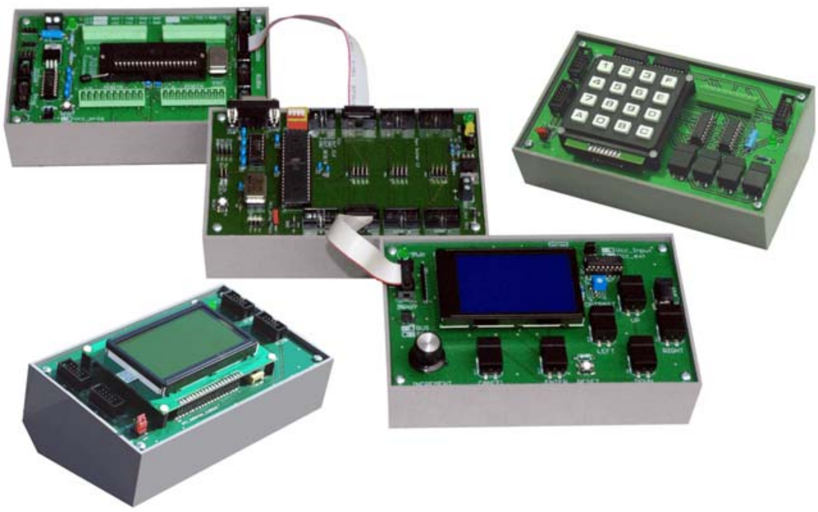
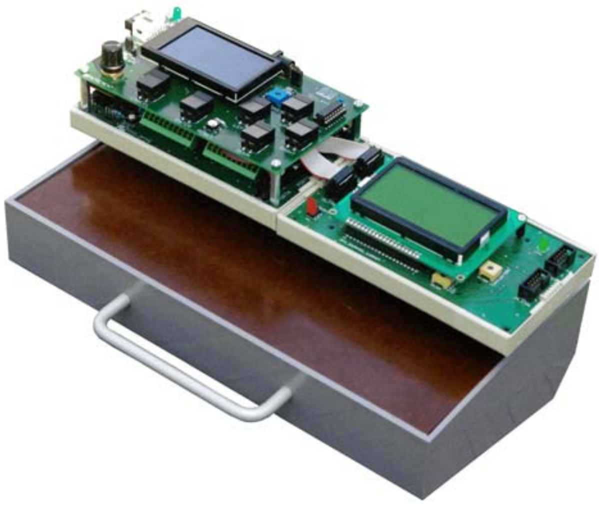
Simple Microcontroller Modules
– A Competitive Analysis –

August 2013





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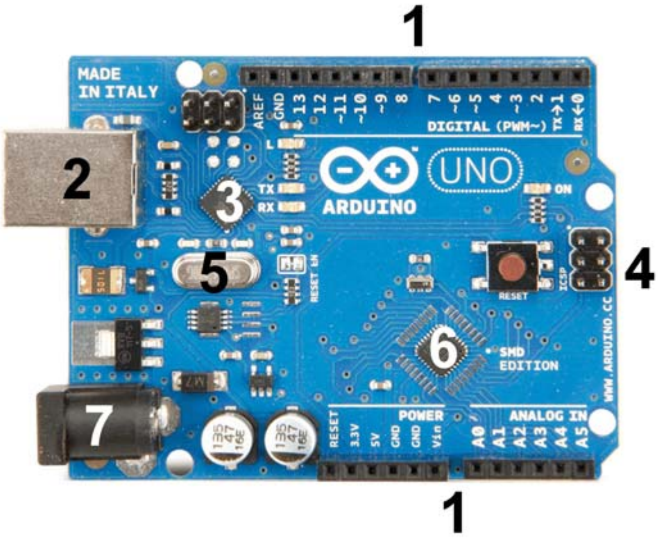
The market seems to be saturated with small, inexpensive microcontroller boards, starter kits and the like. EBlocks, Arduino, Digilent, Eloxol, Velleman, and Parallax are just a few examples of trade marks and manufacturer names. Nevertheless, a closer look at such modules reveals some shortcomings and consequently, opportunities to make improvements. The modules are often intended for tinkering and experimenting only. They are no OEM modules. Typical examples are modules with switches, keys, displays and the like, which can only be operated on the desk, but cannot be mounted behind a front panel.

Let's begin with an in-depth examination of a well-known competitor:



1 – The connectors are cheap. Attachments have to be made wire by wire. The overall precision is low, so it could be difficult to stack modules one upon another.

2 – In an application environment, USB is not always necessary. It will be used only for programming and debugging.

3 – In this example, the USB attachment has been implemented the easiest way – by a USB to serial converter. To use the serial port (TX, RX) within the own application environment (for example, to implement a multiprocessor system) requires tinkering. The serial port operates only with logic levels, not with RS-232 levels.

4 – In spite of the USB interface, it is still necessary to provide for connecting an SPI programmer (to restore the bootloader, if necessary).

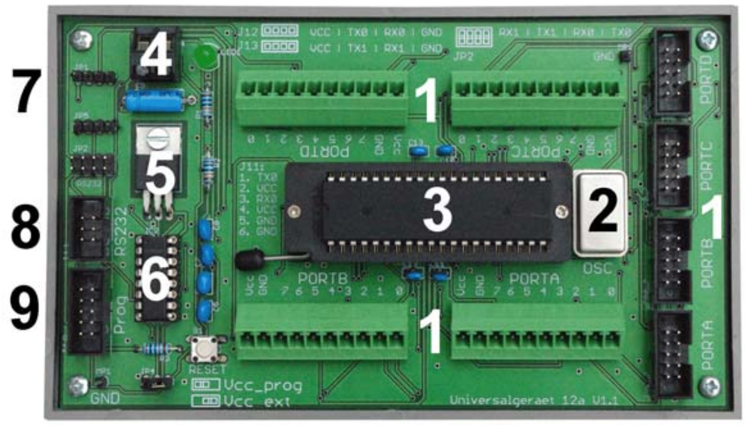
5 – It is only a quartz, not a complete clock generator. However, some microcontrollers allow for the maximum clock frequency only if clocked by an external generator.

6 – SMD components are difficult to solder manually. A defective processor cannot be replaced easily.

7 – The power supply solution is inappropriate for an OEM application environment, in which all components need a common ground. In such applications, it is favorable to feed all modules with the same supply voltages delivered externally.

The modules have not been designed from ground up to build multiprocessor systems with. It would be possible, but not without tinkering.

Now let's have a look at an alternate solution:



Engineering always means finding compromises. To overcome the drawbacks mentioned above, we will use components, which are more sturdy and will build somewhat larger. Our modules should be true OEM building blocks; it should be possible to use them in measuring and test equipment, industrial control units, and other appliances. For these advantages, we allow for a moderate increase in cost and dimensions.

1 – Sturdy I/O connectors. Various types can be inserted. Depending on the connectors, other modules can be attached via cables or stacked. Here, a more comfortable type of terminal strips is shown. The application wiring ends in pluggable screw terminals. Hence it can be removed with little effort.

2 – A complete clock generator can be inserted. Thus the microcontroller can be operated up to its maximum clock frequency.

3 – Enough space to allow for insertion of a 40-pin ZIF socket, thus enabling fastest processor swapping. It is possible to choose between different microcontroller types; ranging from greatest simplicity (for example, ATmega16) up to a maximum number of features and memory capacity (for example, ATmega1284).

4 – Power supply from outside. No voltage regulator on the board. Convenient power sources are a 5-V or 3,3-V power supply unit, a 3,5 V or 4.8-V battery, or the USB.

5 – Antireversal protection (the circuit invented by Bob Pease).

6 – MAX232. Depending on the microcontroller, up to 2 serial interfaces can be supported.

7 – Headers for RS-232 attachment.

8 – Header for multiprocessor coupling (logic level serial interface and power supply).

9 – SPI Header. Allows for attaching an SPI programmer or supplementing small boards containing Ethernet or USB adapters, serial memory and the like.

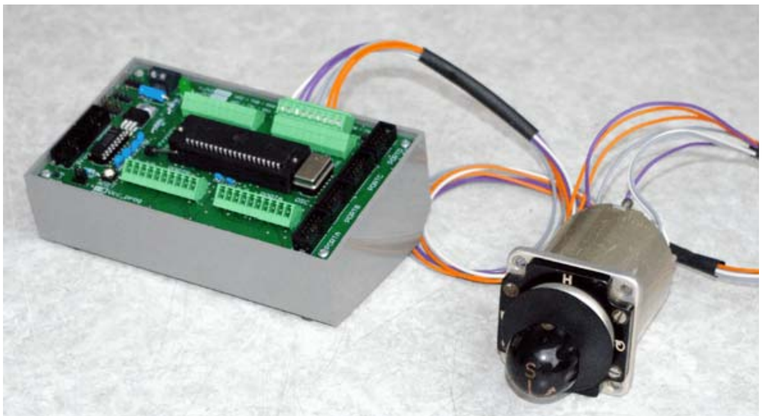


Fig. 1 A historical joystick attached to the microcontroller module (try this with the competitor's board shown above ...).

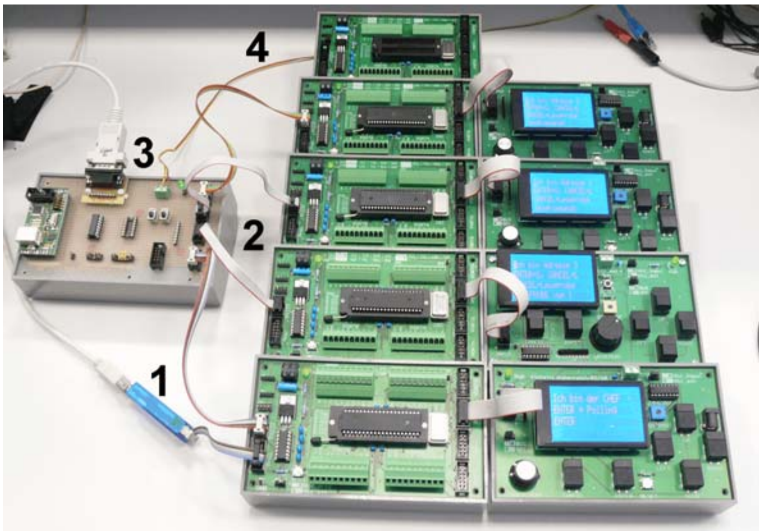


Fig. 2 Microcontroller modules connected to a multiprocessor system. 1 – USB programmer; 2 – multiprocessor connections (only wire); 3 – passive hub (a prototype manufactured in the venerable wire wrap technology); 4 – power supply cable from a wall outlet adapter.

Some pictures of supplementary peripheral modules

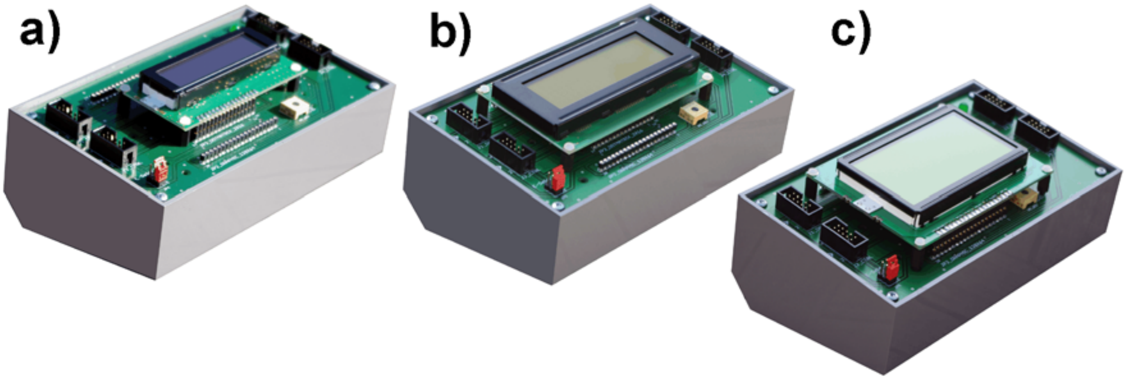


Fig. 3 The LCD module 10. The PC board can accommodate three types of industry-standard LCD displays: a) dot matrix, 2 rows; b) dot matrix, 4 rows; c) graphical, 64 • 128 pixels. Up to three modules can be connected to two microntroller I/O ports in a daisy-chain fashion.

Fig. 4 The keypad/input module 10b can accommodate keypads with 12 or 16 keys. Additionally, eight inputs from outside can be attached.

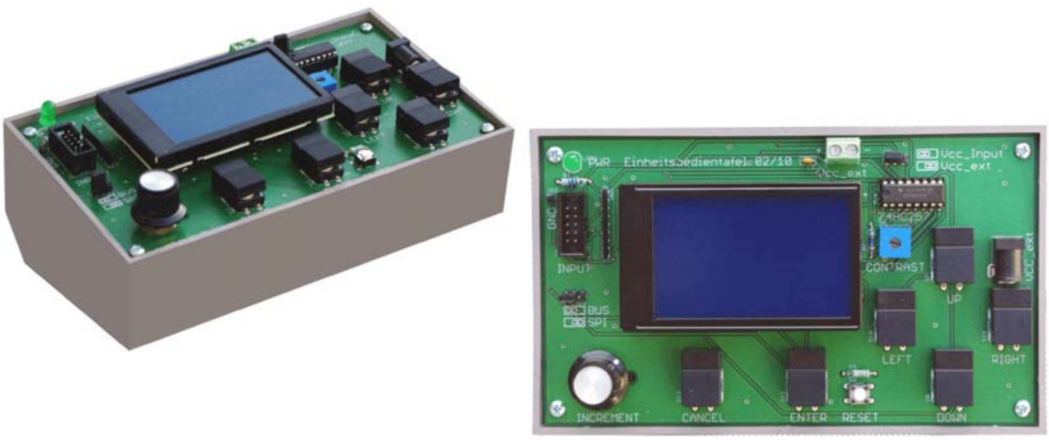


Fig. 5 General-purpose human interface module 02/10. It features a dot matrix display with four rows of 20 characters, 6 keys and an incremental encoder. It requires only one 8-bit-port.

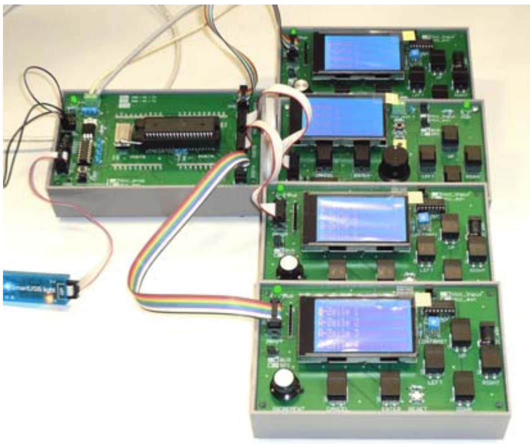


Fig. 6 A strong motivation for developing this module was the desire to demonstrate multitasking principles. Here one microcontroller module supports four human interface modules.

The modules with displays, keys and the like can be mounted behind front panels, provided that appropriate connectors are inserted.

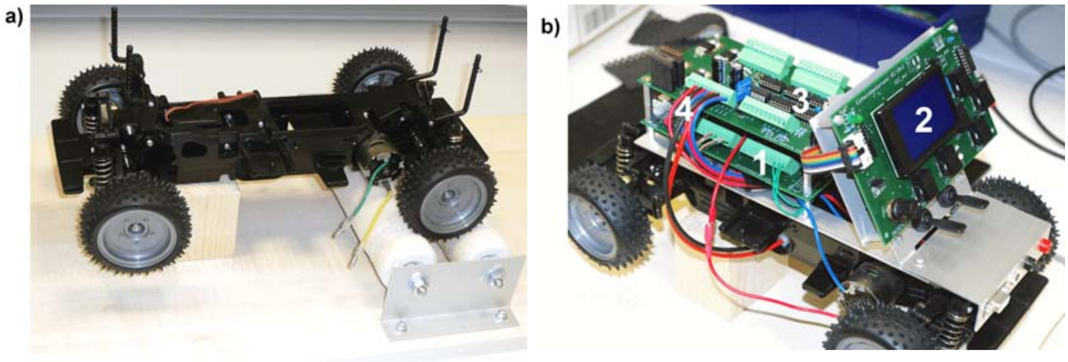


Fig. 7 An educational model vehicle. a) shows the chassis on a makeshift test bench. b) illustrates, how our modules can be used as OEM building blocks. 1 - general purpose microcontroller module 12a. 2 - human interface module 02/10. 3 - an application-specific board. 4 - power wiring.

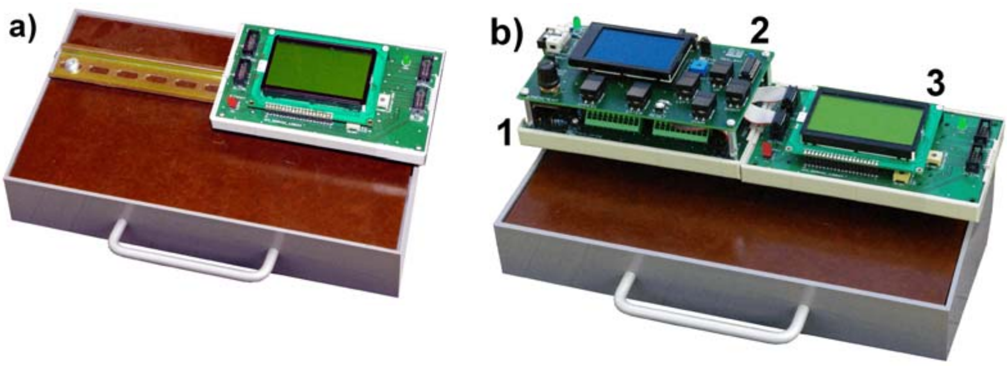


Fig. 8 Modules mounted on a DIN rail. a) shows the mounting principle. b) is an educational system consisting of a microcontroller module (1), a human interface module (2) stacked above, and an LCD module (3), carrying a graphical LCD display.