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Design and Development of a user Friendly Embedded Product for Testing Serial Communication Interfaces

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ABSTRACT
In this paper I'm proposing a novel idea for designing and developing an embedded system which gives a solution for testing various serial communication interfaces of target board. This work reduces total system debugging time since it creates an independent platform, which helps the testing engineers to check their board before the entire completion i.e. it provides the developers an environment which facilitates them to conduct testing along with complete system development. This is going to be a boon to the embedded test engineers by reducing the testing time to a great extend and thereby aiding industry to save a lot of design time as well as money.

General Terms

CAN, I2C, SPI, UART, RS232, and GUI.

1. INTRODUCTION
As the time to market for a product really demands, the product should be fail safe while it's in market. For the same purpose we should test the product thoroughly before its release. In this paper we introduce a product which can test some of the serial interfaces, which reduce the time for debugging.

The motivation lies in the desire to design a board capable of testing I2C, CAN, SPI, and UART interfaces. Using this solution the serial interfaces of all the target boards can be tested independently and issues with hardware interface and serial drivers can be found at an earlier stage of testing. This will drastically reduce the testing effort and time.

In this paper, it describes about the basic block diagram in section 2, Section 3 describes about the components, Section 4 describes the system design, Section 5 the operation and finally about the conclusion

2. BLOCK DIAGRAM
The block diagram of the solution is given in Figure 1.The solution consists of development of a debug board and connector board to connect the debug board to target board (Figure1). The debug board is connected to the Host PC using serial interface and the application running on the host pc shall control the test sequence.

For faster development "PIC32 Starter Kit based on PIC32MX795F512L is selected as debug board. The Drivers and Application has to be developed/ported for this board. The connector board will be newly developed and it will be a complete hardware implementation and no software will be running over this.

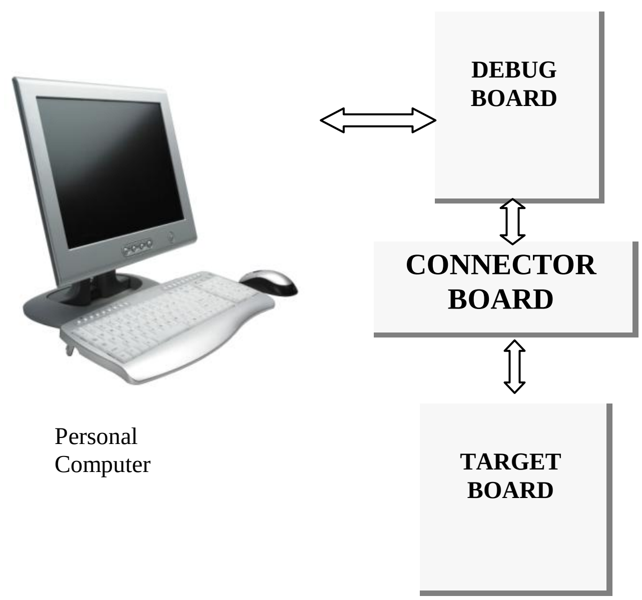

Figure 1. Block Diagram

3. COMPONENT DESCRIPTION
3.1 UART
The universal asynchronous receiver transmitter is a serial communication method in which data can be transmitted serially. It can be used to communicate with low speed peripheral devices. Data is transferred between devices via, transmit and receive lines.

3.2 I2C
I2C stands for Inter Integrated Circuits. The I2C bus is a type of serial communication bus and used in a wide range of applications because it is simple and quick to use. It consists of a two- wire communication bus that supports bidirectional data transfer between a master and several slaves. The master or processor controls the bus – in particular, the serial clock (SCL) line. Data is transferred between the master and slave through a serial data

(SDA) line. This data can be transferred in four speeds or modes: standard (0 to 100 Kbps), fast (0 to 400 Kbps), fast-mode plus (0 to 1 Mbps) and high-speed (0 to 3.4 Mbps). The most common speeds are the standard and fast modes.

3.3 SPI

SPI stands for Serial Peripheral interface.SPI is a synchronous protocol that allows a master device to initiate communication with a slave device. Data is exchanged between these devices. The clock signal is provided by the master to provide synchronization. SPI is a Master-Slave protocol. Only the master device can control the clock line, SCK. No data will be transferred unless the clock is manipulated. All slaves are controlled by the clock which is manipulated by the master device. The slaves may not manipulate the clock. SPI mainly intended for Processor to Processor or Processor to peripheral communication. An SPI protocol specifies 4 signal. 1. Master Out Slave In (MOSI) 2. Master In Slave Out (MISO) 3. Serial Clock (SCLK or SCK) 4. Slave Select (SS).

3.4 CAN

The Controller Area Network (CAN) is a serial communications protocol which efficiently supports distributed real time control with a very high level of security. Its domain of application ranges from high speed networks to low cost multiplex wiring. In automotive electronics, engine control units, sensors, anti-skid-systems, etc. are connected using CAN with bitrates up to 1 Mbit/s.

4. SYSTEM DESIGN

4.1 Debug Board

The debug board in this system is a PIC32 starter kit with a PIC32MX795F512L controller. This board acts as the active interface between the target board and the personal computer.

4.2 Connector Board

The connector board is a board designed in order to connect the target board to the debug board. In thus there is no firmware running over this. The major systems in this board are listed below

4.2.1 Power supply

There is a +5V dc power supply and a variable power supply . The variable power supply can be controlled by programming the ic via I2C lines. The register value stored in the I2C will change output voltage between 0 and +5V. The variable power supply is used since the target board the debug board need not be of same voltage.

4.2.2 Level translator

The level translators are those which convert the signal level of the debug board signals to that of the target board signals for the proper functioning.

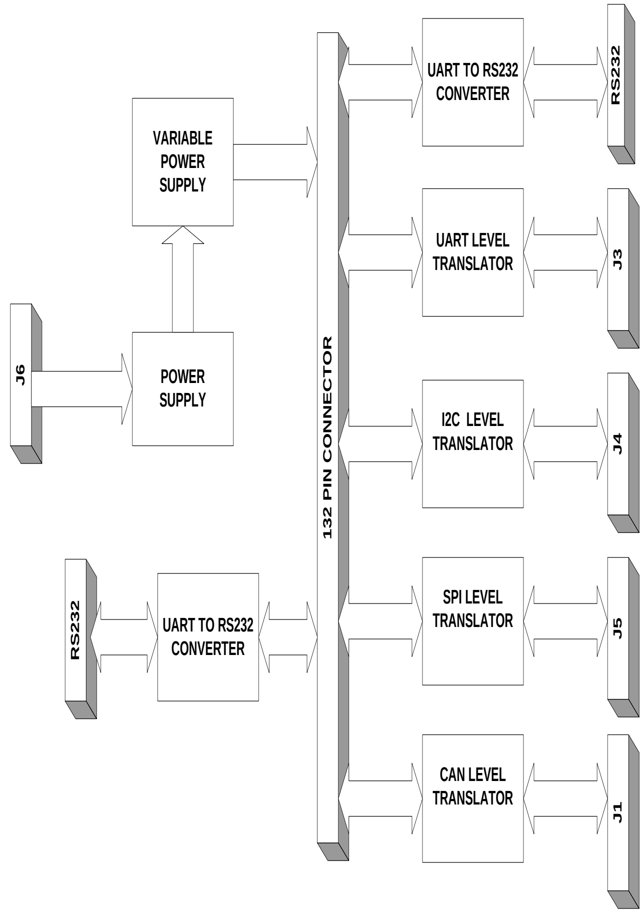

Figure 2. Connector Board Block Diagram

4.2.3 Connectors

As we don’t have standard connectors for I2C, SPI, CAN and UART we are using connectors of our choice. Only the RS232 connector we are using is one of the standard connector available which is a DB9 connector. The 132 pin connector used here will help us to interface the PIC 32 starter kit(Debug board) to the connector board. In Figure 2, the connectors J1, J3, J4 are 3 pin connectors i.e. for CAN, UART and I2C respectively. The dc power supply uses a 2 pin connector-J6, the SPI uses a 5 pin connector-J5 and the RS232 uses a DB9 connector.

4.3 Target Board

The target board can be any board of its type whose serial interfaces like SPI, I2C, CAN and UART need to be tested.

4.4 User Interface

The user interface is designed in lab view, which can be interfaced with a serial cable like RS232. Each button navigates the user to the corresponding panels which helps to configure the specified serial interface which needs to be tested.

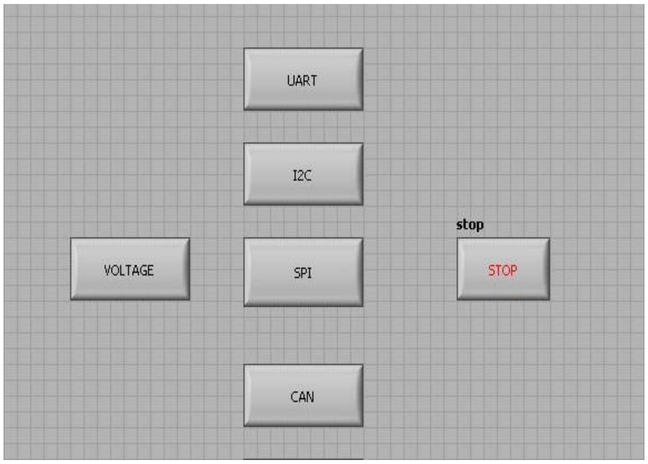

Figure 3. Graphical User Interface Block Diagram

5. OPERATION

The user can set the voltage from the personal computer using the graphical user interface. The data from the pc is send to the debug board via an RS232 cable and which in turn is connected to the connector board sets the voltage to the desired level. Then after exiting from the voltage window we can return to the main window from where we can start testing the desired interface by selecting the button. The data has been send from the GUI to the debug board which configures the debug board. The data send from the debug board to the target board is then returned back to the debug board, there the sent data and the received data is compared for equality. If both the data matches a success message has been send to the GUI to intimate the user that the interface is working.

6. CONCLUSION

The above solution is going to e a boon to the testing engineers which will save the precious debug and testing time of the interfaces and money. This will greatly help when the main or mother board has been completed and the sub board is not yet received after fabrication the testing of these interfaces is a tedious task for the test engineers.

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