ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Web Based SCADA System

V.Anusha
M.Tech, Embedded Systems,
Department of Electronics and Communication,
GRIET, Hyderabad.

B.Navya
Assistant Professor,
Department of Electronics and Communication,
GRIET, Hyderabad.

Abstract:

In the shift towards an Industrial Internet, programmable logic controllers, used to drive processes in industrial facilities, are more intelligent and capable of mutual communication and independent decision-making. Essentially, these controllers are also directly connected to the Internet, which opens new possibilities for the implementation of process control and monitoring systems. The goal of this thesis is to assess the suitability of web technologies for the development of supervisory control and data acquisition systems. SCADA systems are used by private companies and public-sector service providers[1]. SCADA works well in many different types of enterprises because they can range from simple configurations to large, complex projects. Virtually anywhere you look in today's world, there is some type of SCADA system running behind the scenes. The objective of this thesis is to evaluate the applicability of web technologies to the development of industrial monitoring applications for the Industrial Internet. The focus is on finding a way to bridge the gap between browser based operator interfaces and industrial devices.

Index Terms:

web- based, scada system, industrial controlling, Web-based monitoring.

I. INTRODUCTION:

Industrial corporations employ control networks for transferring data and control messages between different levels of the corporate hierarchy. These control networks are used for automating the industrial process. On the lowest level, a large number of various field devices including different kinds of sensors and actuators collect data on the industrial process. Different levels in the corporate automation hierarchy, all the way up to the management levels, use this data to improve the process and to make intelligent business decisions.

In order to ensure successful process execution, control room operators need a means to monitor and control the industrial network. Supervisory control and data acquisition (SCADA) systems are often used to provide such a Human-Machine Interface (HMI) for the plant operators[2]. Traditionally SCADA systems have been implemented as native desktop applications. However, during the last decade software development in general has seen a shift towards mobile and web applications. This development has been partly motivated by the nearly ubiquitous adoption of mobile devices and the high speed Internet connections available today.

Web applications in particular have shown many advantages over native applications, including straightforward cross platform support, ease of development, and faster development cycles. Web applications in turn are increasingly hosted in computing clouds, which offer higher scalability, reliability and flexibility compared to hosting the applications on dedicated servers. All in all, the developments in cloud computing and areas such as sensor networking are paving the road for the highly anticipated Internet of Things (IoT), which among other things is expected to yield considerable savings to industrial plants by allowing a higher level of fine-tuning in the industrial processes.Another advantage of web-based SCADA systems is their portability, as the users need only a standard web browser to access the service.

II. SCADA SYSTEM:

SCADA systems are used by private companies and public-sector service providers. SCADA works well in many different types of enterprises because they can range from simple configurations to large, complex projects[3]. Virtually anywhere you look in today's world, there is some type of SCADA system running behind the scenes, whether at your local supermarket, refinery, waste water treatment plant, or even your own home. SCADA systems deploy multiple software and hardware elements that allow industrial organizations to:

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

•Monitor, gather, and process data

•Interact with and control machines and devices such as valves, pumps, motors, and more, which are connected through HMI (human-machine interface) software.

•Record events into a log file.

In basic SCADA architectures, information from sensors or manual inputs are sent to PLCs (programmable logic controllers) or RTUs (remote terminal units), which then send that information to computers with SCADA software. SCADA software analyzes and displays the data in order to help operators and other workers to reduce waste and improve efficiency in the manufacturing process. Effective SCADA systems can result in significant savings of time and money. Numerous case studies have been published highlighting the benefits and savings of using a modern SCADA software solution such as Ignition.

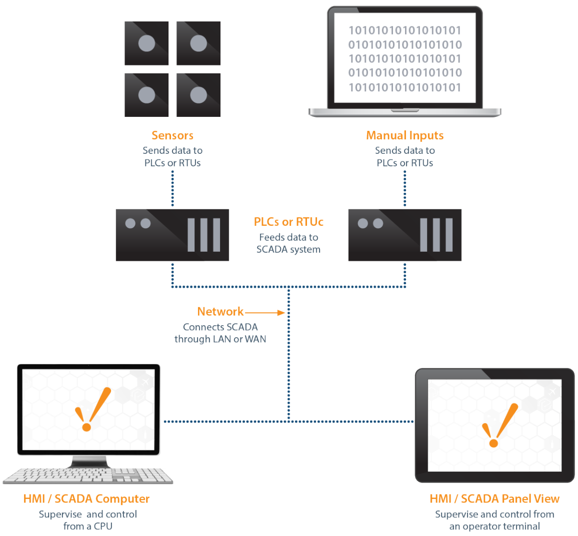


Fig 2.1: A basic SCADA architecture

Modern SCADA systems allow real-time data from the plant floor to be accessed from anywhere in the world. This access to real-time information allows governments, businesses, and individuals to make data-driven decisions about how to improve their processes. Without SCADA software, it would be extremely difficult if not impossible to gather sufficient data for consistently well-informed decisions. Also, most modern SCADA designer applications have rapid application development (RAD) capabilities that allow users to design applications relatively easily, even if they don't have extensive knowledge of software development. The introduction of modern IT standards and practices such as SQL and web-based applications into SCADA software has greatly improved the efficiency, security, productivity, and reliability of SCADA systems. SCADA software that utilizes the power of SQL databases provides huge advantages over antiquated SCADA software. One big advantage of using SQL databases with a SCADA system is that it makes it easier to integrate into existing MES and ERP systems, allowing data to flow seamlessly through an entire organization. Historical data from a SCADA system can also be logged in a SQL database, which allows for easier data analysis through data trending.

III. WEB-BASED MONITORING:

The exponential growth of Internet and computer technology enables the development of complex, hybrid systems which offers greater concern in maintenance and has more flexibility in servicing and fault finding. With the advanced technology industries are interested in automation by introducing remote monitoring and control system for the measurement control of industrial process parameters very precisely and accurately for the quality products. The Ethernet provides an inexpensive gateway through which to data transfer for real-time interaction of the remote monitoring and control of the parameter give many advantages.

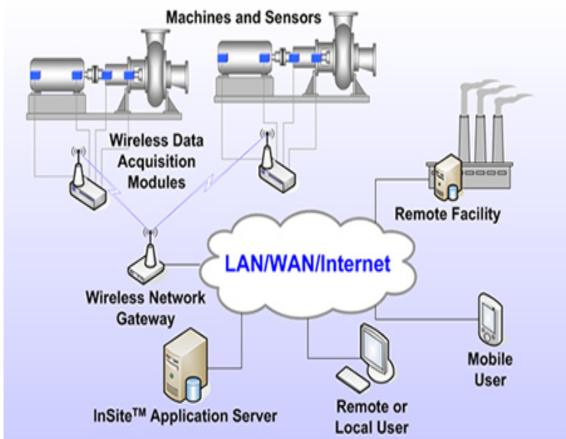


Figure.3.1: Web-based Monitoring of Machines and Sensors

Ethernet/internet-based data monitoring brings new capabilities and unprecedented access to process measurement and control[4]. Using standard process sensors, such as thermocouples or RTDs (temperature), pressure transducers, flowmeters or other sensors that produce a standard analog or pulse output, you can monitor, control or log data in almost any location - across the hall,

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

on the other side of the street, across town, on opposite ends of the country, or anywhere around the world. With Ethernet-based, internet-enabled instrumentation, remote access can be anywhere a smart phone has a signal. From the simplest application, viewing data through the web-browser on your iPhone, Blackberry device or laptop, to more sophisticated uses, such as sending a text or e-mail message when an alarm occurs, or transmitting a data log file over the internet from a remote location to a central office. A user can access this data anytime, anywhere, 24 hours a day, 365 days a year, wherever you have internet access.

IV. SYSTEM ARCHITECTURE:

The framework of proposed system consists of ARM 32 bit micro controller which acts as Real-time task scheduler for heterogeneous multi-core system. The devices like USB camera, Temperature sensor and LDR sensor which were interfaced to ARM board are the coprocessors[5]. Once system is turned ON the devices interfaced to the USB host and I2C protocol starts working. The devices connected to USB host (ex: USB camera) and I2C (ex: temperature sensor, LDR sensor) continuously transmits data to controller. The controller transmits data which is coming from USB and I2C to server through internet by using FTP. FTP is a protocol through which users can upload files from their systems to server. Once data is placed at server we can view the data at remote PC (with internet) on web page with unique IP address provided. We can view continuous streaming of video, temperature data as well as LDR sensor data.

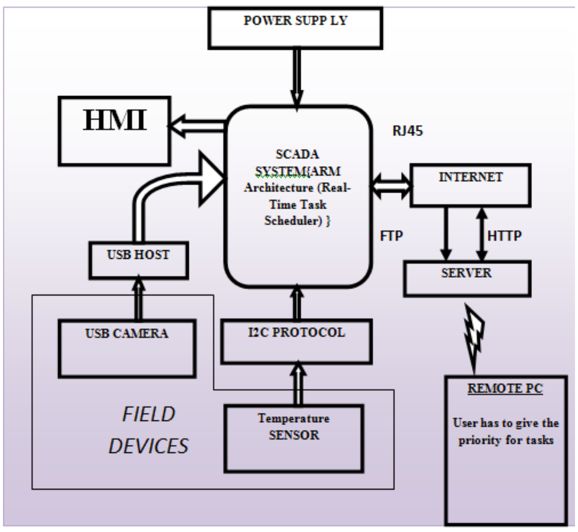


Figure.4.1: Framework for Real-Time Web-Based SCADA System

If we want to change the scheduling of the system then we can change it through web page from remote location using HTTP protocol. HTTP protocol continuously requests the server for the data if any changes had been done at web page like changing the scheduling of either USB or I2C and it receives data from server to modify the scheduling of the tasks inside the controller. Now consider highest priority is given to USB at web page. Once modification is done then server sents the modified data to controller by using HTTP protocol and controller chages the scheduling of tasks inside it according that modified data. Once scheduling is changed successfully, the data which is coming from USB will update continuously on web page but the data from I2C will stop updating its value, simply it shows last monitored condition. In this way we can change the priority conditions on remote PC.

A. Hardware Requirements for Implementation:

A.Raspberry pi:

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi is manufactured in two board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. These companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pis by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers.

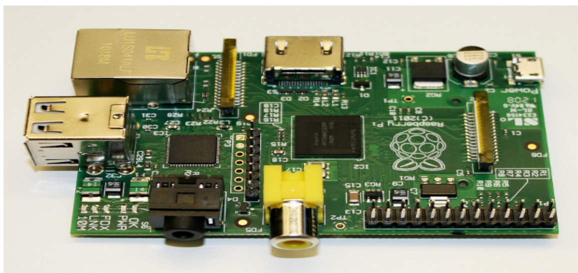


Fig.4.2:. Raspberry pi Development board

The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB.

It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and persistent storage. The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux),C, Java and Perl.

2. UVC Driver Camera:

A UVC (or Universal Video Class) driver is a USB category driver. A driver enables a device, such as your webcam, to communicate with your computers operating system.

Figure.4.3: UVC Driver Camera

A UVC (or Universal Video Class) driver is a USB-category driver. A driver enables a device, such as your webcam, to communicate with your computer's operating system. And USB (or Universal Serial Bus) is a common type of connection that allows for high-speed data transfer. Most current operating systems support UVC.

3. Ethernet LAN:

Ethernet is a family of computer networking technologies for local area networks (LANs). Ethernet was commercially introduced in 1980 and standardized in 1983 as IEEE 802.3. Ethernet has largely replaced competing wired LAN technologies such as token ring, FDDI, and ARCNET.The Ethernet standards comprise several wiring and signaling variants of the OSI physical layer in use with Ethernet. Data rates were periodically increased from the original 10 megabits per second to 100 gigabits per second.

4. PCF module:

The PCF8591 is a single-chip, single-supply low-power 8-bit CMOS data acquisition device with four analog inputs, one analog output and a serial I2C-bus interface. Three address pins A0, A1 and A2 are used for programming the hardware address, allowing the use of up to eight devices connected to the I2C-bus without additional hardware.

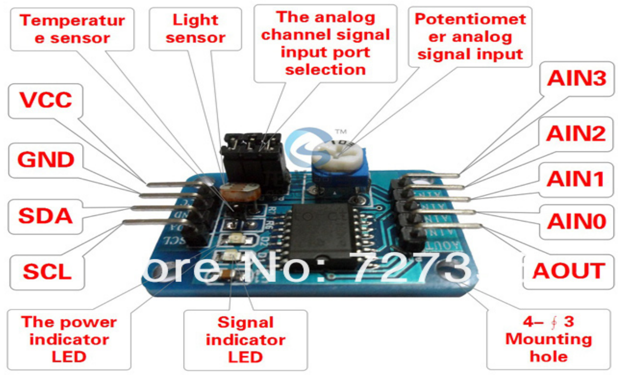


Figure.4.4: PCF module

Address, control and data to and from the device are transferred serially via the two-line bidirectional I2C-bus. The functions of the device include analog input multiplexing, on-chip track and hold function, 8-bit analog-to-digital conversion and an 8-bit digital-to-analog conversion. The maximum conversion rate is given by the maximum speed of the I2C-bus.

B. Software Requirements for Implementation:

1.Rt Linux Operating system:

RTLinux is a hard realtime RTOS microkernel that runs the entire Linux operating system as a fully preemptive process. It is one of the hard real-time variants of Linux, among several, that makes it possible to control robots, data acquisition systems, manufacturing plants, and other time-sensitive instruments and machines. RTLinux controls instrumentation for NASA, high-speed Active Magnetic Bearings (AMBs) for the University of Virginia Rotating Machinery and Controls Laboratory, animatronic puppets at the Jim Henson Creature Shop and satellite base stations for Japan Post and Telegraph.

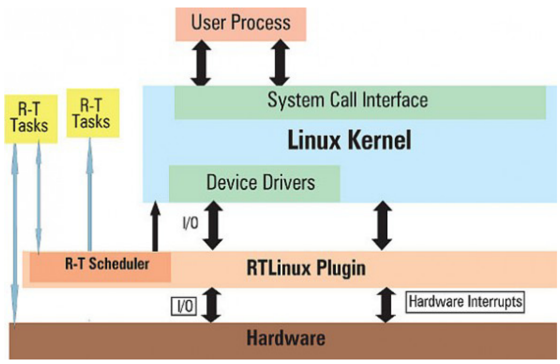


Figure.4.5: RTLinux Operating Sytem Architecture

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

RTLinux is a small, deterministic, RTOS that is somewhat like a single POSIX thread sitting on a bare machine. Hard realtime applications are threads and signal handlers in this process. The regular Linux kernel runs as the lowest-priority thread of RTLinux and is always pre-emptible. The RTLinux programming model is simple. Anything that has strict timing requirements should be written as a thread or signal (interrupt) handler, and anything that doesn't need hard realtime should go through regular Linux. This allows us to keep the RT side small—and as fast as the hardware will permit—while still drawing on Linux for sophisticated services and applications.

2. Qt for embedded Linux:

Qt for Embedded Linux is a C++ framework for GUI and application development for embedded devices. It runs on a variety of processors, usually with Embedded Linux. Qt for Embedded Linux provides the standard Qt API for embedded devices with a lightweight window system.

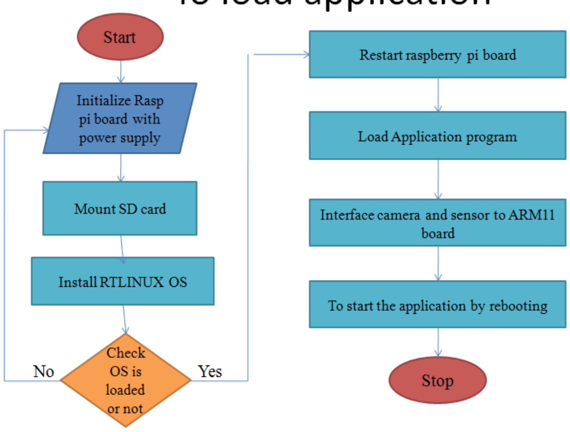
3.FTP(File Transfer Protocol):

File Transfer Protocol is a standard network protocol used to transfer files from one host to another host over a TCP-based network, such as the Internet.

4.HTTP(Hypertext Transfer Protocol):

HTTP is an application protocol for distributed, collaborative, hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web. Hypertext is structured text that uses logical links (hyperlinks) between nodes containing text. HTTP is the protocol to exchange or transfer hypertext.

To load application



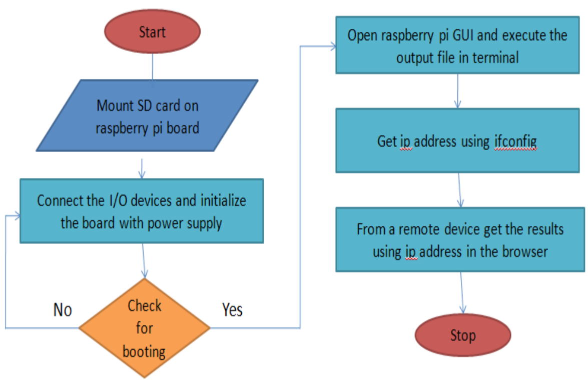
Here we are using raspberry pi board as our platform. It has an ARM-1176JZF-S SOC with integrated peripherals like USB, Ethernet, Audio, display and serial port…etc. On this board we are installing RTLinux operating system with necessary drivers for all peripheral devices and user level software stack which includes a light weight Qt GUI based on Xorg XServer, V4L2 API for interacting with video devices like cameras, TCP/IP stack to communicate with network devices and some standard system libraries for system level general IO operations. The board equipped with the above software stack is connected to a camera is connected to the board through USB bus and sensor board through GPIO interface. On the other side we have to host a web server with remote device connection facility.The architecture of the web server has the following layers.

•In the lower level the web server has the physical hosting interfaces used for storing and maintaining the data related to the server.

•Above the Physical hosting interface the server has HTTP server software and other web server components for bypass the direct interaction with the physical interaction with the lower levels[6].

•The final layer has the tools and services for interacting with the video streams which includes the Image codec and storing interfaces, connection managers and session control interfaces etc.

To run application

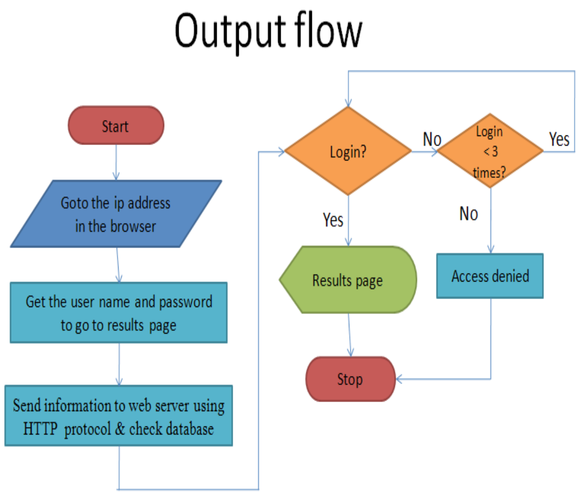


Power up the device after conecting all the devices. When the device starts booting from flash, it first loads the linux to the device and initializes all the drivers and the core kernel.

After initialization of the kernel it first checks weather all the devices are working properly or not. After that it loads the file system and starts the startup scripts for running necessary processes and daemons. Finally it starts the main application.When our application starts running it first check all the devices and resources which it needs are available or not. After that it checks the connection with the devices and gives control to the user. The Interface for the user has the following things.

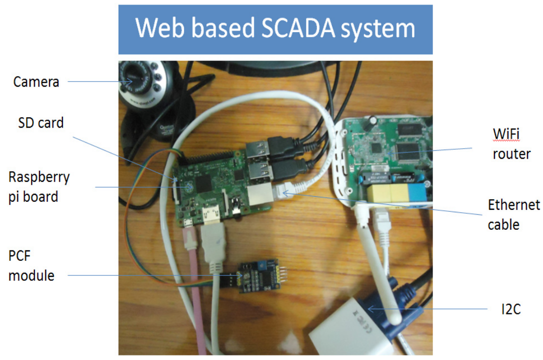
•A label for displaying the image which is coming from the image.
•Text-boxes for showing the sensor values.
•A login form

The board continuously reads data from the camera and at the same time it reads the data from the sensors. The scheduler is monitoring the process dedicated for camera reading and sensor reading. The camera read image and sensor values with scheduler information will send to the web server. Initially the user is provided with a login for. When the user provides with an username and password, the web server checks for the correct combination in the database. If the information matches then the user is directed to web page provided with the monitoring information. If the information does not match for minimum three times access is denied. In the web page to monitor the plant, the camera and sensor values are monitored and the display is also provided with the priorities to monitor the information.

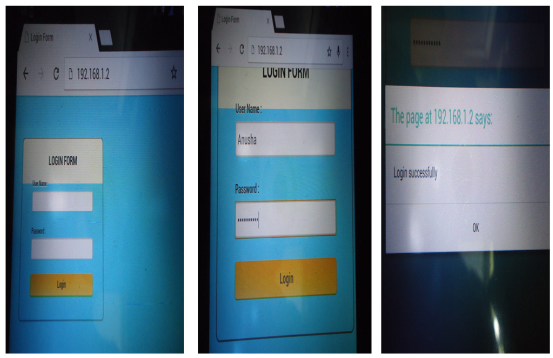


This would be useful when there are a lot of field devices and connectors are available in the plant system.

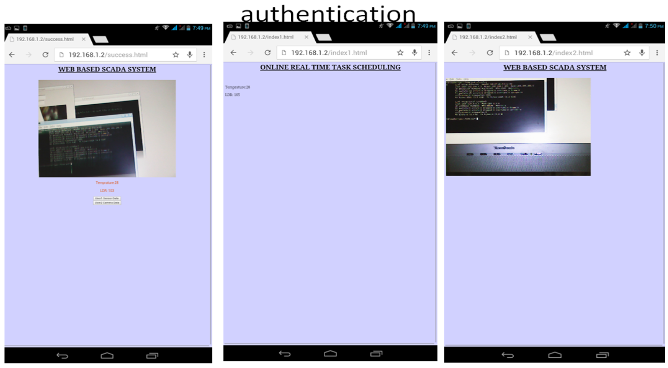
V. EXPERIMENTAL RESULTS:



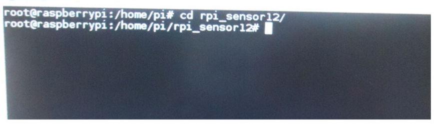
After entering the ip address a login form opens. Enter username and password and login

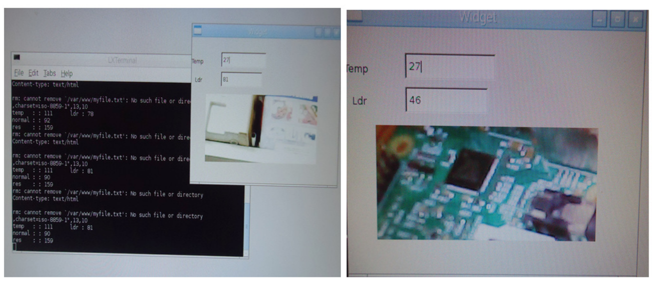


Check the results in the browser after correct authentication



Open the folder containing executable file and run it using commands to view output in QtWidget window





ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

VI. CONCLUSION:

This paper set out to evaluate the applicability of web technologies to the development of monitoring applications for the Industrial Internet. The evaluation was carried out by implementing a generic web client application for industrial monitoring and control, and comparing it to existing monitoring solutions on the market. The OPC UA standard for industrial data transfer and information modeling was used as the target platform for the application. The results of this thesis serve as a groundwork for further investigations on web applications for the Industrial Internet. Future versions of the web client will extend the support for OPC UA[7] client features. In the future the web client may be deployed in a cloud in order to provide an aggregating point for multiple process controllers. The data residing on the OPC UA servers could then be easily accessed by using the service layer, and the presentation layer could be deployed for debugging purposes.

VII. REFERENCES:

[1] Tatu Paronen, Aalto University, School of Science, Finland "A web-based monitoring system for the Industrial Internet" Espoo April 13, 2015.

[2] Atvise - HMI and SCADA in pure web technology, 2014. http://www.atvise.com/ Accessed 12.11.2014.

[3] A SCADA system, https://inductiveautomation.com/what-is-scada What is SCADA?"

[4] Ya-Shu Chen, Member, IEEE, Han Chiang Liao, and Ting-Hao Tsai, Student Member, IEEE, "Online Real-time task scheduling in heterogeneous multicore system-on-a chip," IEEE transactions on Parallel and distributed systems, VOL. 24, NO. 1, JANUARY 2013.

[5] Qualcomm, Inc., "Snapdragon," technical report, Qualcomm, http://www.qualcomm.com/media/documents/snapdragons4- processors-system-chip-solutions-new-mobile-age, 2011.

[6] Bidelman, E. Html imports, Dec 2013. http://www.html5rocks.com/ en/tutorials/webcomponents/imports/. Accessed 2.2.2015.

[7] OPC Foundation. OPC Uni_ed Architecture Speci_cation, Part 2:Security Model, aug 2012. Version 1.02