Sensors Data Acquisition Systemusing ARM Microcontroller

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Abstract—The proposed design is of data acquisition from different sensors processing them for specific means, taking control action based on these data. There aresensors used like GPS for localising and navigational purpose, Temperature sensor for detecting the atmospheric temperature and actuators for moving as per the application. As in such case the sensor data acquisition, processing and taking control action have to be in real time, thus the challenging task. The work content is to develop the controller hardware using an ARM controller (LPC1769) and the embedded software to carry out the above mentioned tasks. The other part of the task is sending the sensor data to the master control station for real-time supervisory and control action at operator level.

KEYWORDS: GPS, Actuators, Lpc1769

1. Introduction

DRDO as the renowned organisation developed many automated vehicles which are served on Indian borders for security services. As they were planning their DAS to be more précised and accurate to be operated on low voltages. Specially designed interfacing electronic for specific applications improves the performance of micro-system and provides the user friendly environment for the control and the communication.DAS is extensively employed in the number of automatic test and measuring equipments. They are used to collect the required data from any peripheral input device, such as sensors etc. via controlling program. The measured data could be stored in PC for further processing and commanding for real time processing. The data that is the parameters measured can be shown numerically whereas they can be displayed graphically. The world is full of new inventions to automate the work in which human has ease in doing the job/work. Everyone is trying to be automated by implementing their ideas in various aspects as example is in India as a smart city projects. This is the main reason for choosing the related topic as an idea in which we will be implementing the work and application where sensor are used for data acquisition and actuator control using ARM microcontroller.

The main action of data acquisition systems is the sampling signals that measure real world physical conditions (voltage, current) and converting the resulting samples into digital values that can be handled, for example, by a computer.Microcontrollers are widely used in the embedded system applications as it can do the repetitive tasks with high throughput. There are various microcontrollers availableand its uses depend on its application. ARM microcontrollers are preferred more as it built on RISC (Reduced Instruction Set Computer) architecture. The RISC has Instruction sets which are simpler and can reduce the size of the program in the microcontroller.ARM has released microcontrollers named as ARM Cortex in which various series of microcontrollers are available. The ARM Cortex series are low power, low cost and has high efficiency and can be used for real time applications. In order to have multi-tasking pipeliningmechanism is also used in this series.The criteria to select Arm LPC They just differ with their values and accuracy, dealing with the information we can process to get the necessary output as per requirement. Discussing with the sensors first we tried to get the detailed information about the communication used to communicate the devices being used or is to be used, to get the total guidance we searched many topics and descriptions/definitions from internet. Defining about the problem we have been searched many relative topics on lpc17xx interfacing; we found

many topics which helped the project to be concluded. The body of the project mainly depends upon the microcontroller as it will be acting as a brain of the complete project, functionality of the UART's, communication. We are using RS 232 serial communication process as it is used in computer serial ports. The standard defines the electrical characteristics and timing of signals, and the physical size and pin out of connectors. In RS 232, user data is sent as a time-series of bits. Both synchronous and asynchronous transmissions are supported by the standard. This was a bit overview for the communication point of view In the broadcast definition, a sensor is an object whose purpose is to detect events or changes in its environment, and then provide a corresponding output. A sensor is a type of transducer; sensors may provide various types of output, but typically use electrical or optical signals. A sensor's sensitivity indicates how much the sensor's output changes when the input quantity being measured changes. These systems will be useful for the security point of view and ease to our soldiers to drive an automated technology else going at the actual intruded place. Searching various papers for many discussions we found many papers and below are the choosen ones from the data. We found the ideas which gave us the procedural description about the DAS.

2. Litrature Review

Many of the papers have explained about the requirement of the embedded system in industrial system as it reduces the presence of human near the system.DAQ modules are components of a complete data acquisition system which perform the input, processing and conversion to digital format of analog signal datameasured from a system or process. The resulting data is then transferred to a computer for display, storage and analysis [1]. System [2] isproposed on obtaining the data from the industrial systemto the embedded system through the use of sensors. It has been designed with the help of many automation instruments and high voltage equipments. This paper approaches a new system that contains inbuilt Data Acquisition and Control system (IDACS) with on-line interaction. To test the site equipments and environmental so it can track state of system in real time Thesystem in [3], concern with designing and

implementing multichannel data acquisition system which can be utilized effectively to reduce the human effort and accuracy of measurement of data. The data acquisition system is the base of automation technologies. The traditional signal acquisition systems are mostly by wire, i.e., the sensor connected acquisition system by cable, when measuring point is dispersed and hidden, especially when we control and monitor large complex equipment, it needs a large number of cabling work, and each measurement can only be concentrated in one area, otherwise, it has a very long connection cable, and a long connection cable will introduce a large number of noise and interference. The main aim behind this work is to make the instrumentation stream more power full by enabling it modern communication technologies. The basic block diagram of the ARM based data acquisition system is shown in Figure. From system [4] the Paper we have studied the content of operating the data logging with real time transfer.In the process of real time data collection, there have some problems, such as the duplication of Data, the complexity of physical cabled connection, the requirement of high speed and real time data processing and the electromagnetic interference and so on, so Goal in it was to develop wireless data acquisition system based on embedded system. Mentioning data comes from the drive and sending it to the virtual terminal for testing purpose. In which there data will be send to server and user can monitor the data. For that microcontroller based systems can be used, to design flexible and adaptable system.This is more reliable, avoids more complication and provides high performance to the system. The system proposed in [5] uses SD card for datalogging and uses GSM for wireless communication between the system and user. The status of the system can be seen on a browser using the IP address of the system for which the TCP/IP network is used. LPC 2148 is used in [5] which has ARM7 processor. Development of technology in industrial field and agricultural field it is necessary to design a system with more sensitivity,reliable, and low cost system. Above proposed data acquisition system fulfils all requirement, mentioned above. Collected data from data acquisition system transfers via Bluetooth which is reliable way of communication. Data put on server via Bluetooth can easily

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accessible via web or internet. So client module can access of server and easily controls the devices. This system can be applied to agricultural field,industry, petroleum and so on, from system [6].The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers. This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its processor is being decoded, and a third instruction is being fetched from memory. ARM based embedded system will be more functional, reliable, cost effective, less in size and low power consumption. Microcontroller has low speed and poor memory, so it can only execute simple control tasks. A single ARM board has been act as data acquisition unit, control unit, embedded web server and self diagnosis. All processes are allocated with essential resources and associated with reliable scheduling algorithms and internet protocols followed by ARM processor. This setup reduces the complexity & size of system. A small 8-bit microcontroller has the portability with RTOS.
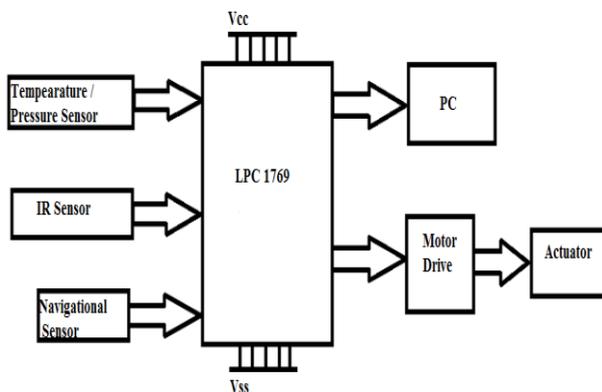

Fig: - Block Diagram

Generally all ARM7 processors have the portability with any kind of higher end RTOS. RTOS comprises of two components, namely, "Real-Time" and "Operating System". Real-Time indicates an expectant response or reaction to an event on the instant of its evolution. Operating System (OS) is a system program that provides an

interface between hardware and application programs. OS is commonly equipped with features like: Multitasking, Synchronization, Interrupt and Event Handling, Input/ Output, Inter-task Communication, Timers and Clocks and Memory Management to fulfill its primary role of managing the hardware resources to meet the demands of application programs.

3. System Module

In the proposed system, the board which is being used is LPC1769 by NXP semiconductor for acquiring the data from the system and performing appropriate function. This board is chosen because of its various advantages. It is a low cost, low power and efficient performance board built on ARM Cortex M3 and can be used for real-time application. The data from the system are obtained through the sensor. The type of sensor to be used depends on the type of system being used from which the data are obtained. Different sensors are used for different system.

POWER SUPPLY: When working with electronics, you always need one basic thing: Power. In every electronic circuit power supply is required. The proper working of each and every component, the exact amount of voltage and current to be supplied to it. If the power exceeds its limit, it can be fatal. Below is the circuit diagram of power supply which gives output of 5V, as only that much is required for microcontroller.

RS 232 :The interface now describes by the electronic industries association RS-232-C standard was started late in 1960's as a method for connecting a computer to a modem. A full implementation compresses two data line, 6 control lines and 1 ground. Data is transmitted using a serial(i.e 1 bit at a time)full duplex (that is simultaneous send and receive is possible) at a rate governed by the cable capacitance. The maximum cable length specified by the standard is 17mtrs. Corresponding to data rate of 20kbps, but up to 10 times this is possible over shorter distance. The objectives and goals of this project report can be briefly summarized in the following points.

UART:-The LPC17xx each contain four UARTs. In addition to standard transmit and receive data lines, UART1 also provides a full modem control handshake interface and support for RS-485/9-bit

mode allowing both software address detection and automatic address detection using 9-bit mode. The UARTs include a fractional baud rate generator. Standard baud rates such as 115200 Bd can be achieved with any crystal frequency above 2 MHz

GPS A101:-Work smarter, not harder. The A101™ Smart Antenna offers an affordable, portable solution with professional-level accuracy for agricultural, marine, GIS mapping, and other applications. Focus on the job at hand with fast start-up and reacquisition times, 60 cm accuracy, and an easy-to-see status indicator for power, GPS, and DGPS.

The durable enclosure houses both antenna and receiver. It can be powered through various sources, making the A101 smart antenna ideal for a variety of applications. Dual-serial, CAN, and pulse output options make this DGPS receiver compatible with almost any interface.

➢ Development of embedded controller for interfacing different sensors.

➢ To design the monitoring system where the temperature and pressure level automatically detects by the sensor system. €

➢ To develop interfacing motor/actuator drive and to develop graphic user interfacing system (GUI) by using software to monitor the temperature, pressure levels and controlling the actuator positions using motors/actuator drive.

➢ Processing the sensor data to take control actions, where necessary the system should be able to activate alarm when operate out conditions then should also send a notification message to the responsible user.

➢ And interfacing a GPS system to get the real time positioning and navigating data to the user.
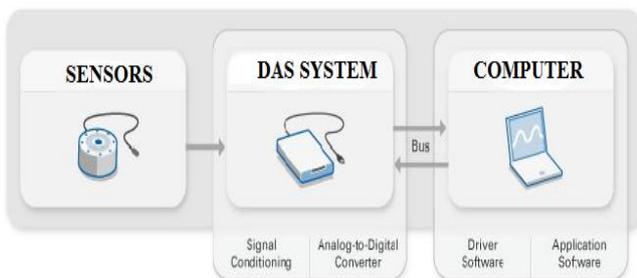
3. Implementation
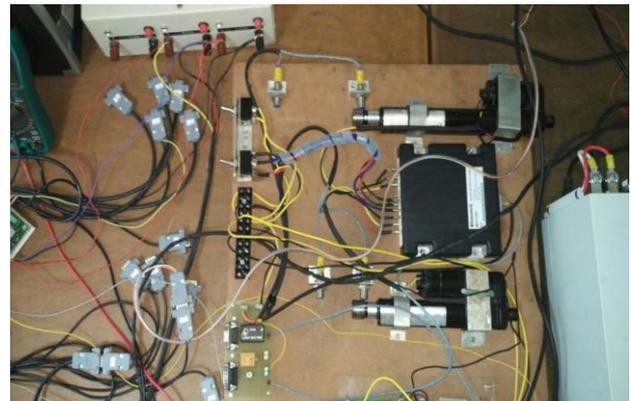

Fig: - Block diagram of DAS

Fig. Actual Photo

The data acquired and the tasks performed by the system can be seen in PC through hyper terminal application. LPCXpresso tool is used for implementation. Below is the Software selection criteria from which we can check and troubleshoot the DAS.

3. Software

KEIL µVISION: µVision is an IDE (Integrated Development Environment) that helps you write, compile, and debug embedded programs. It encapsulates the following components:

• A project manager.

• A make facility.

• Tool configuration.

• Editor.

• A powerful debugger.

Quick Function Navigation, Syntax Coloring with brace highlighting, Configuration Wizard for dialog based startup and debugger setup.

FLASH MAGIC: NXP Semiconductors produce a range of Microcontrollers that feature both on-chip Flash memory and the ability to be reprogrammed using In-System Programming technology. To place device in Boot loader mode Under Windows, only one application may have access the COM Port at any one time, preventing other applications from using the COM Port. Flash Magic only obtains access to the selected COM Port when ISP operations are being performed. This means that other applications that need to use the COM Port, such as debugging tools, may be used while Flash Magic is loaded.

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MICROSOFT VISUAL STUDIO: It is a VB .NET which helps in programming and generating the required GUIs for enhancing results.

4. Conclusion

Fig:- Application used in project

The availability interest in working an on this project to have a scope of interest in developing it. The implementation of the project has been completed towards our need and the DRDO team, thus we have selected and gathered all the information to clarify and start with our procuring work for the actual project.

This project serves as a valuable tool for various purposes as different sensors will be used which will be most efficient and cost methodology used. Thus, on a whole this project comes of great use by serving as a building block for large robotic projects especially for the defence. The actual DAQ system can be seen the DRDO developed ROV, in which it gives the exact location, can show the temperature changing values of some intrusion happening as by thermal imaging process.

6. References

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