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The Architecture & Connectivity of IOT For The Things In Automation and Industrial Environment

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Abstract

For many embedded applications, connectivity can add a large value. In industrial systems, the communication between terminal equipment and remote sensors, end equipment has been established primarily to better productivity and dependability. It can as well be named to as Internet of Everything (IoE). For many industries, connectivity is the greatest challenge while designing for the Internet of Things. The additional benefits have been offered to the entire ecosystem (end customers and service providers) whenever the devices are confiscated to the it cloud for many applications. In club to trim operating costs and to deal with important advances in telecommunications and software, so many significant alterations have earned in the current intelligent building, industrial process control, and automation technologies. In production and enterprise-wide systems, the software have become an indispensable component. The facilities for dealing and control, and the role of clear standards and personal computer systems (smartphones, PCs) were fundamentally altered by the internet connection. These organizations and criteria will give important advantages to their users and vendors. This finalizes the explanation of Industry 4.0 which implements the Internet of Things concept in the industry environment. The structural design of the IoT depends on OPC.NET specifications was presented that will be applied in automation and industrial environments together.

Keywords: WCF, Industry 4.0, Fieldbuses, RFID, OPC DA , IoT, OPC Xi, OPC.NET.

Introduction

In order to provide value-added services, a huge number of things or objects, sensors or devices were connected in IoT through the information and communications infrastructure. Each and every object is identified uniquely and also has very high access to the network because the IOT already described that, these objects are the parts of the internet [2]. In riding the quarter business riot namely "Industry 4.0" [1] or "Smart Factory" [3] which will convert construction and outcome, Germany Trade & Invest campaign message highlighting the role of the Internet of Things, Data, and Services [4]. Germany is unambiguously placed to knock into the potential of a novel case of industrialization namely Industry 4.0. The simplified message of Industry 4.0 is: the devices themselves get more intelligent, communication will be “Service to Service” and the cloud is an option as one service.

Industry 4.0 maps a model switch from "centralized" to "decentralized" construction – readily achievable by technological extensions which build up a turnaround of conservative development process logic. The technological development of implanted systems for cyber-physical systems (CPS) [5] is considered as Industry 4.0 or Smart Factory". With it, the information which is sensed about the environment and data are exchanged by enabling the communication among things. Even with or without human intervention, the things should react autonomously to the physical world.

In industrial production systems, the deployment of cyber-physical systems give birth to the "smart factory." Cyber-physical systems were leading technologies that will fetch the practical and real environments together to bring out a strictly networked environment in which intelligent things will cooperate. Cyber-physical systems articulates the next radical pace depends on presented implanted systems. Embedded systems join to model cyber-physical systems with the cyberspace and possible online avails and data. CPS gives support for IoT formation, that facilitates Industry 4.0.

Network connectivity lengthens to electronic things, so that everything can interact with the Internet. This can be possible through the extended vision of the Internet of Things [6] [7]. Embedded systems, distributed systems and, fieldbuses come forward to provide extended support to perform such a vision. Fieldbus is a digital wire that plug in with smart capacity; display systems and, control objects. The primary destination of the Fieldbus is to restore any node-to-node connection among the field devices (Sensors and Actuators) and their regulators.

ITU recommended that "IoT can tie things from the environment, both in an intellectual and predicting way" [7] [8]. ITU recognized four proportions by arranging various technological evolutions in IoT: recognizing elements ("labeling things") and, implanted standards ("things that imagine").

In IoT, the definition of "things" is extremely wide and contains a diversity of real essentials. Transportable special items, mainly smartphones are integrated in the requisites of things. It also consists essentials of our surroundings (as it house, vehicle or business), and objects outfitted with RFID (Radio Frequency Identification) labels linked to a gateway machine. RFID is used to discover the objects, recover corresponding information, and prevent theft. RFID is a technology similar to bar code identification. Thus far, in the direction of the internet a massive bit of things and twists will be linked. Each device will offer data, information, and various smooth avails. RFID is a dedicated short range communication. In real time, more or less all will be linked to the network; things will be traced.

In the concept of IoT [9], the industrial environment is integrated. The main component ENS (Event Notification Server) in the IoT@Work, aims to collect, organize and provide, the production data for the shop floors. In parliamentary law to hold patterns of kinds single-to -multiple and multiple to multiple and an active pairing of avails, procedures and essentials, the middleware communication replica which is provided by ENS depending on issue/ support communication. The ENS is the IoT@Work middleware component. ENS performs the same as a general collection manager of actions obtained from dissimilar starting places (called Event Publishers or simply Publishers) and transmitted, within a managed method, towards a group of viewers (called Action Subscribers/Customers or simply Subscribers /Consumers). The ENS provides near-real-time, one-to-many or many-to-many communications that facilitates among publishers and subscribers interoperable from their location.

AMQP (Advanced Message Queuing Protocol) protocol and architecture [10] have been used by this model. In order to send and receive messages, AMQP can be used which enables the applications. In this situation, AMQP acts like email or instant messaging [2]. AMQP allows the features of what messages can be received and from, and how trade-offs are performed with respect to reliability, security, and performance. The main purpose of AMQP is to exchange messages between client and server. On five continents, 2,000 users are supported by the AMQP environment to process 300 million messages per day. AMQP contains some parts that direct and preserves the information, a bunch of conditions to link these parts jointly, and the network link-level condition which permits customers to plug into the server and share information. AMQP is a standard protocol for message-oriented middleware that explains: the flexibility to connect applications on different platforms, the possibility to connect business partners, and the state of creative built on the foundation of AMQP.

In this paper, the architecture of IoT depends on the classic proposed in [11] is presented. Mainly, the architecture of IoT which is presented depends on the OPC.NET standards [12]. The rest of this document is arranged as below: Part II introduces OPC.NET, in brief, Part III summarily confronts the IOT projected construction, Part IV renders in which way the fieldbuses were combined in the future design of IoT, in Part V a gateway machine for existent information attainment is proposed, and at last Part VI wind up all the information.

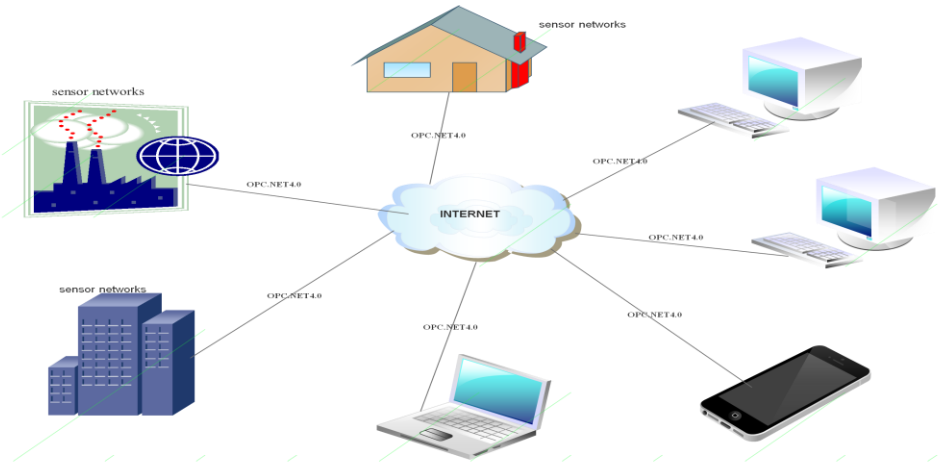

Figure 1: The projected design depends on OPC.NET

OPC. Net & WCF

On top of the .NET Framework, SCADA application has been developed by a group of OPC Foundation member companies by using Windows Communication Foundation (WCF) service. OPC Express Interface (OPC Xi) was developed by the OPC Foundation group which defines a client/server communication, via WCF by making use of any set of interfaces. These sets of interfaces depend on OPC DA 3.0 standard. Furthermore, a wrapper has developed by this group so that OPC.Xi clients can communicate with servers based on DCOM technology and classic OPC specifications. These results were considered through the OPC Foundation, along with the consideration of OPC.NET (renamed as OPC.NET 4.0 designed in favor of .NET Framework 4.0) [14] [15].

In order to build up client/server communication in C#, these interfaces are supplied by the OPC Foundation, which is defined as the SDK and it will be maintained throughout the communication. WCF services are maintained in the SDK, in turn utilized in favor of client & information server communication.

A high level of security can be achieved with the utilization of WCF, because different mechanisms were used by the WCF, for example the customer verification in order to plug in to the host, safety measures which are required to connect with the host, customer and host data encoding, or HTTP message layout. A reliable communication between customer and host will be maintained using WCF [14] [15].

Furthermore, a wrapper which is present in the SDK packet provides one functionality in which the client can access the servers based on the classic OPC specifications.

The Projected Structural Design of IOT

The proposed architecture of IoT based on OPC.NET specifications is presented in Figure 1. This architecture is developed in the order of two primary components: the information host along with the HMI (Human-Machine Interface). The information host collects information from an interconnection of detecting agents called sensors. The data server or information host also addresses some instructions to the actuators (relays) which associated with the fieldbuses. The information host can collect information from fieldbuses that are supported in smart buildings [16] (Lon Work, BACnet), wireless networks (ZigBee), fieldbuses that are used in industrial environments [17] (Modbus, EtherCAT, CANopen).

For the data servers among the two components, HMI application is the client. This HMI application can be implemented on smart phones, tablets or PCs. This application is used in the Internet and OPC.NET interfaces as communication infrastructure. Whenever the information is referred by the servers from the sensor networks, the client applications represent it in a graphical form. In addition, this client can address some instructions in the direction of the server, in which these instructions will arrive at the actuators.

The set of connections from which the information is obtained will be clear by by means of interface supplied by the host which is a fact in the client application perception. The client can get the address space of the server as a tree by making use of these interfaces. The root node which exists in the network will be the server which in turn has multiple networks. Each network will have a huge amount of devices and each device has one more properties such as pressure, temperature, an analogue control, a relay, etc. The operations might write only, read only or read write based on the specific properties. The received data can be shown by using GUI in a variety of formats and it will be linked with a single or various information hosts.

This graphical user interface can be used for taking smart automatic decisions which can be assigned to the servers for implementation and execution as well as for the advanced data analysis and diagnoses. The interconnection of "things" can be allowed by the client from the fieldbuses. These features and the facts that the connection to those "things" will be established through the network, this may claim that the projected design can be an IoT design.

The client/server communication can be an important issue when the host is after a router will make use of Network Address Translation (NAT). The communication between client and server can be achieved by configuring the router to carry out port promote taking place the port that is utilized for interaction. In order to initiate the connection, the customer transmits messages to the router which further forwards them to the host. While configuring the server the communication port choosing is performed, and it uses a eminent measure port which was not allocated to a particular set of rules as of the TCP/IP push-down storage.

The Field buses Integration In The Projected Design

The host application components are displayed in Figure 2. The host application has built up in .NET Framework 4.0 which will implement the services that are specified in OPC.NET. The drivers provide the same interface which is developed as DLL library. Through this method, new fieldbuses can be easily integrated without the need to recompile the system. The drivers for RTU, Modbus TCP/IP, CANOpen fieldbuses are developed, ZigBee and EtherCAT fieldbuses are in the improvement level. In order to use the information from the information server, these drivers permit information attainment from several kinds of fieldbuses and maintain it in the cache memory.

The OPC.NET information host depends on WCF. This expertise allows exposing data on the internet and completely concentrates on top of the web services. This information host gives clear right to use devices that are tied in to the fieldbuses via network or a local web. This amenity is the beginning pace in the direction of the application of the “IoT” kind. Through internet, OPC .NET host can be seen everywhere in the creation by exposing the virtual image of the industrial operation. Using various methods for example security measures or testimonials gathered from a userid and a secured password can have right to use OPC.NET host can be assured.

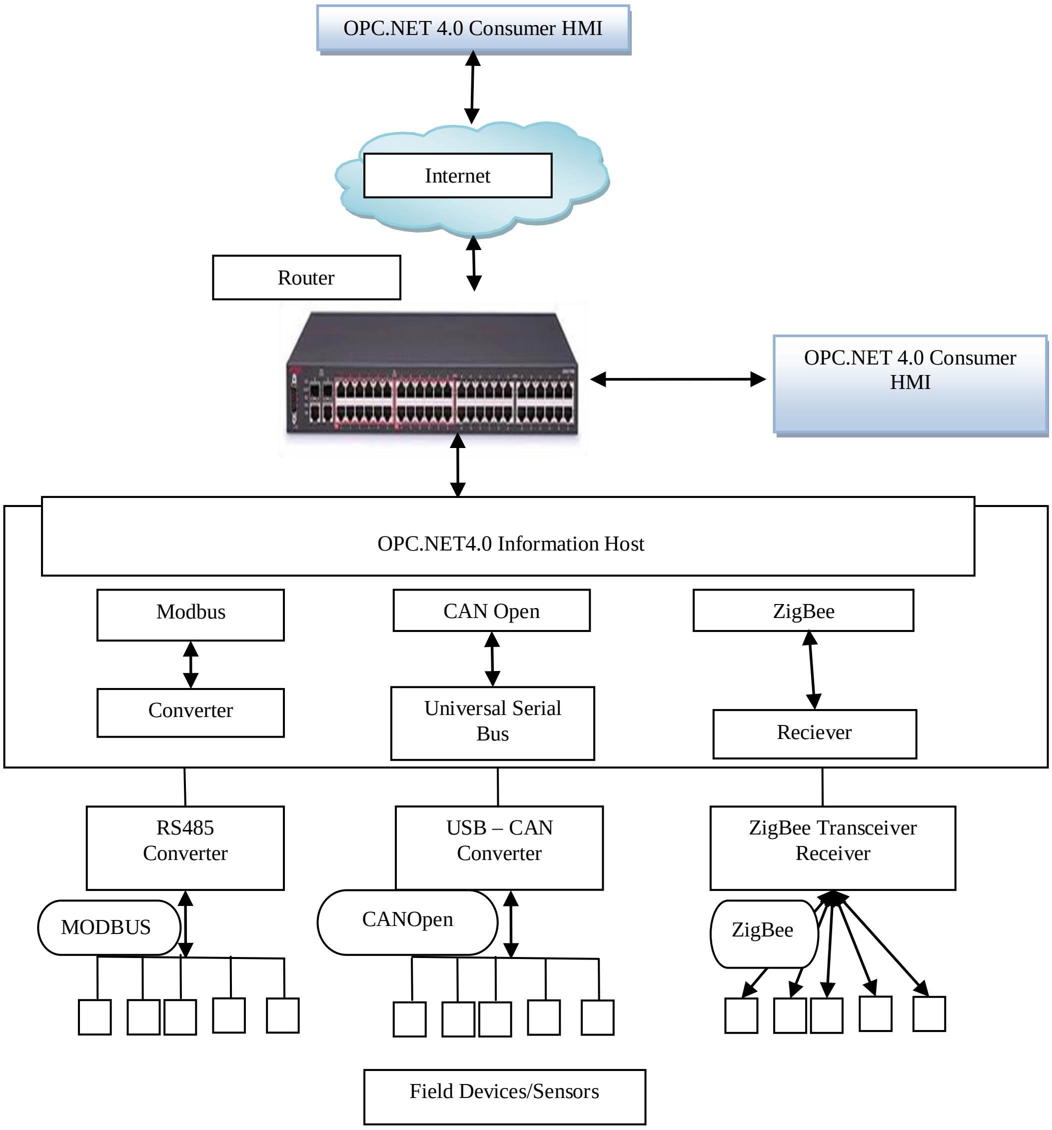

Figure 2: The design of the projected OPC. NET information host

Automatic modeling of address spaces can be performed by the server and also the server supports easy alteration of network configuration (interconnecting new field devices). The dedicated data servers which are highly available in the market will make use of a specific field bus and uses a modeler in order to revise the destination location at every modification lying on connected devices or else field bus. To integrate new configuration, this method corresponds with recompiling the server. But, the information host is inimitable because it supports a robotic modeling of destination location by examining the field buses along with recognizing the plug in devices.

Gateway For Existent Information Attainment and Control

The IOT contains not only the new devices which are specifically modeled for IOT compatibility, but also the systems that are in existence today and implement aside from the IOT cloud. The path to maintain a universal cloud of networked devices have needed a means for devices which are not IP-based to connect without covering the cost of a complete Ethernet or Wi-Fi interface with the additional protocol stack. This can be attained by using gateways [17] that connect these devices to the internet in the background of real world applications. Furthermore, summating embedded and intelligent control to gateways can interpret IoT device model by supplying access to shared processing resources.

Evolution of gateways as the embedded device type has been proposed for the real-time data acquisition. This development happened across a microcontroller and a genuine software platform (OS). The primary characteristics of gateway are:

- It is a twist depends on an Advanced RISC Machines Cortex M3;
- OPC.NET server can be linked with this device through a serial communication protocol TCP/IP or RTU with the help of RS232;
- From various kinds of field buses such as, CAN Open, Zig Bee, Bacnet, the genuine information attained will be permitted by the gateway.
- A genuine software platform is used for the evolution of the gateway.
- This device performs the acquisition cycle for each and every type of field buses specific to the usage of the protocol.

The gateway device proposed architecture is presented in Figure 3. In order to implement the real-time applications, the gateway device provides the hardware resources. An optimized computing power should be provided by the microcontroller at a lower price. For such type of applications, the Cortex M3 architecture of ARM provides sufficient resources. Select one microcontroller with an integrated timer to set particular time. The design of gateway provides some features in order to implement the field bus protocols.

- Successive ports for a serial communication protocol RTU.
- Execution of the serial communication protocol TCP/IP ensured by Ethernet ports.
- Carrying out one or many of the networks which are on rule basis.

Freely available and genuine software platform, namely Real Time Executive (RTX) will be used in order to develop this device. RTX is a tangible kernel on behalf of the microprocessors such as Cortex M3 is auxiliaries of the leading producers of microprocessors depend on ARM structural design. Some basic functions will be used to begin and end tasks, to begin the real-time executive, to forward the direction as of one job to another job (round-robin scheduling). In addition, implementation precedences can be allotted to these tasks. Several types of drivers that are provided by RTX kernel can be used for communication purposes. Those are: serial communication, CAN interaction etc.

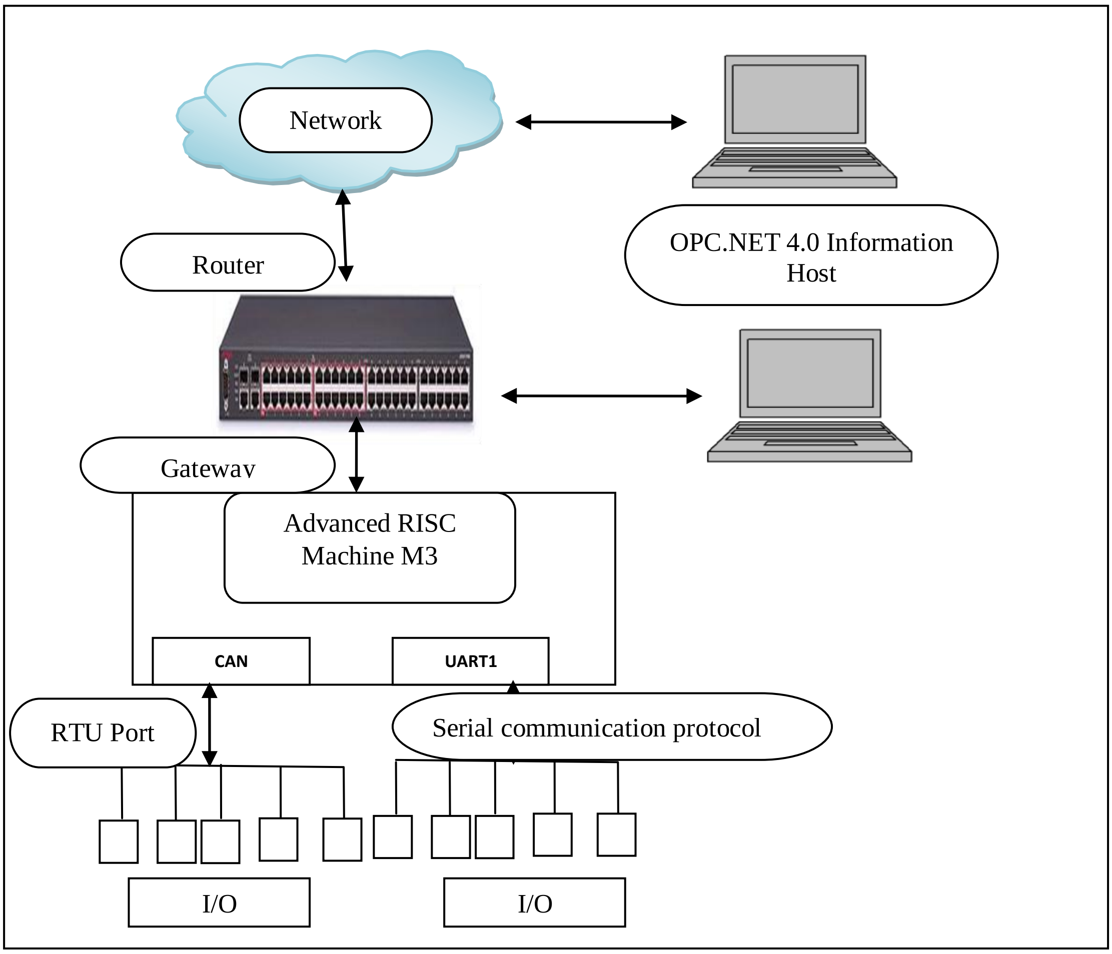

Figure 3: Projected design for Gateway

Conclusion

The IoT which is currently being built is a vision. It depends on the unique and exclusive addressability of a huge number of things/objects which can be sensors, actuators, embedded devices and RFID-based tags which can collect and remit data in an automated way. The fourth revolution in the industrial and automation processes, namely Industry 4.0 will be led by the evolution of the perception of the IoT. This paper incorporates the concept of IoT by presenting the architecture of an SCADA system. This system depends on the OPC.NET standards and can implement both in building automation and industrial applications. This is possible because new fieldbus protocols can be easily introduced and also transportation of information gathered as of the fieldbuses can be performed by utilizing the web design. In the projected design, the combined scheme for incorporation of novel fieldbuses can be highlighted in OPC.NET information hosts among specific elements which do not need recompilation of the complete claim automated modeling of the information destination position such as robotic creation of an icon for the supervising twists as of fieldbuses.

References

[1] Recommendations for implementing the strategic initiative INDUSTRIE 4.0, Final report of the Industrie 4.0 Working Group, 2013, http://www. plattform-i40.de/finalreport2013.

[2] Ioan Ungurean, Nicoleta-Cristina and Vasile Georgette Gaitan "An IoT Architecture for Things from Industrial Environment", ieee transaction 2014.

[3] N. L. Fantana, T. Riedel, J. Schlick, S. Ferber, J. Hupp, S. Miles, F. Michaels and S. Svensson, "IoT Applications—Value Creation for Industry." Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems. p. 153, River Publishers, 2013.

[4] The Internet of Things - High-Tech Strategy, http://www.gtai.de/ GTAI/Navigation/EN/Invest/Industries/Smarter-business/Smart-systems/internet-of-things.html

[5] M. Broy, "Challenges in modeling cyber-physical systems", Proceedings of the 12th international conference on Information processing in sensor networks, ACM, 2013.

[6] M. Wu, T. J. Lu, F. Y. Ling, J. Sun, H. Y. Duo, "Research on the architecture of the Internet of Things," Advanced Computer Theory and Engineering (ICACTE), 2010 3rd International Conference on, Vol. 5, pp.V5-484-V5-487, 20-22 Aug. 2010.

[7] R. Khan, S.U. Khan, R. Zaheer and S. Khan, "Future Internet: The Internet of Things Architecture, Possible Applications and Key Challenges," Frontiers of Information Technology (FIT), 10th International Conference on, pp.257-260, 17-19 Dec. 2012.

[8] Bharath Bhushan, Prathap Reddy, Dhenesh V Subramanian, Gao X. Z "Systematic Survey on Evolution of Cloud Architectures".

[9] L. Coetzee and J. Eksteen, "The Internet of Things - promise for the future? An introduction," IST-Africa Conference Proceedings, pp.1-9, 11-13 May 2011.

[10] International Telecommunications Union, ITU Internet Reports 2005: The Internet of Things. Executive Summary, Geneva: ITU, 2005.

[11] S. Gusmeroli, S. Piccione and D. Rotondi, "IoT@Work automation middleware system design and architecture," Emerging Technologies & Factory Automation (ETFA), IEEE 17th Conference on, pp.1-8, 17-21 Sept. 2012.

[12] J.L. Fernandes, I.C. Lopes, J.J.P.C. Rodrigues and S. Ullah, "Performance evaluation of RESTful web services and AMQP protocol", Ubiquitous and Future Networks (ICUFN), Fifth International Conference on, pp.810-815, 2-5 July 2013.

[13] V. G. Gaitan, V. Pope, C. Turcu, N. C. Gaitan and I. Ungurean, "The Uniform Engineering of Distributed Control Systems Using the OPC Specification". Advances in Electrical and Computer Engineering, vol. 8, No. 2, pp. 71-76, 2008.

[14] What is OPC .NET?", OPC Foundation http://www.opcfoundation.org/Default.aspx/dotnet3/default.htm?MID=A boutOPC

[15] I. Ungurean, V. G. Gaitan and N. C. Gaitan. "Integration of Information Acquired from Industrial Processes in a Data Server Based on OPC. NET Specification", Global Journal of Technology 3, 2013.

[16] V. C. Gungor and P. H. Gerhard, Eds., "Industrial Wireless Sensor Networks: Applications, Protocols, and Standards". CRC Press, 2013.

[17] D. Escobar, F. Garcia and C. Cadena-Gaitan, "Building Automation System (BAS) implementation: A Literature review", 1st International Conference on Innovation and Sustainability (ICOIS 2013), 3-4 April 2013.

[18] Gateway to IoT "http://www.ti.com/solution/iot_gateway" about ARM Cortex M3 microcontroller

[19] V. Vyatkin, "Software Engineering in Industrial Automation: State-of-the-Art Review," Industrial Informatics, IEEE Transactions on, vol. 9, no.3, pp.1234-1249, Aug. 2013.