A MODULAR AND UNIFIED APPROACH TO ENVIRONMENTAL CONTROL FUNCTIONALITY FOR DISABLED AND ELDERLY PERSONS COVERING CONSUMER ELECTRONICS AND SMART HOME BUSSES

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Abstract: **Environmental Control Systems (ECS) are of vital importance for severely motor impaired persons and for older persons in order to empower them to live a self-determined and independent life. Currently, environmental control functionality is often focusing on consumer electronic devices (TV, VCR, CD etc.) which provide a standard infrared interface for handheld remote control. The emerging smart home technology brought additional possibilities but also an enormous increase of complexity concerning set-up and maintenance.**
This paper describes an approach for a unified interface layer which allows configuring the ECS in an intuitive way regardless of the complexity of the controlled system.
Keywords: **remote control, environmental control, infrared, EIB, smart home**

Introduction

Today's consumer electronics devices by default are equipped with remote controls operating via infrared (IR) light signals (modulated IR carrier or pulses, typically in the range 30 – 56 kHz).

The average consumer such owns several incompatible remote controls with different layouts and operation philosophies, moreover tiny buttons make them difficult to use for the average user and especially, for disabled and older persons. Therefore a device that combines the different remote controls under one user friendly and accessible interface is required.

Smart Home technologies like the European Installation Bus [4] or X10 in the US [2] offer additional ways to remote control household appliances, from kitchen equipment or lamps to door control, but require the user or carer to deal with a much more complex technology when only simple configuration changes are required.

The goal of the work presented herein is to develop a combination of the above mentioned technologies such that users themselves (end users or carers/helpers) are able to make use of the combined power and gradually adapt the ECS to the individual needs.

Materials and Methods

In order to facilitate a unified approach to remote control the environment, the different technologies used must be merged seamlessly into one module by a modular driver structure providing command routing. By choosing serial port interfaces the application to standard PC as well as to almost any embedded control equipment can be facilitated.

For the IR part a commercial teach-in infrared sampler device for the serial port can be used. For the EIB part a BCU (Bus Coupling Unit) connects the EIB bus to another serial port.

An intuitive user interface must offer a non-technical way of programming, the teach-in of commands.

The IR sampler offers a "teach-in mode" in which this device is able to learn almost any infrared code. The codes then are transferred via the RS-232 serial link to the host system to be stored there. In the "transmit mode" the codes are sent via the serial link to the IR sampler which itself synthesizes the infrared waveforms and sends it out via high performance IR transmitters.

Figure 1: Infrared receive/transmit box for serial port (Producer: Meschik and Partner KEG [5])

For the smart home bus system the EIB (*European Installation Bus* now *Konnex*) was selected. The setup of the installation requires a pre-programming of the EIB devices to define their inter-operation, this usually is done by the installing company using a special software available from EIBA [4]. After this, the EIB devices communicate via messages on the EIB bus without any host system required and, in e.g. the case of lighting application, for the user they behave like any unintelligent light switch. By sending messages from an attached host system to the EIB devices however it is possible to remote control them or to inquire their status.

Figure 2: EIB installation used for testing

The usual software solution for the EIB is based on the Falcon driver (provided under license by EIBA Brussels) which is written for a RS-232 interface on a standard PC. This software implements the EIB communication stack by using COM objects. To be able to utilise EIB also from non-PC or non-Windows platforms an own software module was written in the C++ programming language that is able to communicate directly with the EIB hardware via the non-standard serial EIB protocol. For simplicity, only the so called Group Data Layer of the EIB protocol was implemented. Group addresses are independent from EIB hardware settings and therefore allow most flexibility concerning installation and maintenance.

On top of (a) the IR software module and of (b) the EIB software module a unified software layer has been implemented providing an easy to use “teach-in” command and a “transmit” command for controlling the environment in a very intuitive way regardless if infrared technology or EIB technology is being used. This structure can be easily extended to support also other technologies.

The requirements to the operating system and software of the host (micro-)computer deliberately are kept at a very low level:

- Serial port driver software for full hardware handshake
- Timer capable of resolutions <=1ms
- Software driver for specific technology

Results

The software prototypes first were tested stand alone on a PC system. The code was then implemented in prototypes of a personalized Alarm System for elderly persons (SILC [1]) to enable persons to control their home environment via a small wrist-worn device. The software further is being implemented into an already existing environmental control and communication system for profoundly motor- and multiple impaired persons (called AUTONOMY [3]) as an improvement to the already existing IR control facility.

In both applications the usage is based on the ability to add new commands by simple teach-in and by giving every command a free user-friendly name. The user (end user or carer/helper) tells the system that a new command should be added or an existing command should be changed. The system then instructs the user to perform the intended operation via standard remote control (in case of an IR code) or via an EIB device and records the generated command sequence. The acquired command can be immediately tested by sending out the new code. Once the correctness of the code is verified, it can be stored using an easy-to-understand name. This name can further on be used when the command is linked to any of the configurable system actions to be performed (refer e.g. to description of AUTONOMY [3] or SILC [1]). Tests with USB-to-Serial adapters (using virtual serial ports) under Windows were conducted to see if the solution also works on systems that nowadays more and more tend to only provide USB ports instead of RS232 type ones. It was found out that high quality adapters usually can be used.

Conclusions

The combination of IR remote control and EIB technology together with a teach-in strategy offers new advantages in user friendly environmental control applications as could be demonstrated for the AUTONOMY and SILC applications. The unified concept thus could be successfully verified. It is planned to implement and test other control interfaces e.g. relays or RF links and extend the functionality to input (detection of events in the environment) also.

REFERENCES

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