A Web Based Temperature Monitoring System

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Abstract— **This research was developed to produce a prototype product of 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 development project was 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 C 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. The research project is considered successful and ready to be launched in the real system implementations.**

Keywords– Temperature Sensor, Web Based, Automated System, Monitoring Application, Modeling and Internet

I. 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. Management has to choose either to place a person to monitor the temperature, or to save on human capital by developing a system that can monitor the temperature from other places at any given time.

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 ro0m 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 the current temperature on the website through a web server. The system will continuously monitor the temperature condition of the room and the data can be monitored at anytime and anywhere from the Internet. 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.

II. PREVIOUS RESEARCH

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.

Another research has elaborate that temperature monitoring will give a big impact on logistic management and production flow management. China is the leading country to implement the temperature monitoring for logistic such as production, storage, transportation, marketing and consumption. One example called a Cold Chain which is supply the chain system in temperature management. It ensures that the core requirements of maintaining low-temperature environment for the purpose of maintaining perishable goods quality, so it has higher requirements than the general logistics system at room temperature [2]. Temperature changes will be recorded in the RFID tags with temperature sensors for the quality and meticulous, real-time management of the fresh products.

In order to develop this we based proposed model, some comparison on previous project that similar with Web-Based Temperature Monitoring has been made. There are three different research projects selected and analyzed in order to get an idea that has been included in this project.

III. TEMPERATURE SENSOR CHARACTERISTICS

Temperature is a physical property of a system that underlies the common notions of hot and cold, something that is hotter generally has the greater temperature. 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.

A. 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 when using such sensors on new applications. Surface temperature measurement problem can be solved in many cases through the use of non-contact sensors. It's almost ideal for those types of applications and use for many industrial plants worldwide in great numbers.

B. 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. This rapid growth has pushed the development of new technologies and also the adaptation of exist technologies to meet the new measurement requirements and to improve measurement accuracies and resolutions. Therefore it is important to understand the strengths and limitations of each noncontact measurement principle when selecting the correct sensor technology for the measurement task.

IV. TEMPERATURE SENSOR TECHNIQUE

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].

The model architecture overview the SENSORD/ Stat, and describe rSensord, an interface module that connects R to SENSORD Core. SENSORD Core is a data management server of SENSORD. The rSensord module converts stored sensor data in the SENSORD Core server to and from analytic data of the R environment, and accommodates a single process command interpreter of the R environment to asynchronous, parallel execution mechanisms of the SENSORD Core server. 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. This model relate to the aim designing model for web based project that is on the run. Research has been done that a sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes. For instance, if the mercury in a thermometer moves 1cm when the temperature changes by 1 °C, the sensitivity is 1 cm/°C. 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.

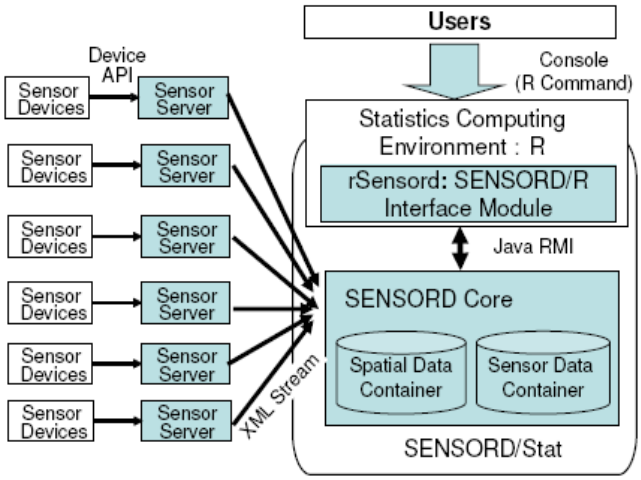

Fig. 1: SENSORD/Stat Temperature Technique

V. AUTOMATED, SPEECH AND REMOTE TEMPERATURE MONITORING COMPARISON

Comparison on the three comprehensive sensor temperature systems has been done and benefits and similarities have been taken as guideline to model the web based architecture system implementations. Therefore these systems benefits the future development and designing of the web based temperature monitoring system either in contributing on the hardware, software or the systems itself.

A. 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.

TINI microcontroller cards and iButton are devices with limited processor power and memory [5]. For better performance and scalability it is imperative to move the processing load to the application server machine, which can easily handle the processing load for very large number of devices at ease. It also includes implementing capabilities like alerts, which are natively supported by the iButton devices, on the application server. 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.

B. 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 warning message can be programmed to execute repeatedly to really get the drivers attention. Also, the device could be used as an aid to the visually impaired. The user can find out many physical aspects of their environment simply by hitting a switch. Some environmental aspects may include temperature, gas leaks, humidity, and etc. The purpose of the project is it will focus on interfacing a speech synthesizer with a temperature sensor.

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. For example, in a Power Plant, water is used as a coolant for the reactor. The temperature of the water vapor must be carefully monitored, meaning that a person must focus their attention exclusively on this task to make sure the temperature is in the desired range. Instead, the Speech Synthesized Temperature Sensor could be adapted to inform the worker of the vapor temperature. This way the worker can focus on other tasks and will simply be interrupted by a message ever so often of the temperature. The user can just hit a switch to activate the device and an internal timer will trigger the device to spit out a message in every five minutes. The device can save a company both in time and money.

C. 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. Figure 2 show the flow chart for the Microcontroller in TST. 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 outlets 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 broadcast goes out over the electrical wiring in a building. Each receiver is set to a certain unit ID, and reacts only to commands addressed to it. Receivers ignore commands not addressed to them. X-10™ specifies a total of 256 different addresses: 16 units

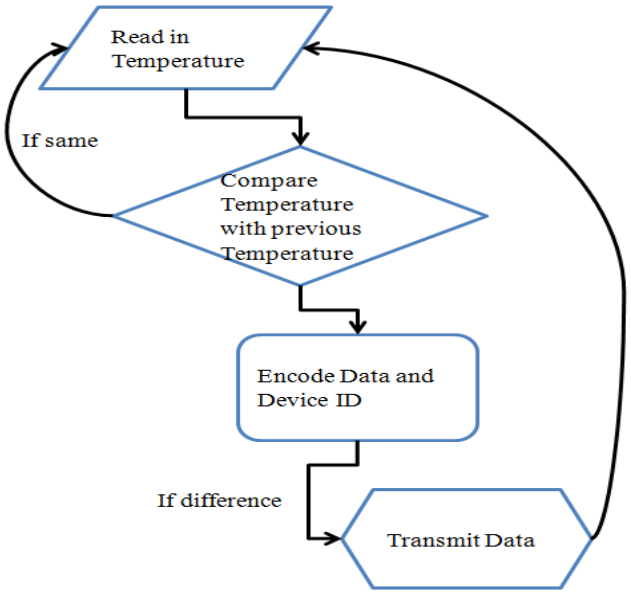

Fig. 2: Microcontroller in TST

codes (1-16) for each of 16 house codes (A-P). The X-10™ protocol sends signals at the zero crossing of the AC line voltage and then at 60 degrees and at 120 degrees after that. This is designed to make X-10™ compatible with three phase power situations. The TST should transmit the current temperature to the 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.

VI. 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. Speech Synthesized Temperature Sensor alerts the user of temperature changes using a verbal message. The device also can issue a warning to the user, but it is not accessible through a web browser. This sensor is mostly used to monitor a temperature changes in a car, power plant or the temperature in a laboratory. X-10 Based Remote Temperature Monitoring System has exactly the same concept as Web-Based Temperature Monitoring. The difference is its using different devices to monitor the temperatures and it only updates the temperature in the web browser when the receiver receives temperature changes, while Web- Based Temperature Monitoring constantly displays the current temperature in the room. Table 1 show the comparison on the analyzed results of the three presented systems.

Table 1: Comparison between Speech, Automated and Remote Temperature Monitoring System.

Project/ Description	Automated Temperature Tracking System	Speech Synthesized Temperature Sensor	X-10 Based Remote Temperature Monitoring
Concept	Automate the monitoring of temperature in critical location throughout Hospital	Automate the environmental temperature via a verbal message	Monitor the temperature in a room using X-10 Based Remote and store the data When there are changes occur
Device	iButton Microcontroller (TINI)	Speech synthesizer chip (SPO256-AL2) Microprocessor	X-10 transmitters
Software	Java Apache Tomcat Java Servlet Pages MySQL	Java Java Servlet Java Server Pages	MySQL PHP Apache

VII. WEB BASED MODELLING ARCHITECTURE

The analyzed result from the three presented system has come out the input for this project to continue on modeling the Web-Based Temperature Monitoring system first before the real implementations hand benchmark is done. 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. The system will continuously monitor the temperature condition of the room and the data can be monitored at anytime and anywhere from the Internet. The propose model is where the temperature sensor is connected to the computer to monitor the temperature, and the data are captured and saved in MS Access database and can be displayed using a web browser. From there, the user can monitor the temperature from the Internet. Placing the current temperature on a web page makes the information easily accessible from anywhere in the world. 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 3 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.

Table 2: Proposed Web Based Temperature Monitoring Project Descriptions.

Project/ Description	Web-Based Temperature Monitoring
Concept	Monitor the temperature in a room and store the data into a web server
Device	Microcontroller (ATMega88)
Software	Microsoft Access latest version Visual Basic C Programming ASP Abyss Web Server

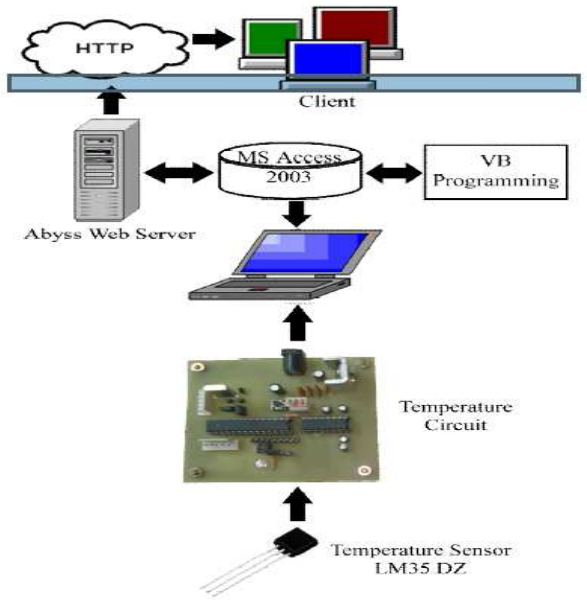

Fig. 3: Proposed WEB Based Temperature Monitoring Model

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.

VIII. INITIATION AND DEVELOPMENT METHOD

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. Lastly, when all the phases were completed, the main documentation was updated and

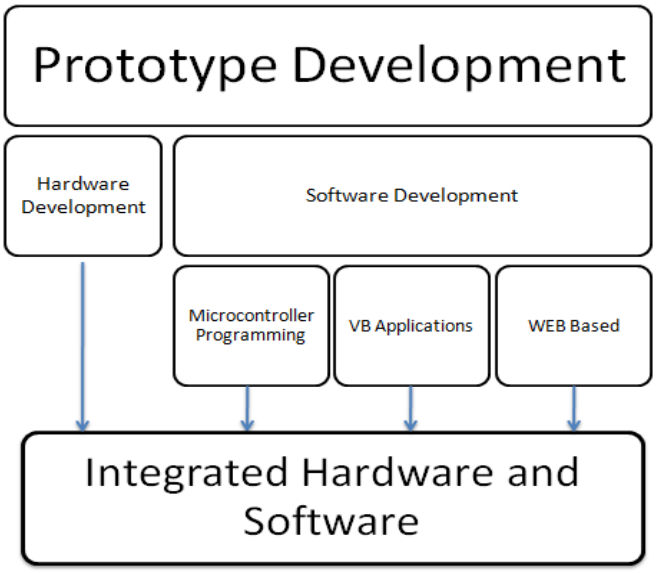

Fig. 4: Flow Model of Prototype Development

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. 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 4 These phases are important in order to make sure all development process was done in a proper manner.

A. Hardware 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. While in the Temperature Hardware Design, the design layouts need to be determined before allocating the components. Figure 5 shown the circuit diagram needs to be referred in order to assemble the temperature sensor board. In this diagram, all of the components are converted into symbols that represents it's functionality. It also defines the power voltage of each component.

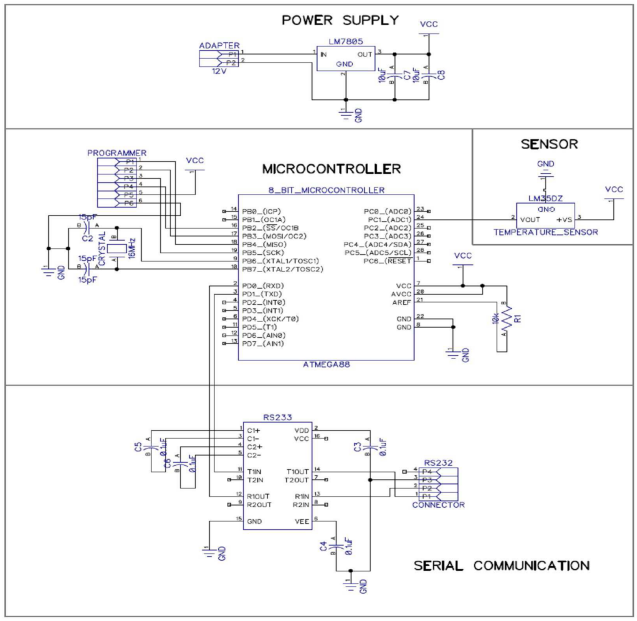

Fig. 5: Full Design of Circuit Diagram

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. To allow communication between the temperature sensor boards with the computer, the sensor needs to be attached to the computer using serial cable or USB RS232 serial converter to connect to the computer. The AC/DC adaptor belongs to the Temperature Sensor Board. It supplies the electricity power to the sensor board in order for it to function.

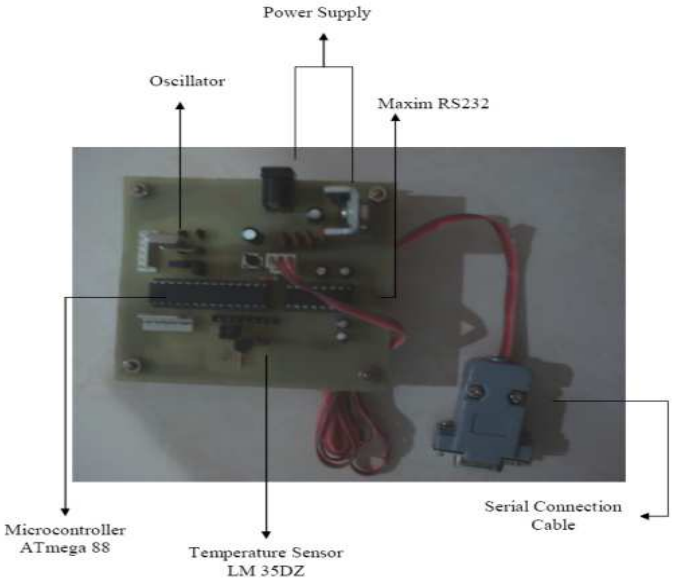

Fig. 6: Soldered Temperature Sensor Board

To allow the connection, the AC/DC adaptor is attached to the temperature sensor board and power up. The adaptor can be adjusted according to the output voltage needed by the sensor board which is 7.5Volt like is used. This is to control the amount of the electricity that goes into the board. Finally is attaching past where the serial cable is attached to USB RS232 or serial port. The proper hardware connection needs to be tested using HyperTerminal or Simple Terminal Software. If the current temperature is displayed, means the hardware is functioning.

B. Software Development

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.

- *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 as in Figure 7.

- *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.

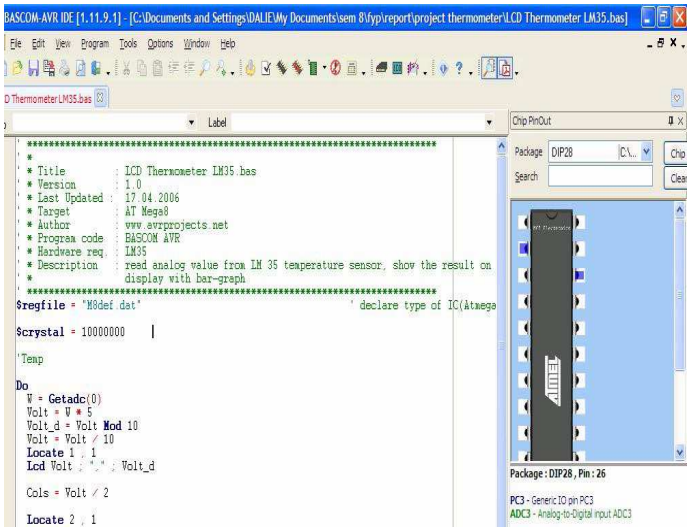

Fig. 7: Modifications of Bascom Software

- *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 Abyss Web Server 2.6.

C. Integrate Hardware and Software

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. Figure 8 shows how the system works. 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

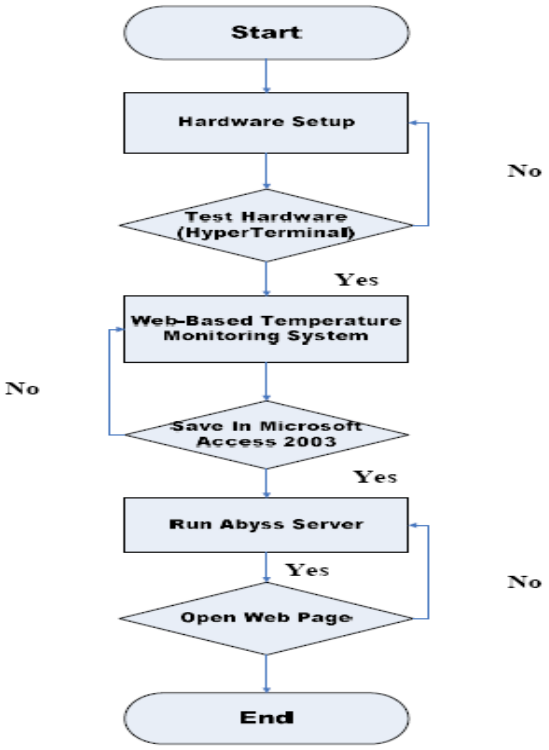

Fig. 8: Data Flow of Prototype Development

because there is only one sensor attached to the sensor board. Other limitation is if the electricity is cut off it will shut down the entire operating system.

IX. TESTING RESULTS

Testing phase is used to evaluate the system's function whether it meets the intended functionality. The system was successfully implemented and developed. However, to ensure that the system will perform correctly, the temperature sensor device and monitoring system need to be tested. Two method of testing was carried out to make sure the hardware and software is functioning according to the objectives.

A. Unit Testing

Unit testing is divides into two phases. The first phase is the Hardware Testing on Temperature Sensor. In order for the temperature sensor board to function, it needs to be set-up. The hardware setup must be done properly. It also must follow the entire step that require for hardware connection. The proper hardware connection must be tested using HyperTerminal or by using Simple Terminal software. Simple Terminal is software to log raw serial port data to a file or view a data communication on screen. For this project, to test the hardware connection, the baud rate must be set at 9600. To test by using HyperTerminal, one must first go to All Program > Accessories > Communication > HyperTerminal. To use a simple term, just click on the icon of the software, and configure the setting to start testing.

The second phase is the Software Testing on Web Based Temperature Monitoring System. In this phase, the

sensor is connected to the computer and runs the VB application program called WebTemp, to display the temperature received from temperature sensor. The WebTemp application is the program which is designed to display the actual temperature transmits from the sensor board. The user will need the WebTemp to display the temperature to the computer. Without the WebTemp application, the user cannot display the current temperature, as well as recording the temperature into the database. WebTemp also functions to store the current temperature into the MS Access database. This is the most critical part of the system.

B. Functional Testing

Functional testing can be performed at the system level or the unit level. Functional testing is performed by created a set of input or outcome relationships that verify whether each specification requirement is implemented correctly. At least one test case should be created for each entry in the specification document preferably; these test cases should test the various boundary conditions for each entry. After the test suite is ready, execute the test cases and verify whether the correct outcomes are produced. Figure 9 and 10 shows the Temperature Sensor testing and also the testing on the final stage of Web Based monitoring system. The test cases are carried out individually and the following are the results obtained from the testing phases. In this testing, the most important function is selected to be test and make sure the product run according to the expected output. Table 3 shows the output of the final functional testing.

X. CONCLUSION

This project modeling is similar to Remote Temperature Monitoring System which has exactly the same concept as Web-Based Temperature Monitoring. The difference is its using different devices to monitor the temperatures and it only updates the temperature in the web browser when the receiver receives temperature changes, while Web- Based Temperature Monitoring constantly displays the current temperature in the room. With this modeling, the research enhanced more in developing where comparison of software architecture model is ongoing evaluations. The design and development of the project research also is on the run. In order to solve the existing problem, the web-based temperature monitoring system that can be access anywhere and anytime through the Internet is build for the enhancement of this project. Cost expenses, software used, hardware involve and system programming is also evaluated during the development of the future project on the designing the WEB BASED temperature sensor monitoring system.

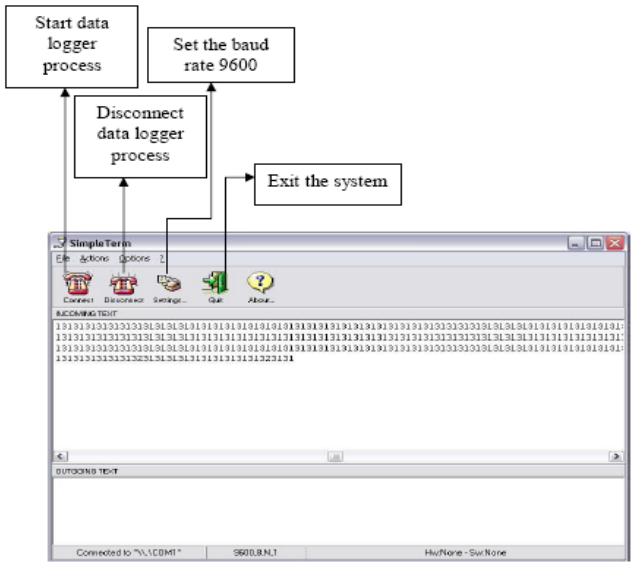

Fig. 9: Temperature Sensor

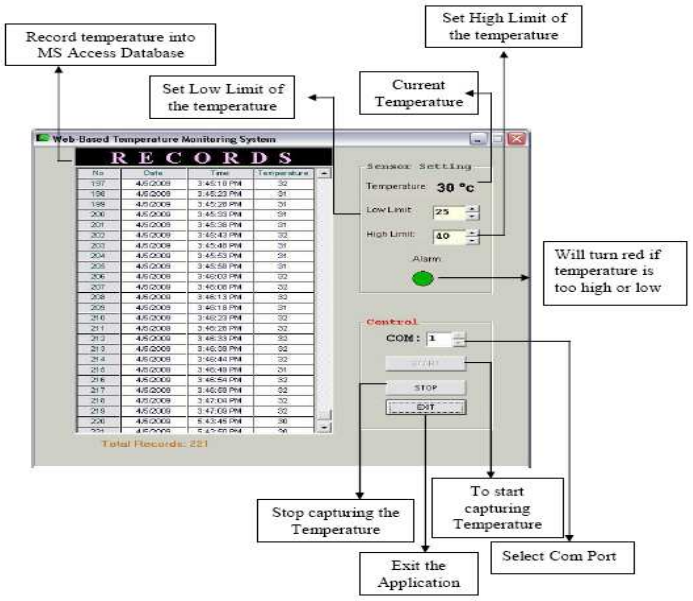

Fig. 10: Web-Based Temperature Monitoring System

Table 3: Functional Testing Table

Hardware/Software	Expected Output	Test	Testing Output
Temperature Sensor	The temperature sensor will sense the temperatures.	√	The temperature is sensed and output is produced.
Web-Based Temperature Monitoring System	Temperature will be displayed and data stored in MS Access Database.	√	The temperature display is stored in MS Access.
Web-Page	Data is connected to the web and the current temperature is displayed.	√	Connect to web and display current temperature for the room

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