Education System for TV Monitors Adjustment with I2C Serial Bus Interface

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Abstract – **Television receivers and monitors have the possibilities to adjustment using built-in microcontrollers and I2C serial bus interface connected to each of the integrated circuits in the receiver or monitor. All parameters for this adjustment are stored in a suitable nonvolatile memory. It is very interesting for the students education to have the possibilities to control this process of adjustment, made this manually and do the appropriates measurements. The goal of this article is to developed an education system, which is capable to do these adjustments and measurements in the time of practical students works. Also it is possible to use these systems as a tool for monitor or receiver repairmen or testament. It is possible to combine these adjustments and measurements with some visual observations of displayed testing signals and data on the monitor screen of the computer. All that can be made with the proposed tool, which is connected to a computer with a serial interface.**

Keywords – **TV Monitors Adjustment, I2C Interface, TV Education Systems**

I. Introduction

The modern TV monitors and TV receivers are made with possibilities to automatically adjustment of there parameters, for example bright, contrast, colors, geometry, size, position, horizontal and vertical frequencies in dependence from the input horizontal and vertical synchronization pulses etc. [1] This is done with implementation of programmable integrated circuits, using a build in the monitor or receiver microcomputer and a memory for keep these values.

It is very interesting and important for education purposes to have the possibilities to control this process of adjustment, made this manually and do the appropriates measurements of the defined horizontal and vertical frequencies, when the monitor or receiver can be repaired or tested. Of course, it is possible to combine these measurements with some visual observations of displayed testing signals and data on the monitor screen of the computer. All that can be made and proposed as a tool, which is connected to a computer with a serial interface.

In the Fig.1 is shown the proposed block schema of the education system for adjustment and measurement of television received and monitors.

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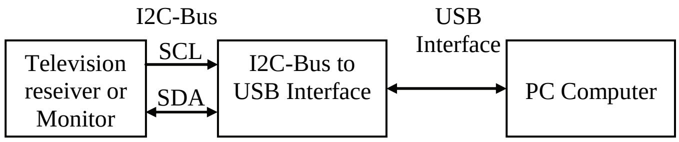

Fig.1. Block schema of the education system for adjustment and measurement of television received and monitors.

The television receiver or monitors, which are under the adjustment, measurement or testing for an education purpose have build-in I2C-Bus [2]. This bus is connected internally to almost all integrated circuits in the receiver or monitor. By means of this bus the build-in microcontroller, transmit data for control and adjustment of the receiver or monitor characteristics or modes of operation.

It is possible to accomplish a connection to this internal for television receiver or monitor I2C-bus, because most of them have a build-in connector for this bus. This connection to one external I2C-Bus to USB Interface is shown in the Fig.1. Of course, there is other possibly to interface I2C-Bus not only with USB to one PC computer, for example Serial Interface RS232, Parallel Port etc., but the USB Interface is more effective and suitable for interfacing with PC computers for software developments and education purposes.

In the monitors there is a standard testing socket utilized to connect an external interface. This socket is shown in Fig.2.

Except of I2C-Bus signals SCL_OUT and SDA_IN/OUT in this socket are included also horizontal HSYNC_IN and vertical VSYNC_IN input signals SELECT_IN. This unification of the pins and signals is very convenient for testing different types of monitors with the same type of an external interface to PC computer.

There are many possibilities to choose the hardware of the I2-C Bus to USB Interface: a specific only for this application designed interface or to use universal I2C-Bus to USB interface, with corresponding software for PC computer. From a point of view of education application it is more suitable to choose and utilize universal interface. Moreover, it can be use too in other students practical work, tutorials etc.

II. The Education System for TV Monitors

In this work it is chosen the popular for education and professional applications hardware and software measurement system of National Semiconductors known as LabVIEW [ ]. This interface is NI USB-8451 [3] and it can be support both I2C-Bus and serial peripheral interface (SPI), which too is very popular as I2C-Bus in television receivers and monitor internal bus for adjustment and control with microcontrollers.

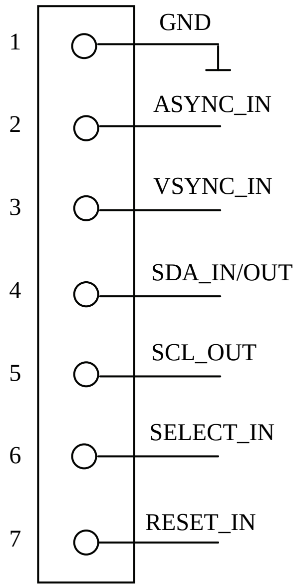

Fig.2.The pins assignment of the standard testing socket utilized in monitors

The main characteristic of this interface is:

- I2C master interface with clock rates up to 250 kHz;
- 8 general purpose digital I/O lines;
- high level, easy-to-use LabVIEW API;
- bus powered, full-speed (12 Mb/s) USB connectivity;
- 7 and 10-bit I2C addressing;
- advanced API for custom I2C and SPI transactions;
- Windows 2000/XP operating system.

III. THE UTILISATION OF EDUCATIOIN SYSTEM

The chosen LabVIEW I2C-Bus to USB interface can be used in the proposed education system for practical works of the students with block schema described in Fig.1.

In the beginning of the practical work students build itself a block diagram used in common LabVIEW applications, which in the other hand contain the specific building block suitable for the application of television receiver or monitor testing and adjustment with proposed I2C – Bus interface. This block diagram is shown in Fig.3.

The blocks for settings of some necessary data are shown in Fig.3 are:

- Data In using for data input and transfer via I2C – Bus;
- I2C Address also needed for addressing the transferred via I2C – Bus data;
- Board Type is needed for a chosen type of I2C – Bus to USB interface;
- Serial Number also is necessary for board type identification.

There are also the execution blocks:

- I2C Open for activating I2C - Bus;
- I2C Tx/Rx for transferring (Write/Read) operation for the data;
- I2C Close for deactivating I2C – Bus connected to the television receiver or monitor.

At the end of this block diagram is added a block for data visualization for example of errors, which is named Error Out.

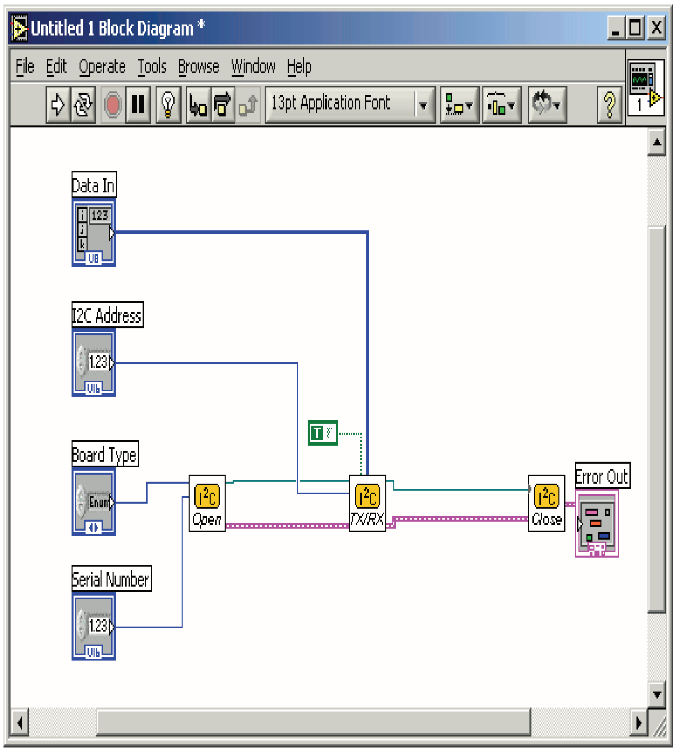

Fig.3. Block diagram in LabVIEW applications for I2C data transferring

In Fig.4 are shown some fields and locations in front panel, where it is possible to enter some initial data for Board Type, Serial number.

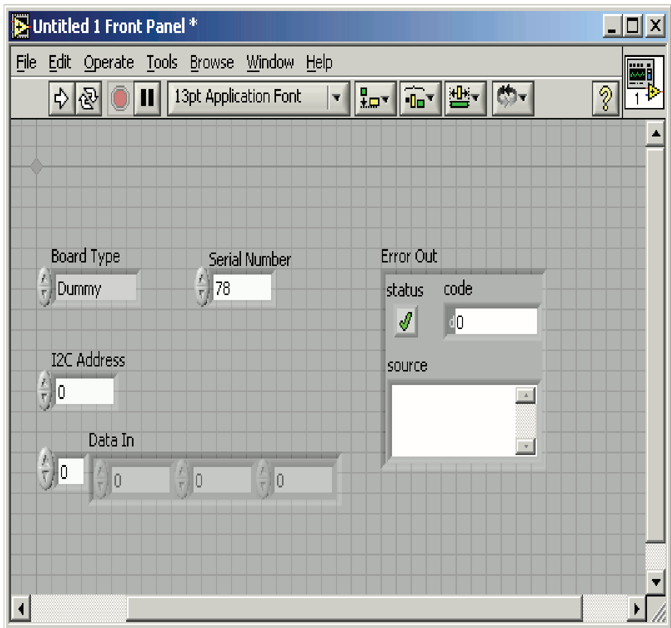

Fig.4. The window with some fields and locations in front panel, where it is possible to enter some initial data for Board Type, Serial number, Address, Data In and seen Errors Out

Also there are the locations for settings of I2C Address and data which are sending via I2C-bis to the television receiver or monitor and especially to the desired integrated circuit in them, where it is necessary to make an adjustment or change of the parameters or mode to operation of the television receiver or monitor.

The software possibilities to examine, testing and adjust the television receivers and monitors are very suitable to perform a varieties of the students practical works mainly to show them all important points and moments of the adjustment or testing process of one television receiver or monitor. These important moments or points are for example the time diagrams for data transferring for PC computer to the adjusted or tested television receiver or monitor, the contents of some important registers or memory cells in the integrated circuits in receiver or monitor, from which the students can understand more clear and deeply the work and adjustment of this part, from which depend the mode of working of the television receiver or monitor.

Some of these and other important moments for proposed education system for television receivers or monitors adjustment are shown in the next figures as windows on the PC computer screen.

It is show in the Fig. 5 the time diagram for an example of transferring data via I2C-bus.

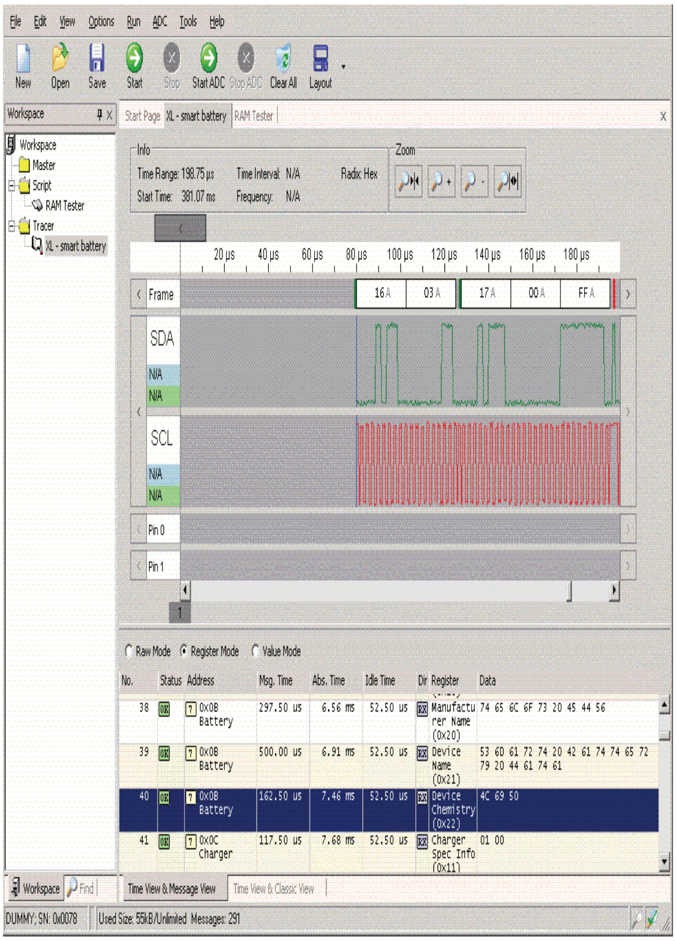

Fig.5. Time diagram of data bus SDA of I2C interface is added also in the window

It can be seen from the students the sequence of the data in the data bus SDA of I2C – bus together or in synchronization with I2C – bus clock signal SCL. Also it is possible to measure the time relations of two wire serial I2C – bus, which are presented as a scale in microseconds above the time sequences for SDA and SCL signals.

A more clear representation of the time diagram of data bus SDA of I2C interface is added also in the window and is shown on the Fig.5 as hex values of a sequence of eight bits or one data byte. This is the line above time diagram for data bus SDA of I2C interface and it is labeled as Frame in Fig. 5. This give to the students the possibility to do the comparison for the data they are set and the data, which are transmit and also the possibility to test whether or not the transmit data are received correctly in the desired integrated circuit under the adjustment in the television receiver or monitor.

Below the time diagrams there in the Fig. 5 are the additional parts of the window, which too are very informative and useful and some of which are presented as values in microseconds and other as hex values.

For some other practical works with students in the area of television receivers or monitors testing and adjustments it is more advisable to have the possibilities of observation not only the transferring process via the I2C interface, but also the contents of some of the internal registers in the integrated circuits in the television receiver and monitor or the contents of some memory cells of EEPROM also in television receiver and monitor. This possibility is included in the described education system. In Fig.6. is shown a window in which it can be seen the contents of some memory cells.

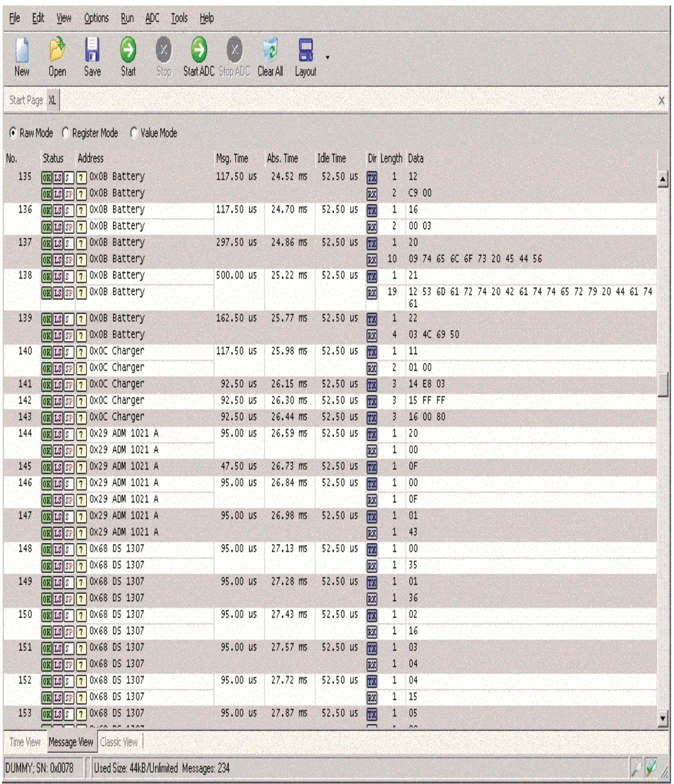

Fig.6. Window for observation of the contents of some of some memory cells of EEPROM

In the Fig.6 it can be seen a list of memory cells with their status, address, contents, direction of data transfer labeled as Tx/Rx and the appropriate message, absolute, idle time and length.

The similar representation of internal register of the integrated circuits in the television receivers or monitors representation is given in Fig.7.

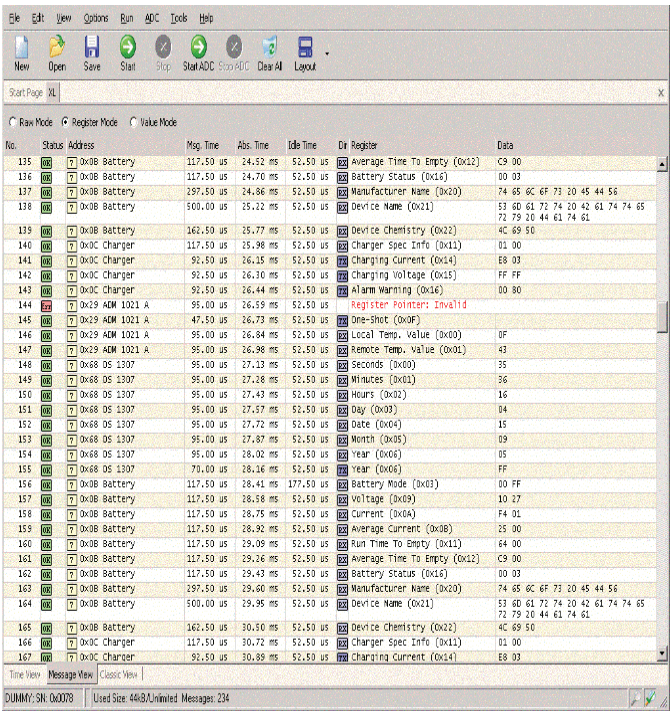

Fig.7. Window for observation of the contents of some of the internal registers in the integrated circuits

Also in Fig.8 there is a window in which can be seen the representation of some values of logical data or variables.

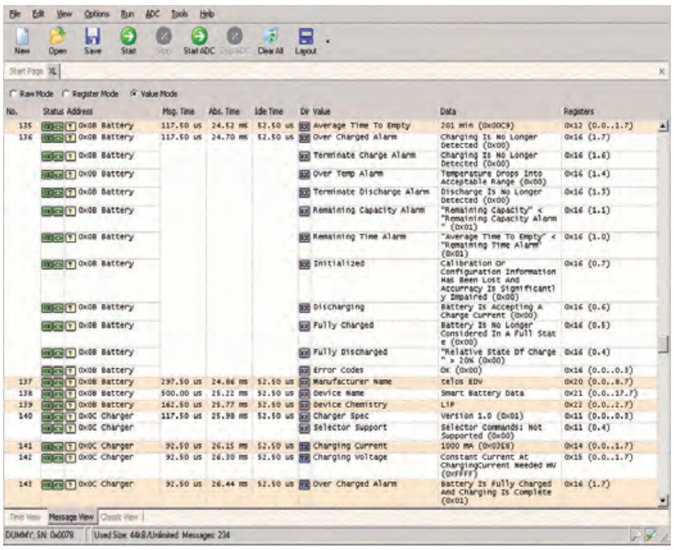

Fig.8. Window which can be seen the representation of some values of logical data or variables

A more difficult, but very important and suitable direction of applying of the proposed education system is not only in the practical works of the students, but also for the students projects. This means, that the students use this education system for development and running of their own projects as a concrete Windows applications written for example in C, C++, Visual C++, Visual Net, Java etc.

Such example for using the proposed education system for the purpose of student projects as application written in Visual C++ is shown in Fig.9.

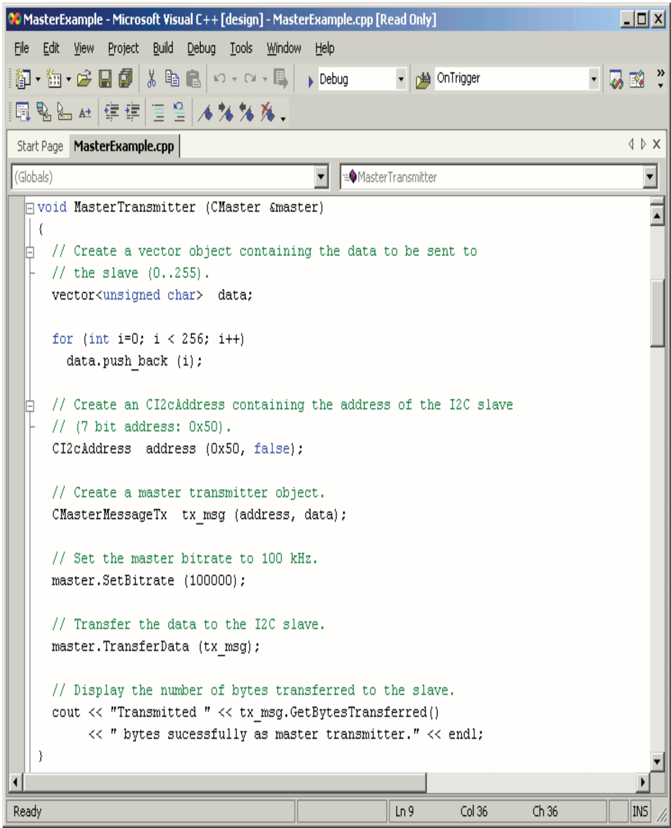

Fig.9. Example of using the education system as students projects application written in Visual C++

IV. Conclusion

The proposed education system for TV receivers or monitors adjustments is realized as standard LabVIEW I2C to USB interface and with using almost existing software for data transferring and visualization, but it is open for student's projects and for other modifications, extensions or new releases.

References

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[2] The I2C-Bus Specifications. Version 2.1, Philips emiconductors, January 2007.

[3] I2C/USB Interface NI USB – 8451. National Semiconductors. LabVIEW, 2006.