Embended systems
Microcontrollers
Fall 2016
Laboratory Work 1

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January 17, 2017

Date Performed:	October 02, 2016
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Introduction

Topic: Initiating in MCU programing. Library organization. Connecting Stdio.

Objectives: Programming a microcontroller using Atmel Studio, organizing libraries, building a scheme in Proteus.

Tasks: Write a program for the microcontroller, that will turn on and off a LED, connected to it, by a command line.

Micro Controller

Definition A micro-controller (or MCU, short for micro-controller unit) is a small computer (SoC) on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Fierroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Micro-controllers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

Usage Micro-controllers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal micro-controllers are common, integrating analog components needed to control non-digital electronic systems.

How does the micro-controller operate? Even though there is a large number of different types of micro-controllers and even more programs created for their use only, all of them have many things in common. Thus, if you learn to handle one of them you will be able to handle them all.

Special Function Registers Special function registers are part of RAM memory. Their purpose is prede- fined by the manufacturer and cannot be changed therefore. Since their bits are physically connected to particular circuits within the micro-controller, such as A/D converter, serial communication module etc., any change of their state directly affects the operation of the micro-controller or some of the circuits. For example, writing zero or one to the SFR controlling an input/output port causes the appropriate port pin to be configured as input or output. In other words, each bit of this register controls the function of one single pin.

UART

Definition A universal asynchronous receiver/transmitter , is a computer hardware device for asynchronous serial communication in which the data format and transmission speeds are configurable. The electric signaling levels and methods (such as differential signaling, etc.) are handled by a driver circuit external to the UART.

Resourses

Short Theory: Proteus developed by Labcenter Electronics, is a software with which you can easily generate schematic captures, develop PCB and simulate microprocessor. It has such a simple yet effective interface that it simplifies the task required to be performed. This one aspect has attracted many users to select this tool amongst many others offering the same services. Atmel® Studio 6 is the integrated development platform (IDP) for developing and debugging Atmel ARM® Cortex®-M and Atmel AVR® microcontroller (MCU) based applications. The Atmel Studio 6 IDP gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code. A microcontroller (sometimes abbreviated μC, uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. In computing, a device driver (commonly referred to as a driver) is a computer program that operates or controls a particular type of device that is attached to a computer. A driver provides a software interface to hardware devices, enabling operating systems and other computer programs to access hardware functions without needing to know precise details of the hardware being used.

About stdio library: Input and Output operations can be performed using theCStandardInput andOutput Library (cstdio, known asstdio.hin the C language). This library uses what are calledstreamsto operate with physical devices such as keyboards, printers, terminals or with any other type of files supported by the system. Streams are an abstraction to interact with these in an uniform way. All streams have similar properties independently of the individual characteristics of the
physical media they are associated with. Streams are handled in thecstdiolibrary as pointers toFILEobjects. A pointer to aFILEobject uniquely identifies a stream, and is used as a parameter in the operations involving that stream.

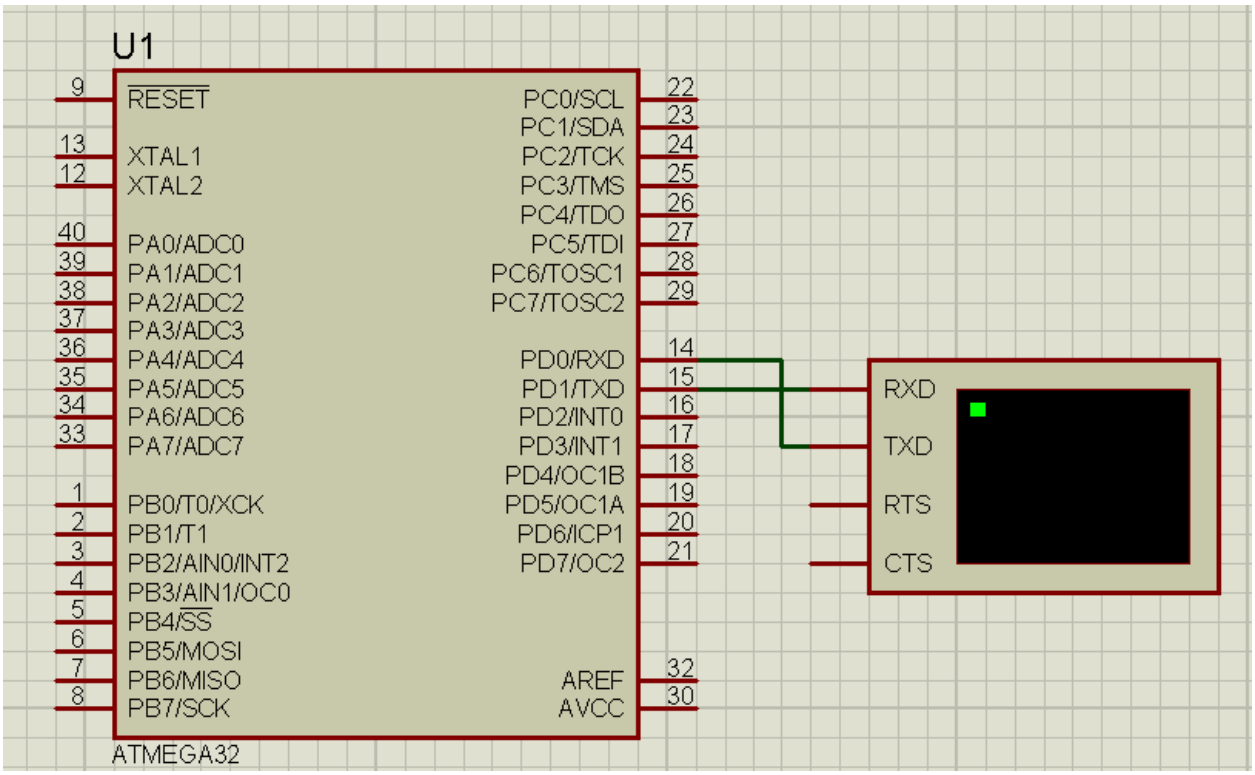
Atmel® microcontrollers: Atmel® microcontrollers (MCUs) deliver a rich blend of efficient integrated designs, proven technology, and groundbreaking innovation that is ideal for today's smart, connected products. In this era of the Internet of Things (IoT), microcontrollers comprise a key technology that fuels machine-to-machine (M2M) communications. Building on decades of experience and industry leadership, Atmel offers proven architectures that are optimized for low power, high-speed connectivity, optimal data bandwidth, and rich interface support. By using our wide variety of configuration options, developers can devise complete system solutions for all kinds of applications. Atmel microcontrollers can also support seamless integration of capacitive touch technology to implement buttons, sliders, and wheels (BSW). In addition, Atmel MCUs deliver wireless and security support. No matter what your market or device, Atmel offers a compelling solution that is tailored to your needs—today and tomorrow. Atmel is a global industry leader in the design and manufacture of microcontrollers and related system solutions, including capacitive touch solutions, advanced logic, mixed-signal, nonvolatile memory, and radio frequency (RF) components. Leveraging one of the industry's broadest intellectual property technology portfolios and backed by a comprehensive ecosystem, Atmel MCU products enable designers to develop complete solutions for industrial, consumer, security, communications, computing, and automotive markets. Developers have the option of combining Atmel microcontrollers with industry-leading Atmel touch technology. Atmel technology for touchscreens and fixed-function buttons, sliders and wheels provides a rich user experience with unparalleled performance, while minimizing power consumption.

ATmega328

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts,serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing

powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

Atmel Studio: Atmel Studio 7 is the integrated development platform (IDP) for developing and debugging Atmel® SMART ARM®-based and Atmel AVR® microcontroller (MCU) applications. Studio 7 supports all AVR and Atmel SMART MCUs. The Atmel Studio 7 IDP gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code. It also connects seamlessly to Atmel debuggers and development kits. Additionally, Atmel Studio includes Atmel Gallery, an online apps store that allows you to extend your development environment with plug-ins developed by Atmel as well as by third-party tool and embedded software vendors. Atmel Studio 7 can also able seamlessly import your Arduino sketches as C++ projects, providing a simple transition path from Makerspace to Marketplace.



<cstdio>(stdio.h) refference

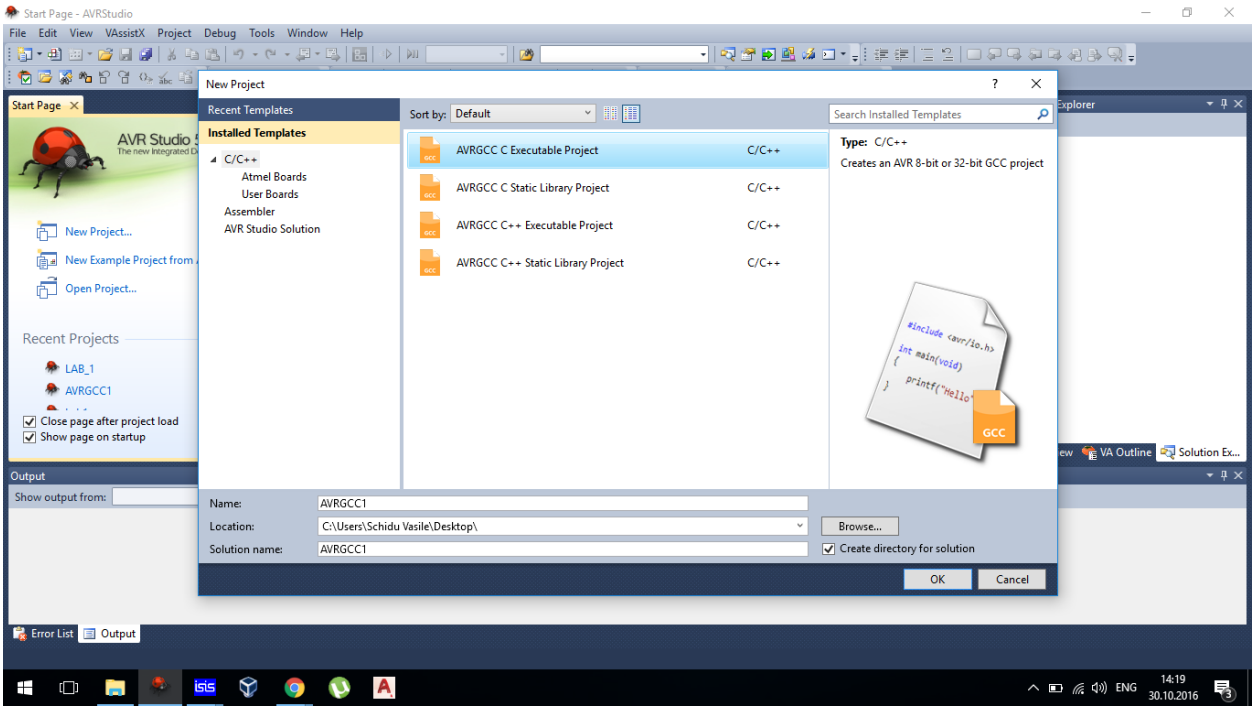
C library to perform Input/Output operations Input and Output operations can also be performed in C++ using the C Standard Input and Output Library (cstdio, known as stdio.h in the C language). This library uses what are called streams to operate with physical devices such as keyboards, printers, terminals or with any other type of files supported by the system. Streams are an abstraction to interact with these in an uniform way; All streams have similar properties independently of the individual characteristics of the physical media they are associated with.

Streams are handled in the cstdio library as pointers to FILE objects. A pointer to a FILE object uniquely identifies a stream, and is used as a parameter in the operations involving that stream.

There also exist three standard streams: stdin, stdout and stderr, which are automatically created and opened for all programs using the library.

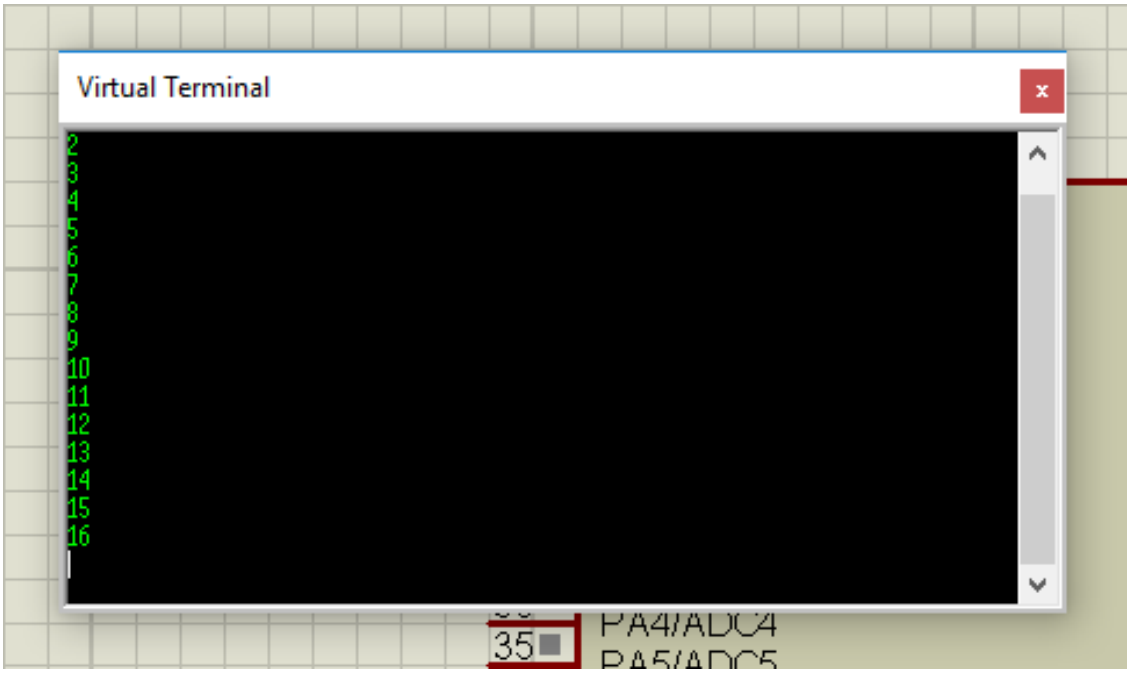
Create your very first project in Atmel Studio

- The First screen shown up after the AS5 has started is the Start Page. The start page helps you quickly create a new project or load your previous project without wasting much time.
  File → New Project → GCC C executable → ATMega32 microcontroller



We want just to display a count variable in the terminal

- Create a main.c file compile it and see if everything works proprelly
- Next create uartstdio.c and uart _stdio.h file, where we created functions uart_stdio_Init(), uart_stdio_PutChar().



Conclusion

By completing this project, I have gained a basic understanding ofabout microcontrolles. I undersand how it work, also I got familiar with AVR Studio and Proteus ISIS. I created a driver for communication with the terminal, and made a couple of basic functions for theterminal such as initialisation and putChar;