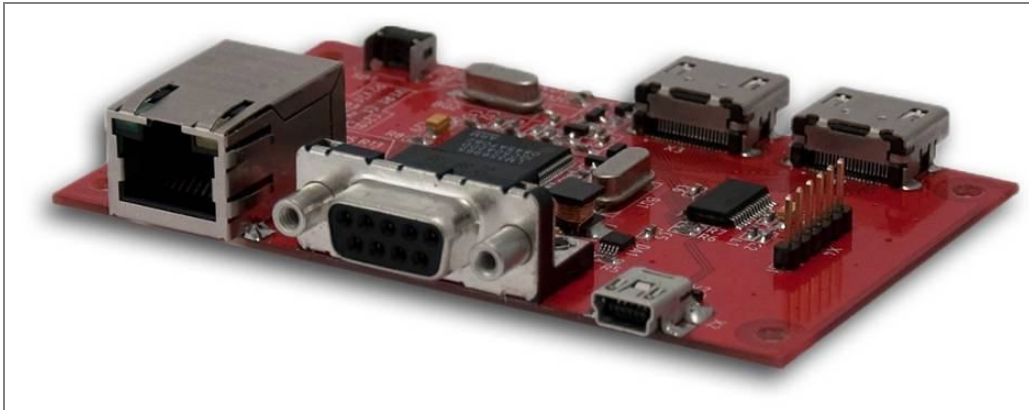# Multimedia controller for smart home

Customer

Incyma - Swiss company specializing in control devices and smart home automation.

Objective

Develop a device capable of controlling home multimedia system (home theatre, tuner, video recorder, etc) with HDMI-interface via Ethernet by using a PC and/or other devices connected to Ethernet. The device must be quickly and easily configured and integrated into the smart home control system.

CEC (Consumer Electronics Control) bus in HDMI cable allows transmitting commands and control signals from one remote control to different devices of home theatre and supports their independent interaction. There are the following commands: switch on/off, play, sleep mode, recording and others. Most manufacturers accepted this bus as a standard, which allows any compatible remote control to control equipment of any manufacturer.

Solution

1. Processor board

CEC protocol analysis showed that a controlling processor does not require to have neither high performance nor rich periphery. The only key requirement is availability

of Ethernet (MAC+PHY). The optimal solution was to use LM3S6965 microcontroller with Cortex-M3 core.

Device prototype was developed on the basis of Stellaris® LM3S6965 Evaluation Board. Device prototypes have only four chips:

- LM3S6965 microcontoller;
- USB UART – FT232RL;
- RS232 – ADM3202;
- DC-DC converter – TPS62007.
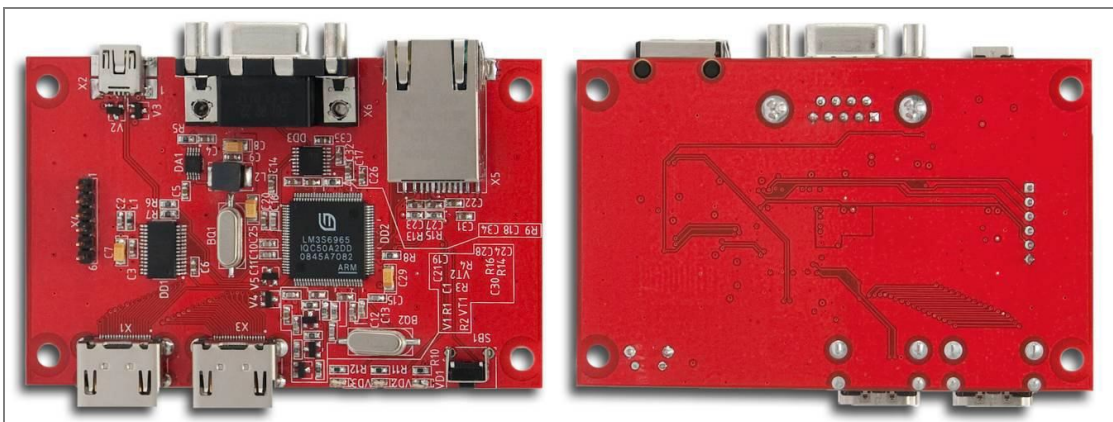
The board has the following peripheral connectors:

- 2xHDMI with through connection between them;
- miniUSB – used for board power and as controlling UART-port;
- DB9 - RS232, as standard for control systems;
- Ethernet-10/100, for device integration into local network.

The board layout was made on four layers with one-sided arrangement of components..

2. Software

Controller's software is based on multitasking library, which allows simplification of program architecture and usage of independent program modules.

One of the main tasks of the developed embedded software is accepting and decoding commands coming from CEC bus. Another main task is TCP/IP stack support. As a ready solution in this case we chose uIP stack as it requires minimum resources. This stack already supports many network protocols and for this objective their number was significantly expanded:

- HTTP: the device provides the user with a web-page with the list of detected devices and control and configuration interface. The user can safely update device firmware via web-forms
- Telnet: the main protocol, by using which a "smarter" device or user can "see" all commands between home theatre components, and also give commands for execution
- SNTP: for automatic time setting via the Internet
- IPv4LL, DHCP, NetBIOS, mDNS: a group of protocols for addressing and identifying device in network. We should especially mention mDNS (Apple Bonjour) protocol, as it allows identifying a device without knowing either its name or address

As a separate task of the device our specialists implemented Lua language interpreter. Such solution allows installers to write a script that will perform command sequences, which can adapted for every specific case. So, for example, a device can switch on a DVD-player to play music at the specified time in the mornings, gradually increase volume, and at the specified time switch TV to a certain channel, etc.

3. Case and construction

To decrease the price of the device we used mass-produced BOPLA EG1230 case.

During design process we created 3D models of the PCB and case in MDT and we made case improvements on their basis.

Benefits and characteristics

- The usage of the controller with integrated controller and Ethernet physical layer allowed decreasing development costs and size of the device
- Application of script language expands capabilities of device configuration
- Automatic firmware update via the Internet allows the user to change scenarios of device behaviour by simple downloading of new script

Design tools	EXP2005, MDT2006
Technologies	Ethernet, uIP, mDNS, CEC, Telnet, Lua
Programming languages	C
Project management tools	dotProject, SVN