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DESIGNING OF ETHERNET MULTI-PROTOCOL FOR INDUSTRIAL DEVICES SECURITY MONITORING

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Abstract— This develops an in-depth analysis of the current industrial ethernet, OPC UA, Modbus TCP, and Profinet, against the vulnerability in the industrial control network, adopts the security strategy under the combination of security function in the mainstream industrial ethernet and protocol deep analysis, and designs an ethernet security monitor in multi-protocol. This monitor may automatically detect various network protocols in one or more network protocols, keep track of network activity in real-time in accordance with the security setup plan, and monitor unwanted device access, strange messages, network anomalies, etc. track the important process data for the equipment and implement local and remote alarm functions. According to tests, this monitor doesn't interfere with the original industrial control network and can successfully safeguard its security.

Index Terms— ***Sender, Receiver, Router, Modbus TCP, security monitor***

and giving assurance for the security of industrial control network in response to the vulnerability of

I Introduction

Industrial ethernet adoption by industrial control systems has increased together with the development of the industrial network. In the USA, China, and other nations, industrial internet has evolved into a national plan that eventually encompasses a variety of industries. When updating and rebuilding integration systems, many businesses need to link their networks, but the adoption of industrial ethernet technology and general standard protocols causes serious information security problems in the industrial control system. In the industrial control system, numerous local and international security events occurred in all spheres of life[1]. For instance, information can be stolen, deployment instructions can be fraudulently altered, and physically isolated lines of defence can be infiltrated via networks. These considerable dangers pose difficult hurdles for industrial ethernet[2]. The national security and growth of the country are directly tied to network security and information technology. This paper designs an industrial ethernet status monitor based on multi-protocols, OPC UA, Modbus TCP, and Profinet, providing protection from different layers

industrial control systems and complexity of industrial environment at present[3]. The most popular type of control architecture utilised in manufacturing systems is hierarchical or central control. In hierarchical control, a central controller determines, either beforehand or online, the order in which a collection of machines and parts will be processed. Despite being commonly utilised, hierarchical control architecture has some drawbacks (Parunak, 1995; Deshmukh et al., 1993). As an alternative to hierarchical control and its drawbacks, the decentralised control architecture has been proposed. These systems, which are also known as multi-agent manufacturing systems, are made up of autonomous components (parts, machines, etc.) that interact with one another and carry out their tasks decentralised from a central controller. The main goal of these systems' design is to decentralise the management of the production system, which will decrease complexity, boost flexibility, and improve fault tolerance. Decentralized control replaces the central controller

with several small controllers
Designing decentralized control protocols for

discrete part production systems was the main goal of this study. The currency and preemption schemes are both included in this research under a single framework. Both the actors' individual goals and the system's overarching goals were achieved with the aid of currency functions. Based on the due dates of the pieces, the preemption technique was employed to speed up processing. Both the machine agents and the part agents have control protocols. An object- oriented simulation platform called Swarm was used to construct these control strategies. Different agent control strategies were evaluated in expansive, flexible job shop settings. Observations of the system's performance were made under various operating circumstances

2 Literature survey

Using energy adaptive immune GA, Laila et al. 2011 addressed collaborative design job scheduling in cloud manufacturing (EAIGA). They took into account the issue of collaborative design task scheduling in a distributed production environment of cloud manufacturing. To assure the concurrent execution of design activities, this sort of scheduling issue involves relationships between design and task units. They altered the Genetic Algorithm (GA) and gave it the name EAIGA in order to address the stated production scheduling challenge. In IGA, the antigen extract and vaccine are chosen in accordance with the problem's feature information. It aids in guiding population evolution in the desired direction. The standard GA uses the same population initialization and genetic evolution methods. New populations are immunised by antibodies following selection, crossover, and mutation. According to the authors, the algorithm's diversity and stability were both increased by the potential detection and parameter adaption, respectively. Both approaches saved time and improved the quality of the solution. EAIGA demonstrated fairly good balancing capacity and seeking ability for addressing the taken production scheduling problem in cloud manufacturing without the growth of time complexity based on IGA.

The architecture for a workflow system on a cloud platform with a scheduling method called Max Percentages was presented by Li et al. (2016). (MP). They talked about what a manufacturing company needs to do to increase productivity and efficiency. They developed a big data environment to build MP, providing the basis for data analytics and the chance to choose the best course of action. To collect the necessary user data, they used smart sensor technology, a wireless sensor network (WSN), and RFID technologies. Cloud computing is a method for computation and computer storage that assists enterprises in resolving issues with fixed resources during data analytics. Using Suffrage algorithms as a guide, this MP algorithm gathers all the information on diverse resources and workflows to confirm load balancing. The main goal of this method is to identify the resources that are most negatively impacted when a job is assigned to them during their service time. By determining the percentage of time spent on each online task and the overall time spent on each resource, the impact on resources is quantified. When there are numerous long and short independent tasks that are roughly equal, the MP Algorithm is significantly more useful. The study's findings showed that the proposed MP algorithm makes use of the inherent connections between data about activities and resources. In order to achieve optimal scheduling, the percentage of completion time is calculated. According to the authors, the MP algorithm's overall performance is the best and most satisfied when compared with with classic Dynamic Critical Path, Max-Min, Min-Min, GA, and Sufferage algorithms

A scenario of dynamic scheduling in cloud manufacturing was addressed by Zhou et al. (2018). They took into account the task's dynamic arrival, and their scheduling goal was to have each task do its work on average. The cloud agent system proposed by Ma et al. (2014). It includes the contract net approach to schedule production on the cloud. Additionally, from the standpoint of cloud manufacturing, some researchers are focusing on the issues with workshop scheduling. Jian and Wang (2014) presented workshop scheduling for a batch task in cloud manufacturing. Additionally, hybrid job shop scheduling with mixed flow in assembly and processing tasks was presented by Lu et al. in 2017. Zhang and others (2017) To accomplish real- time, data-driven, optimum decision-making, a model for flexible job-shop scheduling based on game theory has been presented. Tasks were distributed to the most appropriate computers based on their real-time condition, and each machine is an active entity that can request task processing.

According to Liu et al. (2019), a platform-level multi-agent scheduling system (MAS) and an enterprise-level programming MAS make up a multi-agent architecture for PSMS scheduling. PSMS introduces procedures, features, and coding specifications. On the basis of this design, a PSMS programming model is suggested. To show the value of the architecture and the suggested paradigm, a case study was done.

The real-time multi-purpose task scheduling issue was resolved by Ahn and Hur (2021) to reduce the negative effects on cloud manufacturing's dependability, quality, cost, and delay. The issue is presented as a binary integer programming problem. The goal of the multiobjective-based GA's model-solving strategy was to produce workable solutions. Based on their experiments, it was determined that the timetable for small problems is nearly as good as the optimal schedule. The authors also confirmed that the suggested strategy creates efficient scheduling in real-time for larger, more realistic challenges.

3 Implementation Study

They utilised ethernet security monitor designs from the multi-protocol business in the current system. This monitor has the capacity to automatically recognise various network protocols in single or multiple network protocols, maintain real-time network status monitoring in accordance with the security configuration strategy, and use the MAC key for message authentication before data is transmitted via the network and verified withfirewall status.

3.1 Sender

In this module, the sender will request MAC address of particular Node to Trusted Authority, after requesting, the trusted authority will give response to sender. After getting a Mac address the sender will brose the file and upload to the vehicular router, the vehicular router will send to the particular receiver (A, B, C, D, E), after receiving successful sender will get a response. If sender will enter a fake Macaddress, then he will be considered as anattacker.

3.2 Router

In this module, we can see the all Node details and allocate MAC address. In a vehicular router, the sender will allocate MAC address for each & every Node node, and before allocating Mac address, he will enter validity of particular Node such as valid from, valid to, IP address and submit, then he will get a response Node name & MAC address assigned to particular Node. If we clicks on view vehicular details, it will display all details with their tags such as Node name, token no, valid from, valid to, IP address and attacker status. The vehicular router will receive the file from service provider and then send to the particular receiver.

3.3 TASC

The TASC will receive the allocated Mac address from the vehicular router, whenever the sender will request a Mac address, then the trusted authority will distribute Mac address of particular Node. After getting a Mac address the sender will browse the file and send to the particular receiver (A, B, C, D, and E).

3.4 Receiver (End User)

In this module, there are n-number of receivers are present (A, B, C, D, E and F). The receiver can receive the data file from the sender via vehicular router. The receivers receive the file by without changing the File Contents. Users may receive particular data files within the router only.

3.5 Attacker

Attacker is one who is injecting the fake Mac address and changes the IP address of the corresponding Node nodes. The sender will enter a fake Mac address, then router will considered as message integrity attacker. If the attacker changes IP address of particular node, then he will be considered as privacy identity attacker. The attacker details will store in attacker list with their tags such as attacker type, attacker name, attacked node, time & date.

5

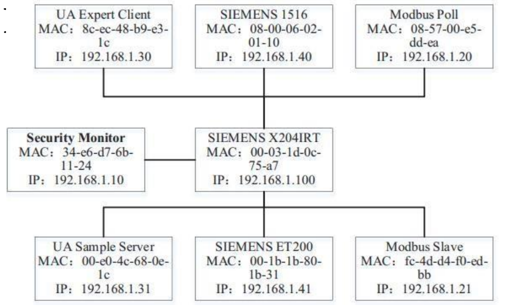

Fig 1:- Use actual Profinet protocol hardware, simulation software for Modbus TCP, and software for OPC UA while undertaking functional testing, along with industrial field cases and a lab setting[10]. The diagram of the test network topology

4 Algorithms And Methdology

The following three modules make up the majority of the application layer analysis module:

Analysis of OPC UA messages: Recognize OPC UA messages and use the boundary approach to keep an eye on the device's important data;

Profinet module: Recognize Profinet messages and use the boundary approach to watch over the device's important data;

Analysis of Modbus TCP communications: Recognize Modbus TCP messages, then use the boundary method and process relationship to track the device's important data.

***Fig2:** - the flow chart of the security system implemented in industrial Ethernet analysis*

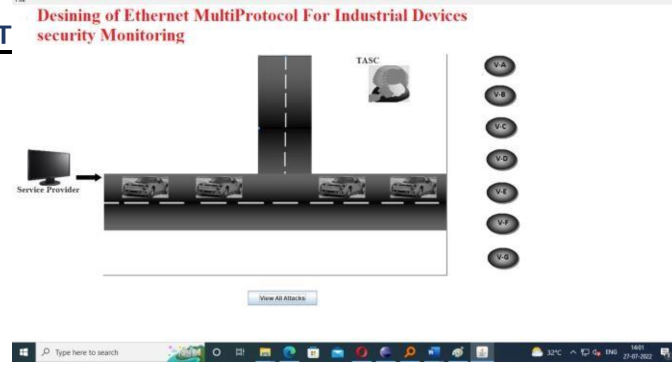

***Fig 3 :-** router file for transmission of messages*

***Fig 4 :-** Sender sends the messages*

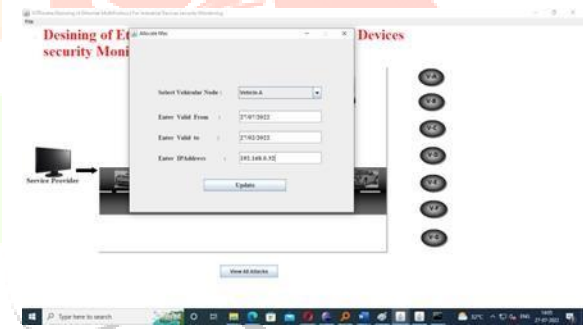

***Fig 5:** - allocating the MAC address to the nodes*

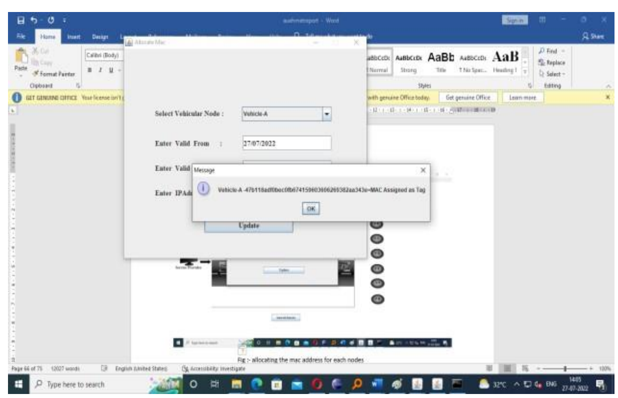

***Fig 6:-** MAC adress genrated for each node*

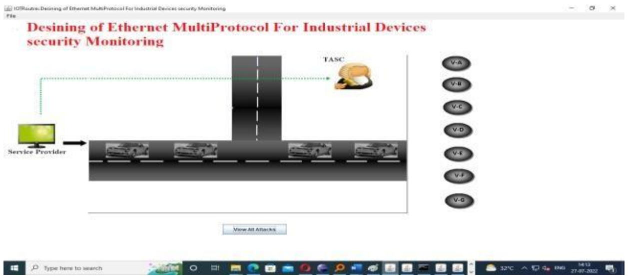

Fig 7:- *router monitor the ipaddress of the nodes*

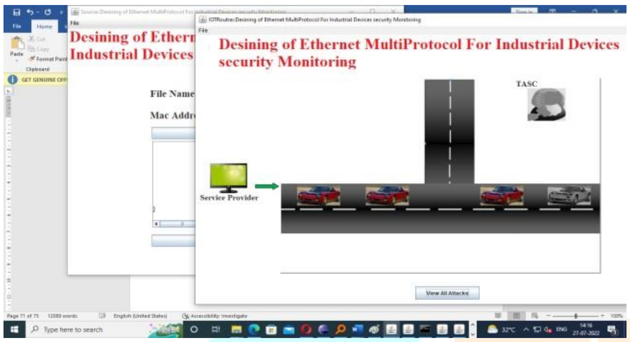

Fig 8: *- data transmitted successfully*

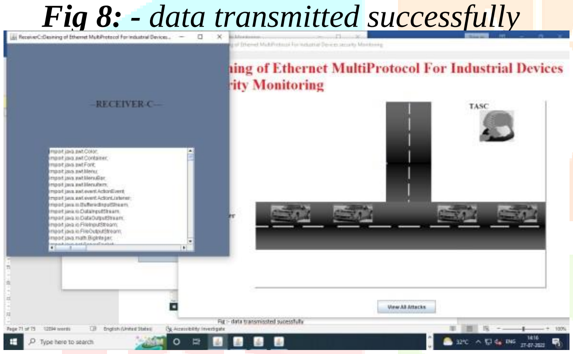

Fig 9 :- *data received by the receiver node*

6 Conclusion

Future development will center on industrial control system network and information security. An industrial Ethernet security monitor implements security monitoring at the network and application layers and is equipped to sound security alerts in response to current widespread virus attacks. The on-site engineering staff must set the protection strategy in accordance with the actual scenario, and staff members who are unfamiliar with the process are more likely to raise false alarms. It is crucial for the network security of industrial control systems that the follow-up study also undertake security protection testing andstability testing of the security network.

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