ULAAAS: Unified Local Automation as-a Service using Web Service Architecture

Suresh S[1], Mrs. L. Sheela M.E (PhD) [2]

PG Student [Embedded Systems Technologies], Dept. of EEE, Regional Centre of Anna University, Tirunelveli,

Tamilnadu, India [1],

Assistant professor, Dept. of EEE, Regional Centre of Anna University, Tirunelveli, Tamilnadu, India [2]

ABSTRACT: Automation has become more important in many of the application like plant monitoring, home automation, and sensor and actuator integration. Presently automation vendors like ABB, LANCIER, CA, provide tools for these applications are efficient for the large scale automation. In this project we address local automation problem, due to different controllers and tools where there is no integration schema. Each of the local users is in need of web address for controlling the device remotely. Commercial web server modules are available which need the hosting or can be accessed through the IP address. Different product development leads to lack of web standardization. To give an elucidation to this inconvenience a unified monitoring approach is introduced in this scheme. It uses interoperable web service for all users to afford an open source web service with personalized GUI. Security policy and Base-station-level system integration are of prime concern. The web service run different services namely, Database service, User management service, Unified Display service, Configuration service, Web admin service. The access definition of each service is modeled by Unified Modeling Language (UML).

KEYWORDS: Automation, Web service, Open Source Website, unified motoring, Smart Home**.**

I.INTRODUCTION

Web technology endow with simplest static page to more sophisticated dynamic page which connect to the database for application like internet application, electronic banking. This paper deals with the state of home automation which is referred to local automation. The eagerness towards automation of home through internet is a great conjure. Home automation includes the monitoring of household activity and controlling the appliances. Comparing with Industrial automation use robotic devices to entire manufacturing tasks. It is becoming increasingly imperative in manufacturing process because computerized or robotic machines are capable of handling repetitive task quickly and efficiently. They employ large PLC, SCADA, and HMI systems to control this activity. The efficiency of industrial automation is measured in terms of accuracy, but in case of home automation the user need cost efficiency at their prime concern.

The integrated monitoring system takes the advantage of networks technologies. The integrated monitoring systems are more important for investigation, detection and policy decision in many fields [1]. The integrated monitoring is more beneficial than single measurement in a local system. Home automation systems that are implemented are of single measurement and controlling is done through IP address. This infrastructure state have to use static addressing, the cost of static addressing very high since cannot be suitable for the home automation. The embedded controller with the Ethernet connectivity available in market can be used for this purpose need high operating cost.

The previous works in the integration architecture mainly focuses on high-end systems with eddied wireless sensor nodes. They provide new availabilities for the control and monitoring appliances. The implementation done using the SOAP based web service [2]-[3].This paper polymorph the unified web service for the IEEE1451 smart transducers, which provide a standardization way for sensor application to access and interoperate with smart transducers [3].

The growing demand for the new service on the internet, the network control plane has evolvers in ISP networks through much generation. The major issues facing are the scalability and the flexibility in cloud computing services [4].

The cloud computing have may service architecture to run efficiently, this paper inspire this service to make use in the home automation.

In [5], we described a layered model and given an approach for simplifying software development. We developed a system for integrating all home user to single monitoring system in this paper, in which user can access the data from different home with the security policy described later in this project. The customizable GUI is developed for the user that unified and more interactive compared to the commercial products. The home automation needs fetching of the energy meter value to monitoring station, the monitoring station provide a database to store these values. The database has greater advantage in serving monitoring system. Today most of the dynamic websites run the database server at the back end and the front panel is well designed to represent the data in the database. Similar approach is followed in this paper; all users are provided with secured username through which they can access.

The core project of this paper is communication between the databases, SQL SERVER 2008 serve as the database. It coordinate all users bring under the single monitoring system. To validate the performance of the system multiple home are connected to the system each of the controlling is done simultaneously. The main works behind this project are as follows.

1) Bring down the running cost of home automation as every user share the common domain for accessing the home.
2) Remove hardware dependency, any type of hardware interfacing can be used.
3) Open source web to create new user with customizable pages. The server runs each of service separately.
4) Security policy and access control are well defined by the UML modeling.
5) SSIS integration to transfer the data between the databases, as each node is the control of database parameters.

The organization of this paper as follows. Section II describes home automation stricture and presents the definition of the home automation system. Section III gives the systems architecture. Section IV gives the implementation. Section V describes the validation of the system. Finally, conclusion and futures works are given in section VI.

II. HOME AUTOMATION STRICTURE

A. *Interface of Monitoring System*

The main attribute of the automation system is accuracy to increase the accuracy feedback from output is feed directly to the input. The feedback system consists of sensors or sensor networks, second generation sensor technologies are networking enabled [16]. Some of the commercial automation tools and their interface standards are listed in following.

ABB uses i-bus with 4 or 8 modules can simply inserted to basic home appliance. SIEMENS (Synco living) is capable of KNX connection. CA process automation is comprised of modular components standard technologies.

Every automation system have microcontroller which convert the physical parameter to digital parameter which can be given as feedback. The microcontroller can prompt the network through interface standards like LPT, RS-232, RS-422, RS-485, GPIB, USB and PCI through some middleware or directly. In this project the automation controlled by the PC uses any of the interfaces as mentioned. A simple middleware is developed in Visual Basic 2010 to connect hardware to PC without hardware dependency.

B. *Unified Automation scheme*

Fig. 2 shows the automation scheme that is used in this paper. It resembles the base station integration [1], each of the homes is considering as the base station. The home automation unit is predicted as the location automation system. Each local automation system consists of both the monitoring and control devices. The home automation include energy meter as primary monitoring device, control devices are connected to the relay or contactor. Based on the device power ratting relay and contactor are used respective. The control of device is on demand process whereas the energy

meter enters the data continuously to database. Here raises the problem of data lose and synchronizing. The data are stored in the local database while the loss of internet, these data is migrated to server database through integration process.

This problem is worse when there are large numbers of automation systems are connected to the system. The major advantages of this kind of systems are: 1) No need to change scheme individually ; 2) Security policy can changed often without cause user burden; 3) cost effective monitoring; 4) all the monitoring systems are modular can be removed from the system with less configuration.

In this automation system are accessed through URL address which is more convenient than access through IP, the dynamic IP is entered to the database along with username and password when the local system reconnect to main server. This feature is most essential for the local automation which removes the dependency of static IP. The automation can run at varies technologies GPRS, EDGE, 3G, response of the local automation system is least considered. Some critical electrical safety measures are implemented locally on hardware.
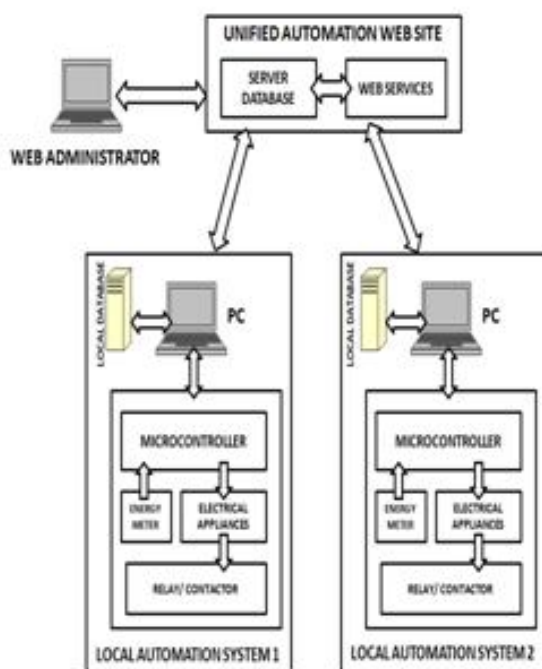

Fig. 2 Unified Automation scheme

III. SYSTEM ARCHITECTURE

A. System Design

Fig. 3 shows the system design of the unified local automation system. In local monitoring base station, it has sub modules like hardware configuration, data collection, local database and interface. The functionality of module as follows.

Hardware configuration: it provides the interface between the software and automation hardware. It interface is done by common buses like RS-232, USB, GPIO. The drivers used are the system driver no special firmware where used here. The phase includes the work which supports the Windows platform.

Data collection: it provides the framework to collect the data from each node in the automation device. The data collected are queried into local database.

Local database: it is used to store data collected. Local database deployed using SQL SERVER 2008

B. Web service

Website of the system holds the sub modules similar the local monitoring base station. All the modules are deploying over the internet hosting. The functionality of each module is described below

User management service: it runs the web page where the user can add new user, edit the profile of user.

Unified display service: it include service for displaying the data from automation node of each user.

Configuration service: it runs a web service where user can edit device type, interface method with the middleware.

Web administration service: it is dedicated to web administrated can view the critical information web service runs. In each web service it runs database at the backend the administrator hold the role definition to change edit the database related operation.

Database: it runs SQL SERVER 2008 R2. It pulls data from each local database and store to corresponding user table.
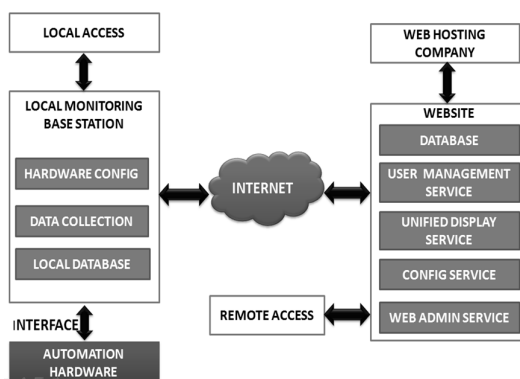

Fig. 3 System Design of Local Automation System

C. User Access definition

fig 4.3 shows the UML diagram of the user access definition model of local user, remote user and management user. Local user access the hardware and changes made entered to the local database. Remote user access the home through the internet, the remote database get the information of the home through the local database, the remote user have to cross the user login authentication. The management user deals with the management of the website and its service.
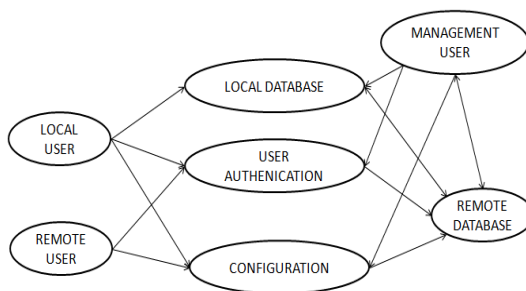

Fig. 4 UML diagram of User Access definition

D. Mechanism for Non-Queried data

The data is fetched from each of the node through the internet. If the loss in the internet leads to the data loss from the local database to main database. In this project, it includes the work simple insert mechanism from the middleware

standalone module. The complete methodology includes SSIS integration process is useful in data migration. Fig 5 shows the data fetching model from local to remote database
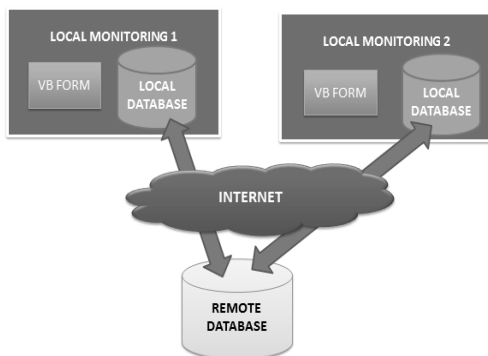

Fig. 5 Data fetching model from local to remote database

E. Layer wise Architecture Implementation

Fig. 6 shows the implementation of the design discussed in previously. The software tools and the corresponding layer of the design are shown in the figure. The sub module of the local monitoring base station is implemented in VISUAL BASIC 2010. The sub model of web service is implanted in VISUAL STUDIO 2010.
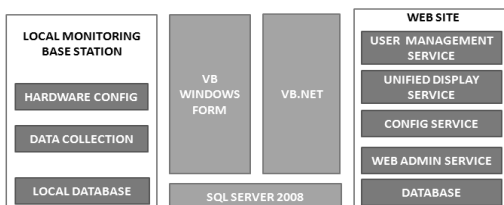

Fig. 6 Layer wise implementation of Local Automation System

IV. INVESTIGATIONAL STUDY

A. Hardware

In order to validate the functionality of the software and web service, prototype hardware is simulated using the Proteus ISIS7 software tools. The simulation includes PIC16F877a microcontroller, where four devices are connected represented with the LED in simulation. Fig. 7 shows the simulation result obtained. The simulation result show the virtual serial port which is paired via VSPE with the standalone module
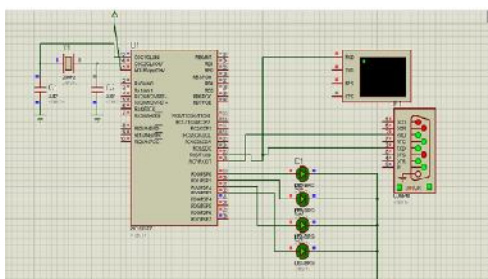

Fig.7 Simulation of circuit using Proteus ISIS7

B. Middleware

The standalone module for hardware interfacing was developed in visual basic 2010. Fig. 8 shows the middleware of home automation system, in which the user need of login provided by the web service for access the local database and main database to log the status of the monitoring system. This phase of work, the user login and status windows are deployed. Hardware interface is done by RS-232 port we use VSPE (Virtual serial port emulator) it run virtual serial port pair.

Fig. 8 Middleware of home automation system

C. Website

The website are hosted on the server, it run the service each service take the reference of WCF web service to extract, update and display the contents of user. Fig. 9 shows the new user creation and user login module that runs on the server.

Fig. 9 New User creation and Login module of website

V. CONCLUSION

In this paper, a unified local automation has been developed by running different web service like database service, user management service, unified display service, configuration service and web admin service are implemented and the functionality of each service is validated. In this data migration from local database to main database that are left due to network failure or power failure that is achieved by SSIS integration. The website is hosted with the commercial web hosting company; the web site is shared with multiple users which make the running cost as low. With help of the archetype hardware the household appliances are controlled through the internet more easily.

The open source automation system and website give the end users a very feasible and reliable automation at low cost. In this paper the security consideration such as password management and hardware key authentication are done. In future complete automation system for both small scale and large scale will be implementation through this integration process. In addition this integration can be done for other database like ORACLE, MYSQL.

ACKNOWLEDGMENT

REFERENCES

[1]   ZhongwenGuo, Pengpeng Chen, Hao Zhang, Mingxing Jiang, andChunrong Li, "IMA: An Integrated Monitoring Architecture with Sensor Networks", *IEEE Trans. Instrum. Meas.*, vol. 61, no. 5, pp.1287-1295, May 2012.
[2]   Rumen Kyusakov, Jens Eliasson, Jerker Delsing, Jan van Deventer,Jonas Gustafsson, "Integration of Wireless Sensor and Actuator Nodes With IT Infrastructure Using Service-Oriented Architecture", *IEEE Trans. Indus. Inform.*, vol. 9, no. 1, pp. 43-51, Feb 2013.
[3]   Eugene Y. Song, and Kang B. Lee, "STWS: A Unified Web Servicefor IEEE 1451 Smart Transducers", *IEEE Trans. Instrum. Measum.,* vol. 57, no. 8, pp.1749-1756, Aug 2008.
[4]   Kim-Khoa Nguyen and Mohamed Cheriet, Écolede Technologie Supérieure, "Enabling Infrastructure as a Service (IaaS) on IP Networks: From Distributed to Virtualized Control Plane", *IEEE Comm. Mag.*, pp. 136-147, Jan 2013.
[5]   Miguel A. Zamora-izquierdo, Jose Santa and Antonio F. Gomez-Skarmeta, "An Integral and Networked Home Automation Solution for indoor Ambient Intelligence", *IEEE CS,* pp. 66-77, 2010.
[6]   Cameron L. Smallwood, Jared Wennermark, "Benefits of Distributed Automation system", *IEEE Indus. App. Mag.*, pp. 65-73, 2010.
[7]   Scott de Deugd, Randy Carroll, Kevin E. Kelly, Bill Millett, and Jeffrey Ricker, "SODA: Service-Oriented Device Architecture", *IEEE CS and IEEE ComSoc,* pp.94- 97, 2006.
[8]   Fernando Pianegiani, David Maci, and Paolo Carbone, "An Open Distributed Measurement System Based on an Abstract Client-Server Architecture", *IEEE Trans. Instrum. Measum.,* vol. 52, no. 3, pp. 686-692, Jun2003.
[9]   Matteo Bertocco, Franco Ferraris, Carlo Offelli, and Marco Parvis, "A Client– Server Architecture for Distributed Measurement Systems", *IEEE Trans. Instrum. Measum.,* vol. 47, no. 5, pp.1453-1458, Oct 1998.
[10]   YuliangQiao, Guo-Ping Liu, GengZheng, and Wenshan Hu,"NCSLab: A Web- Based Global-Scale Control Laboratory With Rich Interactive Features", *IEEE Trans. Indus. Elect.,* vol. 57, no. 10, pp. 3253-3265, Oct 2010.
[11]   Wieslaw Winiecki, Michal Karkowski, "A New Java-Based Software Environment for Distributed Measuring Systems Design", *IEEE Trans. Instrum. Measum.,* vol. 51, no. 6, pp. 1340-1346, Dec 2002.
[12]   Luigino Benetazzo, Matteo Bertocco, Franco Ferraris, AlessandroFerrero, Carlo Offelli, Marco Parvis, and Vincenzo Piuri, "A Web-Based Distributed Virtual Educational Laboratory", *IEEE Trans. Instrum. Measum.,* vol. 49, no. 2, pp. 349-355, Apr 2000.
[13]   Alessandro Ferrero and Vincenzo Piuri, "A Simulation Tool for Virtual Laboratory Experiments in a WWW Environment", *IEEE Trans. Instrum. Measum.,* vol. 48, no. 3, pp. 741-746, Jun 1999.
[14]   DomenicoGrimaldi, LiberoNigro, Francesco Pupo, "Java-Based Distributed Measurement Systems", *IEEE Trans. Instrum. Measum.,* vol. 47, no. 1,pp. 100-103, Feb 1998.
[15]   Myongsoo Kim and John J. Metzner, "A Key Exchange Method for Intelligent Electronic Devices in Distribution Automation", *IEEE Trans. Power Delivery,* vol. 25, no. 3, pp.1458-1464, Jul 2010.
[16]   Deborah Homan, "Accelerate Instrument Control and Automation", *IEEE Instrum. Measum. Mag.,* pp. 40-44, Aug2013.