Detail SW design specification document

Embedded Software and Design

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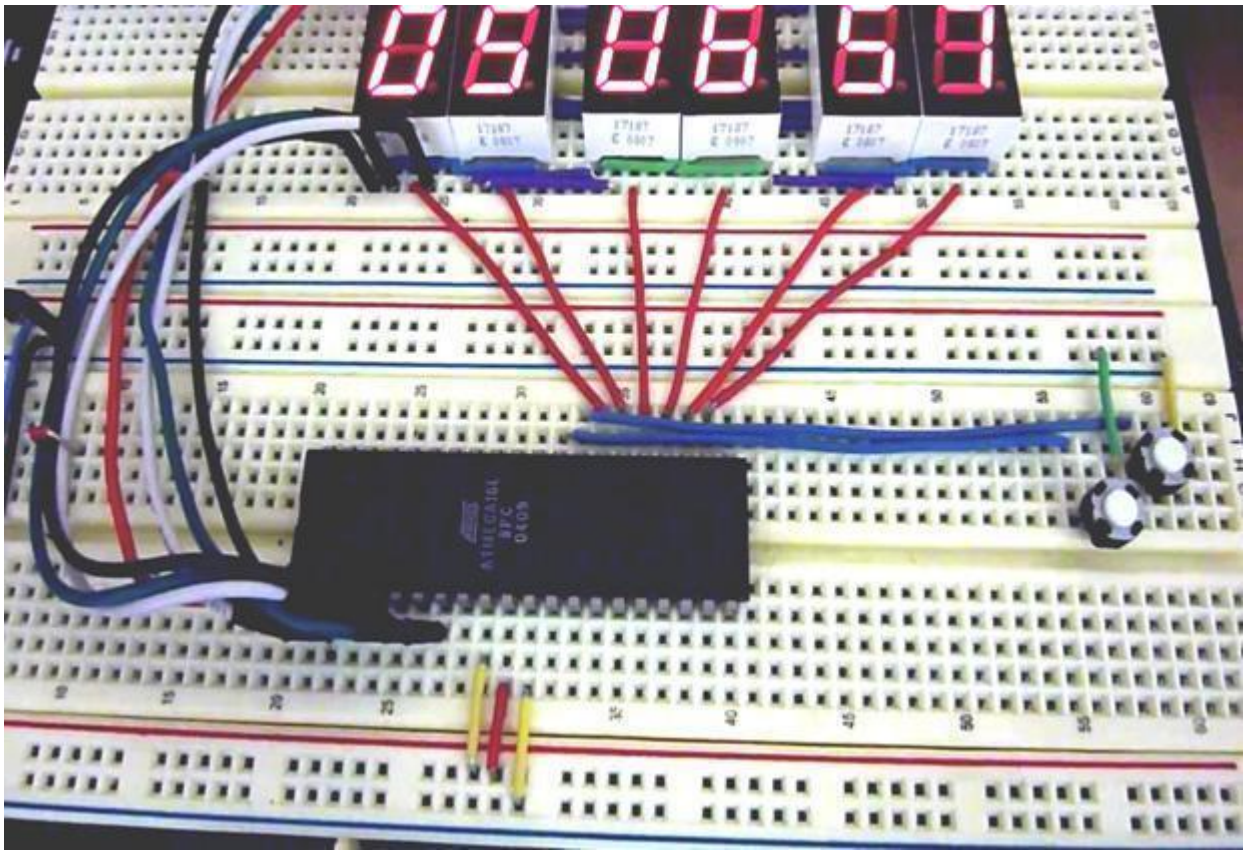
Digital Alarm Clock using Atmega128 Microcontroller[1]



[1] Digital Clock - Real world implementation using Atmega128

Contents:

1. Introduction

The project is going to be a digital clock. The Digital clock has 4 functionalities and it is an alarm clock that is capable of displaying dates, days and years and alarms of given time. The project is implemented using knowledge based on Assembly and C programming Languages. The clock is able to display change modes between normal time display, alarm and stopwatch. It is expected to run on Atmega128 which has around 14 MHz and an LCD display connected on PORT B.

Purpose:

The reason why we need to implement this project is to understand to work with different processors and very low level instructions. Using different PORTS and different types of LCD displays and button controls helps us to understand how overall constructions of complex systems and computers work. During the project we are limited with no operating system as microcontrollers just execute the cycle of instructions and operate on a very small flash programmable memory, it helps us to visualize the memory efficiency which is better to develop software applications.

Scope:

We are going to develop the project using programming language C and we will try to follow all possible best coding practices to make our codes clean. The scope that we can go so far is providing simulation tools and clean source code that is written in C. And Instructions of using digital clocks that we have developed.

Definitions:

Atmega128:

This is the microcontroller that has an 8-bit RISC CPU and built in programmable flash which is good enough to deliver a lot of embedded system products.

C:

It is a general purpose low level programming language which support wide range of lexical and grammar scope

GitHub:

It is a platform which provides a hosting for a developed softwares using a version control called Git.

Git:

It is a version control which is implemented using a state based machine. Every new edit is a new state and can be confirmed using commits. It supports branching and moving between different branches and commits. It is one of the best possible solutions to collaboratively develop the source codes.

LCD:

LCD is a liquid crystal display which is used to display the characters on its screen. The LCD display consists of 8 data lines and 3 control lines which are used to control and display.

References:

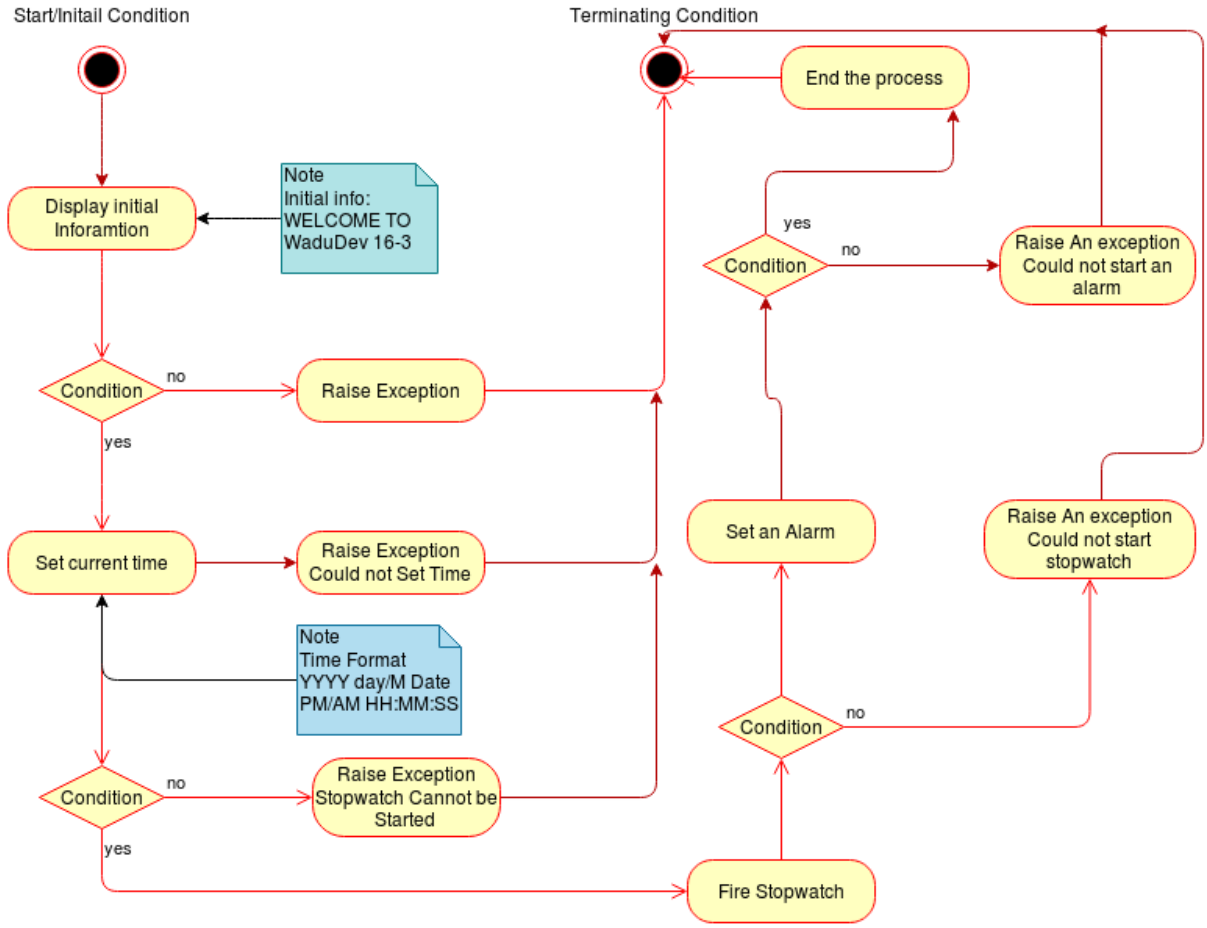
GitHub: visit link for platform

Git:

- 2.26.2 *Release* Notes (2020-04-19) (Available for all major operating systems like Windows, MacOS, and Linux) Visit link for a program

2. Use Cases

Use cases are needed to understand the whole big picture of the project and it makes it easy for developing the source code. We chose the Flow Chart method of available use cases. We have used use cases to connect the whole understanding and coding. Below use case displays the one of simple flows of digital clock.

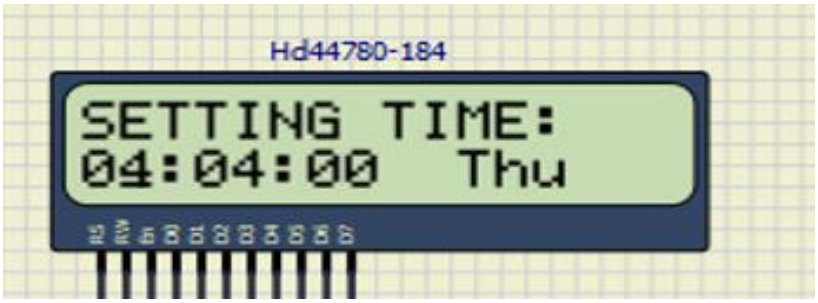


Above graph of the flowing chart explains how a digital clock can work in a simple case. As the given requirements digital clock can be in three different modes such as Clock, Stopwatch and alarm which lets it even be displayed as sequentially. The initial point display shows a text message of “WELCOME TO WaduDev 16-3” and it proceeds with setting the current time in a given format. And then it chaines up with firing a stopwatch which continues by setting an alarm. Every action is taken into round edged rectangles and every single of them is followed by conditional flow which goes forward if there is no error and raises a specific exception according to the case if

something goes wrong. The above diagram includes some notes which are with blue colors and they display extra useful information. Above diagram shows one example of a digital clock life cycle from the start to the end.

3. Design Overview

In this section we are going to tell how we have handled the designing this specific application. After long time of brainstorming we came to know that to design our specific Digital Clock we need to have understanding of all functions and characteristics of LCD. As we know, we are provided with LCD circuit that has two lines and each line consists of 20 characters overall 40 characters can be displayed at the same time.
For that reason, we have design like that.



From the above picture it is clear that we use 1st line as name of the mode, 2nd line for showing the timer.

Here is our detailed SW design:
Initially our Digital clock starts with Setting Time function, then after setting time (PD2 for changing, PD3 for setting) it automatically goes to current time. Then if you press the button PD0 it switches between modes. After switching to stop watch mode it automatically starts counting from 0 and if you press PD3 it will stop. Similarly, using PD0 u can switch to Alarm mode and u can set the alarm as Setting Time function using PD2 and PD3 when current time reaches the alarm time LED will start blinking.

Reference:

1. Image of Digital Clock -

   URL: https://atmega32-avr.com/digital-clock-using-seven-segment-display-atmega16/

   Date Visited: 2020-05-11

   Website uri: https://atmega32-avr.com

2. Draw.io - it is a platform to design and draw use cases, flow charts and a lot more other diagrams.
   Used: it is used to draw a flowchart
   URL: https://app.diagrams.net/
   Name: Draw.io
   Available: Online as a web, and cross-platform as Web based Chrome Apps.