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Enhanced Security Hybrid Communication for Complex Industrial Embedded System

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***Abstract*— With the fast pace of industrial & concentration of population in urban area unit & sleep size in load prices industries are locating plant to remote sites. Also as the technology is getting advanced automation data logging & remote monitoring have become an indispensible tool for industrial automation & are heavily dependent on connectivity options available. Also there are a variety of devices which are to be monitored & controlled remotely via a single connection along with security. This work presents a unique method of encrypting data from various devices such as plc's, DCS embedded controller & data loggers & multiplexing it on a single TDM (Time Division Multiplex) channel. ESP8266 wifi module is employed at the communication and of communication controller PLC/DCS to connect to IOT cloud via wifi this operation has been demonstrated using the thingspeak API. Encryption & multiplexing code has been demonstrated using MATLAB while IOT/cloud communication using ESP8266 demonstrated using ladder logic. Thus a comprehensive industrial communication system for remote site management has been presented.**

***Index Terms*— Industrial Automation, PLC,DCS, ESP8266,NodeMCU, IOT.**

I. INTRODUCTION

In industrial automation there is the use of control systems and information technology to deal with different processes and mechanisms in an industry to replace human. This is the second step behind mechanization in manufacturing.

The purpose of automation earlier was to increase productivity and to reduce the cost associated with human operators. Industrial automation reduces the prices of healthcare vacations and paid vacations and holidays associated with the human operator. Industrial automation does not require benefits like bonuses, pension coverage as given to the employees. As they are associated with a high initial cost, they provide monthly wages to employees resulting in significant cost savings for the company. The maintenance cost of machines used in industrial automation is lower because they do not fail often. If machine fails, only computer and maintenance engineers will need to fix it.

As there are large number of devices working in synchronization with automation technologies industrial automation can be complex in nature. The figure explains the hierarchical arrangement of the automation system consisting of different hierarchical levels.

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II. OBJECTIVES OF STUDY

[1.] Design & Development of a Remote Monitoring & Control of Industrial Site(s) with No Wired Internet Connectivity, using Internet & IOT techniques without employing public IP Addresses.

[2.] The proposed system should be able to monitor or control Industrial Control Hardware such as PLC (Programmable Logic Controller) & DCS (Distributed Control System).

[3.] The system should facilitate control of multiple devices with varied configurations such as PLC's, DCS, Data Loggers, & PC's used for MIS(Management Information Systems) & Industrial Automation.

[4.] Design of a channeling or tunneling protocol to multiplex or de-multiplex data from the gateway to various connected devices & vice versa. The protocol should be able to handle variable data sizes with variable priorities & real time requirements.

[5.] The proposed system should be able to cater to magnitude of Industrial Intra-Connectivity Techniques such as Zigbee/WiFi/Bluetooth or LORA, & integrate all data in a single gateway for internet connectivity.

[6.] Optionally, for achieving real-time monitoring & control objective, multiple internet connections using 3G/4G GSM routers, P2P(Point to Point) Microwave Links may be employed on sharing/fail-safe basis. In fact, P2P Microwave links can be used as Primary Connection & 3G/4G GSM used as bandwidth or downtime backup.

[7.] Also, the proposed system, must be highly secure & should not be vulnerable to online attacks, & thus, the proposed system, may implement multilevel hardware address/ configuration based cryptography schemes.

III. EXISTING TECHNIQUES

Remote plant monitoring and control becomes more accessible with the latest technologies that provide reduced latency even for mobile communications. To benefit most from these advances, reduced cost and secure solutions can be implemented without the acquisition of a public IP from the services providers. This paper presented and tested two such configurations for a typical PLC to a remote decision support system connection. Results showed that such architectures

enable greater accessibility and improved plant operations. Future work will include performance evaluation between these two options and the implementation of algorithms for wastewater plant operation optimization. [1]

Informational communication technology (ICT) is a tool of global educational development. The use of information communication technology in the third world countries has witness a number of pitfalls, despite relevant educational stakeholders' effort to savage the situation. Some of the possible solution insight as exaggerated by the researcher will serve as benchmark for ICT to be fully optimized in the educational system of these third world countries, for it to yield its lantern benefit in terms of making teaching/learning more efficient/ effective which is a pivotal for manpower and national development. [2]

Research in the field of science communication started emerging about 50 years ago and has since then matured as a field of academic enquiry. Early findings about research-active authors and countries reveal that scholarly activity in the field has traditionally been dominated by male authors from English-speaking countries in the West. The current study is a systematic, bibliographic analysis of a full sample of research papers that were published in the three most prominent journals in the field from 1979 to 2016. The findings reveal that early inequities remain prevalent, but also that there are indications that recent increases in research outputs and trends in authorship patterns — for example the growth in female authorship — are beginning to correct some of these imbalances. Furthermore, the current study verifies earlier indications that science communication research is becoming increasingly institutionalised and internationalised, as demonstrated by an upward trend in papers reflecting cross-institutional collaboration and the diversity of countries where authors are based. [3]

This study has discovered that use of ICTs by livestock keepers for the purpose of improving their livestock production activities in the southern district of Botswana is not satisfying. Radio, mobile phones, and television are the identified types of ICT that are used most frequently by livestock keepers, though they are not used at satisfactory level for livestock production. ICT usage and access is limited by lack of computer skills, high cost of computers and Internet access, unawareness of livestock programs on radio and television, lack of ICT infrastructure in rural areas, and others. If these challenges can be resolved, there can be a significant improvement in livestock production especially in remote rural areas where livestock keeping is highly practiced. [4]

This paper discusses the different dimension of the ICTs. It gives an awareness of technology in library and why there is a need to understand the use of ICT in the library for rendering enhanced library services and information to users. The current study highlights the areas where ICT can be applied. Basically, the paper explains different technologies and their use in the library operation. How library services are prompted with the use of technology like RemoteXs, RFID Technology, QR Code, etc. have discoursed in the study. The present study discusses various library operations using library automation. In this paper, the benefits of institutional repositories have been discussed for archiving the library resources. The very purpose of this study is to express the usefulness of the different ICT for quickest and approachable information dissemination. [5]

The case study proves architectural design plays an important role when efficiency of studied virtual laboratory environment is in question. By using container virtualization for laboratory module isolation hardware resources can be utilised to their full potential. Performance results show the system is capable to run more laboratory exercises than before. We also found out the computing resources were not the current limiting factor but storage capacity. Storage capacity can be better utilized by using Thin provisioning, which will be implemented in the next maintenance revision. The next limiting factor is RAM capacity, which will be addressed on the upcoming hardware upgrades. As based on the results, 384 GB of RAM per node will give an optimal price to performance ratio for our system. Teachers also adopted the virtual laboratory well; Even if on the Fall of 2016 semester the system was still in development, many of the teachers saw the benefits and adopted the system to the course curricula. Ten courses in total used the virtual laboratory as a primary exercise platform during 2016-2017 academic year. Two years ago all the laboratory exercises were performed in a hardware laboratory, with only adding some virtualized components which were primarily ran on workstations. Based on our estimations, in the current curriculum 75 out of 80 ECTS worth of studies which uses laboratory in South-Eastern University of Applied Sciences Information Technology department could be moved to the virtual environment. However due to practical knowhow of hardware systems, some of the low level studies still benefit from hardware based lab. [6]

Li-Fi is an emerging technology currently attracting us a great deal of the interest because of its latest and very efficient alternative to wireless technology. It uses the visible spectrum of light which is much better than the RF. Li-Fi has large bandwidth and high speed than Wi-Fi. With the use of LEDs the information can be transmitted with just the simple turning on and off of the LEDs. This technology is a effective not only for wireless but also underwater communication. This technology minimizes the effect of high absorption/attenuation that has significant effect on the transmitted signal. This technology is not only free to use but also provides a safe and secure access. By using this technology we can proceed towards a greener, safer and cleaner future. It is an advanced approach that will make our lives more technology driven in the near future. [7]

The future smart grid is based on combination of legacy grid with advanced smart metering, remote sensing, remote control of all key components and equipment. The success of the smart grid depends directly on reliable, robust and secure communication system with high data rate capability. This paper presented comparison between legacy and future smart grid communication system and an overview of existing communication infrastructure and technologies that can be used for smart grid. The paper also outlined the problems of these technologies and the research challenges that aim to solve these problems. Future work should concentrate on

development of improved security algorithms that could be adapted for the smart grid communication and protocols and methods for interference reduction and elimination. [8]

The IOT promises to deliver a step change in individuals‟ quality of life and enterprises‟ productivity. Through a widely distributed, locally intelligent network of smart devices, the IoT has the potential to enable extensions and enhancements to fundamental services in transportation, logistics, security, utilities, education, healthcare and other areas, while providing a new ecosystem for application development. A concerted effort is required to move the industry beyond the early stages of market development towards maturity, driven by common understanding of the distinct nature of the opportunity.

This market has distinct characteristics in the areas of service distribution, business and charging models, capabilities required to deliver IoT services, and the differing demands these services will place on mobile networks. Connecting those smart devices (nodes) to the web has also started happening, although at a slower rate. The pieces of the technology puzzle are coming together to accommodate the Internet of Things sooner than most people expect. Just as the Internet phenomenon happened not so long ago and caught like a wildfire, the Internet of Things will touch every aspect of our lives in less than a decade.

We have already seen the wide application of internet of things. In this work we will present a model of IOT based E-Advertisement system for the applications of Shopping malls & other organizations. This proposes model will replace the advertisement system in big shopping complex like Big bazaar, Reliance Fresh etc. Even we can maintain the humidity inside the big shopping malls without any Human efforts. Also we can use this prototype system for the educational organization or Railway stations. [9]

This paper introduces Using Asterisk Call center, webRTC build a complete call center solution. Any web Client coming to the system can simply click the buttons and get calls, this is a totally free service. Providing this solution to the web clients who are busy with their schedules can collaborate people who are in live and get information and documents that they want. Not only can that most of the organizations private companies Hospitals use this solutions for make their client’s satisfaction. [10]

Much of the internet transmission at the backbone is handled by the Optical Fiber Infrastructure that can achieve data speeds on the order of Tb/s. On the other hand, these high data rates at the backbone part cannot be perceived by the end users. Since the existing bandwidth cannot satisfy the required capacity and speed demands, as well as multiple technologies contemporaneously share the same bandwidth (Wi-fi, bluetooth, cellular phone network, cordless phones), scientists and professionals have focused on new research areas in wireless communications. [11]

IV. METHODOLOGY

Process Block Diagram

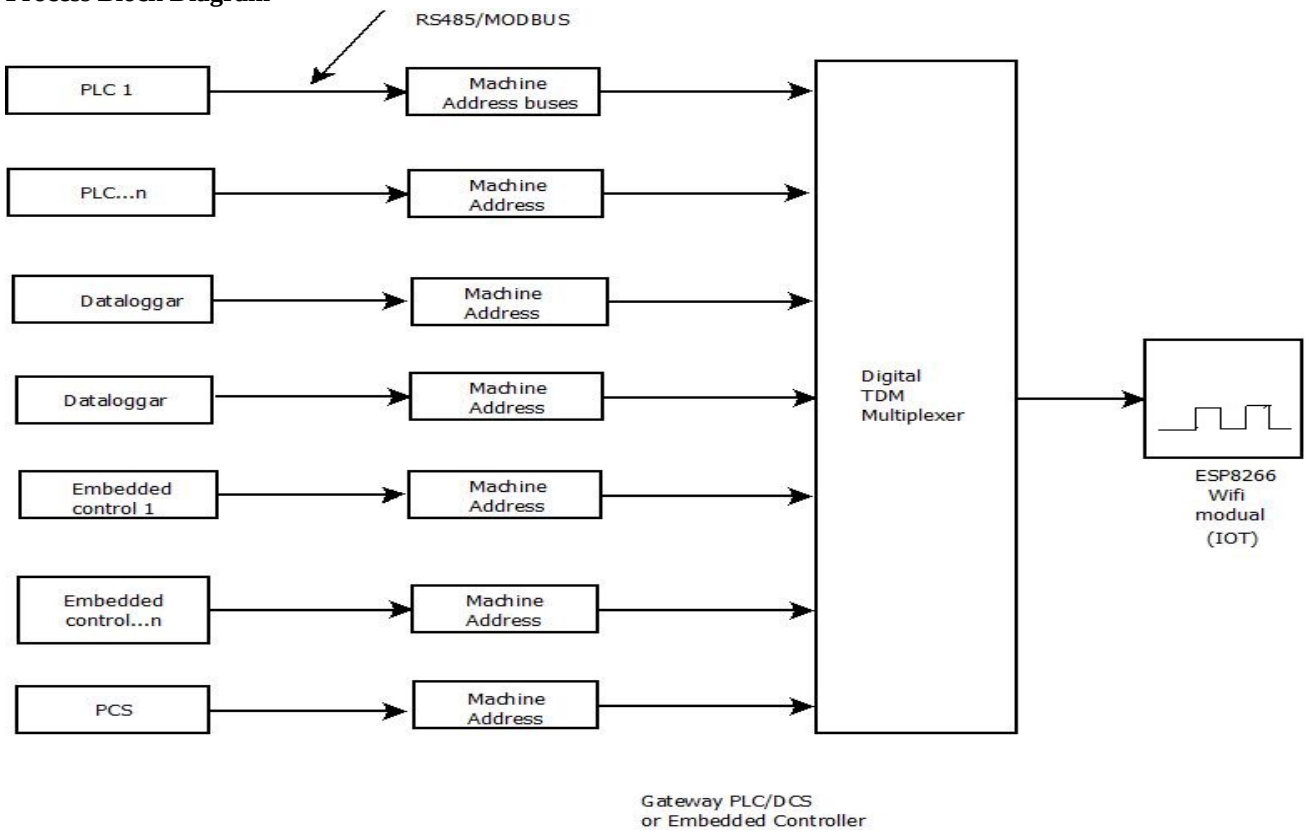

Fig: 1 Process Flow

V. RESULTS

A. *Ladder PLC Result:*

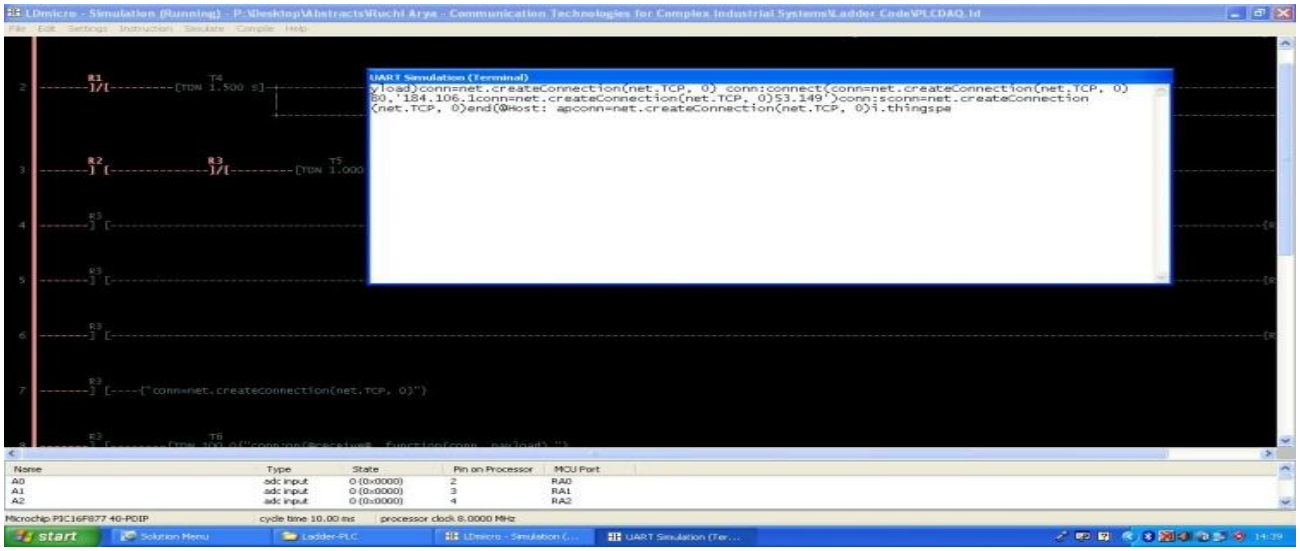

Fig 2 Real Time Simulation

In this window we can see a USART terminal that is used for see real time simulation.

B. *MATLAB Results:*

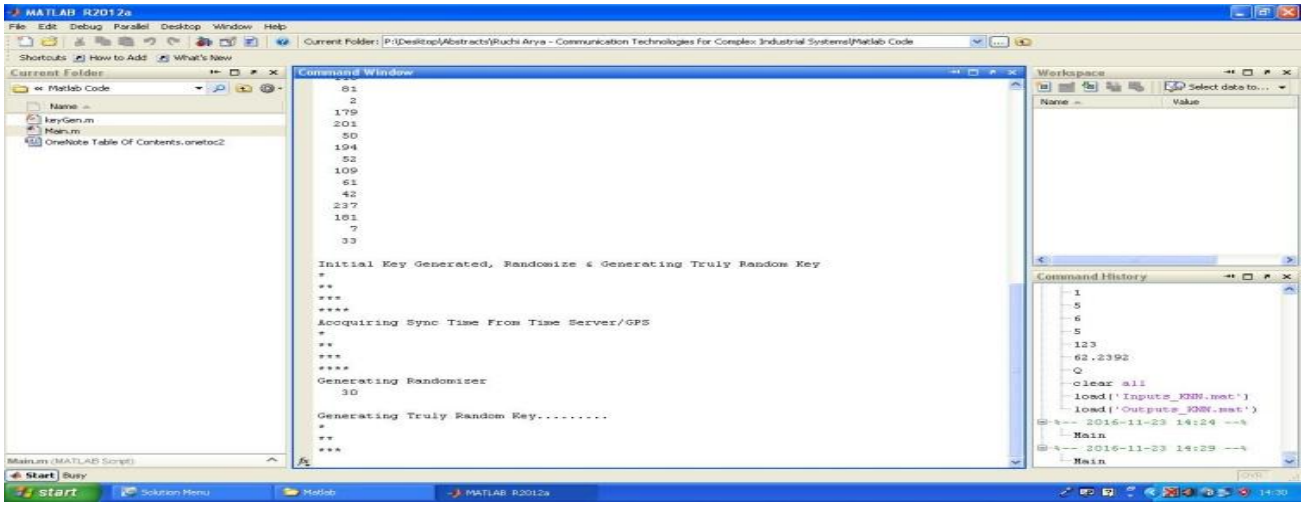

Fig 3 Generate Random Key

In this window we see the generated random key.

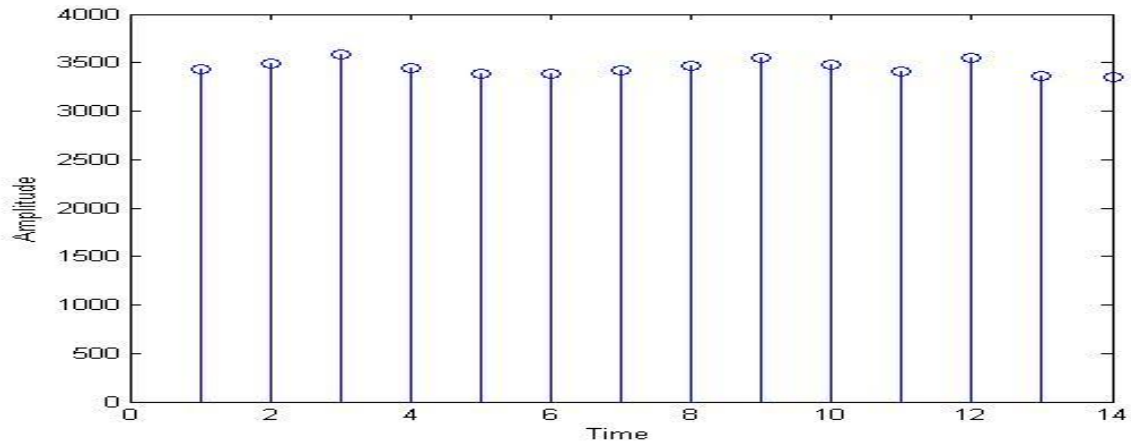

Fig4 Graph Between Amplitude and Time

In this window we can see the graph between time and amplitude.

C. Ostonsoft PIC Simulator

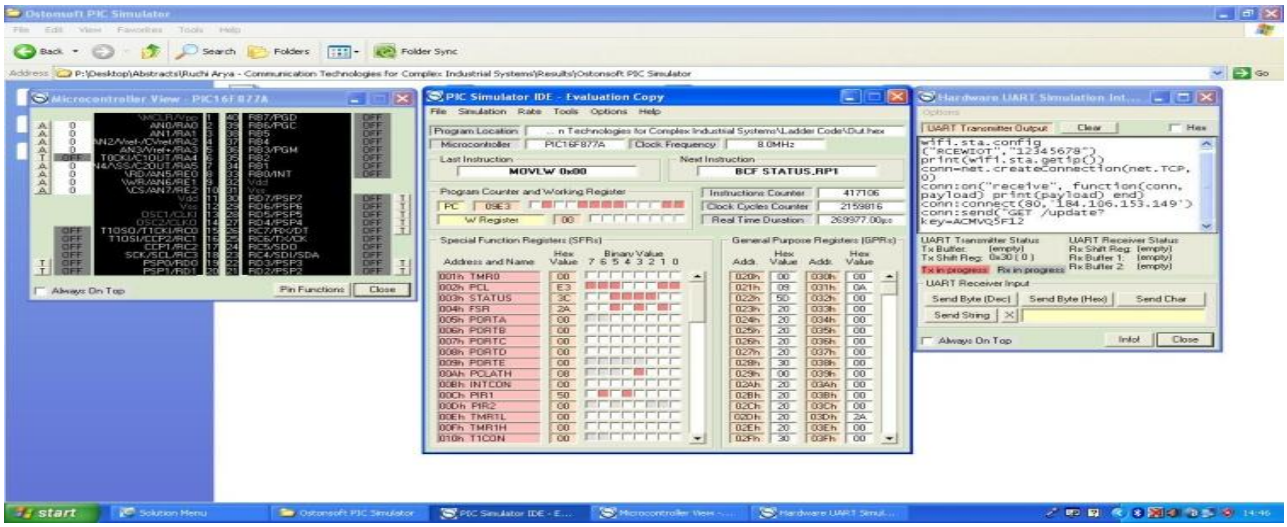

Fig5 USART Simulation

In this window we can see how we select program location, clock frequency microcontroller and we can see USART simulation.

VI. CONCLUSIONS

Conclusion work presents a unique method of remote monitoring & controlling of industrial automation setup using IOT & cloud technology along with improud security & throught put. The proposed system is compatible to take input form various industrial devices such as PLC(programmable logic controller) DCS(distributed Computing System) Data loggers & embedded Controller the proposed system employs truly random variable length key based encryption on every communication channel as iginating from industrial controller which is implement with machine address or device address security. Also the data to & from various independent industrial controllers is multiplexed into a single digital TDM (Time Division Multiplexing) & The master communication controller PLC/DCS acts as a gateway between the digital TDM stream & ESP8266/NodeMcu to data exchange via IOT Cloud. Various software tools have been employed in this research via MATLAB is used to demonstrate truly random variable length encryption technique & Digital TDM (Multiplexing and demultiplexing) Ldmicro is used to realize & simulate the ladder logic for PLC interfacing to ESP8266/NodeMcu. & Used to verity the result. As seen in the results above a low cost secure & variable connectivity devices has been demonstrated & the some is verified by Ldmicro Uart simulation output & PIC simulator Uart screenshots.

VII. FUTURE SCOPES

A unique communication controller has been demonstrated in the proposed work but as industrial automation is a rapidly evolving technology the proposed systems have to up with the changing trends & challenges. One of the most sough changes for the system is the integration with LORA(Long Range) Framework to reduce dependence on mobile data in failure of broodband/Fiber connections. Also the various industrial controllers can communicate with the gateway wireless by using Zigbee/Z-wake Technique instead of wired RS232/RS485 Connectivity.

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