ENTRANCE MONITORING SYSTEM

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Abstract: This paper presents design of an embedded device for entrance monitoring system. It is controlled by a microprocessor module including a web server, hence the device can be used as a simple information center. For interaction with users a wireless card reader, keyboard and LCD are present. Control program uses Dynamic C environment and multitasking. A functional model was obtained when the system was implemented in a compact box with a battery backup.

Keywords: embedded system, entrance monitoring system, microprocessor module Rabbit, card reader

1 INTRODUCTION

Maintaining evidence of entrances and exits is common in every institution to supervise a presence of employees and for security reasons - number of workers stated by the monitoring system is very helpful in case of an evacuation. Within big institutions an expensive database system with distributed terminals is often used. Even though this system is the best solution for big companies, for small firms much more simple and cheaper device is sufficient.

This simpler solution can be easily developed for departments with one main entrance on an embedded system platform. This system must be focused on collecting simple data, opening door and provide data to managers and for security purposes. Use of wireless cards simplifies monitoring and entrance for employees while possibility of entrance on password satisfies cases of forgotten card.

2 HARDWARE DESIGN

The system must meet parameters that will grant him as an universal entrance monitoring system for a small working compartment. The fundamentals are:

- real time clock to save time of logs and calculate time in work
- possibility to communicate with the wireless card reader
- non-volatile type of memory for data storage
- simple access to data and easy system management, preferably solved by the direct Ethernet connection
- enough power and memory for the system and especially for the web server if Ethernet is present
- switching of external mechanisms like door opening
- possibility of configuration without a remote connection or password input

2.1 CONTROL MODULE

The RCM3200 RabbitCore microprocessor module [2] was chosen for the core of the device, see Figure 1. It measures only 69 x 47 mm, operates at 3.3 V and uses Rabbit 3000 microprocessor with frequency up to 44.2 MHz. It have RAM and contain also a flash memory. Rabbit have serial ports and fully integrated 10/100 Base-T Ethernet. In addition it contains enough 5 V-tolerant I/O what makes it the ideal control module for our application. Detailed comparison with other control solutions can be found in [1].

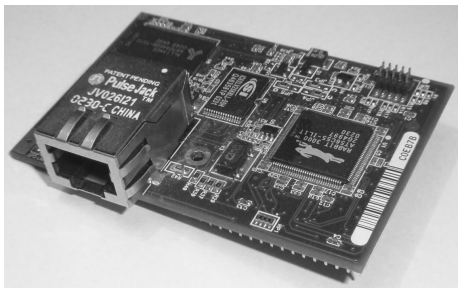

Figure 1: RCM3200 RabbitCore microprocessor module

2.2 CARD READER

Used card reader is the AXA020MF series from Elatech company [3], see Figure 2. It have a compact package with dimensions 37.5 x 40.0 mm. Working frequency is 13.56 MHz and the maximum read/write distance is 30 mm without external antenna. This reading distance is sufficient for our purpose. Operating voltage is 5 V and a serial interface is used for a communication with control device. This card reader is aimed for embedded applications and therefore includes sleep mode feature for low power consumption.

Figure 2: RCM3200 RabbitCore microprocessor module

2.3 PERIPHERALS

To comply all fundamental parameters mentioned earlier, other peripherals were implemented. LEDs indicate running of device and basic functions. LCD and 4x4 matrix keypad is used for a communication with user and direct management of the device. The LCD is 16 character wide, two lines heigh, which is enough for interaction with user [4]. Two 250 V relays can provide opening of doors or switching on and off of other devices.

2.4 POWER SUPPLY

The problem of more voltage levels is present. The Mifare card reader and generally all common peripherals need 5 V while the Rabbit operates at 3.3 V. The nature of the system demands at least partial independence from an external power, therefore two 6 V plumb batteries were added to the device. The power source is supposed to be 15 V which grants good efficiency of the voltage regulator stabilizing 12 V for batteries. Peripherals and rabbit module have high maximum currents and a simple voltage regulator to 5 and 3.3 V would have low efficiency. Consequently a DC-DC converter ensuring more than 84% efficiency, see [5], was used for this application. Resulted power scheme is on Figure 3.

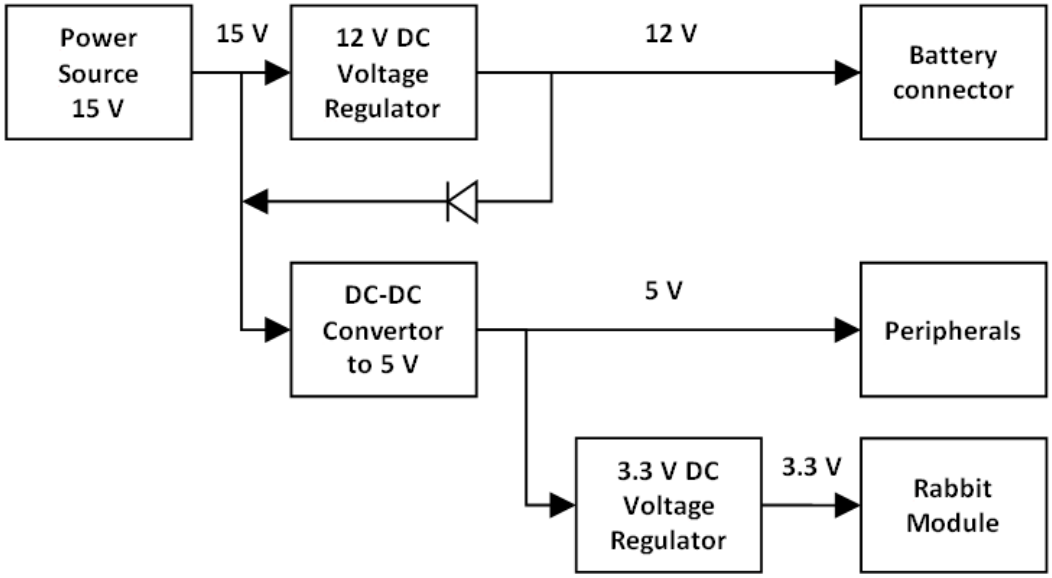

Figure 3: Power scheme of entrance monitoring system

2.5 PRINTED CIRCUIT BOARD

With completed hardware and power supply design a printed circuit board was created. It is based on requirements of the system and acts as the communication and power center of device. Consequently it contains electrical parts needed by power supply, electrical relays and contain connectors for rabbit control module, card reader, batteries, keypad and LCD.

3 SOFTWARE IMPLEMENTATION

3.1 DYNAMIC C

Software for RabbitCore module was developed in dynamic C. It is a development system designed for embedded software and especially for Rabbit controllers. It joins editing, compiling, linking, loading and debugging into one powerful program. The programming language is based on ANSI C and have a number of features added. These C language extensions are focused on embedded applications. Details may be found in [6].

3.2 RABBITCORE MODULE SOFTWARE

Modular libraries were created in dynamic C. These libraries serves for sending data to LCD, enabling use of flash filesystem for data, keyboard checking, communication with card reader and communi-

cation over TCP-IP. TCP-IP library use DHCP to obtain IP-address and then turns on a web server for remote administration and access to data. Not all libraries were needed to be coded, some existing libraries provided by Rabbit company were used, especially these for operating web server, file system implementation and dynamically allocated memory. Running device is controlled by Dynamic C cofunctions which implements cooperative multitasking model.

Figure 4: Final device

4 RESULTS

4.1 COMPACT DEVICE

As a result a prototype of the embedded entrance monitoring system with battery backup was obtained, see Figure 4. The device is fully functional, communicates over Ethernet or by keypad and LCD. Keypad can fully operate the system and for the letter insertion a commonly known cellphone approach is used. A brief help is implemented too. It is possible to log in to system with a wireless card or with a knowledge of ID and password. After a log in a user can check own data. Administrator have a possibility to see and manage all users.

4.2 WEB INTERFACE

The device well connected to Ethernet can be accessed by its IP address through any web browser, as a result anybody can check number of employees and who exactly is present, see figure 5. This can be very helpful for searching if some co-worker is yet present. Additionally in case of evacuation from first view anybody know how many people are in danger. Administrator can log in and get all details of employees from ID, name to sum of time in work. He can also manage users and their data in the system by this remote connection.

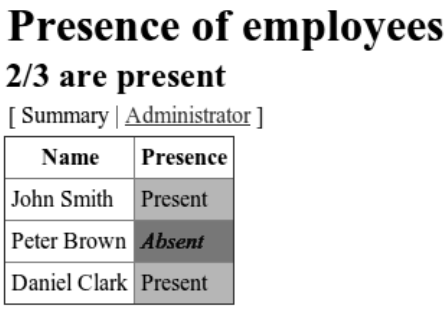

Figure 5: Brief info of presence visible by everyone on web interface of device

5 CONCLUSION

The idea of simple embedded entrance monitoring system was presented. During next work the suitable control hardware (Rabbit microprocessor module) was chosen. Other contained parts (card reader, LCD, keypad etc.) of the device were described and a power supply design was detailed. The result is the fully functional compact device with battery backup.

Software of the device was implemented in dynamic C featuring cooperative multitasking. Information about employees is provided by the web server and administrators can use it for the remote administration.

The system can be further improved in hardware part by power consumption and size optimization. In software part a communication between more embedded entrance monitoring systems can be implemented as well as transfer from cooperative to preemptive multitasking. More functionalities can be implemented in web interface as for example sorting of records.

6 ACKNOWLEDGEMENT

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