

Advanced Embedded Laboratory Security System

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Abstract — This paper explains the design and Implementation of an Embedded Laboratory Security System(ELSS).The system uses and ARM7 Controller for the development of the most advanced Laboratory Security System, which acquires video information through camera, and Wireless Sensor Network (WSN) which gets environmental parameters through sensors and sends them to the web server. Users can access the Monitoring Server (MS) through PCs or Wireless Mobile Terminals(WMT) which are developed using Qt, to watch video Live/ Recorded and check environmental parameters in real-time. When an exception occurs, the MS sends Short Message Service (SMS) through GSM Modem, gives sound and light alarm, etc. SQLite database stores historical information related to environmental parameters for users' query. This system is a new technique of monitoring the security system which can be used widely for labs and in areas where stored valuables play a vital role.

Keywords — ARM7 (LPC 2148); GSM; RFID; Security Monitoring System; Video Transmission; Video Recording; Wireless Sensor Network.

I. INTRODUCTION

Presently we already have monitoring techniques such as Intelligent Monitoring System (IMS), Video Monitoring System (VMS), Sensor Monitoring Systems^[3-4], etc, IMS cannot be widely implemented due to the technology difficulties. VMS is useful for Live Video Transmission and for viewing the recorded videos. However, using the VMS costs too high. Sensor Monitoring systems require specific software's to be installed for its functioning. These where previously implemented using microcontroller. This paper explains the design of an Embedded Laboratory security System (ELSS) which is designed for the very high secure areas which involves all the latest security features. . In this paper we designed Embedded Laboratory Security Monitoring system combined with advantages of SMS and VMS, functions as real time video transmission but instead of video we are capturing and transmitting only images. This system continuously monitors the environmental parameters and any of them reached abnormal condition then an alarm blows. Here ARM7 (LPC 2148) Controller is used for the entire control of the System. This system uses the VMS and SMS Functions, RFID tags, Sensor to monitor the environmental conditions in the lab 24/7, light indicators and alarming in the real time when there is any problem. Using GSM an SMS will also be sent to the central control system for immediate action.

II. SYSTEM DESIGN

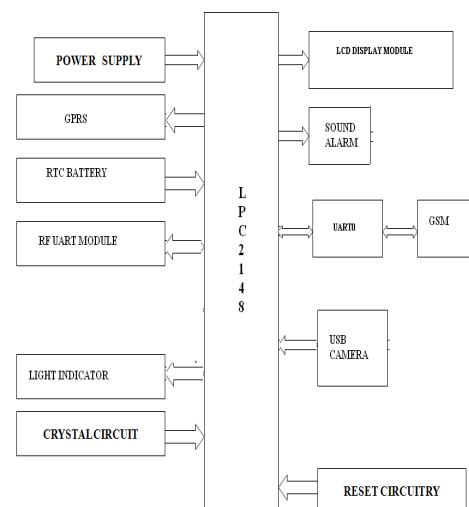
Monitoring Server is the key component of this design. It receives the data of the number of persons present in the lab at any particular point of Time. If there is any unauthorized access trial it will be intimated to the Monitoring Server through GSM Technology. The entire process is implemented using and ARM 7 Controller with all the new feature.

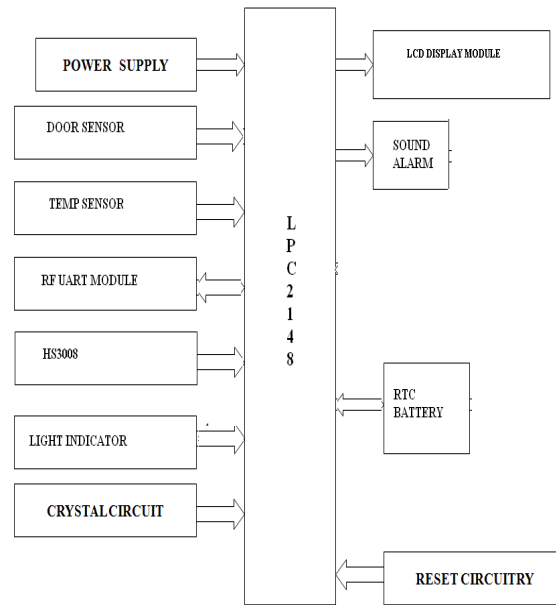
RFID tags are used as the door sensors which are placed here to restrict the unauthorized access in to the lab, It will send the updated information of all the entries and exits to the monitoring server continuously at all times.

A RFID system consists of three parts: radio frequency (RF) tags, RF tag readers and the back-end database that associates records with tag data collected by readers. Readers interrogate tags for their contents through RF antenna and interface to back-end databases for more functionalities.

Monitoring Server also receives the data from the Some Sensors if there is any presence of it in the lab environment. Correspondingly an alarm and an light indication will be displayed at the control station.

III. HARDWARE DESIGN





A. Monitoring server

The Monitoring System collects information through the USB camera and by using the GSM and feeds back the collected information to display or to any authorized person in the form of GSM SMS.

B. Monitoring Server

We use Philips LPC2148 controller as the Monitoring System. The NXP LPC214x is a 32-bit RISC microprocessor with an ARM7TDMI-S core. Depending on the specific model chosen, it contains up to 512kB internal Flash and up to 32kB SRAM. It is capable of running at speeds of up to 60 MHz.

It includes a Full Speed USB 2.0 controller, up to two 7-channel 10-bit ADCs (one in the LPC2141/2), one **10-bit** DAC, a vectored interrupt controller, two UARTs (including one with full modem interface), two I2C serial interfaces, two **SPI** serial interfaces, PWM, real time clock with optional battery backup, brown out detection circuit, on-chip crystal oscillator and PLL, two 32-bit timers, and 45 high-speed GPIOs with 15 MHz switching.

IV. SOFTWARE DESIGN

Software design of MS mainly includes, acquiring and transmitting video data, accessing and analyzing the wireless nodes' environmental parameters, etc. Software design of Wireless Sensor Nodes mainly solves problems of collecting and sending the sensor information.

A. Video Data Acquisition and Transmission

Video data are accessed through the USB interface; program should be load in kernel to support Video4Linux.

Video data's acquisition and transmission can be realized by some API functions in Video4Linux, or by transplanting mature server software servfox client software spcaview directly. As a server program, servfox transmits video data on the basis of Boa Web server.

Through modifying CC = gcc to CC = arm-linux-gcc in file Makefile, and compiling it using cross compile tool chain which version is 3.4.1, an ARM architecture binary executable file servfox will be generated.

On the other hand, we get binary executable file spcaview by compiling it directly. The next step is to copy the folder httpjava- appletwe in directory spcaview to the target board server root path (/var/www), and change its permission to be executable. Then by running the next commands in the target board terminal can we start the video monitoring server.

```
[/mnt/yaffs]./boa &
[/mnt/yaffs]ln-s /dev/v4l/video0 /dev/video0
[/mnt/yaffs]servfox-d /dev/video0-s 320x240 -w 7070
```

B. Collection and analysis of environmental parameters

Collection and analysis of environmental parameters contain device initialization, access and analysis of environmental parameters of wireless nodes, reading Monitoring Server's surrounding environment parameters, determining alarm, controlling GSM modem to send SMS, reading system time and inserting relevant data into a database, etc. In this paper, we take multi-thread mechanism to achieve the above functions.

In the star WSN, coordinator controls multi-nodes communication. Each wireless node is set into receiving statues in general. When the coordinator's request frame is accepted, the sensor node replies to the coordinator immediately by sending the environmental parameters. In order to reduce power consumption, we set every sensor node to be interrupt mode. Schematic diagram of sensor monitoring and historical information query

V. CONCLUSION

We designed an Embedded Laboratory Security System, and implemented its functions. In this system, camera

collects video information through USB interface, star WSN acquires and transmits environmental parameters, and a database is created in the MS to save historical environmental parameters. The system has advantages such as real-time video data transmission, extensive monitoring of environmental parameters and convenience of operation and management. The system can be widely used in universities, intelligent buildings and other places that need High secure monitoring. The most advantageous part of this project is that the continuous monitoring can be done by mobile phone itself as there will be an SMS sent for every change in the parameters specified.

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