 and the maximum value of level sensor_21 =11When the value of level sensor_21 is less than or equal 3.5 or more than or equal 11 indicated alarm. Now the value of level sensor_21 is = 3 so the result is default indicated by red color. See figure (4.5)



Figure (4.5):Default of Level Sensor _21

If the minimum value of level sensor_21 = 3.5 and the maximum value of level sensor_21 =11 When the value of level sensor_21 is less than or equal 3.5 or more than or equal =11 indicated alarm. Now the value of level sensor_21 is = 8 so the result is running indicated by green color. See figure (4.5)



Figure (4.6):Running of Level Sensor _21

≻ The status of pressure meter_1

The minimum value of pressure meter_1= 1 and the maximum value of pressure meter_1=3.5 When the value of pressure meter_1 is less than or equal 1 or more than or equal = 3.5 indicated alarm. Now the value of pressure meter_1 is = 1 so the result is default indicated by red color. See figure (4.7)



Figure (4.7):Default of Pressure Meter 1

If the minimum value of pressure meter_1= 1 and the maximum value of pressure meter_1=3.5 When the value of pressure meter_1 is less than or equal 1 or more than or equal 3.5 indicated alarm. Now the value of pressure meter_1 is = 2 so the result is running indicated by green color. See figure (4.8)



Figure (4.8):Running of Pressure Meter 1

NO	Device	Name of process	High value	Low value	
1	Level sensor 21	Intake	11 m	3.5 m	
2	Flow meter_22	Intake	10000 m^3/hour	0 m^3/ hour	
3	Pressure meter_ 1	Intake	3.5 bar	1 bar	
4	РН	Intake	8.5 moles/liter	7 moles/liter	
5	TUR	Intake	5 NTU	1 NTU	
6	Level sensor_24	Sedimentation	90%	30%	
7	Level sensor_25	Sedimentation	90%	30%	
8	Flow meter_ 24	Sedimentation	2500 m^3/ hour	0 m^3/ hour	
9	Flow meter _25	Sedimentation	2500 m^3/ hour	0 m^3/ hour	
10	Flow meter_ 23	Lifting pump	8500 m^3/ hour	0 m^3/ hour	
11	Level sensor _22	Lifting pump	98m	45m	
12	Level sensor _23	Lifting pump	98m	45m	
13	Pressure meter _2	Lifting pump	6 bar	5 bar	
14	РН	Lifting pump	8.7 moles/liter	7.5moles/liter	
15	TUR	Lifting pump	12000 NTU	500 NTU	
16	Chlorine	Lifting pump	4 mg/L	0 mg/L	

Table (4.1): Actual Value of Device Using In theProcessfromSoba Station

Table	$(12) \cdot \mathbf{C}$	of Taxan		I Latin a In	Translama and a dia	
I able	(4.2):50me	or input	inioaule	Using in	implementatio	П

NO	Input address	Description			
1	10.0	Electrical valve V_127 intake process			
1	10.0	(digital input)			
2	I0.1	Pump 1 intake process (digital input)			
3	PIW100	level sensor 21 intake process			
5	1100	(analog input)			
1	PIW102	pressure sensor 1 intake process			
+	1102	(analog input)			
5	PIW/10/	PH intake process			
5	1104	(analog input)			
6	PIW106	level sensor 24 sedimentation process			
0	1100	(analog input)			
7	DIW/108	flow sensor 23 lifting process			
	1100	(analog input)			
8	PIW/110	level sensor 23 lifting process			
0	1100110	(analog input)			
Q	PIW112	pressure meter2 lifting process			
	1100112	(analog input)			
10	PIW/11/	PH lifting process			
10		(analog input)			
11	PIW116	TUR lifting process			
	1100	(analog input)			
12	PIW /118	Chlorine lifting process			
1 4	1199110	(analog input)			

CHAPTER FIVE

CONCLUSIONSAND RECOMMENDATIONS

5.1 Conclusions

The control center had been configured for authorized users at Khartoum state water corporation center, for remote monitoring of water plant, communications, and system diagnostics. The WINCC software also provides real-time information on reservoirs water level, flow values, water pressure and other mission-critical data, as well as reporting.

SCADA WINCC in each station and DSL router in the center and SINAUT ST7cc for communication use for data exchange between two stations.

5.2 Recommendations

The SINAUT ST7cc. Would is useful to further for communication between Khartoum state water corporation and more than sub-station using DSL or GPRS.

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