What Can You Make With Microcontrollers?

Dorkbot Bristol

Oct 16th 2007

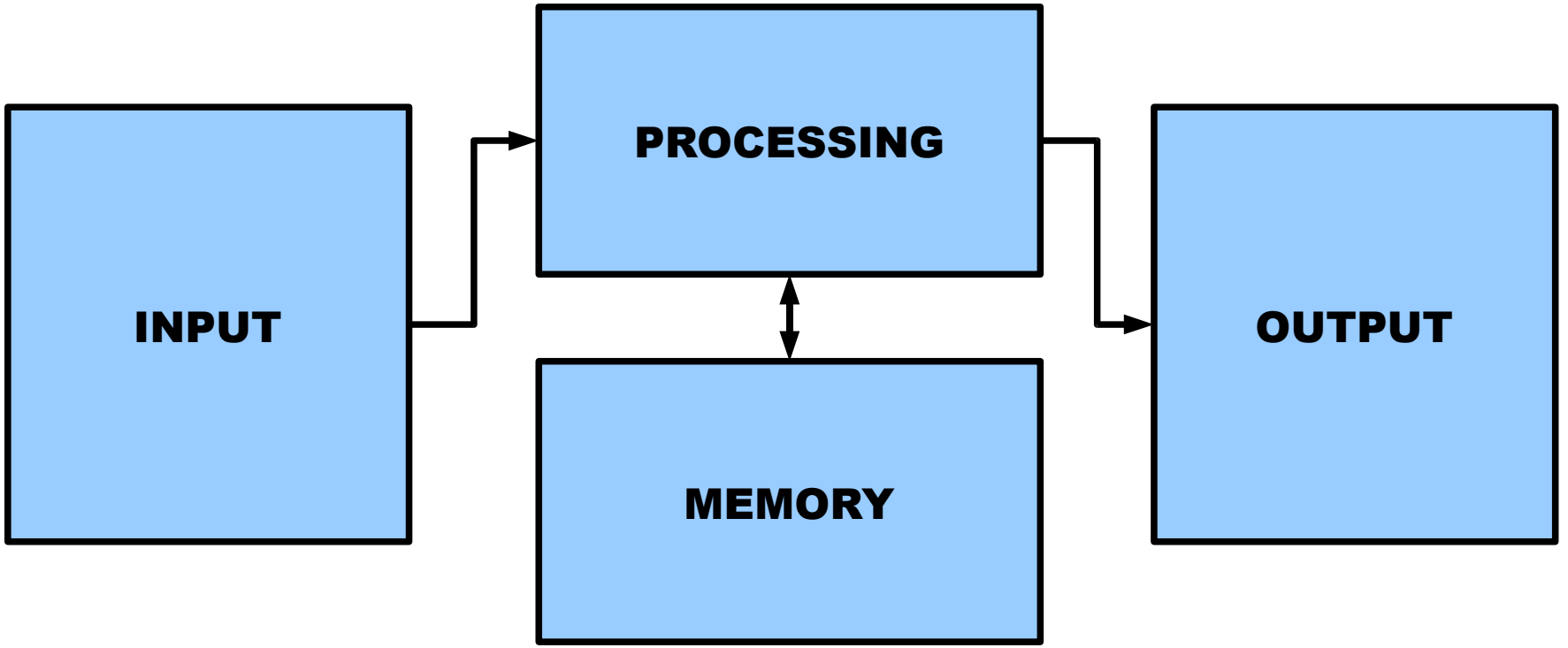
John Honniball

Overview

- What is a microcontroller?
- Why use one?
- Examples of microcontroller chips
- Examples of microcontroller boards
- Demo
- What else can you do?
- Questions

What is a Microcontroller?

- A Computer-on-a-Chip
- But not just a CPU



Why Use a Microcontroller?

- Complex behaviour from a single chip
- Cheap and easy to wire up
- Computer interfaces
  - Serial: RS232, USB, MIDI
  - Memory: MMC/SD, CF
  - Network: Ethernet, Infra-Red
- Low Power Consumption
  - No heat; No fan; No noise
  - Powered by batteries

Things You Can Make

- Games and fun gadgets
  - Mignon, XGS, controller interfaces, light wand
- USB devices
  - Joysticks, keyboards
- Musical gadgets
  - MIDI devices, synthesisers
- Robots
  - Sensors, motor controllers

The Mignon Game Kit

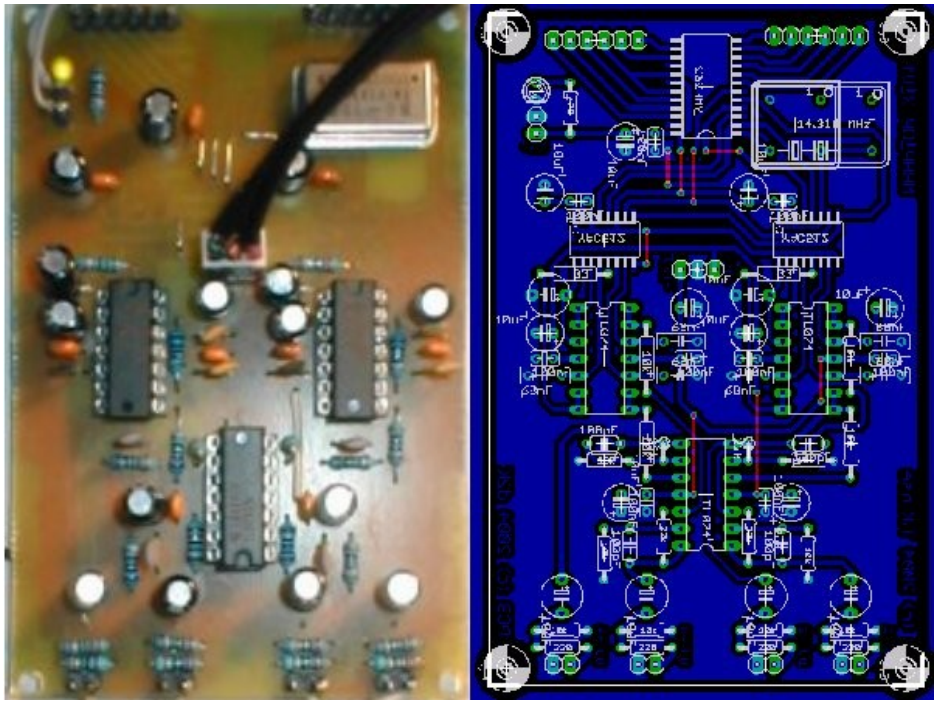
- Handheld game kit
- 5 x 7 LED matrix display
- http://www.olafval.de/mignon/english/index.htm

The XGameStation

- Programmable game console
- Output to TV
- Ready-made board
- Write your own games
- http://www.xgamestation.com

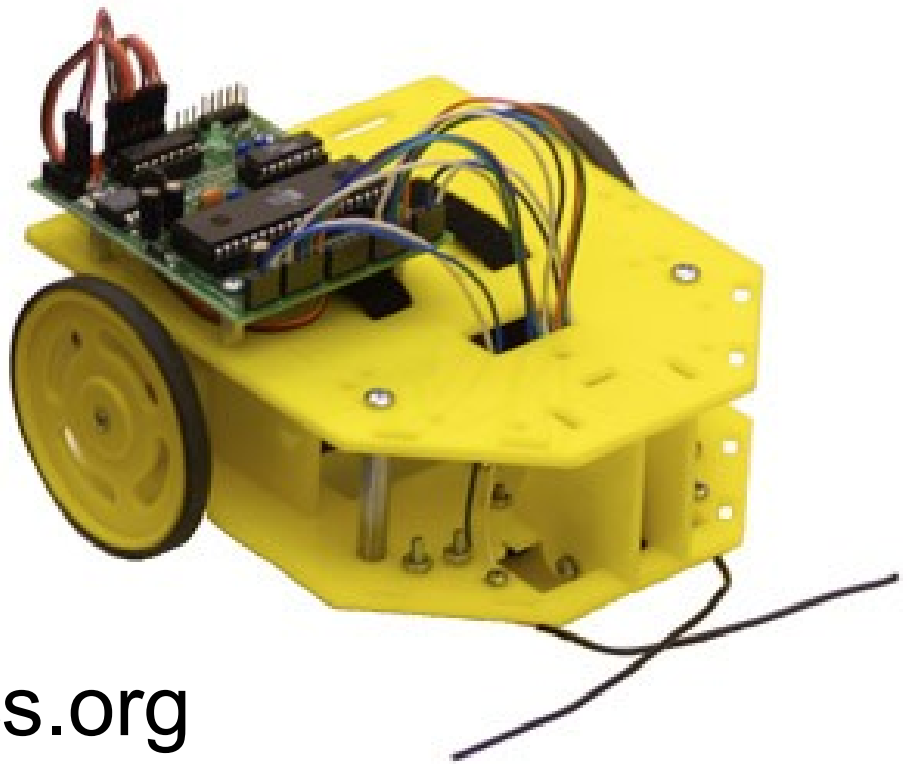
MIDIbox OPL3 Module

- MIDI in, audio out
- Synthesiser based on 8-bit sound chips
- Sound chips salvaged from ISA soundcards
- http://www.ucapps.de/mbhp_opl3.html



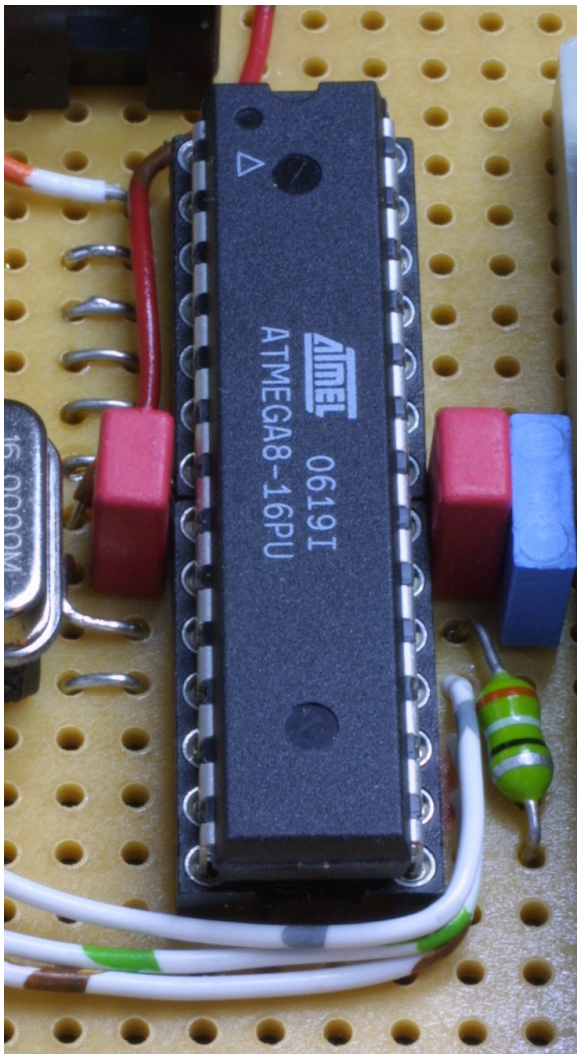
Seattle Robotics Society

- The Level 1 Robot
- Atmel AVR ATmega16
- TI 754410 H-bridge
- Two drive motors
- Light sensors
- Bump sensors
- http://www.seattlerobotics.org



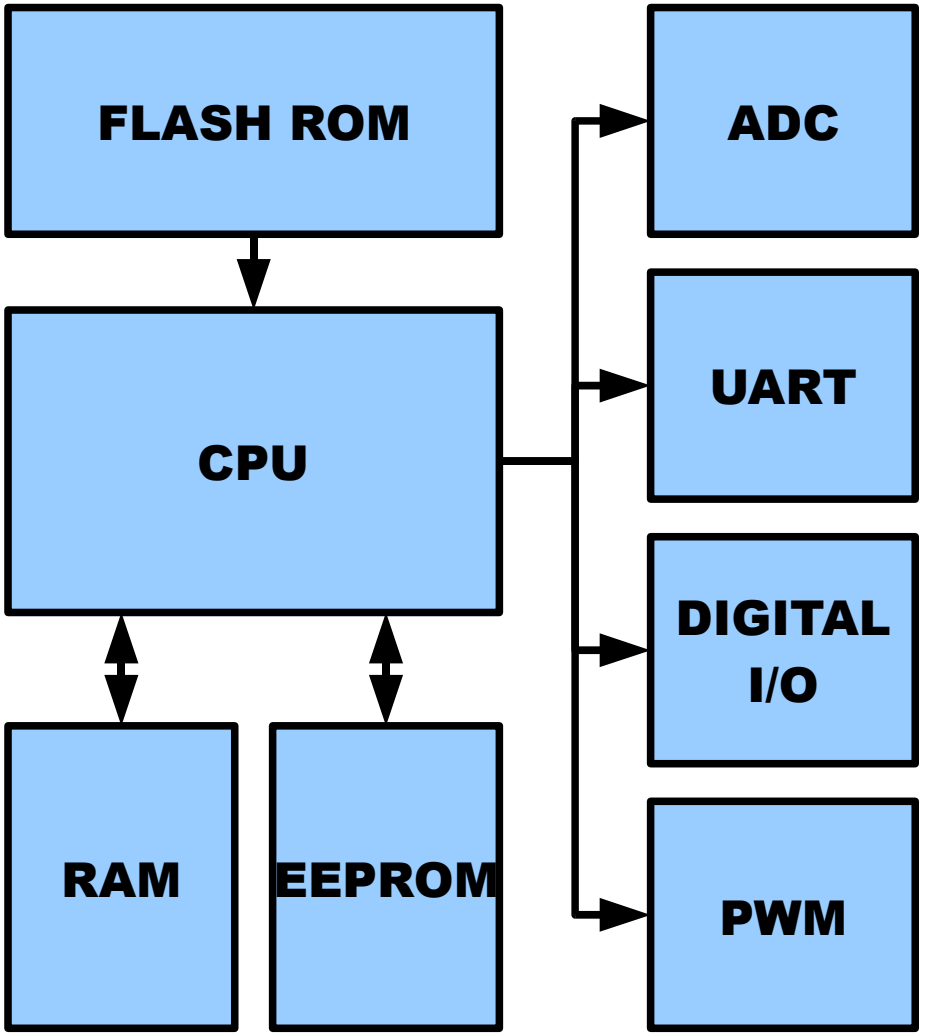
Examples of Microcontroller Chips

- 8-bit
  - Intel 8051
  - Motorola 68HC11
  - Microchip PIC
  - Atmel AVR
- 16-bit
  - Texas Instruments MSP430
- 32-bit
  - ARM



Atmel AVR

- 8-bit microcontroller
- Designed in Norway
- RISC architecture
- 32 registers
- On-chip RAM, Flash ROM and EEPROM
- Lots of variants
- C compiler: GCC

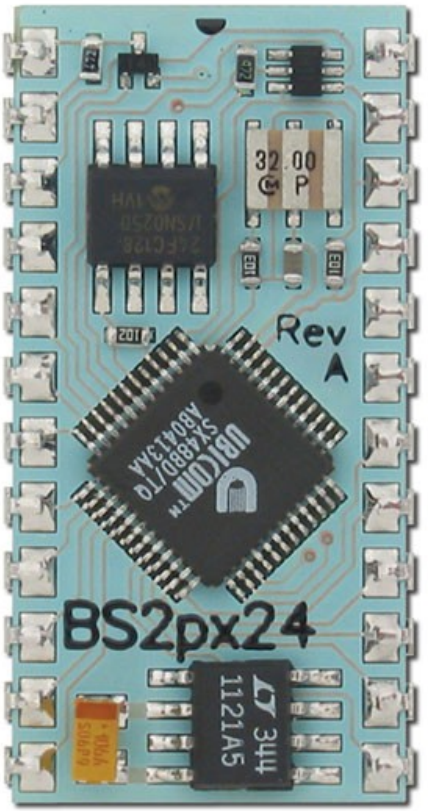


Microcontroller Modules

- Chip, plus clock crystal, plus supporting components
- Easier to handle and plug in
- Avoids surface-mount parts
- Avoids need to make a Printed Circuit Board
- But, may be less configurable
- May be larger than microcontroller alone

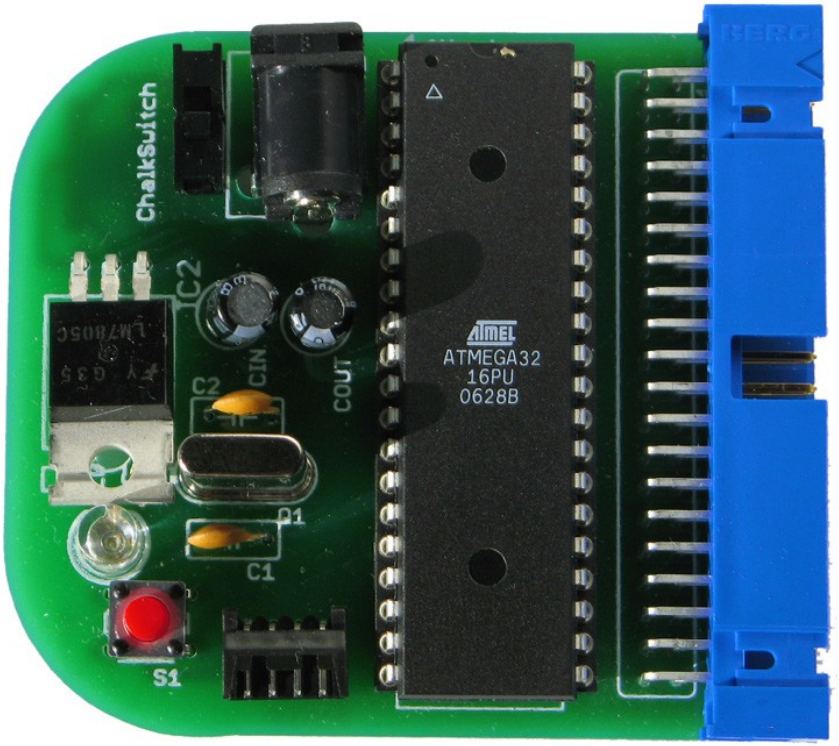
The BASIC Stamp

- Microchip PIC
- 24-pin DIL package
- Established design
- http://www.parallax.com



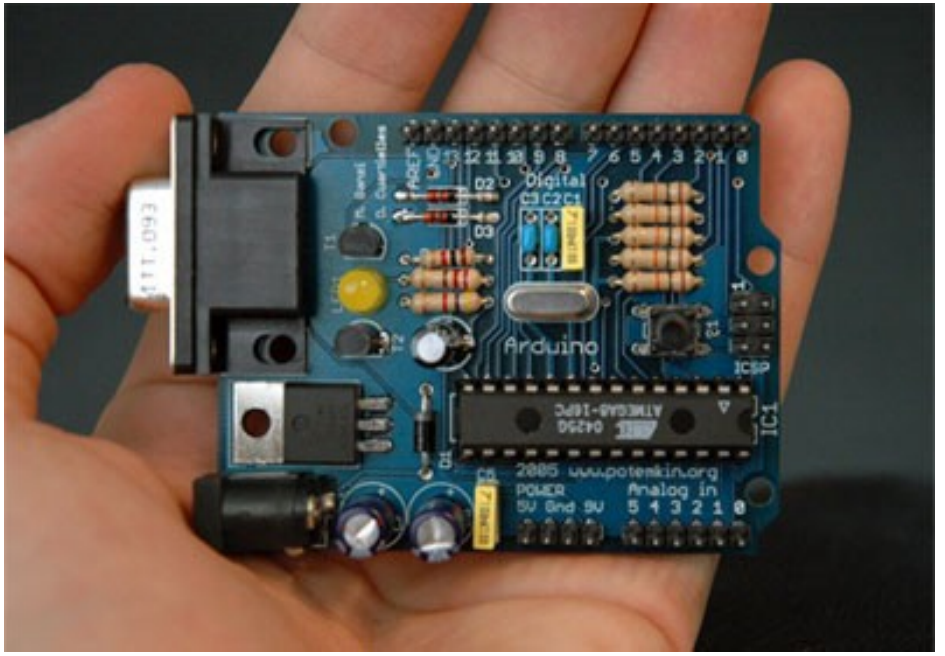
The Number Six Board

- Atmel AVR
- ATmega32 chip
- 16MHz crystal
- MIT design
- Open Source
- http://six.media.mit.edu



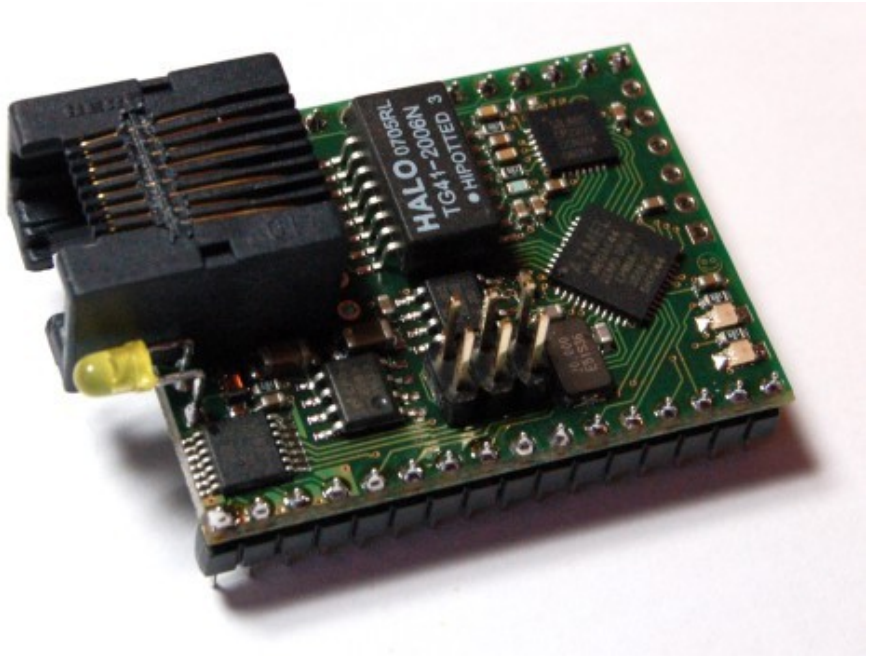
The Arduino

- Atmel AVR
- ATmega8 chip
- Serial or USB version
- Open Source
- http://www.arduino.cc



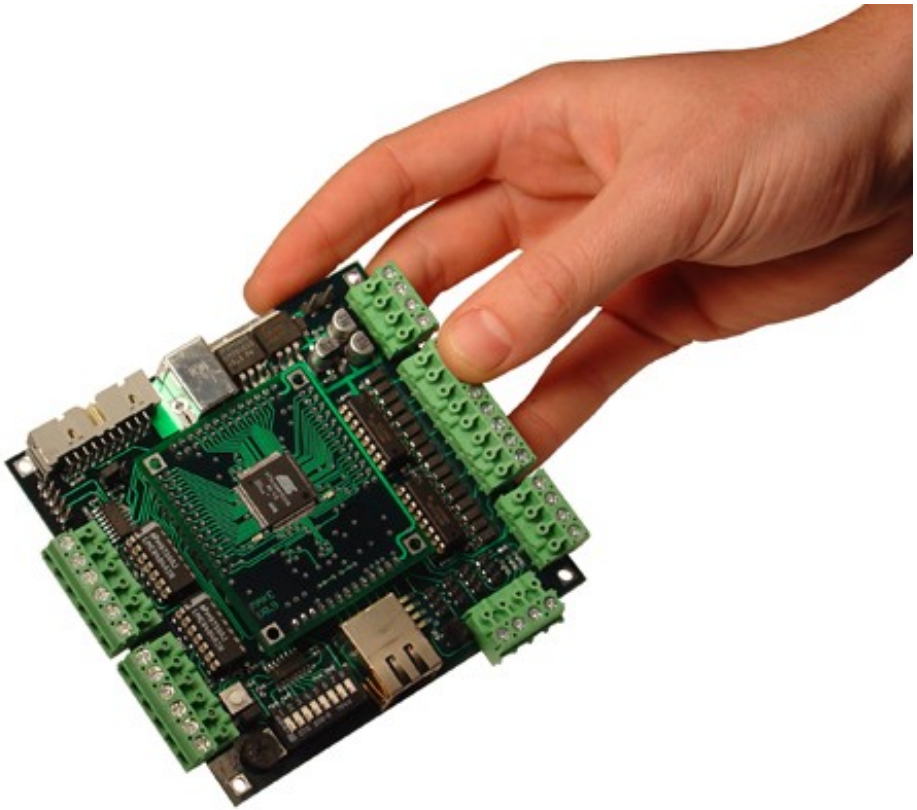
The Crumb644-Net Board

- Atmel AVR
- ATmega644 chip
- 10Mbit ethernet
- 32-pin module
- http://www.chip45.com



Make Controller Board

- 32-bit ARM board
- 55MHz ARM7 CPU
- 256K Flash, 64K RAM
- Ethernet and USB
- 8 analog inputs
- 8 motor driver outputs
- http://makezine.com/controller/

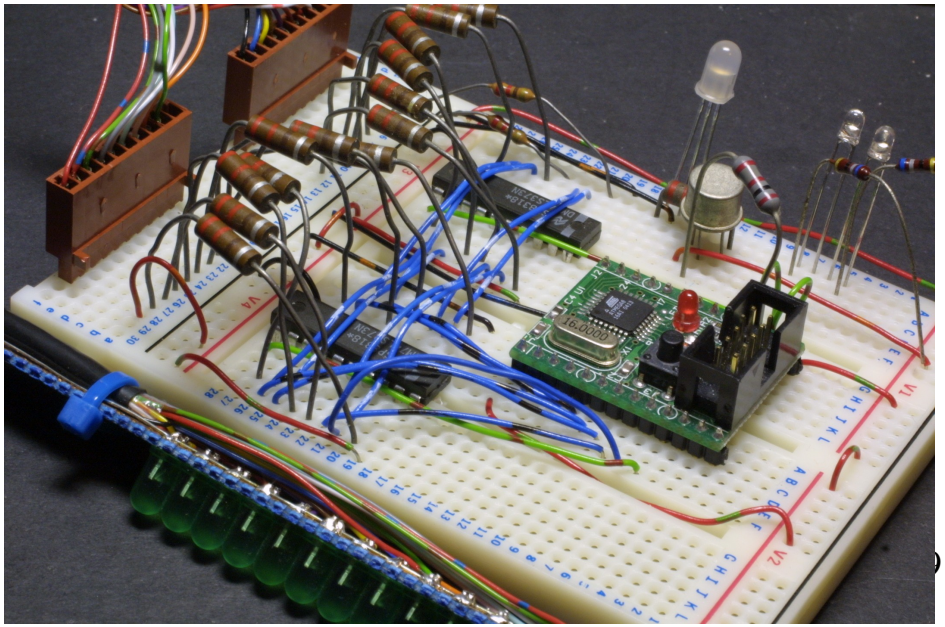


The MR-8 Board

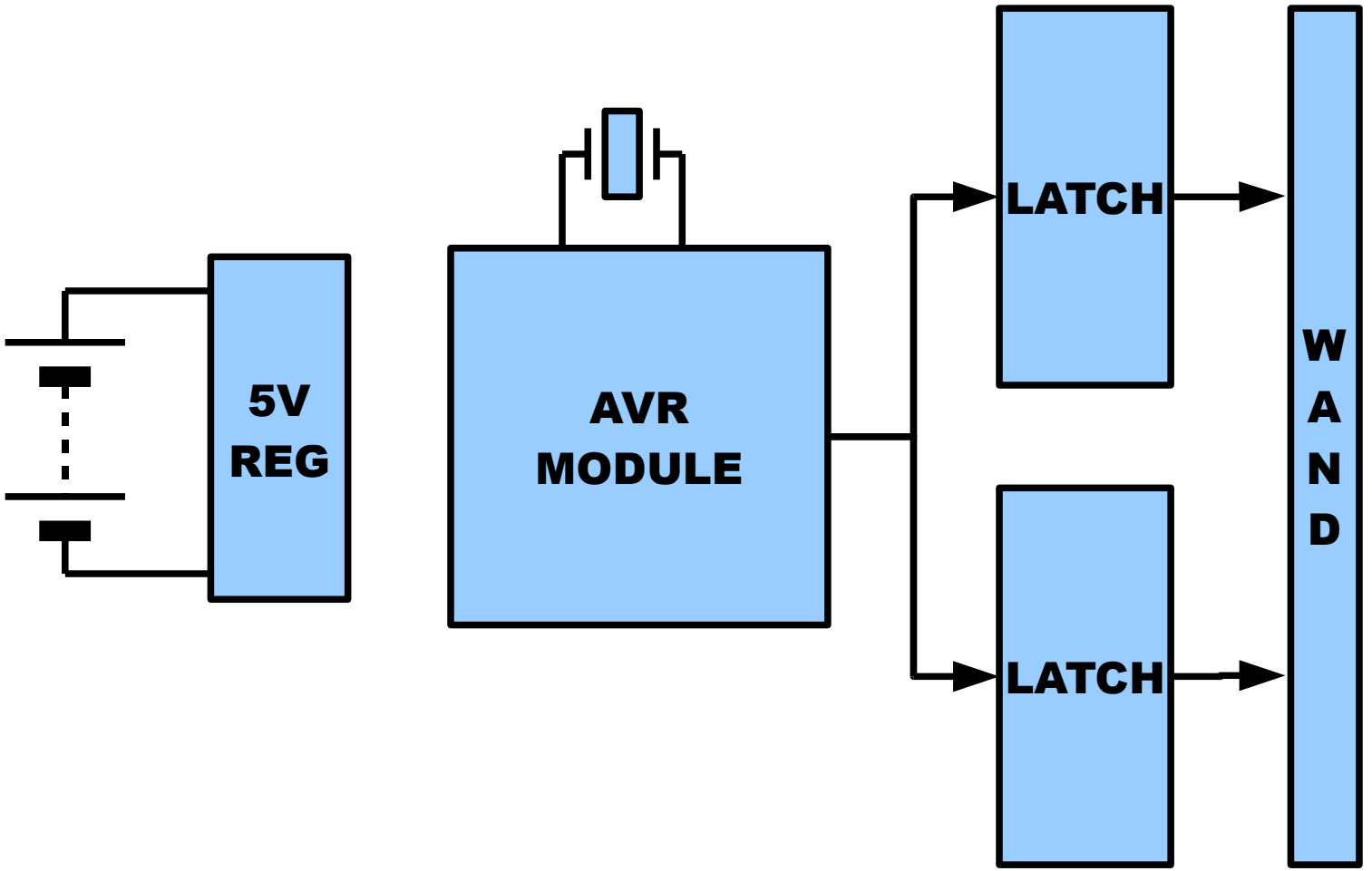
- Atmel AVR
- ATmega8 chip
- 16MHz
- 26 pin module
- http://www.active-robots.com

The Light Wand

- Atmel AVR chip on MR-8 module
- Two 8-bit latch/buffer chips (74LS373)
- 16 resistors (220Ω)
- 16 green LEDs
- Battery and 5Volt regulator



Light Wand Circuit



Light Wand Software

- Written in AVR assembler
- Assembled with AVR Studio 4
  - Atmel's IDE (Integrated Development Environment)
  - IDE runs under Windows
  - Development tools also available for Linux and Mac
- Programmed into Flash with AVRISP
  - In-System Programming (ISP)

Demo

- Devise a better light pattern
- Convert it to hex
- Program it into the chip
- Test

What Else Can They Do?

- Motor control (stepper and DC motors)
- R/C servo control
- Temperature sensors
- 7-segment and dot-matrix LEDs
- Text and graphical LCDs
- Accelerometers and gyroscope sensors
- Relay and solenoid control

Useful Links (AVR)

- http://www.atmel.com
- http://www.avrfreaks.net
- http://winavr.sourceforge.net
- http://instruct1.cit.cornell.edu/courses/ee476/

Useful Links (PIC)

- http://www.microchip.com
- http://www.picaxe.co.uk
- http://www.piclist.com
- http://microchip.htsoft.com

Useful Links (General)

- http://www.makezine.com
- http://www.freecycle.org
- http://www.instructables.com
- http://www.beyondlogic.org
- http://www.artofelectronics.com

URLs For These Slides

- My home page:
- http://www.gifford.co.uk/~coredump
- Things I Have Made:
- http://www.gifford.co.uk/~coredump/make.htm
- My e-mail:
- coredump@gifford.co.uk

Questions

- Any questions?