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An RTLinux Based Intelligent Multi-Task Data acquisition System for Remote Industrial Applications

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Abstract:*Wide variety of real world signals like electrical and Non electrical signals are quantified, monitored and controlled is the challenging work in industries with authentic time and withal its require the special data acquisition system with some circumscriptions; Therefore, We propose the Perspicacious Multi-Task data acquisition system predicated on RTOS RTLinux. The scope of embedded contrivances is incrementing day by day and the injuctive authorization will be further more when networking technology is incorporated into these contrivances. These Paper approached towards the development of Intelligent Multi-Task Data Acquisition System for remote Industrial appliances predicated on Authentic Time RTLinux Operating System .In this Paper, the techniques employed for picking up thy real world signals from remote distance sensors and making it compatible for data acquisition to control the Industrial Applications. This system uses Mini 2440 ARM 9 Board , which is an real time processor that handles real time processes predicated on multi tasking and reliable scheduling mechanisms with RTLinux Operating System, an Ethernet card & SHT71 Sensor so the whole system opportune for ameliorating security in industry by remotely monitoring and controlling temperature & Sultriness Parameters where high safety & rigorous action requisite.*

Keywords: MINI 2440 ARM, RTLinux Operating System, SHT-71, Intelligent Multi-Task DAQ.

1. Introduction

The scope of embedded contrivances is incrementing day by day and the ordinant dictation will be further more when networking technology is incorporated into these contrivances.Rapid advances in the embedded contrivance hardware and software technologies become resulted in facile and efficient adoption of the embedded in sundry precise measurement and intricate control applications. An embedded–based measurement application requires conversion of authentic or real world's analog signal into digital format and transfer of the digitized data into the Embedded Processor. Similarly, an Embedded- predicated control applications requires conversion of digital data into analog signal. A data acquisition system that performs conversion of analog signal to digital data and the digital data to analog signal is interfaced to an ARM Processor to implement the functions of a measurement and control instrumentation applications.

Because of wide variety of signals of quantified object e.g. electrical parameters of voltage, frequency, current, analog circuit breaker status, digital signal protective actions and non-electrical parameters of temperature, pressure, relative humidity and other thermal signal; pulse ,speed and other signals, the conventional practice is the design special data acquisition systems according to different signals, and thus there are some circumscriptions; Therefore, we propose to build a Keenly intellective Multi-Task Data acquisition system [1] .

Data acquisition is the process of accumulating signals from quantification sources and digitizing the signals for storage, analysis, and presentation on a PC. Data acquisition systems come in many different PC technology forms to offer flexibility when culling your system. Data acquisition (DAQ) process involves quantifying an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer. A DAQ system consists of sensors, DAQ quantification hardware and a computer with programmable software. Compared to traditional quantification systems, PC-predicated DAQ systems exploit the processing potency, productivity, exhibit and connectivity capabilities [2].

Computer data acquisition boards plug directly into the computer bus. Advantages of utilizing boards are speed (because they are connected directly to the bus) and cost (because the overhead of packaging and power is provided by the computer).Boards offered are primarily for IBM PC and compatible computers. Features provided by the cards can vary due to number and type of inputs (voltage, thermocouple, on/off), outputs, speed and other functions provided. Each board installed in the computer is addressed at a unique Input/output map location. The I/O map in the computer provides the address locations the processor uses to gain access to the concrete contrivance as required by its program [7].

2. literature survey

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An real-time system is one whose correctness involves both the logical correctness of the outputs and their timeliness. An real-time system must satiate bounded replication-time constraints; otherwise risk rigorous consequences, including failure. real-time systems are relegated as hard, firm or soft systems. In hard real-time systems, failure to meet replication-time constraints leads to system failure. Firm real-time systems are those systems with hard deadlines, but where a certain low probability of missing a deadline can be abode. Systems in which performance is degraded but not eradicated by failure to meet replication-time constraints are called soft real-time systems. An authentic-time system is called an embedded system when the software system is encapsulated by the hardware it controls.The microprocessor system used to Adaptive Cruise Control (ACC) and Cooperative ACC systems. While customary cruise control systems track a desired conveyance speed, Adaptive Cruise Control (ACC) systems acclimate their deportment if there is a conveyance ahead on the roadway, and follow the bellwether conveyance at a driver requested time gap utilizing line-of-optical discernment sensors such as radar is an example of an real-time embedded system. An RTOS differs from mundane OS, in that the utilizer when utilizing the former has the ability to directly access the microprocessor and peripherals. Such an ability of the RTOS avails to meet deadlines.

The organization of this report is as follows. We observed the rudimentary requisites of an RTOS to be POSIX 1003.1b compliant. We review memory management and scheduling algorithms utilized in an RTOS.We outline and briefly explicate the steps in the implementation of a project with an RTOS. We cull a popular RTOS in each of the different categories of real-time applications and observe the real-time features of the culled RTOS. We additionally compare the different up-to-date commercial RTOSs.We conclude by observing the results of this scrutiny and our suggestions for future research in the field of RTOS [11].

3. The Overall System

The rudimentary conception abaft this project can be described with the avail of above diagram. Fig. 1 shows Structural diagram of the system. It is utilized over LAN of any institute, Hospital, college, MNC etc. Industry parameters such as temperature, Pressures, Humidity etc. The data sensed utilizing these sensors is applied to the ADC that is available on board of Mini 2440 ARM board. This data is exhibited on the LCD interfaced to the board. This data is additionally transferred to the clients PCs via Local Area Connection(LAN).Whenever the data from any sensor transcends the designated value then the program running on the ARM board sends a vigilant message on the utilizer's mobile via GSM Modem affixed to the system. Withal audio indication is additionally provided for some time through buzzer provided on the board. The system is made in closed loop Configuration. That is when we optate to make any relay circuit ON/OFF; we can make it ON/OFF by pressing one button provided on a GUI of the PC screen. So the system can be controlled through the LAN. This can be then elongated to sizably voluminous circuitry by providing its output to the relay circuit to make on/off the fan or some cooling system. Real-Time inputs are applied to the Analog to Digital Converter (ADC) in built on the board. These inputs are processed and checked for their values. If these values are in designated range then no action to be taken but if these inputs are in higher ranges then the program running on ARM board sends a vigilant message on the users mobile. There is withal an audio indication by the beeper available on the board. There is additionally Ethernet connection is provided to transfer the values over the LAN [2].

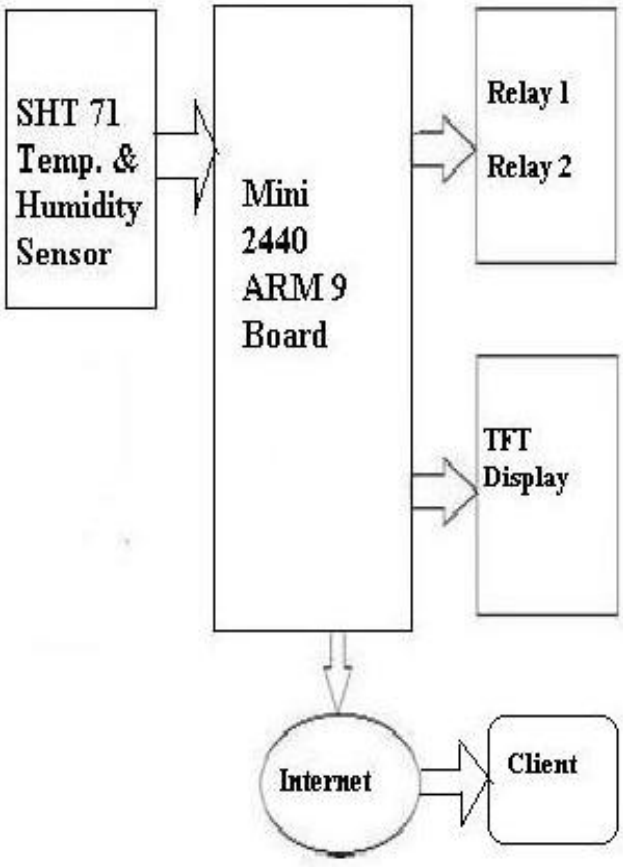

Figure 1: Structural diagram of the System

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4. Hardware design

4.1 SHT-71 Sensors (Temperature and Humidity Sensor IC)

These sensors integrate sensor elements plus signal processing in compact format and provide a plenarily calibrated digital output. A unique capacitive sensor element is utilized for quantifying relative sultriness wheras

temperature is quantified by a band-gap sensor. The applied CMOS Sensor technology guarantees excellent reliability and long term stability. Both sensors are seamlessly coupled to a 14bit analog to digital converter and a serial interface circuit. This results in excellent signal quality, an expeditious replication time and callousness to disturbances.SHT71 is distinctively calibrated in a precision humidity chamber. The calibration coefficients are programmed into an OTP memory on the chip. These coefficients are habituated to internally evaluate the signals from the sensors. The 2-wire serial interface and internal voltage regulation sanctions for facile and expeditious system synthesize. The minuscule size and low power consumption makes SHT71 the eventual cull for even the most authoritatively mandating applications.SHT71 is the planarity evaluated, Digital output, Low power dissipation, excellent long term stability, Pin type package & facile synthesis temperature & Humidity Sensor [9].

5. Software design

Software design is the main key design of the system

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5.1 Linux Operating System Development

ARM platform support for ARM Multifarious Express development staging and ARM Development Studio 5 to the main Linux kernel. The other tabs contain Linux kernel images, sphares and service to run Linux on ARM processors and ARM adptable platforms. Linux is the version of Linux running on processors with a Memory Management Unit. Processors without MMU can run a modified version of Linux called uClinux. The uClinux tab provides re-build uClinux images for categorical ARM processors [6].

RTLinux is developed and distributed by Finite State Machine Labs. RTLinux support a inhibited number of architectures, like 8086 microprocessor, PowerPC, MIPS, Alpha, unlike eCos. RTLinux is a hard real-time kernel that co-exists with linux kernel. Linux kernel is a lowest priority task or RTLinux kernel and it can be planarity preempted.

RTLinux kernel communicates with Linux kernel utilizing shared memory. This approach sanctions real -time applications to capitalize on non authentic-time features of Linux. RTLinux fortifies prioritized FIFO scheduler and expandable scheduler with 1024 priority levels. Lock-free data structure and priority ceiling are two accesses to evade priority inversion. RTLinux claims to have hard real-time interrupt latency. All the other latencies are CPU relying on [10].

5.2 Linux Support for the ARM Architecture

Linux Penguin Logo Linux is an open source operating system running on all leading processor architectures, including ARM processors. It relishes support by an immensely colossal group of engineers providing back into the open source. This makes Linux a very powerful and expeditious moving operating system [8].

5.3 Socket Programming in C

To perform the communication between the ARM Board and LAN, Socket programming is utilized in a client-server configuration. A cyberspace socket is a commence or endpoint in a TCP/IP network connection. You can visually perceive a cyberspace socket as the ingress or exit of a tunnel. A socket translates all incoming data in to "human readable text" or translates all outgoing data into networks packets. The purport of sockets is simplifying the network code of your c++ application. All the utilizer has to do is engender a socket and connect it. Once your socket is connected the socket takes care of the networking part, and all you have to worry about now is sending data to, or receiving data from, the socket. A socket can be a server or a client. Before a socket can be connected to another socket and "engender a tunnel" you have to designate what type of socket it will be and where it should connect to.

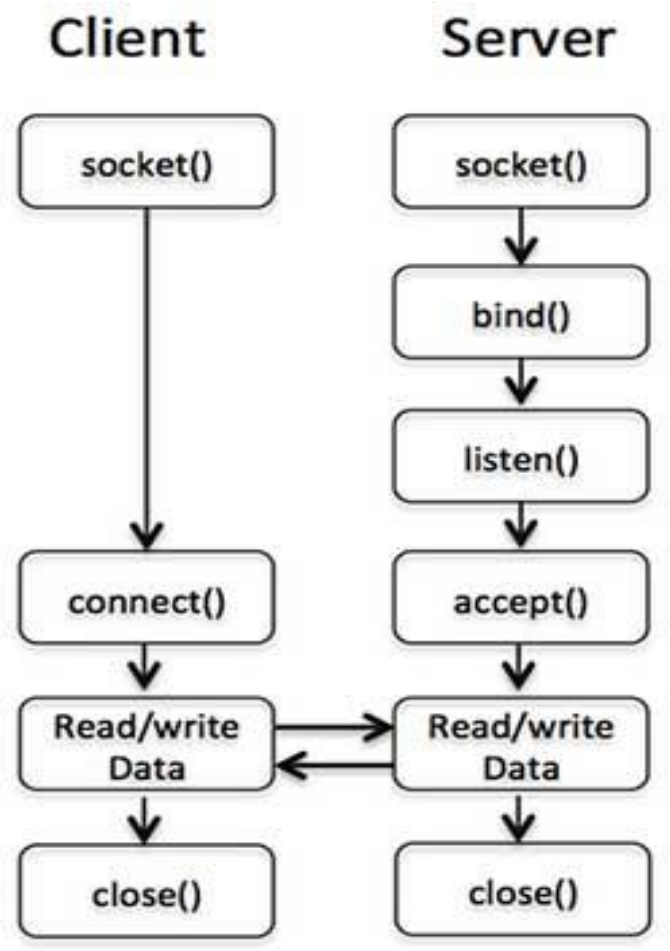

Figure 2: Socket programming Diagram

When you have engendered a socket, and it is connected to another (remote)socket, communication with the sockets is facile. Communicating with a socket is done utilizing unix file descriptors (file handlers) and its associated functions like indite() and read() (for internet sockets send() and recv() are preferred). If you never worked with files in Linux in that way, don't worry. You just need to recollect that when you engender a socket it returns a socket descriptor. This socket descriptor is just an integer. You can optically discern it as the "denomination" of, or reference to the socket. You will require this socket descriptor if you optate to interact with the socket. [8].

6. Result Analysis

SHT-71 Sensor is connected to the GPIO pins of the Friendly ARM9 board. This sensor provides most precise temperature and humidity values compared to other sensors. Hence it is culled for the hard real time purport SHT-71 sensor is connected to ARM board directly without the desideratum of any signal conditioning circuit because the sensor itself has inbuilt ADC and an amplifier, OTP memory and a digital interface.

Figure 3: Components of Server System.

6.1 Transferring Data on the LAN

The following diagram shows the data acquired has been transferred on the LAN. The sensors are interfaced to the ARM 9 board and this data appears on the Graphical User Inerface of the PC's connected over the LAN. This is plenary connection view of project. Utilizing multiport switch we can connect maximum clients through LAN to the friendly ARM 9 Board.

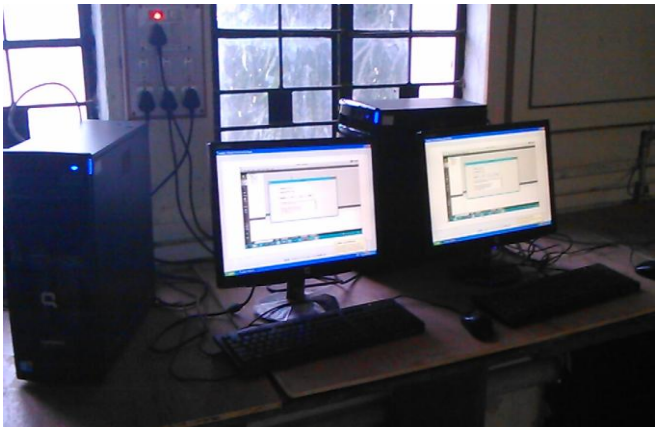

Figure 4: Transferring Data on the LAN Connected Clients

6.2 Storing the Sensor Data

On the host side there is one show logs button to exhibit the stored data of sensor reading. That is shown in Below text file.The data that is captured in real- time is saved on screen.

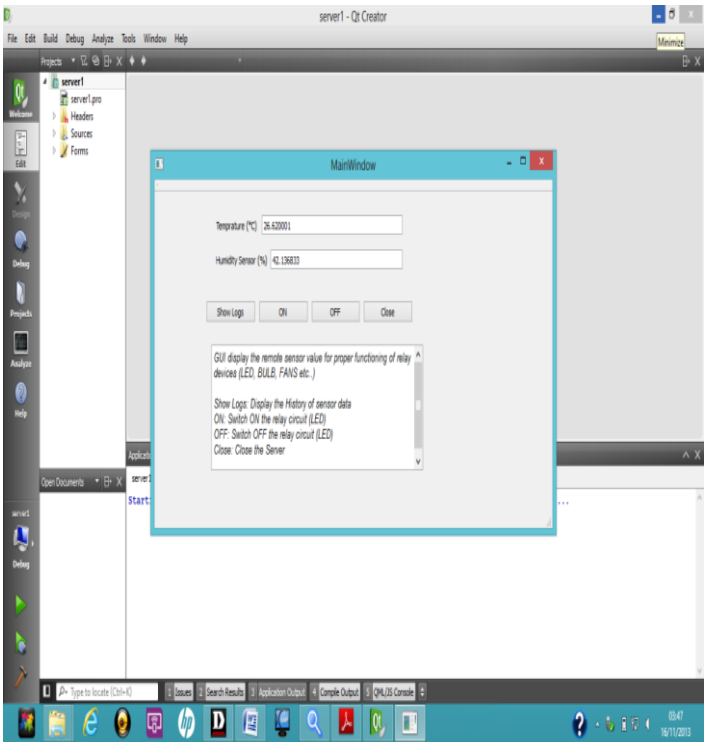

Figure. 5: Temperature and Humidity Sensor Parametrs on Screen

7. Conclusion and Future Scope

For web-predicated network element management provide an administrator to solve remote equipment's data acquisition, monitoring, network communications quandaries. Thus the system provides higher authoritative ordinance of data precision, multitasking and the reliability of the control system. A Future research is needed to ameliorate performance. A final consideration of this work is that there is a very affluent field involving the cull of the most felicitous RTOS for may be critical or non critical embedded tasks, it is compulsory to make a testing the system under an overload situation, i.e. the system is presented with more transactions than it can handle. Withal testing the real -time applications have the requisite to meet task deadlines in advisement to the logical correctness of the results. This embedded ARM system can habituate to the rigorous requisites of the data acquisition and control system. In these System efficiently carried out by real-time multi tasking operating system is RTLinux. This system can be widely applied to chemical Plant, Metal plant, pharmaceutical industry, sugar industry, Distlaries,water mineral plant, Power genetor plant and others.

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