A Web based Temperature Monitoring System using Linux

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ABSTRACT
A Web Based Temperature monitoring system that allows the user to continuously monitor the temperature condition of a room. The enhancement from the existing system on the temperature monitoring is that this prototype system allowed the data to be monitored anytime and anywhere from the Internet. This research divided into two parts that involved with the hardware and software. The hardware part involved building the temperature Sensor board and for the software part involved written programming and construct coding using Linux language program. The programs then are uploaded into the microcontroller which then created Visual Basic 6.0 application to display the temperature and saves the data into a database. An active Server Page (ASP) scripting language is used as server side scripting to publish the current temperature at the web browser. This prototype of a Web-Based Temperature Monitoring has met all the objectives derived and planned.

KEYWORDS–
Temperature Sensor, Web Based, Automated System, Monitoring Application,

1. INTRODUCTION
Monitoring is employed in various applications, including temperature, pressure, flow rate, capacity, acceleration, and so on. According to the quantities, distribution and detected frequency of the monitored objects, there are different monitoring methods to acquire the measurements [1]. Several problems usually occur during the monitoring process of the temperature in a room. For example, a server room must be kept between 15 to 20 degree Celsius to monitor a temperature in or else the server might crash and can cause a loss of hundreds thousands.

In order to solve the problem, the web-based Temperature monitoring system that can be access anywhere and anytime through the Internet is build. With this system a user can remotely monitor the room temperature from anywhere which could save the human expenses. Web-Based Temperature Monitoring is one type of temperature recorder that monitors a temperature in a room and stores the data into a database and display he current temperature on the website through a web server. The temperature monitoring is widely used in various processes like in automotive industries, air Conditioning, power plant and other industries that need the data to be saved and analyzed. Proposed design is to have the data acquisition system to measure and log some parameters. The main purpose of this system model is to make it easy for the user to view the current temperature.

2. RELATED WORK

Temperature monitoring is employed in various applications, including temperature, pressure, flow rate, capacity, acceleration, and so on. According to the quantities, distribution and detected frequency of the monitored objects, there are different monitoring methods to acquire the measurements. A research has introduced a remote wireless monitoring system applied in the building construction to get the concrete temperature [1]. The system can be real–time and multi-regional access to information without the limits of distance between the monitored object and the monitor [2]. This system consists of PC monitor and multi terminal and all the devices must be located within GSM and SMS network. The system has two ways to access the information from remote terminals. First is using hand phone to check real-time monitoring information and second is to visit the PC monitor to access all monitoring information through the internet.

3. TEMPERATURE SENSOR
To measure temperature, a device like a sensor is used. A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. For example a mercury thermometer converts the measured temperature into expansion and Contraction of a liquid which can be read on a calibrated glass tube. For accuracy, all sensors need to be calibrated against known standards. Sensors that measure very small Changes must have very high sensitivities.

There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, Aerospace, medicine, manufacturing and robotics. For environmental temperature, the sensor that usually used to indicate the temperature is biological sensor.

Big differences exist between different temperature sensor or temperature measurement device types. Using one perspective, it can be simply classified into two groups, contact and non-contact.

3.1. Contact Sensor
Contact temperature sensors measure its own temperature. One infers the temperature of the object to which the sensor is in contact by assuming or knowing that the two are in thermal equilibrium, that is, there is no heat flow between them. Temperatures of surfaces are especially tricky to measure by contact means and very difficult if the surface is moving. It is wise to be very careful

3.2. Non-Contact Sensor

The use of non-contact displacement technologies in the field of precision measurement is rapidly growing. This is due to many factors however; two of the main drivers are the users need to measure much more accurately which is to sub micron or even nanometer resolutions and its need to measure against difficult surfaces or surfaces that cannot be touched during the measurement process.

For example silicon, glass, plastics, miniature electronic components, medical components and even food-based surfaces. strengths and limitations of each noncontact measurement principle when selecting the correct sensor technology for the measurement task.

Temperature technique is one of the principal parameters of thermodynamics. On the microscopic scale, temperature is defined as the average energy of microscopic motions of a single particle in the system per degree of freedom. To measure temperature, a device like a sensor is used. A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. For example a mercury Thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. For accuracy, all sensors need to be calibrated against known standards. Figure 1 shows the temperature architecture model that was design called SENSORD/stat [3].

Then, it describe a prototype of a room temperature monitoring system based on SENSORD/Stat to show the usefulness of combining sensor middleware with a statistical computing environment.

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3.3. Automated Temperature Tracking System

Automated Temperature Tracking system has been implemented in Clueless Hospital, USA. It operates seven Operation Theaters, Intensive Critical Care Unit (ICCU), and Neonatal Intensive Care Unit (NICU), which are regularly monitored for ensuring optimum ambient temperature. Maintaining them manually is labor intensive and error detection process for maintenance. The project aims to automate the monitoring of temperature in critical locations throughout Clueless Hospital. The data will be accessible from a central server using any web browser connected to the Local Area Network (LAN). The project has provided custom software to simultaneously monitor room temperature in several locations throughout the hospital using iButton temperature sensors and Tiny Internet Interface (TINI) networked microcontrollers [4]. Web based user interface will be provided which will be accessible from computers in the hospital's LAN network with a proper authorization.

As a result low cost temperature sensors can be used without compromising on functionality. Objective of the project is to automate continuous temperature monitoring with alerts across Clueless Hospital using sophisticated highly scalable, robust software solution based on Java platform and hardware from Dallas Semiconductor. It is expected to yield significant cost and effort savings over time. The project also provides a test platform to access viability of hospital automation in other sectors. The solution will be accessible using any web browser across LAN network throughout the organization.

3.4. Speech Synthesized Temperature Sensor

Speech Synthesized Temperature Sensor is the device that informs the user via a verbal message of the current environmental temperature. The project is versatility in applications. The device could be used as an extra layer of security in the car safety seat project. Given a user defined temperature threshold, the device will issue a warning to the driver to remove the child from the car.

The main objective is for the speech synthesizer to produce and output of a clear message that accurately reflects the current temperature within a one-degree Fahrenheit tolerance and to work in temperatures ranging from zero to one hundred degrees Fahrenheit. The project will activate the device by a switch to provide a onetime only reading. The nature in which the device outputs can be changed according to user needs however. That device could also be used in laboratory settings where constant monitoring of the temperature is required.

3.5. X-10 Based Remote Temperature Monitoring System

X-10 Based Remote Temperature Monitoring system is made up of two separate components, the Temperature Sensing Transmitter (TST) and the central receiver. The TST can be plugged into any standard 110V AC outlet. Once plugged in, the TST broadcasts out the current temperature of the room (over the power line) every few minutes. The Temperature Sensing Transmitter (TST) can be plugged into any standard AC outlet within 2,000 feet of the central receiver. The central receiver which is plugged into a web server receives the current temperature. Each time the receiver receives a new temperature reading the web page is updated to display the current temperature. X-10™ is a communications protocol for remote control of Electrical devices. It is designed for communications between X-10™ transmitters and X-10™ receivers which communicate over standard household wiring. Transmitters and receivers generally plug into standard electrical utlets although some must be hardwired into electrical boxes. Transmitters send commands such as "turn on", "turn off" or "dim" preceded by the identification of the receiver unit to be controlled.

This is designed to make X-10™ compatible with three phase power situations. The TST should transmit the current he central receiver. From there the user can view the current temperature on the computer screen. After running a web server on one of the machines, the temperature of the room can be seen from any web browser.

4. WEB BASED MODELLING ARCHITECTURE

The model of the Web-Based Temperature Monitoring is a temperature recorder that monitors a temperature in a room and stores the data into a database. Table 2 derived the model of project descriptions on concept, device and software that will be used in the development and design stage. The diagram in Figure 1 above shows the proposed architecture model of this research project. The temperature sensor (LM35 DZ) senses the

temperature in the room and passes the data to the microcontroller.

The microcontroller will read the analog value from the sensor and convert it to the digital value that can be understood by the computer. Visual Basic 6.0 is the software that is used to build an application to capture and display the temperature and also store it into the MS Access database. Abyss Web Server is used as the medium to generate the web page to the web browser using ASP scripting language.

This was to ensure that the temperature sensor and the web-based ran as it should be Documentation was done when each of the phases was completed or if any changes were made during the second part of the project. Lastly, when all the phases were completed, the main documentation was updated.

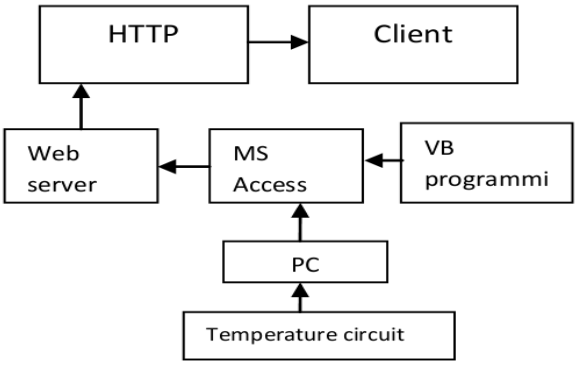

Fig. 1: WEB Based Temperature Monitoring Model

A few models on the research methodology have been done in conducting this research method. Chaos model is chosen as one of the research methodology. Chaos model is a structure of software development that extends the spiral model and waterfall model. In a Chaos model, there is a combination of linear problem solving loop with fractals solving loop to describe the complexity of software development.

The Chaos model was chosen because in the development there is programming part involved. Previous research shown that, errors might occur in the programming or the output. The first element of the Chaos model is covered which is the Problem Definition. This is important to gain ideas on how to develop the project in the next stage. For the programming solution, the fractal solving method and for the hardware development, linear approach was chosen. In this phase, a temperature sensor was successfully built. The temperature sensor was patched with web-based was created and then tested if it could run without any critical error. If any part of programming stages in this phase was found faulty, the process was then restarted from the previous step. This was to ensure that the temperature sensor and the web-based ran as it should be. Documentation was done when each of the phases was completed or if any changes were made during the second part of the project.

The Technical Development phase is divided into several stages, beginning with hardware development, then with software development and finally is the process of producing output from the system which combines both hardware and software development, shown in Figure 2. These phases are important in order to make sure all development process was done in a proper manner presented to the board with the system that is successfully functioning. Technical Development is the phase where the implementation of the project is carried out. The device system was identified and studied in the pre-development phase.

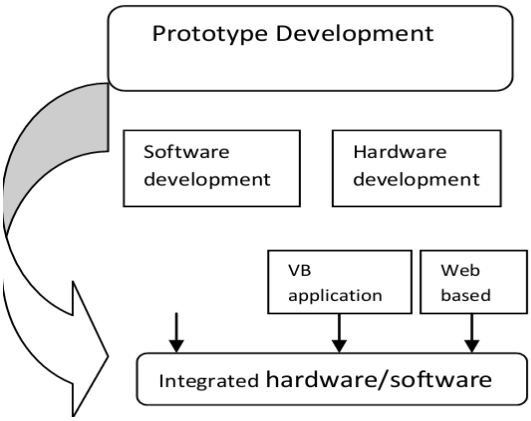

Fig. 2: Flow Model of Prototype Development

This process is related on how to develop the physical device of temperature sensor and also how it can communicate with the system efficiently. In this stage the hardware for temperature sensor is produced. The temperature sensor board is developed with the function to detect or sense a current temperature using the LM35 sensor and at the same time it sends the information to the computer that is physically connected to it through a serial port. The temperature sensor board is built by using a

temperature sensor tool kit. The hardware development involved the hardware and temperature hardware design. In temperature hardware design, LM35 sensor will detect and

sense the temperature and it connects to the computer serial port and sends information to the computer monitoring software. This temperature hardware design is already provided by the temperature sensor kit and it only needs to be defined before the start of the hardware development.

After the components and hardware design are determined, all the components are allocated on the board and need to be soldered as shown in Figure 6 below shows the conclude product of the temperature sensor board. The hardware setup for the devices includes the temperature sensor board used a data cable that can be attached to a serial port.

Develop a system that is used to capture data from the Temperature Sensor, save into the database and display it to the webpage. In order to monitor the temperature, the specific programming needs to be used to interfacing the temperature sensor hardware with the system and the web based. This software design can be divided into three stages, which are Microcontroller Programming, Web-Based Temperature Monitoring System application and Web page development. Each of the stages involved in different language of coding on the software design as derived.

4.1 Microcontroller Programming

Bascom is used for the programming at microcontroller software. It writes Basic scripting language to the microcontroller. Then the basic program translates the computer readable format to machine code which is a format the AVR controller can execute. The program at microcontroller has been adapted from the Internet, but a lot of modification has been made to suite with the project requirement.

4.2 Web-Based Temperature Monitoring System

The function of Web-Based Temperature Monitoring System is to capture the data obtained by the temperature sensor. The system communicates with the sensor board through the COM Port. Web-Based Temperature Monitoring System will display the current temperature and previous temperature that are stored in the database along with the timestamp. The user will monitor the recorded temperatures. Web-Based Temperature Monitoring System is also the medium that records the incoming temperature into the database. The database status is updated every five seconds (+/- buffer between sensor board and computer) and will continue to send an update until the system is shut down or the user shuts off the power supply to the sensor board. Visual Basic 6.0 programming platform is used to develop this system.

4.3 Web page

Active Server Pages or ASP is a technology that enables users to make dynamic and interactive web pages ASP uses server-side scripting to dynamically produce web pages that are not affected by the type of browser the web site visitor is using. In this project, ASP was used because the default scripting language for querying data from the MS Access database is ASP. Inside ASP file, VB Script or Java Script can be used to query a data from the database. Any web pages containing ASP cannot be run by simply opening the page in a web browser. The page must be requested through a web server that supports ASP, this is why ASP stands for Active Server Pages, no server, means no active pages. Web server that has been used is Web Server 2.6.

4.4 Why Linux Server

4.4.1 Cost

The most obvious advantage of using Linux is the fact that it is free to obtain, while Microsoft products are available for a hefty and sometimes recurring fee. Microsoft licenses typically are only allowed to be installed on a single computer, whereas a Linux distribution can be installed on any number of computers, without paying a single dime.

4.4.2 Security

In line with the costs, the security aspect of Linux is much stronger than that of Windows. Why should you have to spend extra money for virus protection software? The Linux operating system has been around since the early nineties and has managed to stay secure in the realm of widespread viruses, spyware and adware for all these years. Sure, the argument of the Linux desktop not being as widely used is a factor as to why there are no viruses. My rebuttle is that the Linux operating system is open source and if there were a widespread Linux virus released today, there would be hundreds of patches released tomorrow, either by ordinary people that use the operating system or by the distribution maintainers. We wouldn't need to wait for a patch from a single company like we do with Windows.

4.4.3 Choice (Freedom)

The power of choice is a great Linux advantage. With Linux, you have the power to control just about every aspect of the operating system. Two major features you have control of are your desktops look and feel by way of numerous Window Managers, and the kernel. In Windows, your either stuck using the boring default desktop theme, or risking corruption or failure by installing a third-party shell.

4.4.4 Software

There are so many software choices when it comes to doing any specific task. You could search for a text editor on Freshmeat and yield hundreds, if not thousands of results. My article on 5 Linux text editors you should know about explains how there are so many options just for editing text on the command-line due to the open source nature of Linux. Regular users and programmers contribute applications all the time. Sometimes its a simple modification or feature enhancement of a already existing piece of software, sometimes its a brand new application. In addition, software on Linux tends to be packed with more features and greater usability than software on Windows. Best of all, the vast majority of Linux software is free and open source. Not only are you getting the software for no charge, but you have the option to modify the source code and add more features if you understand the programming language. What more could you ask for?

4.4.5 *Hardware*

Linux is perfect for those old computers with barely any processing power or memory you have sitting in your garage or basement collecting dust. Install Linux and use it as a firewall, a file server, or a backup server. There are endless possibilities. Old 386 or 486 computers with barely any RAM run Linux without any issue. Good luck running Windows on these machines and actually finding a use for them.

4.4.6 Integrated software development

In this process, the integration of the hardware was implemented with the system that was created before it can be tested to find the weaknesses. First is to check the hardware connection and make sure it is properly set-up. After that is to test the hardware. If the hardware is working, then it can be proceed with the running of a Web based Temperature Monitoring System. If there is a problem, the hardware setup must be checked because it may not have been configured correctly. At Web based Temperature Monitoring System, all the data are saved into the MS Access 2003 database. The user must ensure that the temperatures are saving in the database before proceeding to the next step. If everything runs Smoothly, run the Abyss Web Server, and access the current temperature using the web page. The system is considered successful if there is no error detected during the testing. Because the hardware device was not built with expensive materials, so it can only be used in a limited geographical area. It can only be used for indoor temperature monitoring and limited only for one room.

5. COMPARISON RESULT

Almost all the sample projects are using the same concept as Web-Based Temperature Monitoring project. The project that is most alike is Automated Temperature Tracking System. The system uses an iButton temperature sensor where it can monitor a temperature in a large scale of environment, but the temperature can only be monitored through a LAN network, and not accessible through the Internet compared to Web-Based Temperature Monitoring.

6. SUMMARY

The survey resulted that developing a Home Monitoring System that uses distributed data storage, handles multiple devices, is small, and power saving may be a useful alternative in certain applications.

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