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On-line IDACS for Embedded Real Time Application

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Abstract: Design of on-line embedded web server is a challenging part of many embedded and real time data acquisition and control system applications. The World Wide Web is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billion of users worldwide and allows the user to interface many real time embedded applications like data acquisition, Industrial automations and safety measures etc,. This paper approached towards the design and development of on-line Interactive Data Acquisition and Control System (IDACS) using ARM based embedded web server. It can be a network, intelligent and digital distributed control system. Single chip IDACS method improves the processing capability of a system and overcomes the problem of poor real time and reliability. This system uses ARM9 Processor portability with Real Time Linux operating system (RTLinux RTOS) it makes the system more real time and handling various processes based on multi-tasking and reliable scheduling mechanisms. Web server application is ported into an ARM processor using embedded 'C' language. Web pages are written by Hyper text markup language (HTML); it is beneficial for real time IDACS, Mission critical applications, ATM networks and more. Mission critical applications, ATM networks and more.

Key words: Embedded ARM9 Processor, Real Time Linux Operating system (RTLinux RTOS), Embedded web server, Interactive data acquisition and control system (IDACS).

I. INTRODUCTION

Online Interactive Data Acquisition and Control system plays the major role in the rapid development of the fast popularization and control in the field of measurement and control systems. It has been designed with the help of many electrical, electronic and high voltage equipment i.e. electrical parameters of current, voltage, power, frequency, analog, circuit breaker status, digital signal protective actions, the amount of electrical pulses degree, non-electrical Parameters of temperature, pressure and other thermal signal, water level , signal pulse, ECG, speed and high voltage signal flow and other hydraulic signals the usual practice is to design special data acquisition systems.

It makes the system more complicated and not reliable. This system Develop a new system that contains inbuilt Data Acquisition and Control system (DACS) with on-line interaction. It makes the system more reliable and avoids more complication. It is the great demand in consumer applications and many industries. This system replaces various complex cables which are used for acquisition and it uses FPGA and ARM processor for data acquisition and digital diagnosis. There are various digital DAC systems are available for the substitution of multisite job operation. A single worker can interact with the machine and collect

Various data from on-going work in a single work station. The simplest design of data acquisition system is detailed in [2], which is based on Linux Operating system [3]; it is the popular choice for many embedded real time applications and PC systems. The design of flexible and networked data acquisition architecture was approached in [4], where the software resources are stored in local memory to avoid the level of resource usage and increases system's efficiency. This system process the client based on dynamic manner by server response and it maintains separate data base with DAC controller. In [5] advanced traffic survey mechanism uses data collection process for post processing of vehicle's position. Signal conditioning is the major part of any data acquisition unit. High level integration architecture was discussed in [6]; it allows signals to be conditioned, simultaneously acquired according to the external clock and triggers processed and transferred data to real time servers. Signal measurement from astrophysical sources is described in [7]; where the shared memory and internet protocols are used for data handling and process from remote users. It was developed with Global Positioning System (GPS) and Environmental monitoring system. Similarly depends on industry and its location General Packet Radio Service (GPRS) also used for data transmission through on-line. But this paper doesn't use GPRS and GPS systems for data uploading into internet. It reduces the system complexity and effective for all kind of real time applications. Every real time embedded system should be run by real time operating systems. Even a small 8-bit microcontroller has the portability with RTOS is developed in [8].

II. BASIC SYSTEM STRUCTURE

Its structure configured in five sections such as supply system, communication system, control system, sensor system, web system. Fig.1 shows the overview of IDAC system. Every client can access the industry directly without any interaction with additional server and modules. IDACS shows Intelligent Data Acquisition and Control System. This system contains single ARM9 processor which is portable with Real Time Linux RTOS.

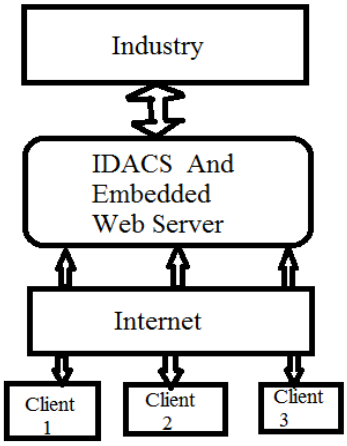


Fig.1: Basic system structure

ARM processor is the heart of this work. It handles two modes at same time, DAC and Web server. During DAC mode Processor can measure signals which are coming from various external sources and applications. And it can control the industry machineries by the control instruction sent by client via embedded web server. During signal measurements Analog to digital converter is very important, because almost every external source is giving analog signal only. While converting these analog to digital processor has to handle asynchronous interrupts. This system uses RT Linux so it can handle many interrupts in an efficient manner because RT Linux has pre-emptive kernel with required privilege levels. Similarly during web server mode processor will handle client request and response to the particular client by sending web pages, client can interact the industry by giving instruction in web page on its own web browser. This setup can be suitable for intercommunication with other nodes via Ethernet and higher end ports. Ethernet programming and execution is very easy and adaptable with various applications. Embedded web pages are designed by HTML language.

III. SYSTEM DESIGNE

Hardware design, Software design and Porting are the entire important steps in whole system design.

A. Hardware design:
Fig.2 Show IDACS design Hardware consist of such as ARM 9 i.e. LPC 2929, Sensors like LDR, Temperature, Humidity, Gas, Fire etc. It is having Ethernet interface with PC web server.

B. Software design:
The software design ARM controller used with C language coding used to run the system.

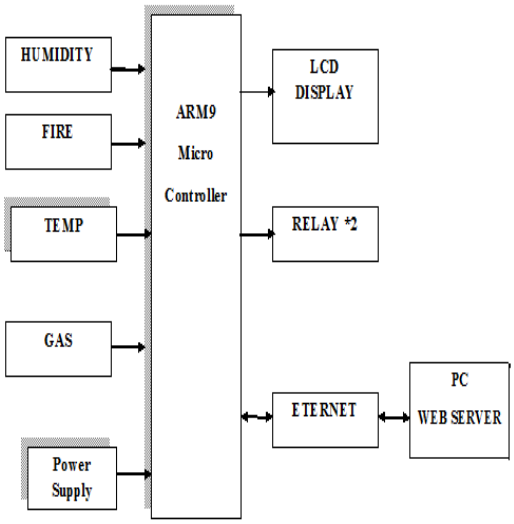
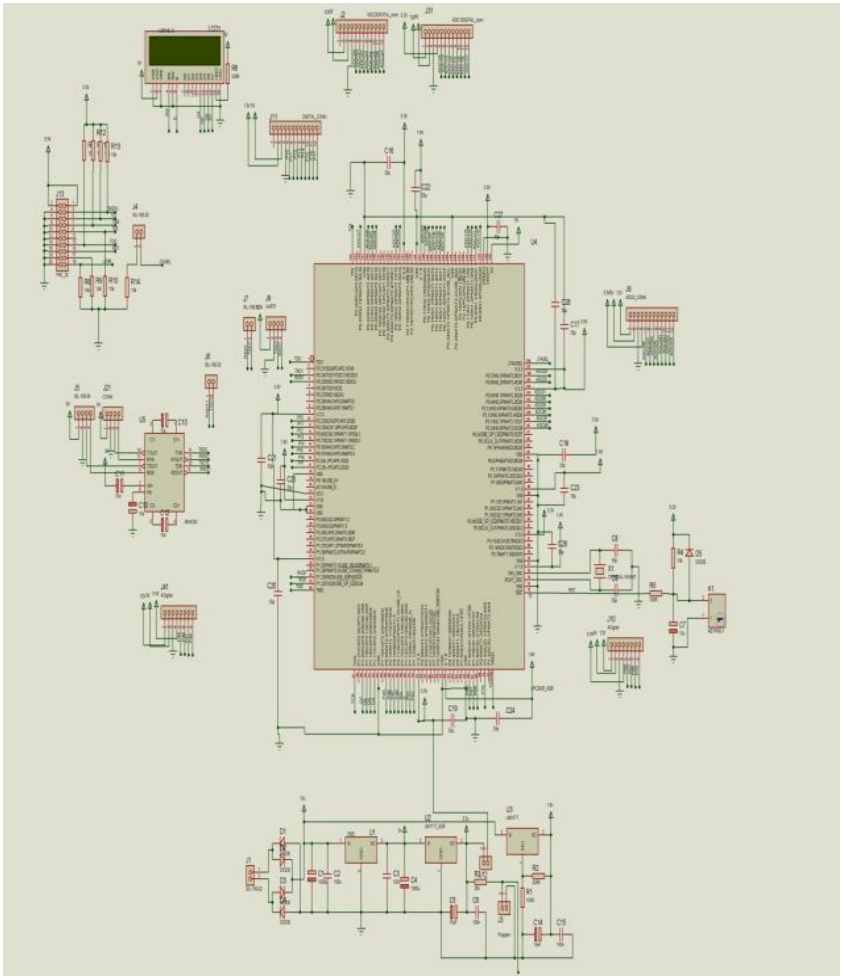


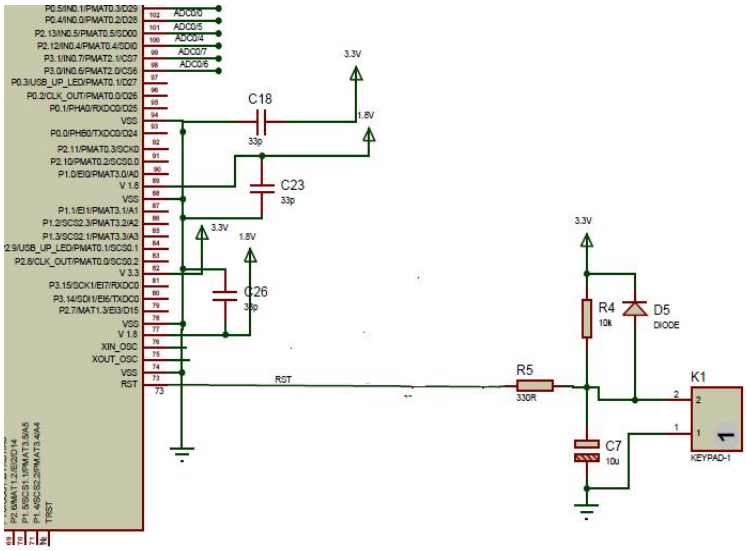
Fig. 2: IDACS Design

IV.RESCUE IDACS ARCHITECTURE:

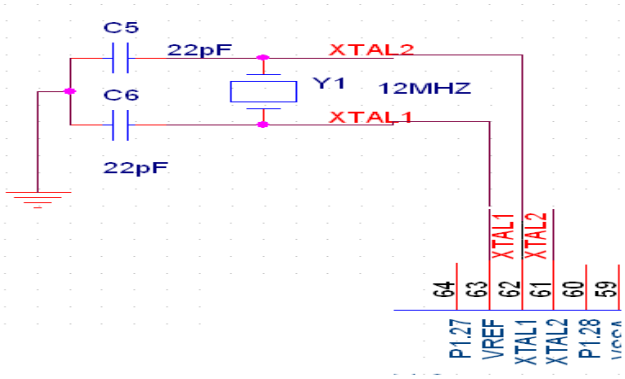
Here we developed working model of IDAS for acquisitions and control system. In which uses a desktop computer to monitor and control the parameter of the DAS using Ethernet module and to detect the parameters like Gas using Gas sensor, Temperature with temperature sensor, Fire with fire sensor, Humidity etc.



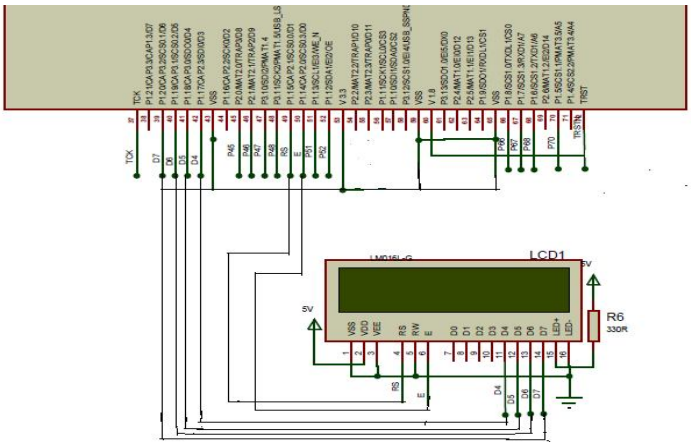
Picture 01: IDAS Fabrication on Chip



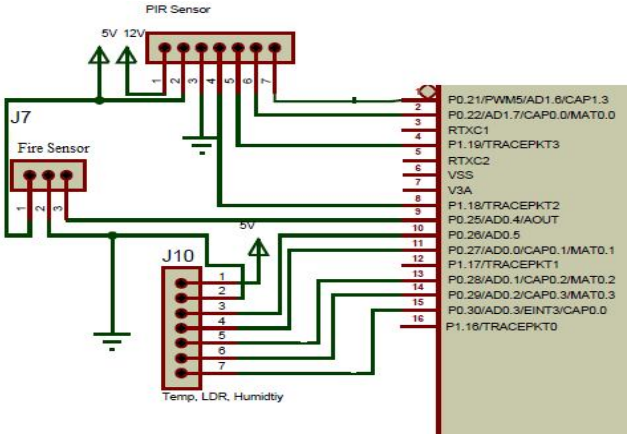
Picture 02: Reset Circuitry



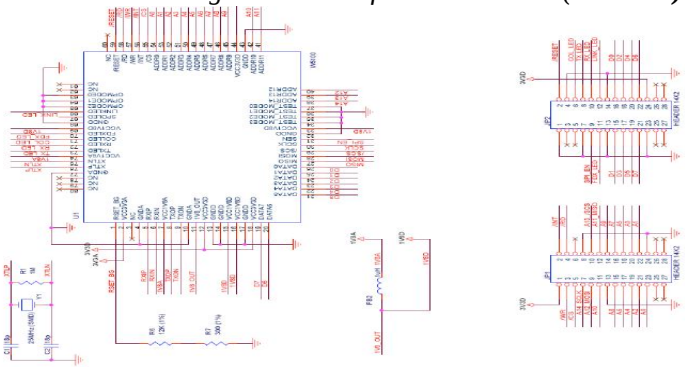
Picture 03: Crystal Circuit



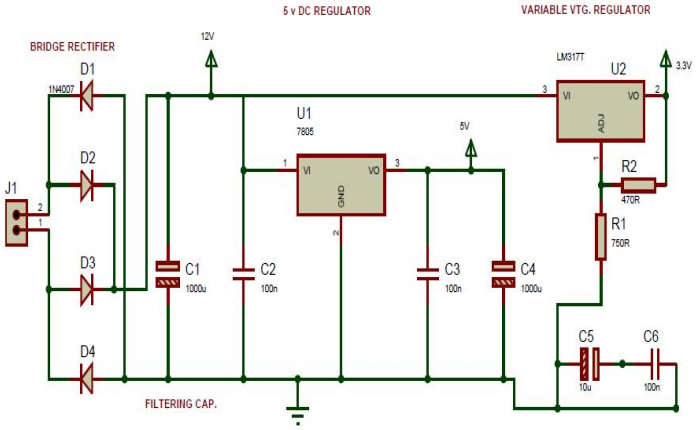
Picture 04: LCD interfacing



Picture 05: Analog Sensors Interfaced with ARM7 (LPC2138)



Picture 06: Ethernet module interface with ARM 9



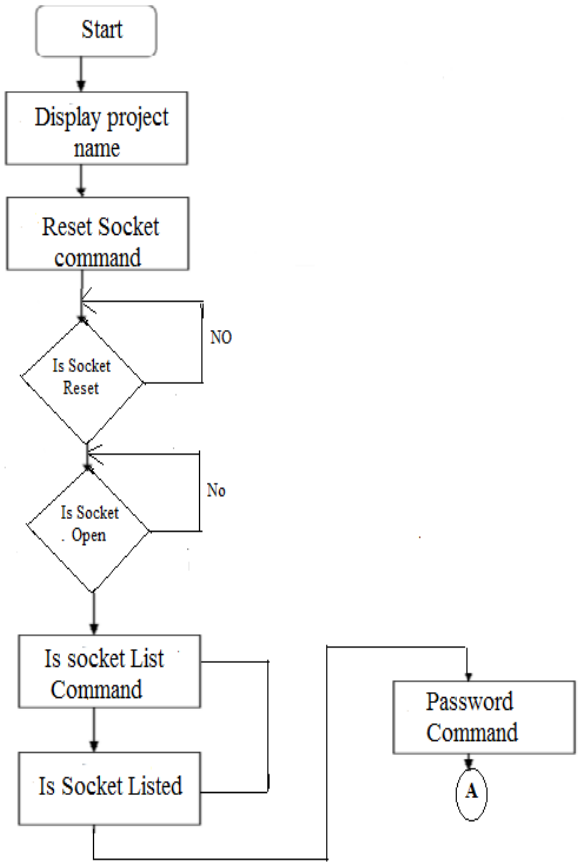
Picture 07: Power Supply Circuit

V. SOFTWARE DETAILS:

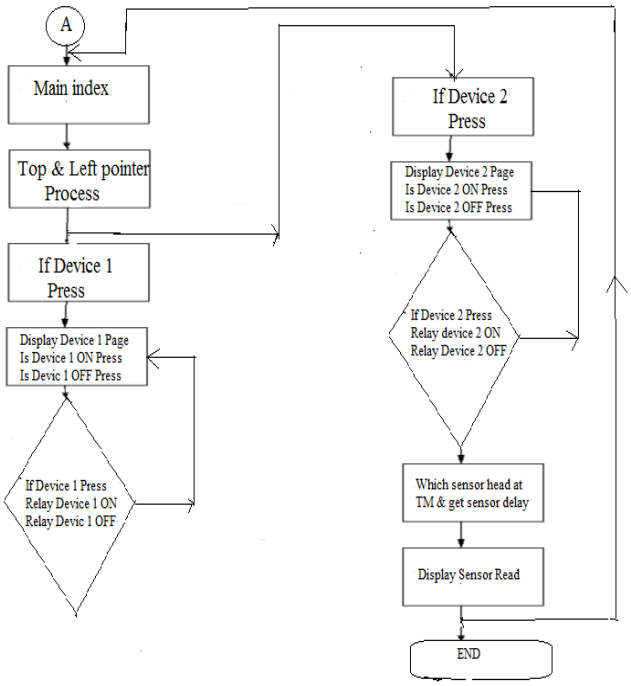
For the IDAS, Embedded 'C' language is used for Arm 9 programming. **Flash Magic** is a tool which supports ISP (In System Programming) feature. It is used to burn a hex code in EEPROM of microcontroller.

Keil µ Vision IDE: The µ Vision IDE from Keil combines project management, source code editing, program debugging, and complete simulation in one powerful environment.

Ethernet Module: Ethernet module used in our project is "WIZ810MJ". WIZ810MJ is the network module that includes W5100 (TCP/IP hardwired chip, include PHY), MAG-JACK (RJ45 with X'FMR) with other glue logics.



Flow chart 1: Main Flowchart for IDAS



Flow chart 2: Sub Flowchart for IDAS.

VI. PERFORMANCE ANALYSIS

Their analysis of the different parts of the system is as follows-
1] Analysis of Temperature Sensor (LM 35).
2] Analysis of Gas Sensor (MQ 6)
3] Analysis of Humidity Sensor.

1] Temperature sensor LM35-

Temperature sensor LM 35 kept in different temperatures situations like in Air conditioner (A.C.) at 25ºC and at normal room temperature 33 ºC. Then observed output of LM 35 on LCD and PC as below.

S. NO	DIFFERENT CONDITION	TEMP MEASURED ^{0}C	TEMP BY LM35 ^{0}C
1	AIR CONDITIONER (25ºC)	22	24
2	NORMAL ROOM AT 32 ºC	31	31.7
3	NEAR OPEN FREEZE	6	6.7
4	NEAR ELECTRICAL ROOM HEATER	40	41.2

Table 1: Analysis of Collected Data for LM 35

2] Gas Sensor MQ 6:

Condition I-If LPG Gas releases intentionally for 30 sec, then Gas sensor indicate the following reading after particular time.

S. NO	TIME IN MIN	GAS % CONCENTRATION	REMARK
1	30SEC	99.9%	GAS DETECTED
2	1MIN	86.4%	GAS DETECTED
3	2MIN	74.2%	GAS DETECTED
4	3MIN	63.1%	GAS DETECTED
5	4MIN	50.9%	GAS NOT DETECTED

Table 2: Analysis of Gas Sensor for condition I

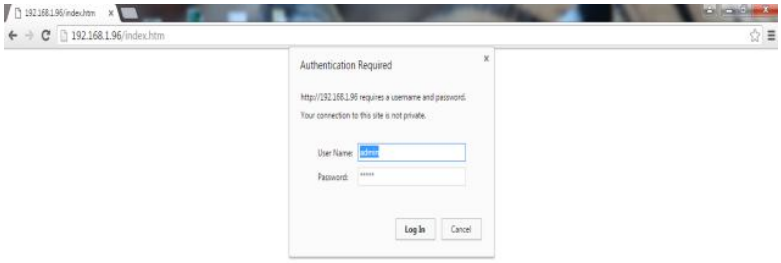
Condition II-If LPG gas leaks continuously on one place, then gas sensor indicate the following reading considering the distance in one minute.

S. No	Distance	Gas % Concentration	Remark
1	2mtr	99.9%	Gas Detected
2	4mtr	84.1%	Gas Detected
3	6mtr	73.9%	Gas Detected
4	8mtr	62.7%	Gas Detected
5	10mtr	51.4%	Not Detected

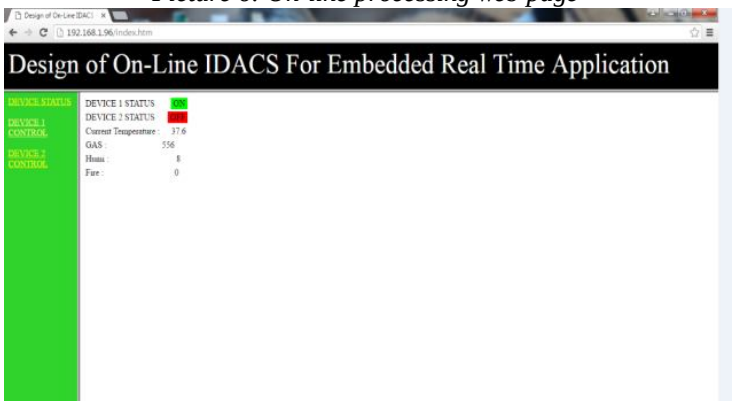
Table 3: Analysis of Gas Sensor for condition II

3] Humidity sensor:
Humidity sensor is used to measure humidity in %RH. The humidity sensor indicates the following reading at different atmospheric conditions

On-line processing web page shows the working on PC



Picture 6: On-line processing web page



Picture 7: Client requested web page (issued by ARM web server)

Above showed web page are requested by the client and served by the embedded web server which is ported on ARM9 processor. Dummy Client can interact with the machine through its own browser via these embedded web pages. Every client control has been executed in industry via the embedded web server.

OBJECTIVES FOR FUTURE WORK

In the future work, we will extend the on-line DAS system using technology of Ethernet and Advance ARM processors to implement the systems in places such as small industry etc.

In future, it is also possible to provide the security to on-line DAS ARM processor using RT Linux Operating system. Web pages are written by Hypertext mark-up language (HTML); it is beneficial for real time IDACS, Mission critical applications, ATM networks and more.

VIII. CONCLUSION

Hence with the rapid development of the field of industrial process control and the wide range of applications of network, intelligence, digital distributed control System, it is necessary to make a higher demand of the data accuracy and reliability of the control system. This embedded ARM system can adapt to the strict requirements of the data acquisition and control system such as the function, reliability, cost, size, power consumption, and remote access and so on. This paper operated by DACS mode to acquire the signals and control the devices remotely. Embedded web server mode is used to share the data with clients in online. Both modes are efficiently carried out by real time multi-tasking. This paper system can be widely applied to electric power, petroleum, chemical, metallurgy, steel, transportation, Electronic & Electrical industries, Automobiles and so on.

The paper is based on the embedded technology of ARM processor in the development and research of data collection. The main goal of designing hardware is to meet the demand of low cost, low power consumption, small volume and real-time.

The on-line DAS control part is designed using the micro controller which communicates with PC using on-line DAS Ethernet is used to interface the software and the hardware. Finally the performance of the on-line DAS is compared with that of the traditional DAS on-line DAS systems used in the most of company; the analysis shows the better features available in on-line DAS.

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