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Remote control and

Tele-supervision of an X-RAY collimator

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Abbreviation list

HMI: Human-Machine Interface

SCADA: Supervisory Control and Data Acquisition

CTM: Centralized Technical Management

DCS: Digital Control Systems

ERP: Enterprise Resource Planning

MES: Manufacturing Execution System

PLC: Programmable Logic Controllers

CIM: Computer Integrated Manufacturing

PID: Proportional Integrator Derivative

WMI: Windows Management Instrumentation

SNMP: Simple Network Management Protocol

WAN: Wide Area Network

RTU: Remote Terminal Unit

MTU: Master Terminal Unit

Profibus: Process Field Bus

Modbus: Modicon Communication Bus

LAN: Local Area Network

IP: Internet Protocol

TCP: Transmission Control Protocol

UDP: User Datagram Protocol

WinCC RT: Windows Control Centre Runtime

OSI: Open Systems Interconnections

WinCC: Windows Control Centre

SQL: Structured Query Language

HTTP: hypertext transfer protocol

HTTPS: Hypertext Transfer Protocol Secure

FTP: File Transfer Protocol

AWP: Annual Work Plan

IIS: Internet Information Services

RT: Run Time

CPU: Central Processing Unit

HTML: Hypertext Mark-up Language

WWW: World Wide Web

SMTP: Simple Mail Transport Protocol

MRI: Magnetic Resonance Imaging

SMS: Signifie Short Message System

Abstract

In general this thesis discuss Supervision including SCADA systems which signify to supervisory control and data acquisition, and all important information about the implementation, structure and function of supervision. The purpose of these systems are to guarantee the proper functioning of the process and for safety reasons of individuals and installation. And specifically, we discuss Tele-supervision with remote control of an X- RAY collimator using SIMATIC software solutions.

ملخص

بشكل عام ، تناقش هذه الرسالة الإشراف بما في ذلك أنظمة SCADA التي تدل على التحكم الإشرافي والحصول على البيانات ، وجميع المعلومات المهمة حول تنفيذ وهيكل ووظيفة الإشراف. الغرض من هذه الأنظمة هو ضمان حسن سير العملية ولأسباب تتعلق بسلامة الأفراد والتركيب. وعلى وجه التحديد ، نناقش المراقبة عن بعد مع التحكم عن بعد في ميزاء الأشعة السينية باستخدام حلول برمجية.SIMATIC

Résumé

En général, cette thèse discute de la supervision, y compris les systèmes SCADA qui signifient le contrôle de supervision et l'acquisition de données, et toutes les informations

importantes sur la mise en œuvre, la structure et la fonction de la supervision. Ces systèmes ont pour but de garantir le bon fonctionnement du procédé et pour des raisons de sécurité des personnes et de l'installation. Et plus précisément, nous discutons de la télé-supervision avec la contrôle à distance d'un collimateur de rayons X à l'aide des solutions logicielles SIMATIC.

General Introduction

Tele-supervision including SCADA (supervisory control and data acquisition) are widely used in many field and disciplines such as industry , Oil and Gas sector , health care, agriculture. The implementation of Tele-supervision is in upward curve due to the advancement in technologies nowadays there are powerful processors, smart sensors and better network all these advancement contribute in the enhancement of Tele-supervision features which lead to a better use of it.

Remote control, monitoring, and data acquisition are SCADA features that have an outstanding impact on the performance of the process as well as enhancing the security of individuals with the preservation of (installation, devices, and all equipment). Also allows reducing costs and the number of visits to the site. The human-machine interface is the intermediary tool between the human and the process that allows real-time visualization and control basing on software or hardware. A soft interface is a graph designed by the supervisor engineer with all necessary elements for example (buttons, texts, LEDs, the displays, actuators). Nowadays telemedicine has become a reality in all departments including Tele-care, Tele-radiology and Tele-surgery, the Tele-supervision adds a great value and feature to this new domain that can save lives, having to ability to take radiology images and process them remotely through the internet is a great advantage. Because a radiologist can make and obtain X-Ray radio images remotely even in other countries, this can help in emergencies and allow experts to share their proficiency and minimizes the risk of x-ray radiation on radiologists.

The present work essentially deals with remote control of an X-ray collimator through the internet with a designed interface. There are features offered by Siemens in many software such as WinCC Explorer and TIA Portal that lead accomplishing this application. Therefore, talking about remote control of the process we have to research and learn more about network and communication protocols, which are Profibus and Profinet protocols developed by Siemens for their PLCs in local area network and TCP/IP protocol when using the wide area network which is the internet.

General Introduction

The organization of this work in the first chapter discuss about supervision its implementation, objective, functions, the CIM pyramid. Chapter two, discuss about SCADA systems for supervision and data acquisition with general information on its main component (RTU, MTU, PLC), the evolution of SCADA systems and areas of application it also contain a representation on Tele-medicine and It's different departments Tele-care, Tele-radiology, Telesurgery. While the Chapter three explain our application using two methods realization and simulation by different SIMATIC software, with details on how to set up the process, create the graphical interface, configurations and provide information's on local area network (LAN) and wide area network (WAN).

Chapter 1

Supervision aspect

1.1 Introduction

Supervision comprises two words, namely "super", that is, superior or extra, and "vision", that is, sight or perspective. The literal meaning of the term "supervision" is to "oversee". Supervision is defined as the use of suitable network resources (hardware or software) in order to obtain information on the use and status of networks and their components (software, hardware). This information can then be used as tools to manage in an optimal way (automatic if possible) the treatment of breakdowns as well as the quality of the networks (problems of overload). They also make it possible to predict any future necessary developments [1].

Supervision is at a higher level and which superimposes the control loop, it ensures the operating conditions for which the estimation and control algorithms order have been designed. Among the main tasks of supervision are monitoring, decision support, diagnosis and detection. The goal is to have a real-time visualization, thanks to previously created and configured views, presenting the operator with useful information, which allows him to make good decisions appropriate to his objectives such as the conduct of the process, production rate and product quality and safety of goods and equipment [1].

1.2   General information about supervision

1.2.1 Definition of supervision

Supervision is an advanced form of human-machine dialogue, it has many advantages for industrial production processes. It makes it easier for the operator to monitor the operating status of a process as well as its control, as it allows, to create and configure using supervision software, to integrate and to visualize in real time all the steps necessary for the manufacture of a product and to detect the problems that can overwhelm during operation in an industrial plant [4].

The functions of supervision are numerous, we can mention a few:

- Ensures communication between the automation equipment and the IT tools for scheduling and production management.

- Coordinates the operation of a set of linked machines making up a production line, ensuring the execution of common orders (start, stop, etc.) and tasks such as synchronization.
- Assists the operator in diagnostic and maintenance operations [4].

1.2.2 Utility of supervision

The main tasks of supervision are given as follow:

- We supervise to have visibility on the information system. This allows to have information in real time, to know the state of health of the network, the systems,

The performances.

- Supervising also makes it possible to prevent breakdowns and anticipate breakdowns.
- By supervision, you can also know the effect of an action (adding a new client, new machine, etc.) on the system. So we can know and technically quantify the impact of this type of modification and react quickly if necessary.
- In the event of a malfunction, the productivity of the company is affected. So you always have to be aware of what's going on.

To sum up, we supervise to be alerted to problems, and if possible to anticipate them. We will carry out tests, and analyze the results in the form of graphs or other, and according to criteria trigger actions (restart of services, alert of the administrator on the behavior of a process etc.), set up actions in the face of events [1].

1.2.3 Where and when the supervision is introduce

- When designing a new means of production and when a strong investment is decided, the addition of supervision has only a minor impact. It is therefore desirable to include it from the design stage [2].
- When it is necessary to improve the efficiency of existing means of production.
- If the equipment is old, the documentation weak or if the designers of the production tool have disappeared, then it is not advisable to set up supervision a posteriori.
- The return on investment is very high [2].

1.2.4   Procedure for carrying out a Supervision

Supervision quickly becomes exciting, as the possibilities are numerous. This is why, before embarking on the programming of the API or the HMI, it is necessary to clearly define the different possible scenarios and then to establish the specifications [2].

The main steps to achieve optimized supervision are given as follows:

Step 1: Definition of scenarios, functional specifications.

Step 2: Modification of the original API program.

- Simulation (forcing) of the supervision created.
- Validation of the new API program.

Note: At this stage, it is essential to ensure that the API program is working perfectly. Debugging the supervision without being sure that the application is correct is not an option [2].

Step 3: creation of the transfer table.

Step 4:

- Creation of variables.
- Communications setup.
- Design of synoptic and animations.
- Supervisory testing.
- Validation of the overall operation.

1.3   Supervisory implementations

In supervision, we find the functions of failure detection or monitoring, diagnosis andreconfiguration:

1.3.1   Control

Supervisory control has been emerging as an element in process control for several decades in such systems the operator can become part of the control loop by switching to manual control. Usually each control station displays both the variable being controlled (e.g., room temperature for the thermostat) and the control signal (e.g., the flow of heat from the furnace). The role of controlling is to execute a set of operations (elementary or not depending

on the level of abstraction at which we place ourselves) to the process by setting instructions operation in response to work orders [3].

It generally involves carrying out a sequence of operations constituting a range of manufacturing for the purpose of manufacturing a product in response to a customer request [3].

The command groups together all the functions, which act directly on the process actuatorsthat ensure:

- Operation in the absence of failure,
- Recovery or mode management,
- Emergency treatments,
- Part of the corrective maintenance [3].

1.3.2 Monitoring

Monitoring is limited to functions that collect information, archive it, make inferences, etc. without really acting on the process or on the order. Monitoring therefore has a passive role vis-a-vis the control system and process the monitoring part:

- Continuously collects all signals from the process and control
- Rebuild the real state of the controlled system
- Makes all the necessary inferences to produce the data used to draw up operating histories
- Implements a fault handling process when a system breakdown appears [3].

1.3.3 Diagnosis

Consists of determining the origin and/or the causes which may have generated the detected symptom. At this stage, the system must have the ability to decide when the process is in a normal operating condition, and when corrective action should be applied [2].

1.3.4 Reconfiguration

The corrective action corresponds to the step of reconfiguring the control so as toreturn the process to a normal operating mode

Industrial supervision is used by many processes:

- For the monitoring of equipment or premises, we will then speak CTM (Centralized Technical Management).

- for process control mainly of the continuous type: DCS (digital control-command systems); or SCADA (Supervisory Control and Data Acquisition);

- For manufacturing systems, these processes group together all the functionalities of the supervisor) [2].

1.4 Supervision software

Supervision software is a class of application programs dedicated to production, which has the following role:

- Assistance to the operator in his production process control actions (dynamic HMI interface)

- Visualization of the state and evolution of an automated process control installation, with highlighting of anomalies (alarms)

- The collection of real-time information on processes from remote sites (machines, workshops, factories, and their archiving

- Assistance to the operator in his work and in his decisions (parameter proposals, signaling of faulty values, help in solving a problem) [2].

1.4.1 Synoptic

Essential function of supervision, provides a synthetic, dynamic and instantaneous representation of all the means of production of the unit, it allows the operator to interact with the process and to visualize the normal behavior.

A synoptic editor makes it easy to create human-machine interfaces that combine a modern look and the efficiency of the interactive operator: zoom in operation, transparencies [3]. Figure (1.1.) shows examples of human interfaces.
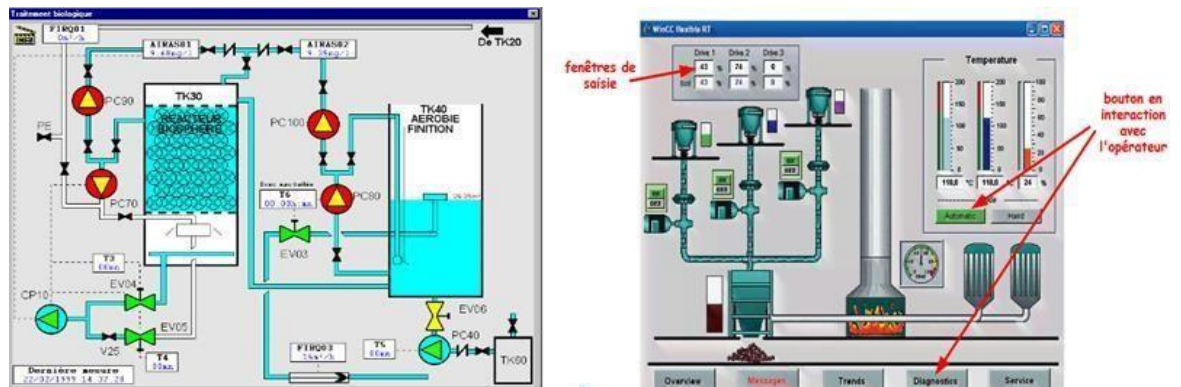
Figure 1. 1. Synoptic function [1]

1.4.2 Curves

In general curves are used as a graphical representation of different process data. Also,the curves represent a powerful tool for analyzing historical variables [3]. Figure (1. 2) illustrates an example about a graphical presentation.
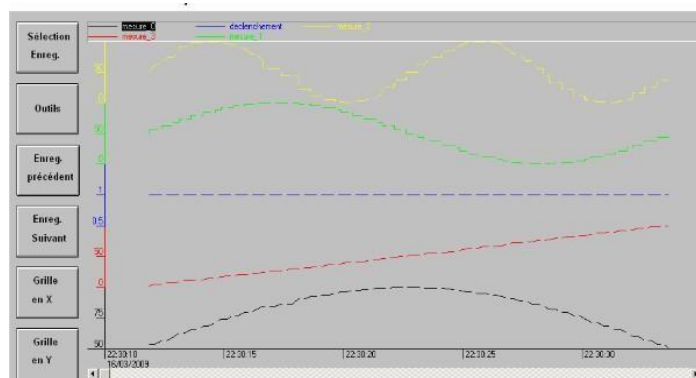
Figure 1. 2. View of curves [3]

1.4.3 Alarms

Alarms play an important role in supervision of process. They allow to :

- Calculate in real time the triggering conditions of the alarms.
- Display all alarms according to priority rules.
- Provide management tools from consideration to complete resolution.
- Ensure the recording of all the alarm processing steps [3].
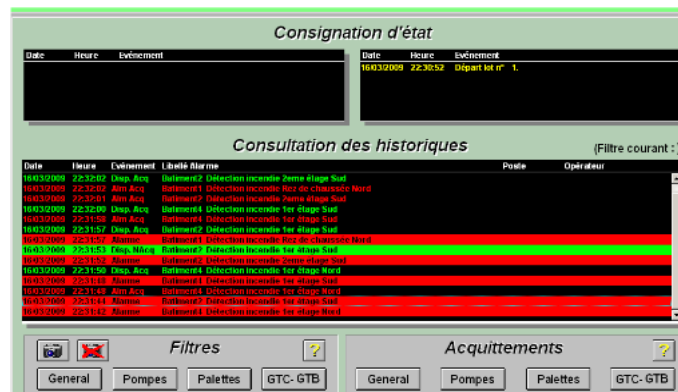
Figure 1. 3. Alarms view [3].

1.4.4 History of the process

Historization allows:

- Periodic saving of quantities (archiving over time)

- Backup of time stamped events (selective archiving)

- Provide search tools in archived data

- The possibility of redoing the synoptic with the archived data (video recorder or replay function)

- keep a validated trace of critical data (production data traceability) [3].

The following picture shows an interface of archiving.

Figure 1. 4. Process history view [3].

1.4.5 Routing management

Range management allows to provide a management tool for manufacturing batches(batches), and manage machine settings for each batch as given in Figure (1. 5.).
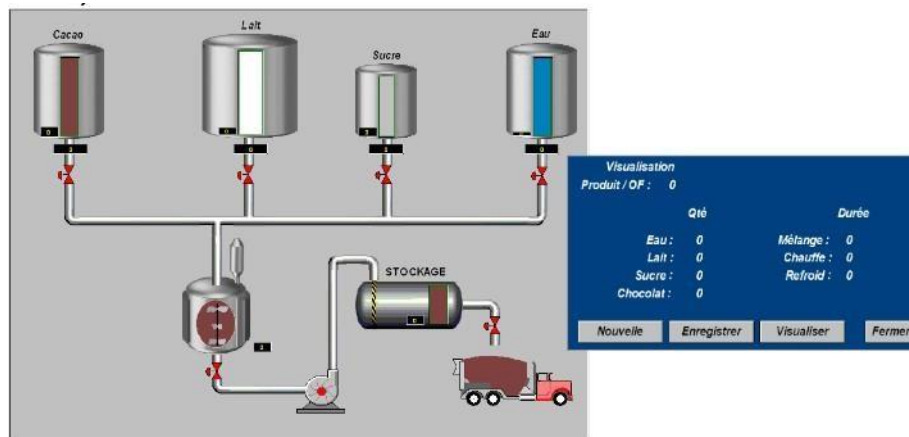
Figure 1. 5. Routing management view [3].

1.5   The role of supervision

Nowadays, new supervision processes are beginning to emerge based on distributed system architectures allowing remote surveillance or monitoring. Supervision is therefore practically indispensable on complex automated installations. Supervisory systems may also include systems that allow you to send an SMS or notify the operator in the event of a problem on the production [4].

From the evolution of the need for data processing, supervision includes:

- HMI, SCADA, MES, ERP
- Simulation
- Traceability
- Modeling
- Open communication

1.5.1 The functional modules of a supervision system

In general, a supervision system consists of software to which data from equipment (PLC, etc.) is attached. The supervision software provides display, data processing and communication with other applications [4].

The main functional modules of a supervision system are:

- Graphic editor
- Data history
- Archiving and retrieving data for analysis and for maintenance purposes

- Management of alarms and events

- Acquisition of data from the process via a programmable logic controller.

- Production follow-up report.

- Flexibility

- Quality management

- Knowledge management of and in the company

1.5.2 Data processing

1.5.2.1 Graphical representation of data

In the form of curves and pipes or history presented on the screen with various facilities (magnifying glass, window, etc.) [4].

1.5.2.2 Treatment of alarms and faults

The operator must each time acknowledge a fault that has appeared, in order to ensure better management of the alarm history [4].

1.5.2.3 Communication area

A communication zone provides access to an address range defined in the PLC in order to ensure data exchange with the control panel [4].

1.5.2.4 Display area

It is the graphic representation of the process or one can display the course of the process by indicating the state of the equipment (running and stopping of the motors, etc.) [4].

1.6 Passive or active supervision

The two golden rules of supervision are to be as less intrusive as possible and as independent as possible of the supervised elements in order to guarantee an unbiased outside view. Two main methods of supervision are used with several variants:

The active and passive methods, detailed in the following paragraphs [1].

1.6.1 Active supervision

Active supervision is the most classic, it consists of sending requests Query and measurement by the supervision platform. This method consists of the following three steps:

- The server sends a request to the monitored resource.

- The resource depends on the server's request.

- The server analyzes the information and determines a state for the resource.
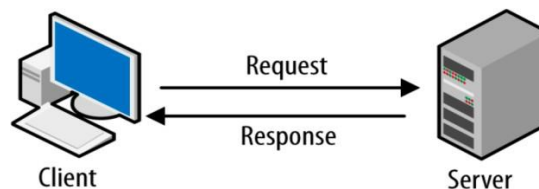
Figure 1. 6. Message exchange between the server and the supervised resource

This method is the most used. It has the advantage of being reliable: checks are carried outregularly and in question-answer mode.

The two active supervision protocols are:

- The **SNMP** protocol is the standard for active monitoring. It is widely adopted and used [1].

- The **WMI** protocol (Windows Management Instrumentation) is a Supervision standard for Microsoft Windows System [1].

1.6.2 Passive supervision

Passive monitoring is from the point of view of the monitoring server: it is the supervisedresources that transmit alerts to the monitoring server:

The supervised resource checks its state and autonomously transmits the result to thesupervision server. The monitoring server receives the alert and processes it [1].
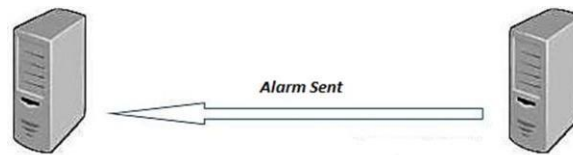
Figure 1. 7. alarm sent [1]

The passive method has several advantages. First, it consumes less resource from the monitoring server and network point of view. The main downside of passive supervision concerns the freshness of the information: there is no guarantee that the supervised resource is in a correct state if no alert is received. The resources only very rarely send messages to signal a state correct [1].

1.7 Supervision, an industrial reality

The supervision tools are aimed at all manufacturers who need remote control and visualization of the status of their equipment. These "real-time" tools are mainly intended for graphical representation and support of advanced functions of the process. Supervision systems make it possible to obtain synthetic views of equipment or sets of equipment in order to visualize their physical or functional states; located in control rooms or at the foot of the machine [2].

Supervision systems offer the possibility of deporting and centralizing the vision and control of physical organs (sensors, actuators) which are sometimes very distant. Called upon to dialogue with command and control systems (PLC, special machines, etc.), the interface contracts put in place are supported by standard or proprietary industrial communication protocols [2].

The main objectives of supervision systems are:
- Concentrate the data, deport or centralize the piloting of the process.
- Provide a real-time vision of the states allowing operators to react and decide quickly, provide the first analysis tools necessary for the control of the equipment concerned (history, curves, alarms, login)...[2].

1.8 CIM Pyramid

The CIM (Computer) Integrated Manufacturing) pyramid is a conceptual representation comprising 4 levels to which correspond decision levels. The higher you go in this pyramid, the higher the level of decision/abstraction, the more global the visibility and the longer the horizons and operational cycles [2].

The industrial automation pyramid is organized hierarchically as shown in Figure (1.8.) It consists of four layers:

- The first is called the instrumentation layer where we find sensors, pre-actuators and actuators.

- The second layer is the control part: where you can find programmable logic controllers (PLC), regulators (proportional, integrator, derivative) PID, PC computers.

- The third level is the Modular Software Platform (SCADA/MES "Manufacturing Execution System").

- At the top of the pyramid, we find the ERP "Enterprise Resource Planning". The latter is software that manages enterprise resource planning (administrative aspect). This pyramid has undergone an evolution of optimization over time. Instead of having two separate layers: the SCADA and the MES (whose main role is to monitor production), the latter have been merged into a single layer. This optimization was done because there was not much information exchange between the MES and the SCADA [2].
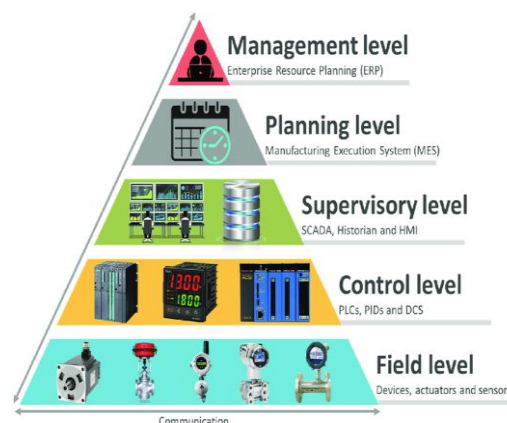

Figure 1. 8. The industrial automation pyramid   [2].

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1.9 Application Areas

1.9.1 The management of large automated industrial installations

- Metallurgy (rolling mill), oil production (distillation),
- Food production and storage (milk, cereals, ...)
- Manufacturing (automotive, consumer goods, ...)
- Oil rig [3].

1.9.2 Control of distributed installations

- Supply of consumable water
- Management of hydraulic flows (canals, rivers, dams, etc.)
- Tunnel management (ventilation, security) [3].

1.9.3 The technical management of buildings and centralized technical management (CTM)

- Management of heating and lighting means (energy savings)
- Management of fire alarms
- Access control, management of intrusion alarms…. [3].

1.10   Conclusion

We can see how important is supervision in several applications and fields especially in large establishment and we learnt how we can use supervision for improving (production, services, quality, management, Maintenance work). In addition reduces the number of visits to the site way much due to many operations from within supervision as (control, monitoring diagnosis, and reconfiguration). SCADA System allows the visualization of different systems within analysis and really useful information about their state. Also it detects alarms and get all the data about performance, history of functioning and all important details that grant a better outcome.

Chapter 2

SCADA   and   telemedicine

2.1 Introduction

Supervisory systems allow information from production processes or physical installations to be monitored and tracked. Such information is collected via data acquisition devices, which handles them, analyses them, store them, and finally present them to the user. These systems are called SCADA (Supervisory Control and Data Acquisition). Nowadays, industrial automation systems use computing and communication technologies to automatize both monitoring and control of industrial processes, collecting data in complex environments (occasionally in different geographical locations) and presenting them to the operator in a friendly way, with elaborate graphic resources (human-machine interfaces) and multimedia content [5].

SCADA implementation has been extended other than the industrial field to include medical field and other domains , it's progressing fast in many departments due to improvement in technologies as the new developed interfaces ,IOT , robotics , high internet bandwidth allowing the transmission of considerable data. All these contribute in the creation of new departments like telecare, teleradiology, telesurgery all based on monitoring, data acquisition and carry out tasks remotely.

2.2 Definition of SCADA

SCADA (Supervisory Control and Data Acquisition) stands for the control of monitoring and data acquisition. As its name suggests, designates a category of software for process control and real-time data collection from remote sites, in order to check equipment and operating conditions. It's not about not a complete control system, but rather a level of supervision. It is a purely software package positioned on the hardware to which it is interfaced, usually via programmable logic controllers (PLCs) or other hardware modules

Commercial. We can also see that it is a large-scale remote management system allowing process a large number of telemetry in real time and remotely control technical installations.

SCADA systems are widely used in industry for the acquisition of data, management and monitoring of industrial processes [2].

2.3 Evolution of the SCADA system

When SCADA was first conceptualized in the late 1950 s, many of these functions were notpossible or were very limited. In fact, looking back at the brief history of SCADA systems, it took multiple generations of development before we achieved the level of connectivity and functionality that today's systems provide, we are interested in the evolution of SCADA systems and description of the following four generations:

2.3.1 Monolithic Systems (First Generation)

The first SCADA concepts were based on mainframe systems, which had little to no networking capabilities. Because of their limited networking capabilities, the first generation of SCADA systems were unable to interconnect with each other making them standalone systems. Despite their lack of interconnectivity, the first generation of SCADA system could still create a wide area network (WAN). However, at the time, the only function of these wide area networks was to connect to different remote terminal units (RTU) to communicate data back and forth from the master computer. To communicate with the RTUs, the first generation of SCADA systems only used proprietary protocols developed by RTU vendors that were only compatible with master computers from the same vendor. Additionally, these protocols only provided the ability to scan, control, and exchange data between the master computer and the RTUs sensors and inputs in the field. These first SCADA systems quickly became in high demand from manufacturers across industries [12].
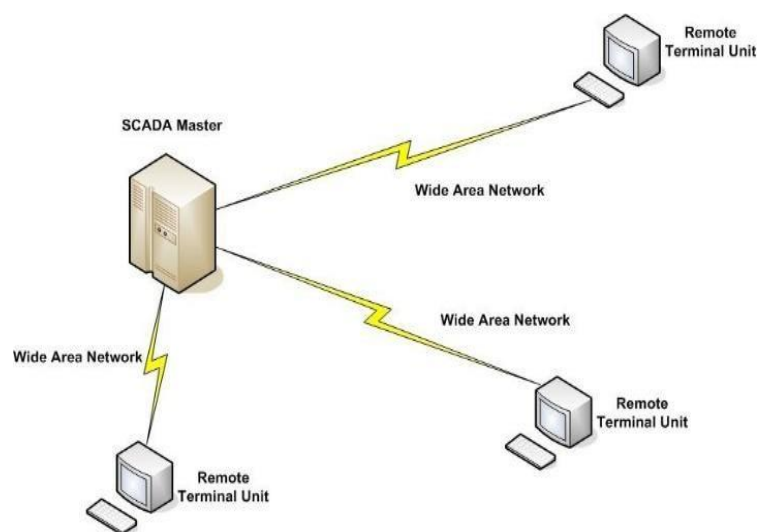

Figure 2. 1. Monolithic SCADA System [2].

2.3.2 Distributed SCADA (Second Generation)

With manufacturers pushing for improvements, the second generation of SCADA arrived, bringing system miniaturization and local area network (LAN) technology. Termed distributed SCADA, the improved systems were now able to communicate with each other allowing for multiple stations that could exchange data in real-time. The systems also became smaller in size and were less expensive than the first generation of SCADA.

The second generation of SCADA also brought the first instances of common system components, which included communication processors, human-machine interfaces (HMI), RTUs, and databases. Distributed SCADA systems were smaller, less expensive, and more connected [12].
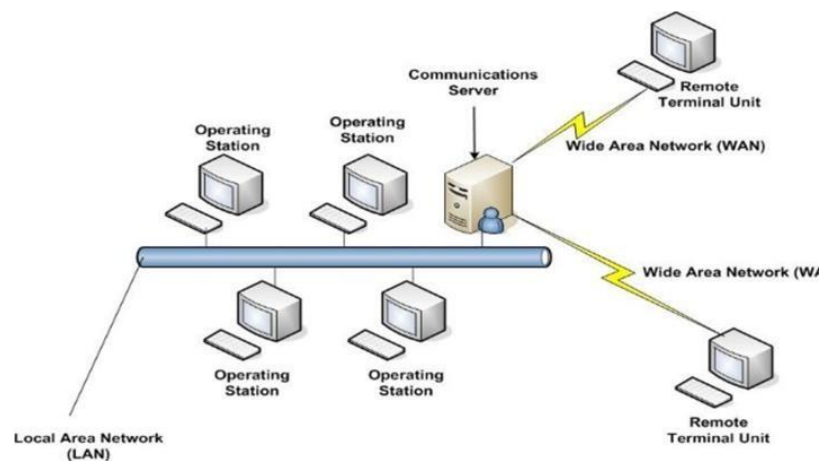

Figure 2. 2. Distributed SCADA system [2].

2.3.3 Networked SCADA (Third Generation)

The third and current generation of SCADA was brought on by advances in industrial automation, and the vendor"s willingness to understand and adapt to the needs of the market.

Now dubbed networked SCADA, the third generation finally breaks away from relying on the vendor"s proprietary components and introduces an open system architecture. This open architecture allows for the use of open communication protocols and standards, which enables SCADA functionality to be distributed in WANs versus only being able to use closed LANs. With the ability to use WANs for more than just connecting to different RTUs to exchange data, the third generation of SCADA introduced WAN protocols, such as Internet Protocol

(IP). This was a ground breaking development, as it enabled all components of a SCADA system to communicate with each other through an Ethernet connection [12].
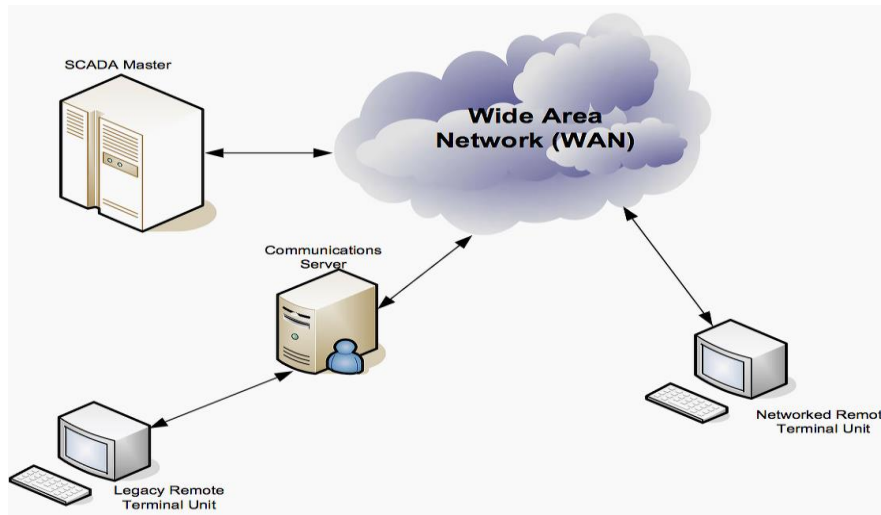

Figure 2. 3. Networked SCADA system [2].

2.3.4 Internet of Things SCADA system (Fourth Generation)

With the commercial availability of cloud computing, SCADA systems have increasingly adopted Internet of Things technologies to significantly reduce infrastructure costs and increase ease of maintenance and integration. As a result SCADA systems can now provide near real-time status and use the scaling factors enabled by cloud computing to implement more complex control algorithms than can be done in practice with programmable logic controllers. . Additionally, the use of open network protocols such as TLS inherent in the Internet of Things provides a more understandable and manageable security perimeter than the heterogeneous mix of proprietary network protocols typical of many previous decentralized SCADA system implementations [2]. We can see different devices connected in this SCADA IOT system as shown in Figure (2. 4).

Figure 2. 4. Internet of Things SCADA system [2].

2.4 SCADA for automation and control

Once the configuration of the system installations has been carried out, The programming of the inputs/outputs of the controller, the configuration of the server, the configuration of the measuring instruments, the communication between the different equipment, it is advisable to concentrate on the installation of a SCADA system.

Indeed, the SCADA system is able to transfer information between a control room composed of one or more "host" computers or also called MTU (Remote Master Unit) to a certain number of remote terminal units RTU or to PLCs located at the same place or at different places. In this way, the SCADA ensures the monitoring and safety of the entire system by emitting critical data. It makes it possible to take emergency decisions which aim to improve the maintenance of the installations [2].

2.4.1 Alarm management

The configuration of alarms has evolved dramatically over the past few decades. In the 1970s, adding a new alarm was complex and had high costs. Nowadays, with the use of SCADA systems, this has become easier to achieve.

The main role of alarms is to maximize the productivity of the production system and provide more safety to both facilities and operators. Alarm management is not only about reducing anomalies [2].

2.4.2 Data Archiving

Data archiving is one of the main elements of a SCADA system. Because of this, it allows archiving data from various system installations.

The information recorded can be structured data (relational data, etc.) or unstructured data(documents, images, etc.) [2].

2.5 SCADA Architecture and components

2.5.1 Components of SCADA systems

SCADA systems include hardware and software components. The hardware components collect data and aggregate it on a computer equipped with a SCADA software.

2.5.1.1 Hardware components

- **Human-machine interface (HMI)**

This interface provides the operator with access to a set of inputs and outputs to control and monitor installations in several ways. This interface can include graphs, diagrams, windows, drop-down menus, touch screens, curves, etc. So, through these graphic interfaces we can introduce parameters or digital-analog values, read the evolution of analog signals [13]

- **Master Terminal Unit**

Equivalent to a master unit in a master-slave architecture. This master unit presents data to the operator through the HMI interface, collects data from the source and transmits control signals to the remote site. The data transmission rate between the master unit (MTU) and the remote site is relatively low, and the control method is usually open-loop due to possible delays or interruptions in data flow [13].

- **Communication intermediary**

These media ensure communication between remote terminals by transporting the necessary data flows. These means of communication can be guided media (cables) or unguided media (wireless). So, communication can take place over the Internet, wireless or wired networks, or the public switched telephone network [13].

- **Remote Terminal Unit**

Operates as a slave in master-slave architecture. Sends control signals to the device under control, acquires data from these devices and transmits the data to the MTU. The MTU unit can be a programmable logic controller (PLC). The data rate between the RTU and the controlled device is relatively high and the control method is usually closed loop [13].

- **Programmable logic controllers (PLC)**

In SCADA systems, PLCs are connected to sensors to collect the output signals from the sensors in order to convert these signals into digital data. The APIs are used instead of RTUs due to their advantages such as flexibility, configuration, versatility and affordability compared to RTUs [2].

2.5.1.2 Software component

Programming software for Supervisory Control and Data Acquisition (SCADA) systems involves both SCADA Operations User Workstation software and Programmable Process Controller software. In addition, SCADA systems require programming of an interface between the user workstation computers and the programmable controller equipment. There are many considerations involved in the design and development of the application programming software required at the various levels of a typical SCADA system.this software manages the flow of information between software and industrial equipment. The user operations workstations, usually referred to as the Human Machine Interface (HMI), requires the programming of process graphic displays with animated links to many points in a process database. Configuration programming is also required to establish the process database, the historical database and the communications interface to the field controllers or the PLCs. Additional background programs, called scripts, are often used to perform „behind the scenes"operations for the application, The SCADA workstations present the process graphic displays with operator interaction, such as controlling equipment and requesting information. The software at this level involves the creation of the process control displays, historical trend and historical report displays, alarm and event summary displays, and the process database. Hence, there are both displays which present the information and „behind the scenes" programming to access the information for the requested display [6].

2.5.2 SCADA architecture

Generally, the SCADA system consists of the following components: processors premises, operating equipment, programmable logic controllers, instruments, remote terminal, smart electronic device, master terminal or host computers and a PC with interface man-machine. The block diagram of the SCADA system shown in Figure (2. 5) represents the basic SCADA architecture. SCADA systems are different from distributed controls that are commonly found on production sites. When the distributed control systems cover the plant site, the SCADA system covers much larger geographic areas. In general, an integrated SCADA architecture supports the protocols of communication based on IP, TCP/IP, UDP and others, as well as industrial protocols such as Modbus TCP, Modbus over TCP or Modbus over UDP6. These all work on cellular, private radio or satellite networks. In complex SCADA architectures, a variety of media and protocols wired and wireless involved in the restitution of data on the monitoring site [11].
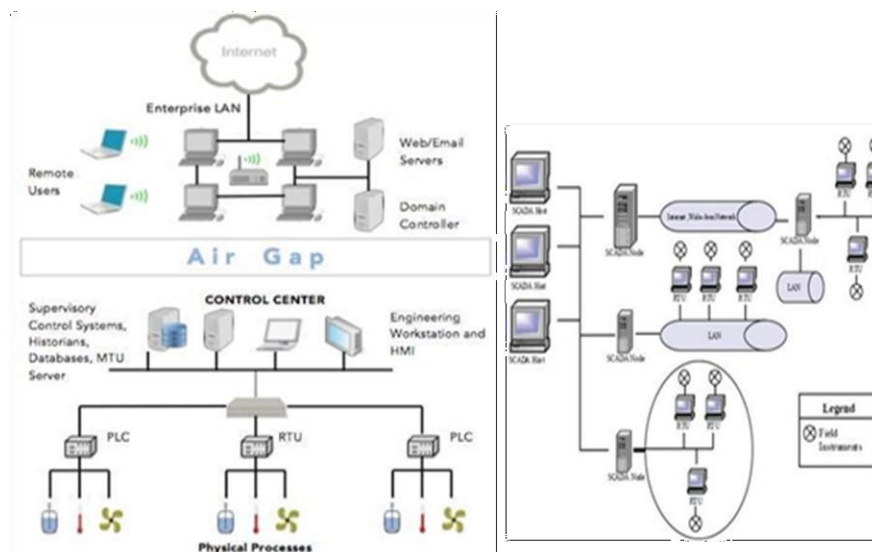

Figure 2. 5. SCADA architecture [11]

2.6 Communication and SCADA protocols

To ensure communication between two entities, they must use the same language (protocol) and follow certain rules for initiating, conducting, and ending the communication. This chapter discusses the most popular protocols for communicating information over networks such as the Internet and explores proprietary and open protocols specifically

designed for use in SCADA systems. SCADA protocols were evolved out of the need to send and receive data and control information locally and over distances in deterministic time. In this context, deterministic refers to the ability to predict the time required for a transaction to occur when all relevant factors are known and understood. To accomplish deterministic time communication for applications in refineries, electric utilities, and other users of SCADA systems, manufacturers of control devices, such as PLCs, have developed their own protocols and communication bus structures. Among the manufacturers who have developed their own communication protocols for the SCADA system we distinguish: Allen Bradley (Rockwell), Siemens and Modicon. The manufacturer Allen Bradley has developed the DeviceNet, ControNet, DF1, Data Highway +, Data Highway 485 protocol. The manufacturer Siemens has developed the porfibus protocol. The Modicon manufacturer has developed the MODBUS, MODBUS Plus, MODBUS TCP/IP protocol. In order to ensure communication between the systems of different manufacturers, these protocols must be improved towards open protocols [13]. In Figure (2. 6) we can see protocols of communication used in different levels
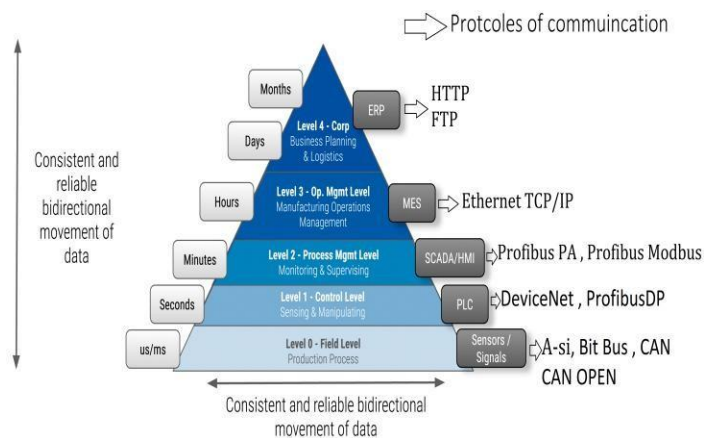
Figure 2. 6. CIM Pyramid with protocol communications [13]

2.6.1 Protocol TCP/IP

The Transmission Control Protocol (TCP) and the Internet Protocol (IP) are reliable protocols that use the transport layer of the OSI models, the data is passed to TCP and then sent to an IP address. Next, IP puts the data into a packet (or datagrams) and transmits it into a receiving device. This protocol works with Client/Server mode. The clients are all active, the server is completely passive. Each client has the right to read and write to the server.

The frames to be sent contain a function and an instruction to be processed: write and/or read. Each server has its Owen IP addresses. The performance of network is highly dependent on the type and design of the Ethernet network. The latter uses the performance of the processors in the communication interfaces for the respective devices [2].

2.7   Telemedicine

2.7.1 Tele-care

The main intent is to protect the patient from serious conditions when the doctors are not available. The temperature ,respiration heart beat and ECG signals are measured by bio-medical sensors these signals are monitored through SCADA which helps us to know the Patient's condition and provide all the useful data in any time they need it. If patient condition is serious then SCADA systems automatically display the guidelines and the medicine could be taken to the patient these guidelines and medicines were taken from the experts, which makes a vital role in the pursuit of patient's health [3].

2.7.1.1 Sensors and signal conditioning circuits

- Thermistor sensors Suitable for temperature measurement
- Heart beat measuring system designed to measure the pulse signals.
- Respiration measurement system measuring the respiration temp, which facilitates oxygenation of the blood.
- ECG measuring system using electrodes for recording the heart's electrical activity.
- Alarm circuit whenever a patient body condition exceeds the normal condition then the alarm will be on [7].

2.7.2 SCADA Based Patient Monitoring System

Where all the previous Data for patient monitoring measured by sensors and signal conditioning circuits are shown, the graphical analysis of each parameter can be done and monitored through SCADA system.

Figure (2. 7) explains the graphical representation of the patient body condition parameters like electro cardio graph, heartbeat, body temperature and respiration rate. Here on-line graph represents the body temperature where x-axis represents time, Y-axis represents temperature [7].
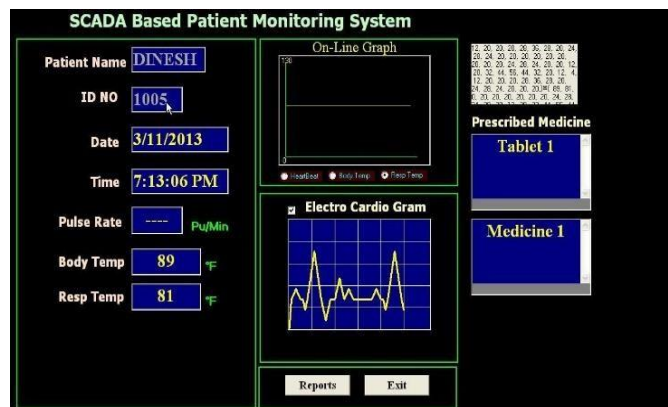
Figure 2. 7. SCADA interface for patient health monitoring [7]

2.7.3 Tele-radiology

Tele-radiology is the electronic transmission of medical imaging to remote sites for consultation, review, or formal interpretation. The network technology may include the LAN or wide area network, as well as the Internet via VPN or cloud computing. Security and privacy standards must be maintained on par with typical data transmission and storage. In addition, the imaging data must be transmitted in a timely fashion using appropriate bandwidth, and the transmission must have no loss of clinically significant information. The goals of tele-radiology are varied. Hospitals or other facilities may require timely review of studies without having radiologists on site, such as providing emergency on-call study interpretations. Radiologist groups may use tele-radiology among themselves or outsource their call to other practices. Sites can also be served in areas of need or areas that require subspecialty radiologic support. Finally, tele-radiology can be used to send interpreted images to additional providers for quality improvement or educational opportunities. The use of

teleradiology grew rapidly after the turn of the century, with a reported 50% of radiology practices outsourcing at least some call responsibility in 2010. More recently the trend has withdrawn from this peak as more practices have reverted to keeping calls in-house. Teleradiology is most commonly used in one of two ways. The images are either transmitted from the hospital to the home of the hospital-based on-call radiologist after usual working hours or transmitted to a commercial teleradiology company that employs radiologists located in other states or countries, who then render preliminary or final interpretations [9].

2.7.4 Tele-surgery

The term "tele-surgery" refers to surgical operations being carried out by surgeons remotely without being physically situated in the operating theater. Robots are only capable of carrying out precise surgery because of the introduction of tiny sensors and actuators that were previously unavailable. These small actuators make very small movements that usually involve moving in all three dimensions. The primary function of an actuator is to initiate a robot's movement based on instruction given by the surgeon. Shows how a surgeon can carry out an operation remotely by using a telemedicine system to control a robot in the operating theater. In addition to hand controls, Peters et al. (2018) reports that eye controlled robots make 3D mappings of tissue possible and automatically calculate the depth of tissue by tracking the controlling surgeon"s eye movement to precisely track where the surgeon is operating. Robotic telesurgery effectively brings a surgeon"s professional techniques into an operating theater that does not have a surgeon physically present. However, in order to make this happen a large amount of data exchange is involved between the surgeon and the robot "acting on behalf". For a start, the surgeon needs a good view of what is going on inside the operating theater. Cameras are installed in the operating theater that must incorporate remotely controllable rotation and high-power zooming functions. Also, the video image captured must be displayed at the surgeon"s side in real time without any noticeable delay so that any movement of the robot to take an action will not be delayed. Even a very small amount of time delay in the robot"s action can lead to irreparable damage to the patient"s body. Time delay (latency) is a big issue with long distance telesurgery. With telecommunications that span continents, transmission delay is an unavoidable issue. This is likely to be one of the most challenging issues for long distance operations. [8]

2.8   SCADA for radiology equipment

2.8.1 Diagnostic

Designing an HMI System for medical diagnostic equipment begins with a clear definition of the operational and functional requirements. An HMI System for an X-ray system is going to have different functional requirements than an MRI, or a PET scanner. The functions for a particular application will drive many of the design considerations For example; patient and operator safety may be the dominant factor with X-ray equipment, while patient comfort may be more important in the interface design for an MRI system. An MRI will require a color display; an X-ray system may use a black and white monitor. A diagnostic system or a surgical laser system could require a foot-pedal control, while a device designed for patient use in the home would typically be handheld. All the functional elements need to be described and addressed early in the HMI System design process [10].

2.8.2 The interface

For medical devices, screen/display aesthetics play an important role. They often provide the user with the first impression of the system and can set the user''s and patient''s expectations for all interactions with the device. A poor first impression can also lower the operator''s motivation to use the device. The appearance should be gauged to match user expectations. For example, a lab technician might appreciate a more serious and scientific appearance in a blood analysis workstation, whereas a nurse might be looking for a friendly, non-intimidating appearance in a handheld blood testing device. A patient might feel more comfortable with a device that mimicked a familiar form, such as a smart phone [10].

2.9   Conclusion

SCADA Has been widely used for monitoring and remote control to provide a better performance, easy maintenance , collecting all Necessary Data that can be useful for analysis and improving the process also reducing the number of visits. SCADA basically and most of the time is used in industrial field but it can be integrated in telemedicine because of the needs of many departments such as teleradiology, telecare and telesurgery for remote control monitoring and data acquisition.

Chapter 3

Remote Supervision of an x-ray collimator using SIMATIC solution

3.1 Introduction

WinCC is a software interface introduced by Siemens that provide many options for HMI design, which facilitates the control and monitoring of the whole process. This software has features like a server/ client station running mode means that a client can receive all Process Data through a LAN network which enables other stations to control and monitor through wireless, Ethernet communication interfaces. Another feature for WinCC is the web navigator, includes a web navigator server and web navigator client allowing communication with WAN network, it offers remote control/monitor of the process through the internet.

Recently Siemens has developed its own interface for SIMATIC PLC s7-1200 and s7-1500 family products and several other controllers. This interface has the all necessary information about the PLC and the process Data and is used for (remote control, monitoring, diagnosis), for the Simulation we need PLC SIM Advanced instead of a real PLC. The aim of this chapter is to develop a remote interface for controlling an x-ray collimator. So before the design of this interface it is necessary to give a general presentation about the x-ray collimator.

In this project we have used two methods for the remote control of the process through the internet, which are SIMATIC software solutions, the first one is implementing remote control of the process using the WebNavigator feature in WinCC Explorer. The other one is a simulation method using the web server feature provided by Tia Portal software with PLCSIM Advanced tool instead of the real PLC.

3.2 X-ray collimator presentation

The X-Ray collimator comprises two shutters and an iris made of x-ray insulation material, which limits the frame of the collimator to reduce the dose and protect the patient from the risk of the X-ray beam as well as modulate image quality.

The control of this collimator can be realized by actuators and sensors, inside of this collimator there are three actuators which are three Faulhaber DC motors. One of them is motor 1524EO24S (9800 tr/min) for Opening and closing the collimator-iris, the two other motors are motor2224R024S (6400 tr/min) to open or close the shutter horizontal and the other shutter vertical. The role of sensors is to determine the position of two shutters and iris

and limit them by Max and min position, these sensors are potentiometers two of them are Rotational conductive plastic with the shutters and the other one is Rotational multi-turn wire-wound works with the iris [18].
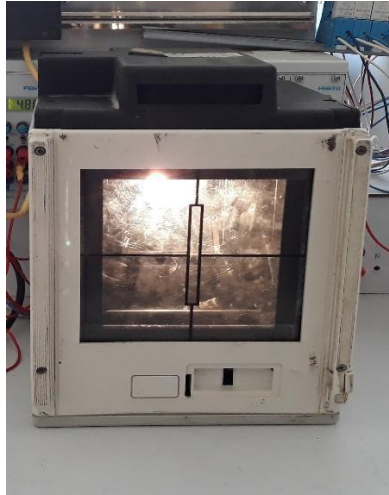
Figure 3. 1. X-ray collimator

3.3 Configuration of the process

This process consists of an X-ray collimator, Electromagnetic relay, PLC S7-300, and a computer with the designed interface. To set up the whole process the PLC must contain the program and all necessary configurations for operating the collimator with predefined specifications, which are the open and close of shutters and iris with the maximum and minimum limit in manual control and cassette dimension in presets. The Tia portal is a software by Siemens used to set the ladder program and all necessary configuration then load it to PLC S7-300.

The next step is to wire up the elements of the process, wiring the collimator including motors with outputs of the PLC S7-300 and potentiometers with the PLC analogic inputs, with an electromagnetic relay as an intermediary, its role is to isolate the control part from the power part. By activating the coil with 24V signal from PLC the relay close the NO and open the NC, which allows the power supply of motors and LED.

The designed interface is an HMI software that must be Connected with PLC s7-300 using a communication link or protocol, that allows the interface to control this process with the buttons to open and close (in/out shutters, iris) one by one or the three simultaneously.

And preset buttons which are specified dimensions in radiology, a LED button, and a LED circle in the interface when off (red) when on (Green).
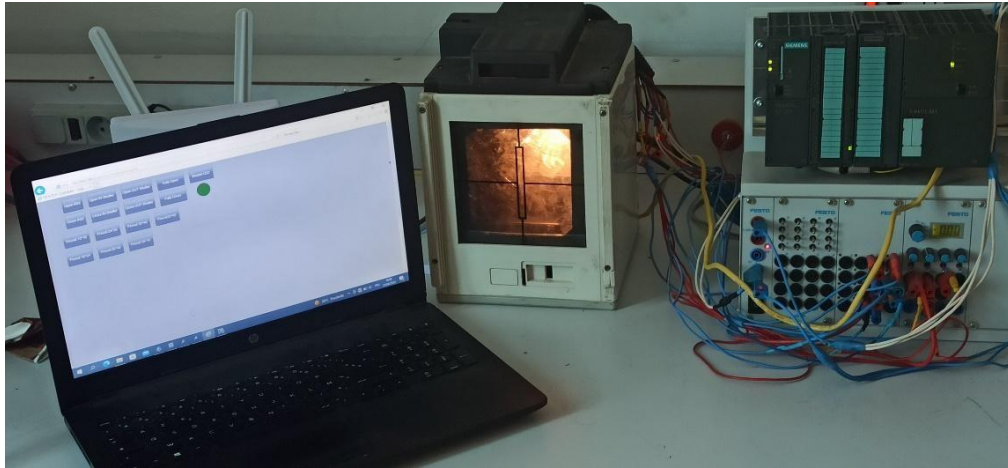
Figure 3. 2. The studied process

3.4 Interface designing with WinCC Explorer

In the WinCC Explorer, you work in the navigation window and in the data window. In these windows, you can open the context-sensitive help for each element with the right mouse button. If a project is active in Runtime, a tooltip is available for elements of the tag management in the data window [14].
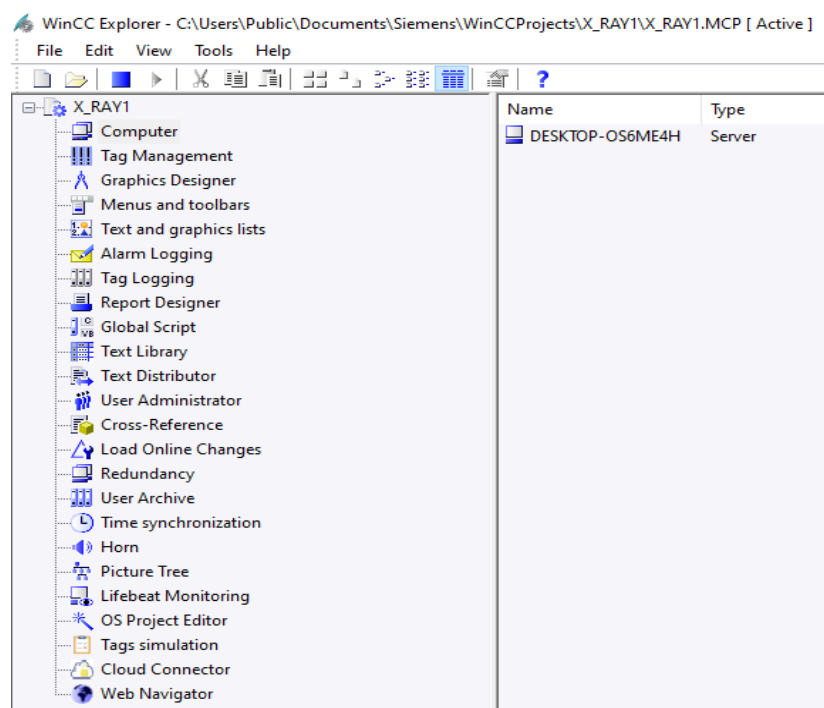
Figure 3. 3. WinCC explorer software

3.4.1 Management and communication

We use the Tag management to manage variables (add ,remove or modify Tags) and to attain communication between the WinCC software and the whole process we add a communication driver.

Step 1: We add a new driver in the "Tag management" in our application we chose the "SIMATIC S7 protocol suite" driver.
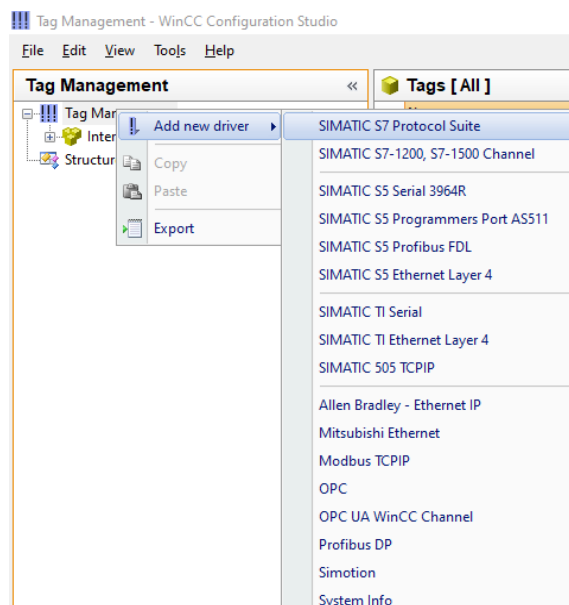
Figure 3. 4. Add a new driver

- **Step 2:** In the "SIMATIC S7 Protocol suite " driver there are many communication interfaces we select TCP/IP and we add a new connection then we name it "TiaPortal".
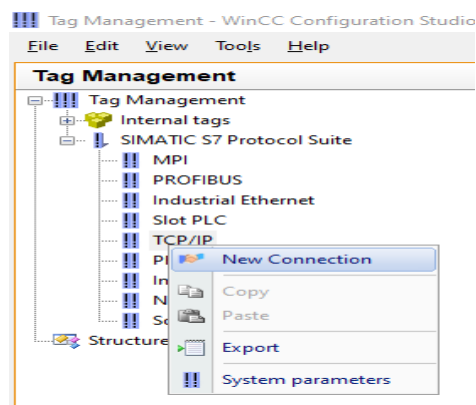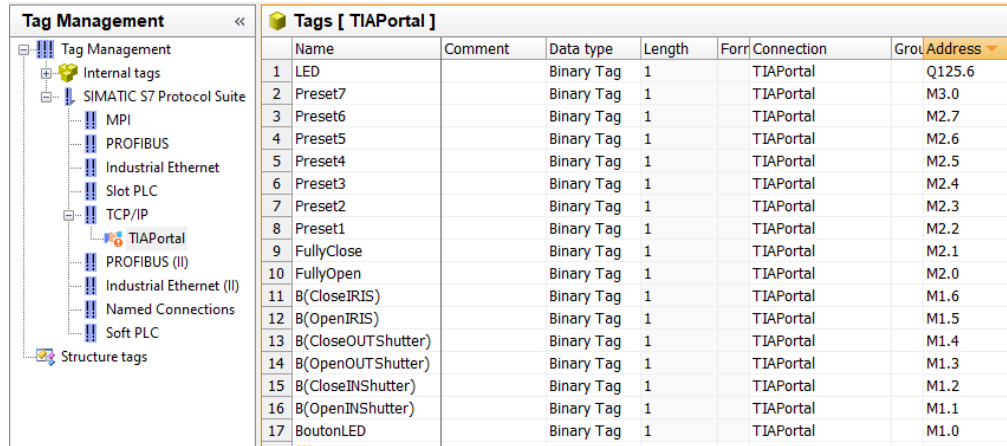
Figure 3.5. Add a new connection in TCP/IP

Step 3: we open "Tia Portal" then we add all the tags necessary for our interface, these tags are already addressed in the PLC.

	Name	Comment	Data type	Length	Form	Connection	Grou	Address
1	LED		Binary Tag	1		TIAPortal		Q125.6
2	Preset7		Binary Tag	1		TIAPortal		M3.0
3	Preset6		Binary Tag	1		TIAPortal		M2.7
4	Preset5		Binary Tag	1		TIAPortal		M2.6
5	Preset4		Binary Tag	1		TIAPortal		M2.5
6	Preset3		Binary Tag	1		TIAPortal		M2.4
7	Preset2		Binary Tag	1		TIAPortal		M2.3
8	Preset1		Binary Tag	1		TIAPortal		M2.2
9	FullyClose		Binary Tag	1		TIAPortal		M2.1
10	FullyOpen		Binary Tag	1		TIAPortal		M2.0
11	B(CloseIRIS)		Binary Tag	1		TIAPortal		M1.6
12	B(OpenIRIS)		Binary Tag	1		TIAPortal		M1.5
13	B(CloseOUTShutter)		Binary Tag	1		TIAPortal		M1.4
14	B(OpenOUTShutter)		Binary Tag	1		TIAPortal		M1.3
15	B(CloseINShutter)		Binary Tag	1		TIAPortal		M1.2
16	B(OpenINShutter)		Binary Tag	1		TIAPortal		M1.1
17	BoutonLED		Binary Tag	1		TIAPortal		M1.0

Figure 3. 6. Tags Window

- **Step 4:** in the "TCP/IP" parameter system we select a logical device name , we chose our network carte "Realtek PCIe GBE Family Controller" , then we assign the IP address of a PLC in the connection parameter for "TiaPortal".
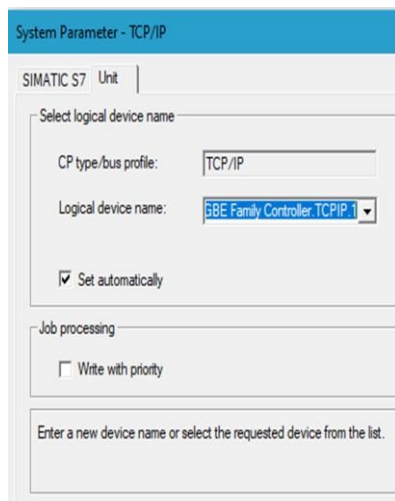
Figure 3.7. TCP/IP System Parameter
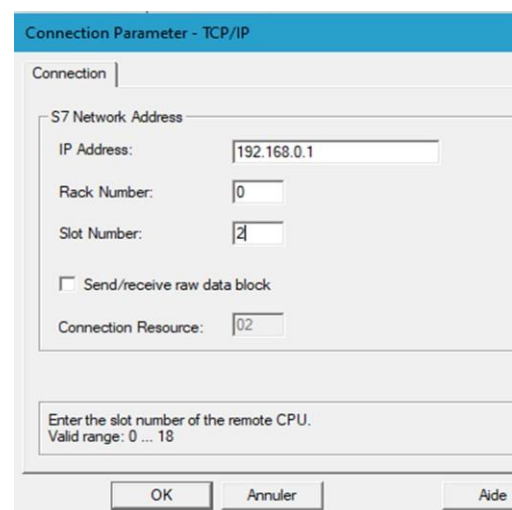
Figure 3. 8. Connection parameter for TiaPortal

3.5   The Graphic Designer in the WinCC Explorer

The role of a graphic designer in WinCC software is to create a graph for the interface.

To start working on a new graph we select a "new picture" in the "graphic designer" it appears with the name "newPdl0.pdl" we rename it in our project "X_RAY.pdl" .
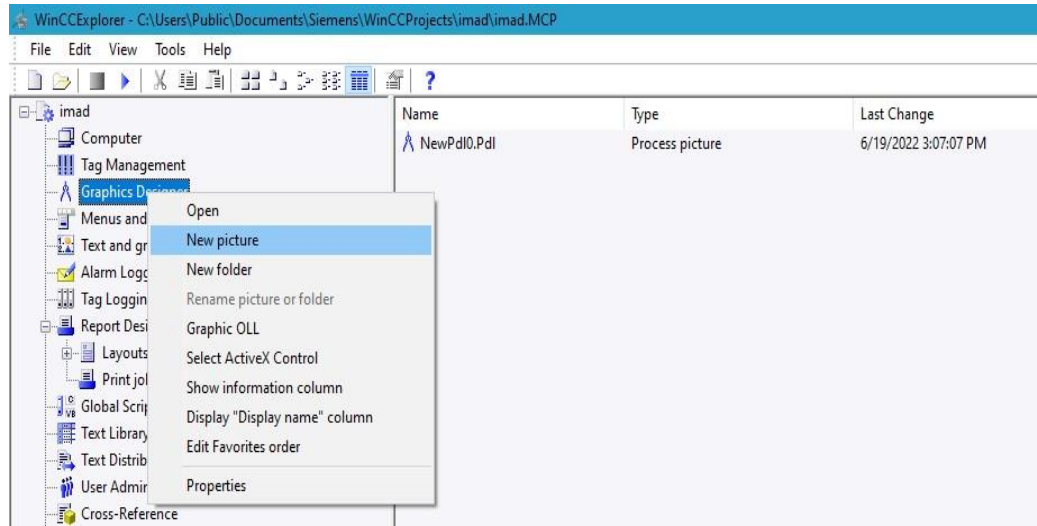
Figure 3. 9. New Picture graph

3.5.1 Graphical interface for control

To create a new graph we start working in "X_RAY.pdl", the graphic designer provide us with shapes and objects to add (button, LED, text and many other options)

For button LED, we select events because it"s a variable entry then we add the Tag B-LED in the mouse window, and for LED we select animation to show the dynamic then we add the LED tag and the colors for two states on/off. As we note in the next Figure (3.10.).
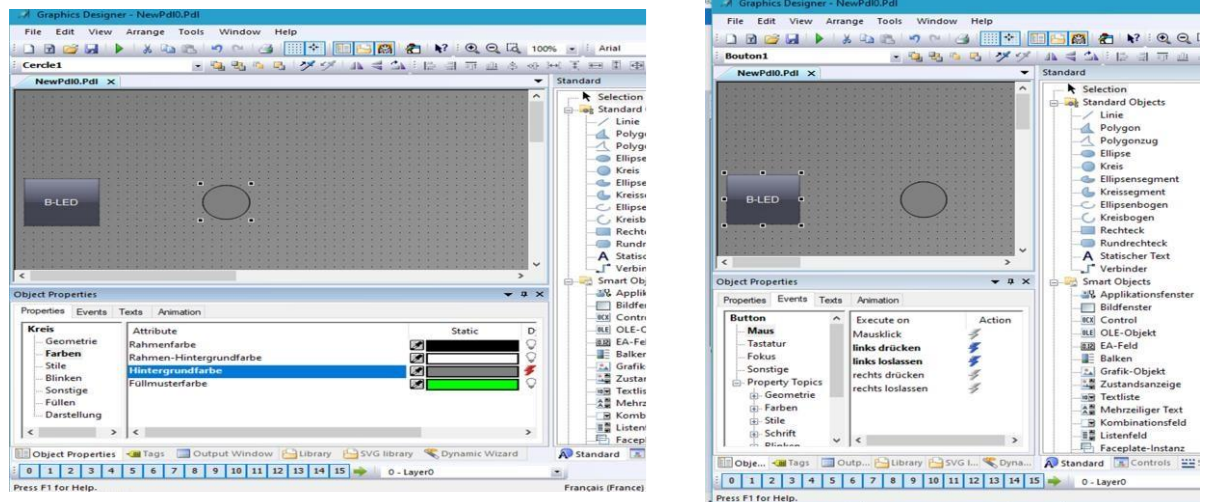
Figure 3. 10. Creating the graph

After creating a new project in WinCC Explorer, we get the new interface, to control the system we activate the Run Time, the next Figure 3.11 is our interface
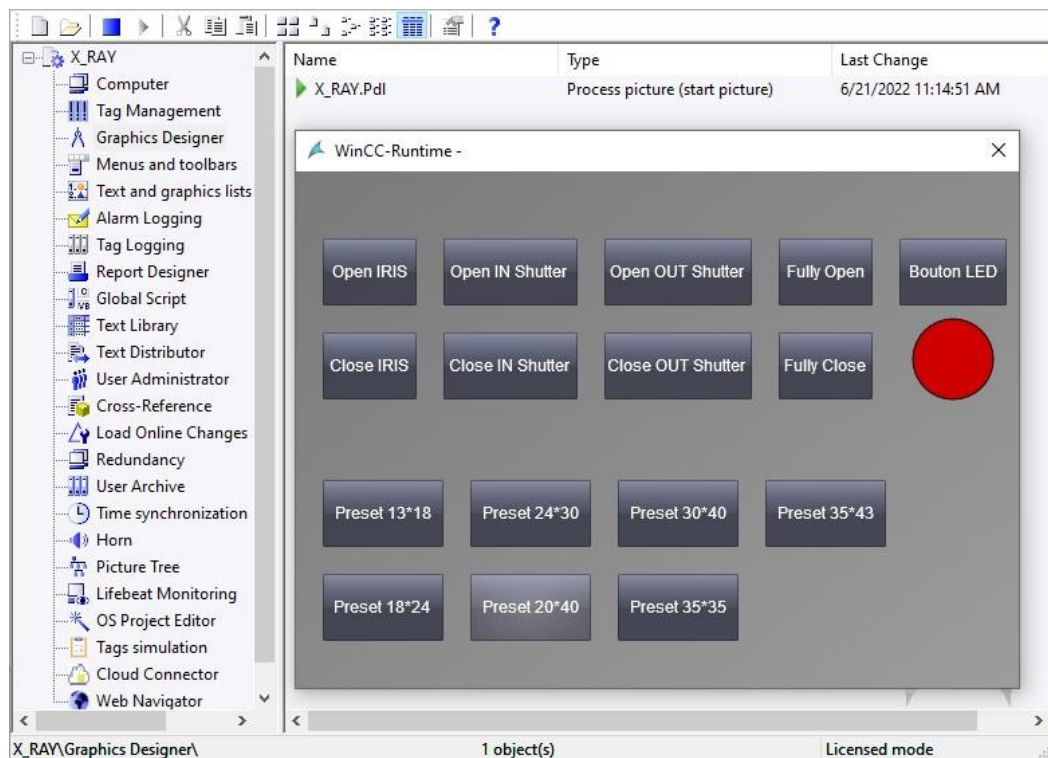
Figure 3. 11. Run time activation

This interface has all the necessary buttons to open or close shutters and iris manually or with presets, assuring allowing the control of the collimator

3.6 Remote control implementation using the WebNavigator feature

This method is based on the server/client principle, the client can get access to the interface and all necessary data stored in the server through a local area network (LAN) or wide area network (WAN)

- For LAN the protocol of communication used are Profibus DP (MPI port) Profinet (Ethernet, wireless)
- For the WAN the protocol of communication used is TCP/IP (The internet)

3.6.1 Communication between WinCC server/ client through LAN

Up to 32 coordinated operator stations (WinCC clients) have a view of the same server project. All WinCC data is stored in the integrated Microsoft SQL Server database on the WinCC server. Since the WinCC clients do not have their own WinCC project, they access the WinCC project on the WinCC server

The same plant processes can be monitored on several operator stations (clients). Any user intervention on an operator station, e.g. value changes, is immediately visible on all other operator stations. A multiple-station system is typically configured for small and mid-sized plants in which distribution of data to several servers is not required.

Distribution of clients.

● With different tasks: You operate and monitor different views of the same process, for example, process screens on one operating station and alarms on another operating station.

● With similar tasks: You monitor and control the same view of the process from several locations, for example, along a production line.

You use access rights to specify exactly which functions or plant sections are available to a given user on which operator stations [15].

3.6.1.1 Structure

The client-server technology makes it possible to easily separate WinCC clients from the WinCC server, configure your project centrally in the TIA Portal on the engineering station and download it to the WinCC server with process connection. The WinCC clients do not

need a project planning, but merely a configuration, the figure .2 shows the general structure of a multi-user system server/client [15].

The WinCC server automatically assumes the task of supplying the WinCC clients with

● Runtime environment

● Screens, process values, alarms, log data, and reports

● Interface with the automation system

● Communication and coordination of clients

● Logging
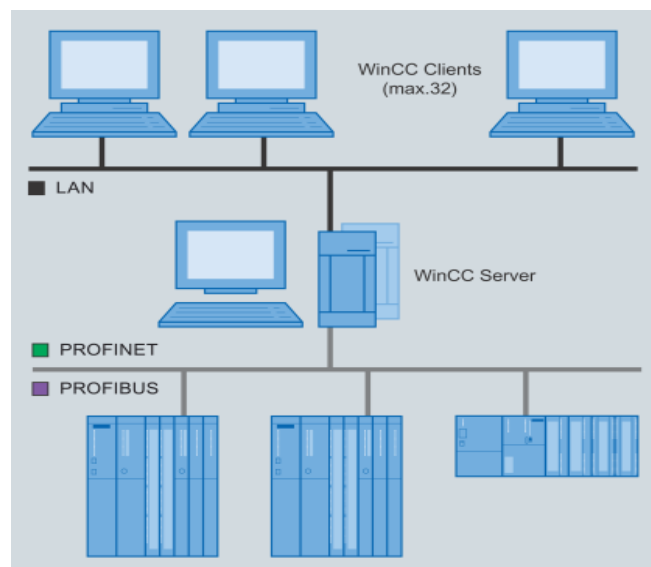
Figure 3. 12. Multiple-station system

3.6.2 Communication between WinCC server/ client through internet

The WebNavigator is an option in WinCC Explorer software provided by SIMATIC responsible for the transition from the local network to the internet, in general, it includes a WebNavigator Server and WebNavigator client. Next, we will define them with and explain the general Structure of the Server /client with the WebNavigator.

3.6.2.1 WinCC WebNavigator Server

All necessary WinCC pictures and functions that are displayed on the WebNavigator Client are stored on the WebNavigator Server. The Web View Publisher automatically makes the required adaptations to the project data that is necessary for the web. This ensures the best possible performance.

The WebNavigator Server needs Microsoft Internet Information Service (IIS) for communication with the WebNavigator Clients. The IIS is set up and managed using the WinCC Web Configurator [15]

3.6.2.2 WinCC WebNavigator Client

The WebNavigator Client is started in Internet Explorer with enabled ActiveX controls. You can operate and monitor a current WinCC project without the entire WinCC basic system

having to be installed on the computer.

You control access of the WebNavigator Clients in the user administration. A different start picture and language can be selected for each user. You can enable scalable access to different project areas and functions for individual users by assigning user authorizations.

The "WinCC Viewer RT" Web Viewer program is used for visualization of web projects only.

The program can be used in place of Internet Explorer to visualize the WinCC project [15]

3.6.2.3 Web Navigator network structure

WinCC explorer and the server components of the WebNavigator are installed on a PC. The WebNavigator client can control and/or monitor the current server project both via the Internet and the Intranet.
To protect against attacks from the Internet, two firewalls are employed. The first firewall protects the WebNavigator Server from Internet attacks. The second firewall provides additional Security for the Intranet [15].
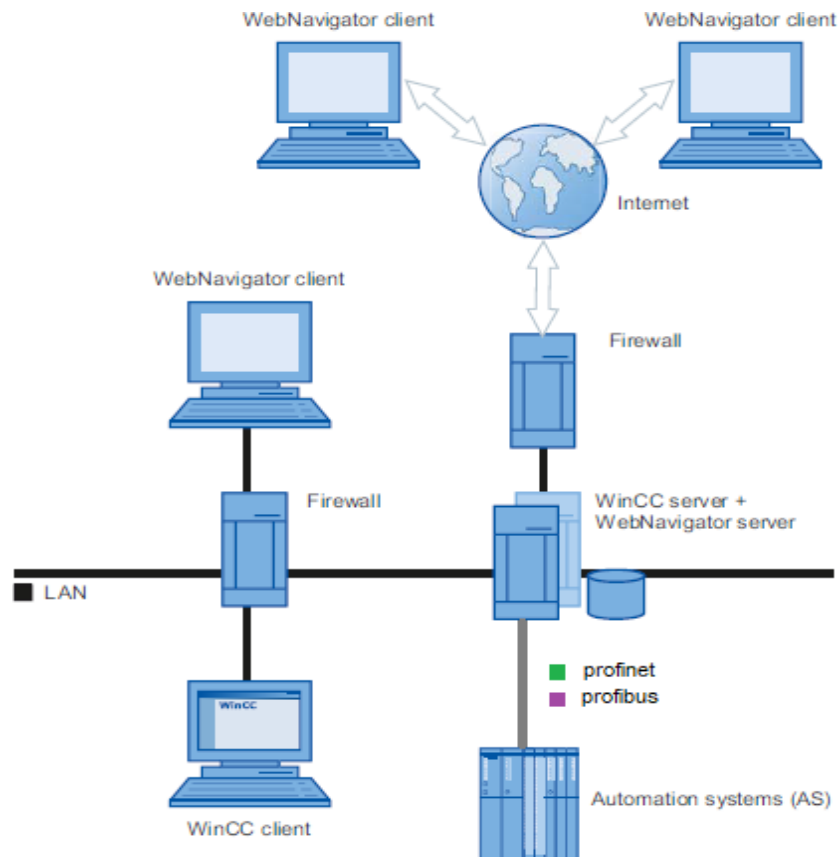
Figure 3. 13. The WebNavigator Structure [15]

3.6.2.4 Internet Information Services (IIS)

Stands for "Internet Information Services." IIS is a <u>web server</u> software package designed for Windows Server. It is used for hosting <u>websites</u> and other content on the Web, Microsoft‟s Internet Information Services provides a graphical user interface (<u>GUI</u>) for managing websites and the associated users. It provides a visual means of creating, configuring, and publishing sites on the web. The IIS Manager tool allows web administrators to modify website options, such as default pages, error pages, logging settings, security settings, and performance optimizations [16].

Before installing the WebNavigator Server, you need to install the Internet Information Service (IIS). You specify the settings for the WebNavigator Server during installation. [15].

3.6.3 Administering the users for WebNavigator Client

It is about adding users and giving them authorizations that allow each user to get access to the server project and every client must have a user name and a password , we follow the next steps to accomplish the client access to the server as in Figure .

Step 1: add a user and giving him a user name and password .

Step 2: activate the "WebNavigator" in the "Properties-User" window and add our project graph"X_RAY" in "WebNavigator start picture".

Step 3: The final step is to enable functions to the client user in the "Authorizations" window.
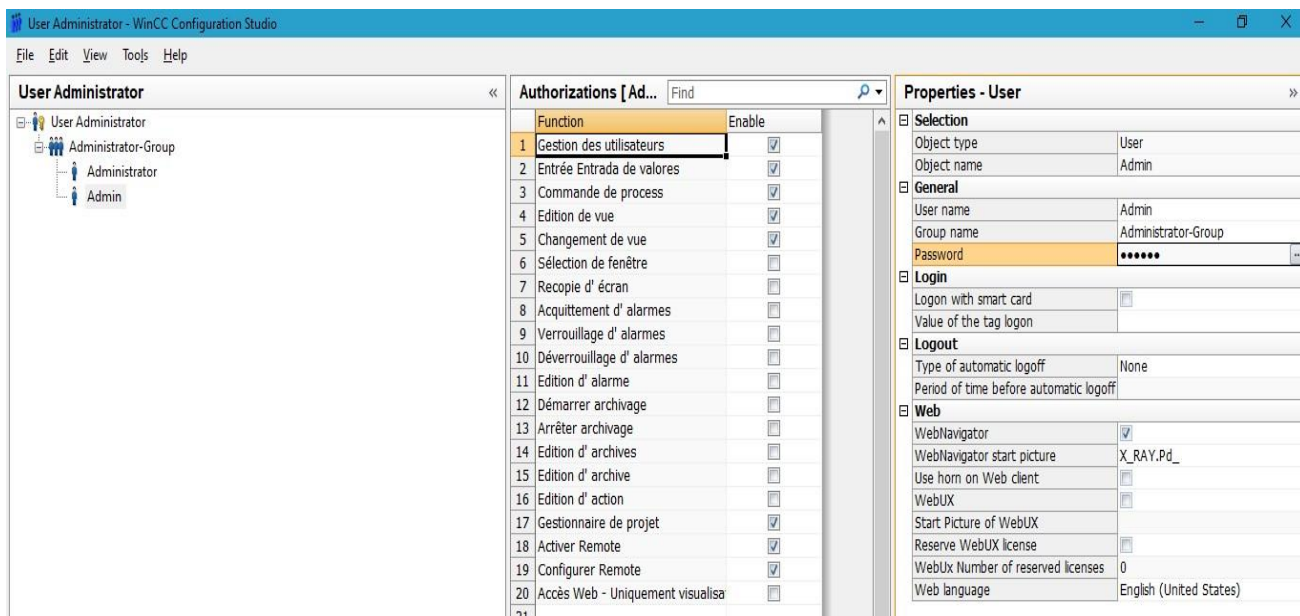
Figure 3. 14. User administrator and authorization

3.6.4 Configuring the WebNavigator web page

3.6.4.1 WinCC Web Configurator

The WebNavigator Server needs the Microsoft Internet Information Service (IIS) for Communication with the WebNavigator Clients. The IIS is set up and managed with the WinCC Web Configurator [15]
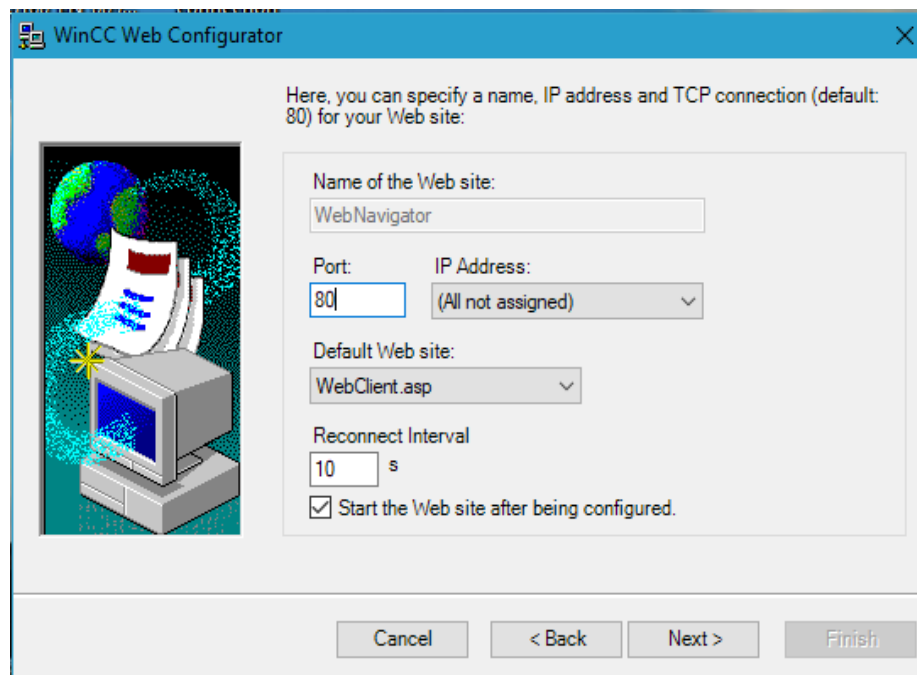
Figure 3. 15. The Web configurator

The procedure of creating a new web site is to create a new standard web site (stand-alone) , then enter the name of the port and the "IP address".

3.6.4.2 Port forwarding

Port forwarding means to open a port to surpass the firewall security of the router and make your server accessible to client on the internet, surpass the firewall security of the router.

Figure 3. 16. Port Forwarding

3.6.5 The remote interface in the client PC

To have the full functionality available on the WebNavigator client, you need to adapt the security settings in Internet Explorer.

- **Step1:** In the address bar of the internet explorer navigator in the client station, we must type the public IP address of the server to obtain the security window that give permission for the client PC to get access to the server PC.
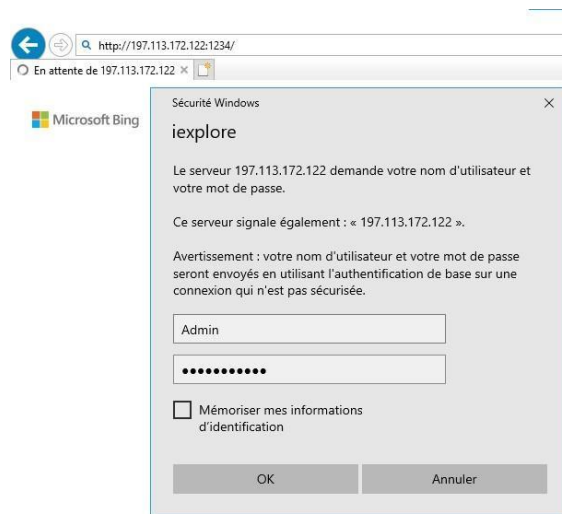
Figure 3. 17. Security Window

Step 2: enter the username and password this step gives you the authorizations assigned by the project creator then we obtain the interface that allows remote control through the internet.
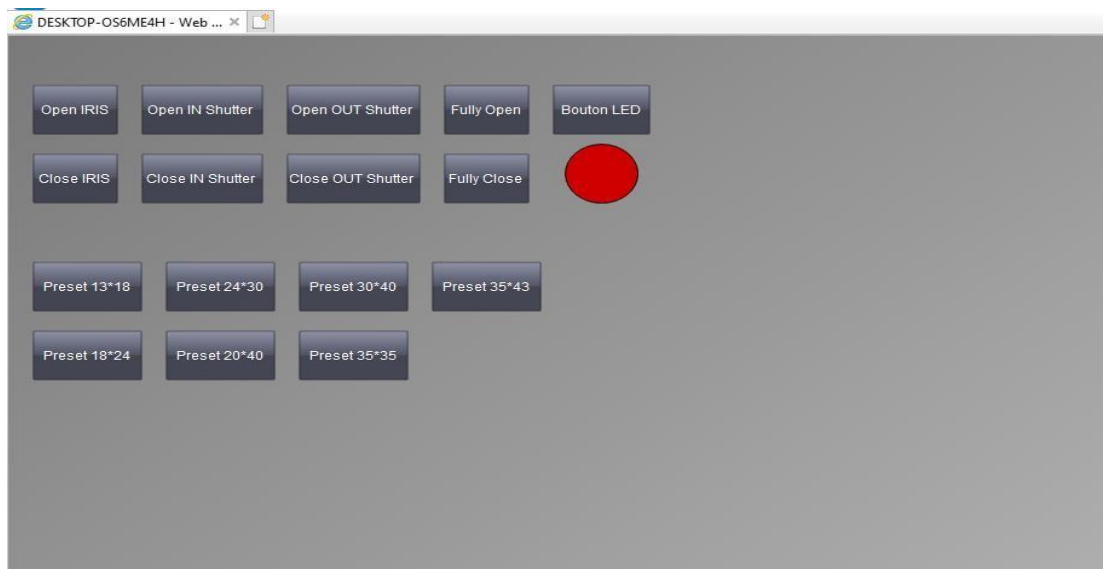
Figure 3. 18. Interface through internet

3.7   Simulation of the remote control using web server

Siemens own interface is a very useful site for Tele-supervision of the process monitoring the state of PLC, getting awareness of alarms and diagnostic messages, having a lot of valuable DATA as communication and tag status DATA.

For remote control, a web server is an option that enables the user to get a web page in Siemens own interface when activated in TIA Portal Software also a WWW instruction is necessary for the organization block to get access to a web page. The HTML file is a programming tool we use for the design of our interface with all the variables in This file must be the same as in TIA portal software so that a data block is generated with all the HTML DATA are stored in TIA Portal software.

3.7.1 web server definition

Is a computer that runs web sites, It"s a computer program that distributes web pages as they are requisitioned. The basic objective of the web server is to store, process and deliver web pages to the users. This intercommunication is done using Hypertext Transfer Protocol (HTTP). These web pages are mostly static content that includes HTML documents, images, style sheets, test etc. Apart from HTTP, a web server also supports SMTP (Simple Mail transfer Protocol) and FTP (File Transfer Protocol) protocol for emailing and for file transfer and storage. [1]

3.7.2 Benefits of the Web server

The Web server gives you the option to monitor your CPU across a network. This permits evaluation and diagnostics over long distances. Monitoring and evaluation is possible without Tia Portal; all you need is a web browser. Make sure that you protect the CPU from being compromised through the use of different methods (e.g., limiting network access, using firewalls).[17]

3.7.3 Configuration in TIA portal

Step 1: We start TIA Portal then we create a new project named "Webserver_S7_1500" Via "Project > New...", we click "Add New Device" >> "PLC > SIMATIC S7-1500" to add our controller "s7-1511-1 PN".

Step 2: in the properties of the Ethernet interface, we assign the IP address 192.168.1.1 of the CPU, as shown in the Figure (3.18.).
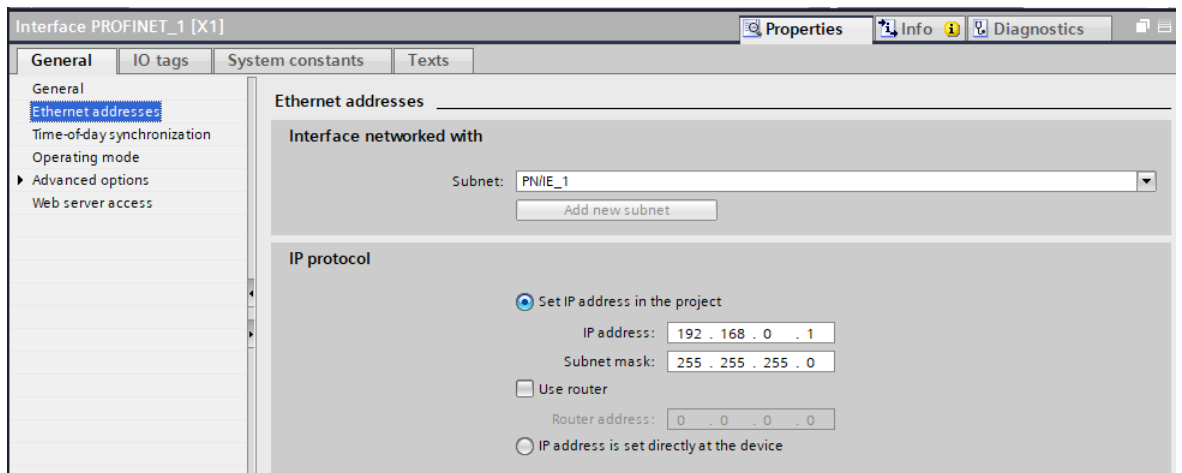
Figure 3. 19. Addresses Ethernet

Step 3: click on "Web server access" in the Properties of the Ethernet interface of the CP. Activate "Enable web server for this interface"
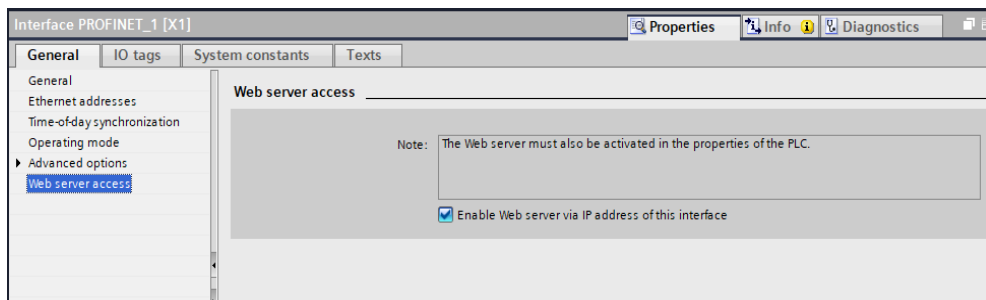
Figure 3. 20. web server access

Step 4: Activate the "PLCSIM Virtual Eth.Adapter", then we enter the IP address of the CPU in the "S7-PLCSIM Advanced".
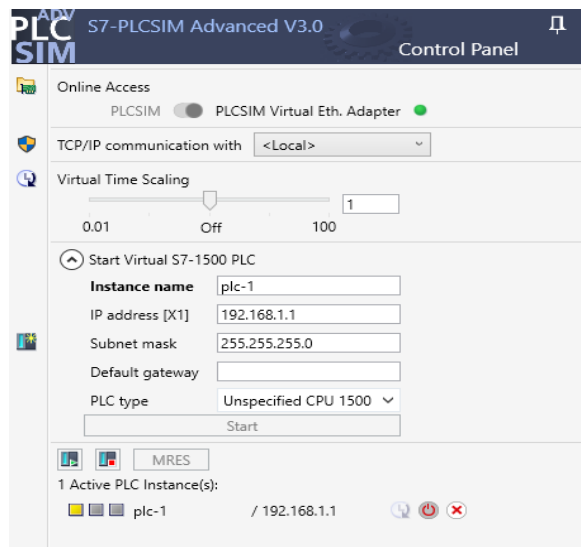
Figure 3. 21. S7-PLCSIM Advanced

Step 5: We click "web server" in the PLC properties file, We activate the checkbox "Activate the web server in this module" and "Enable automatic update", if we want secure access to standard web pages, we enable the "Allow access using HTTPS only" check box.
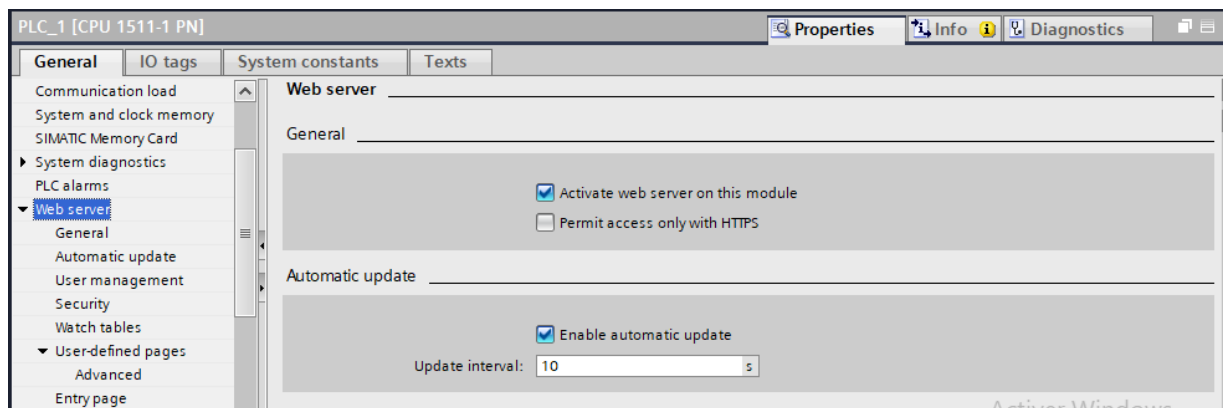
Figure 3. 22. Web server settings in STEP 7

3.7.4   The interface of siemens

First download a project to my PLC then enter the IP address of the PLC in the address bar using my web browser. The interface of Siemens appears with the selected PLC in the start Page.

Figure 3. 23. Welcome page of Siemens interface

3.7.4.1 Start page

Before the log in, the Start page offers information about the selected PLC as shown in the figure below. The CPU image with LEDs refers to the actual CPU status at the time of the data request [17].
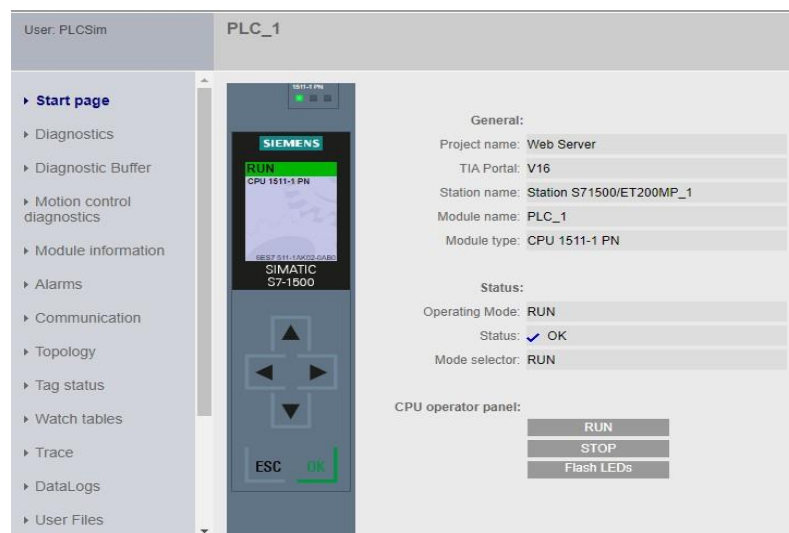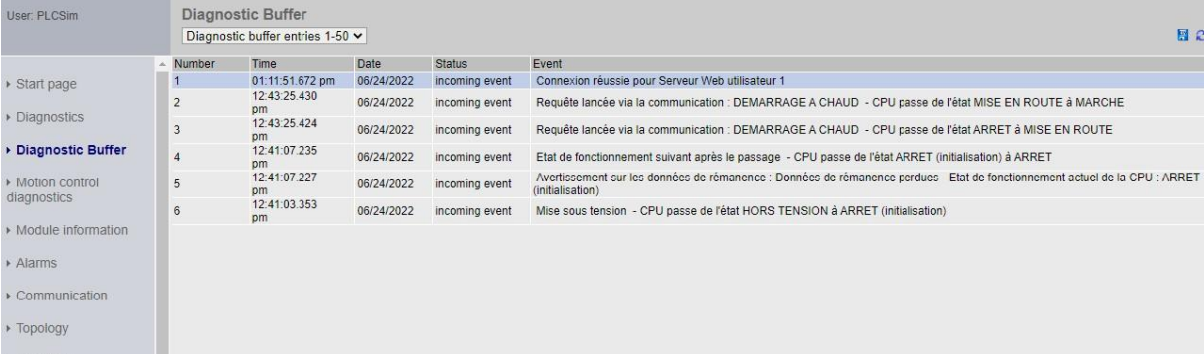
Figure 3. 24. Start page

3.7.4.2   Diagnostic buffer

The browser displays the content of the diagnostic buffer on the "Diagnostic buffer" website [17].

Figure 3. 25. Diagnostic buffer

3.7.4.3   Alarms

To receive compact information on fault analysis, we recommend that you first read out the, content of the alarm buffer. This is the most effective method to get an overview of the pending faults.

The browser displays the content of the alarm buffer on the "Alarms" website [17].

Figure 3. 26. Alarms

3.7.4.4 Communication

All the necessary information about communication interfaces are in the following tabs:

- Parameters

- Statistics

- Connection resources

- Connection status
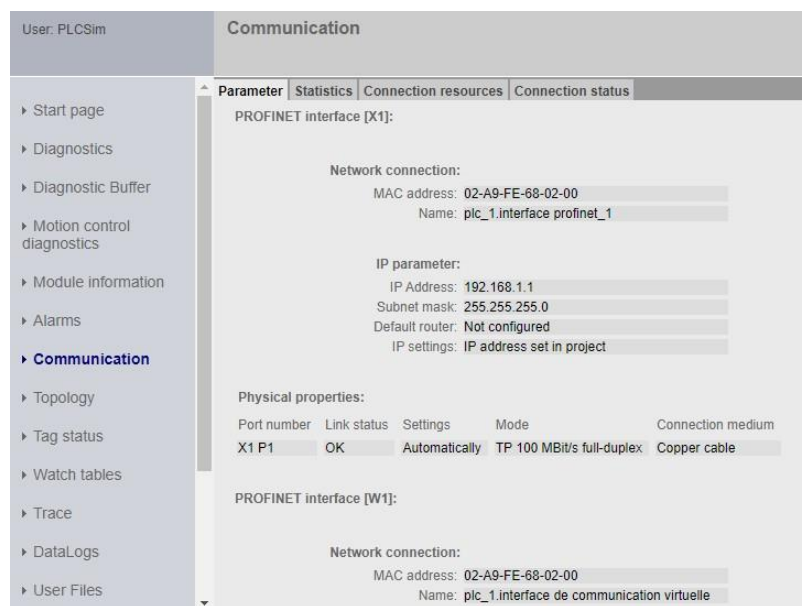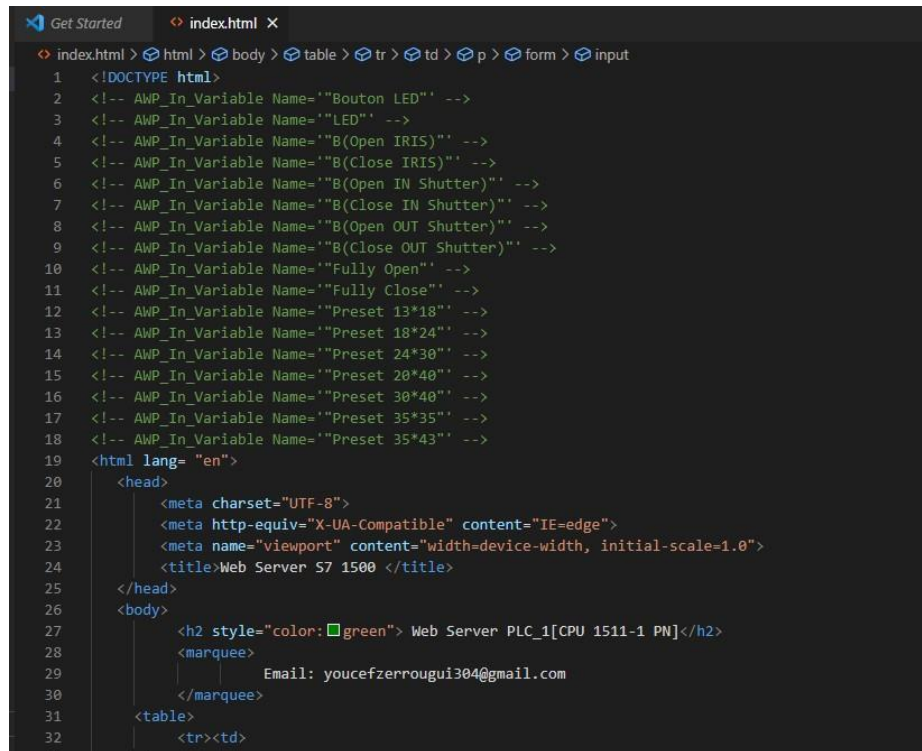
Figure 3. 27. Communication

3.7.5 Creating the HTML file and generating the DB (Data Block)

Step 1: using visual studio software we create a new HTML file then store it in the "user page" of the Tia Portal program file, then with <AWP> instruction we insert all the necessary variables for our interface then name the interface Web ServerPLC_1[CPU 1511-1 PN] with the instruction <h2> .

The file contents should look like this:


Figure 3. 28. Program HTML

We have used the "AWP" instruction to entre variable in HTML file with the same name of the variable in TIA Portal for the exchange of variable DATA between the interface of the web page and TIA Portal ladder program.

Step 2: Now we can enable user page window in Siemens and use this file we created. To enable user pages, go to Device Configuration -> Web Server -> User-Defined Web Pages. We set the HTML directory "user page" and index.html in Default Html page. In the end click generate block which creates DB 333 it is an entry in WWW instruction this transfer all the DATA to the web page of our interface.
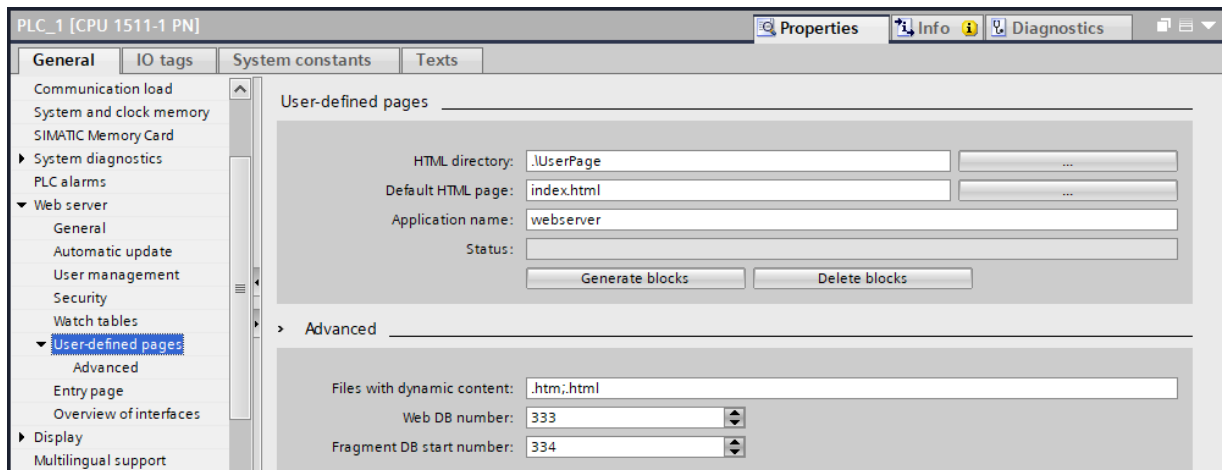
Figure 3. 29. Configuring user pages in STEP 7

The WWW instruction for creating the web page is necessary in our OB (organization block) with ladder program it has the generated data block DB as an entry this instruction look like the figure (3. 30.).
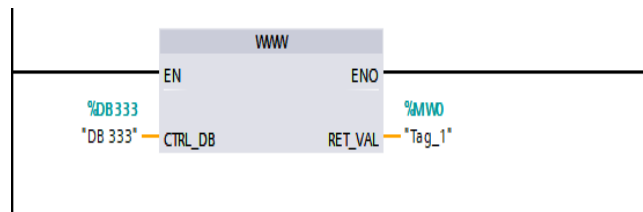
Figure 3. 30. WWW instruction

Step 3: Now we have the homepage of the application Webserver, this is link to get access to our interface for remote control.
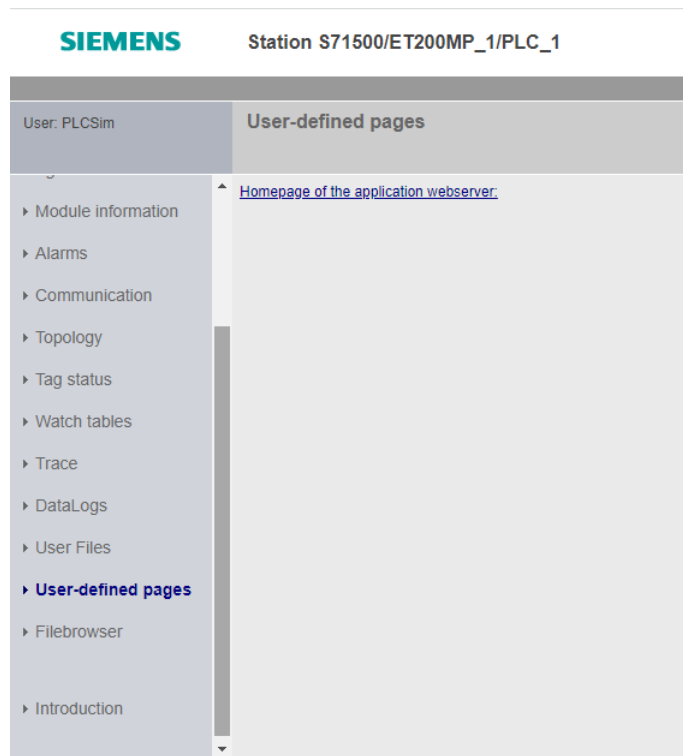
Figure 3. 31. User pages

• As a result we have this interface for remote control through internet in Figure (3. 32.) with all buttons to control the system manually open or close (in/out shutters and the iris) , control the preset with predefined dimensions , light up or light off the led.
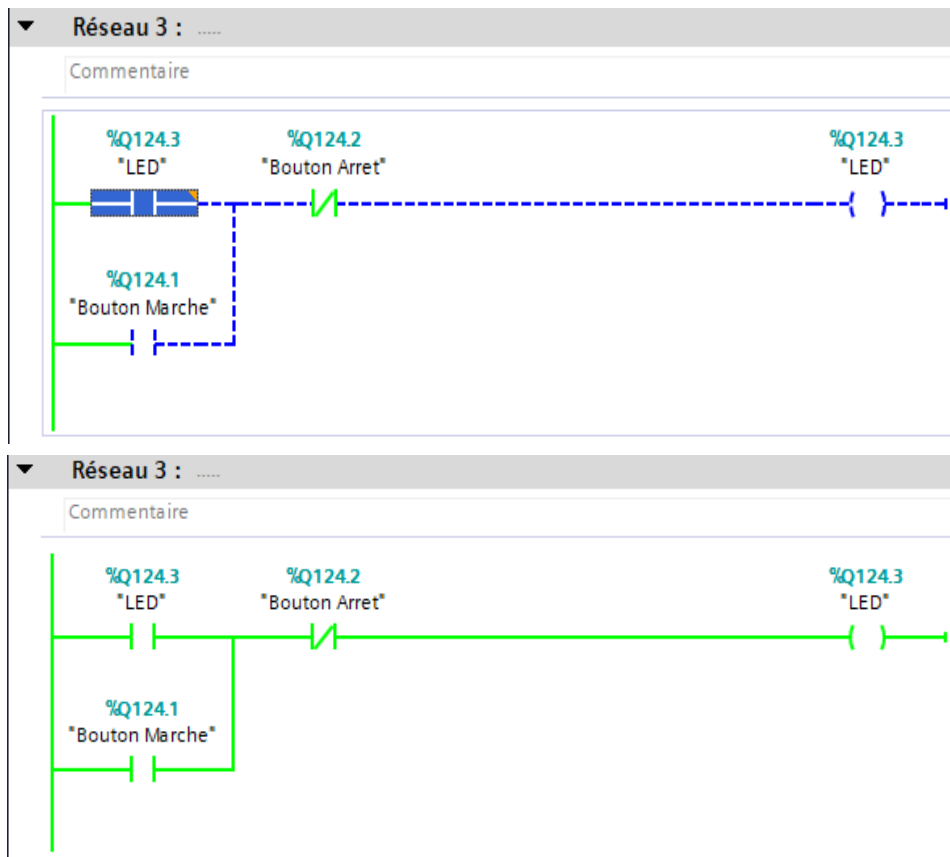

Figure 3. 32. Interface web server

- **Step 4:** activate the visualization in TIA portal and control with interface from the web page for remote control and we demonstrate three examples

- click on "Boutton LED ON" to light up the LED as in the next Figure (3. 33)

Figure 3. 33. Example of the Button LED

- click on "B(open IN Shutter) ON" so it opens the shutter as in the next Figure (3. 34).
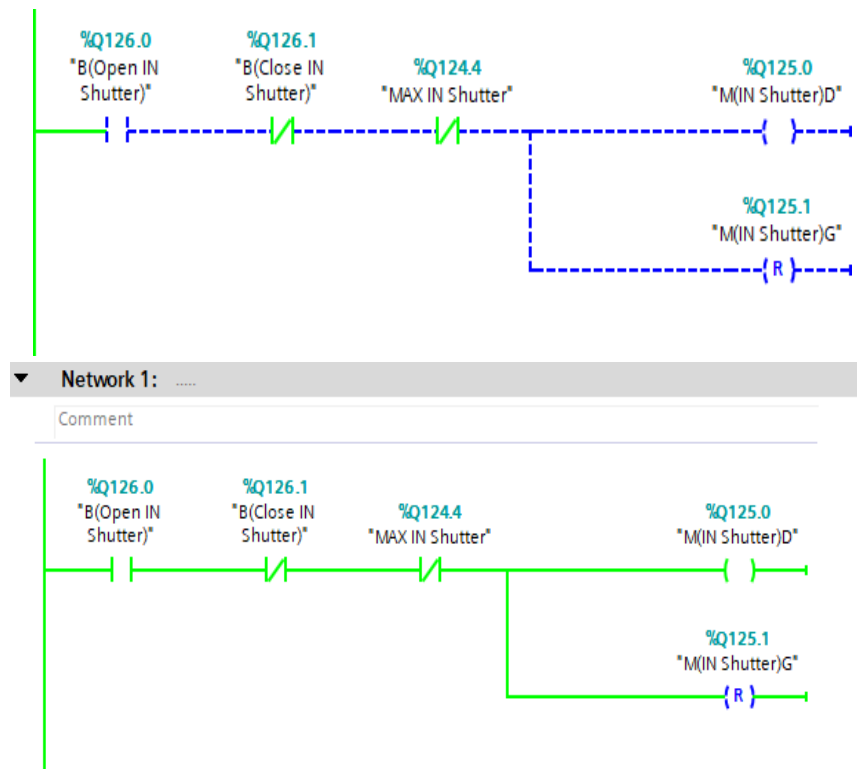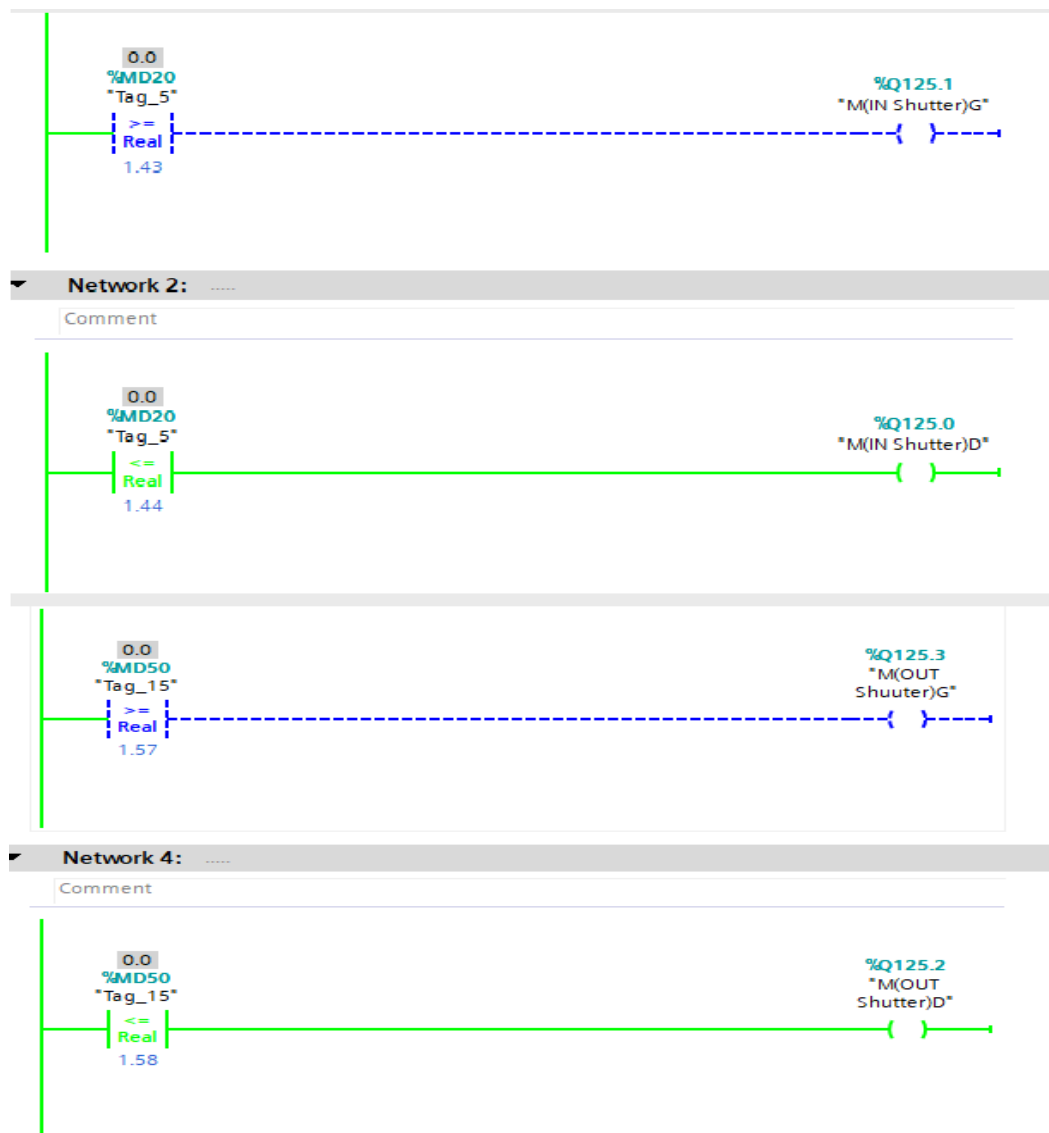

Figure 3. 34. Example of the Open IN Shutter Button

-click on " Preset 13*18 ON" as in the next Figure(3. 35.).

Figure 3. 35. Example of the preset 13*18 Button

3.8 Conclusion

The WebNavigator in WinCC Explorer and the web server in the Tia portal are software solutions that allow remote control, monitoring, and data acquisition through the internet, these advantages will be very beneficial in many fields that use Siemens controllers.

General Conclusion

Tele-supervision and remote control can bring major advances in Tele-medicine which is modern domain with different departments Tele-care, Tele-radiology, Tele-surgery. In this context, our project contributes to the development of Tele-radiology it's about remote and Tele-supervision of an x-ray collimator using our designed interface. For this, two features represent Siemens software solutions which are the WebNavigator and Web server, WebNavigator is an option in WinCC explorer software that allows the transmission of a local network to the internet network based on server/client structure. While, the web server is an option in many modern PLC's made by SIEMENS provide an interface include a web page for our remote interface and supervising the State of PLC, Alarms, Diagnostic buffer, and all necessary data.

This software solutions are not only limited to this project which is the Tele-supervision and remote control of an x-ray collimator but can be extended to all applications using Siemens PLC"s for the control of the process. As a perspective we will use embedded system for the control of this process.

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