EE2016 Micropprocessor Lab & Theory

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Project 2: Controller for BiPAP

1 Aim

1. Implement the basic functionalities of a BiPAP in Atmega8 (as far as possible).
2. Some random quantities are simulated by generating random number in ARM (using RNG utility??/)

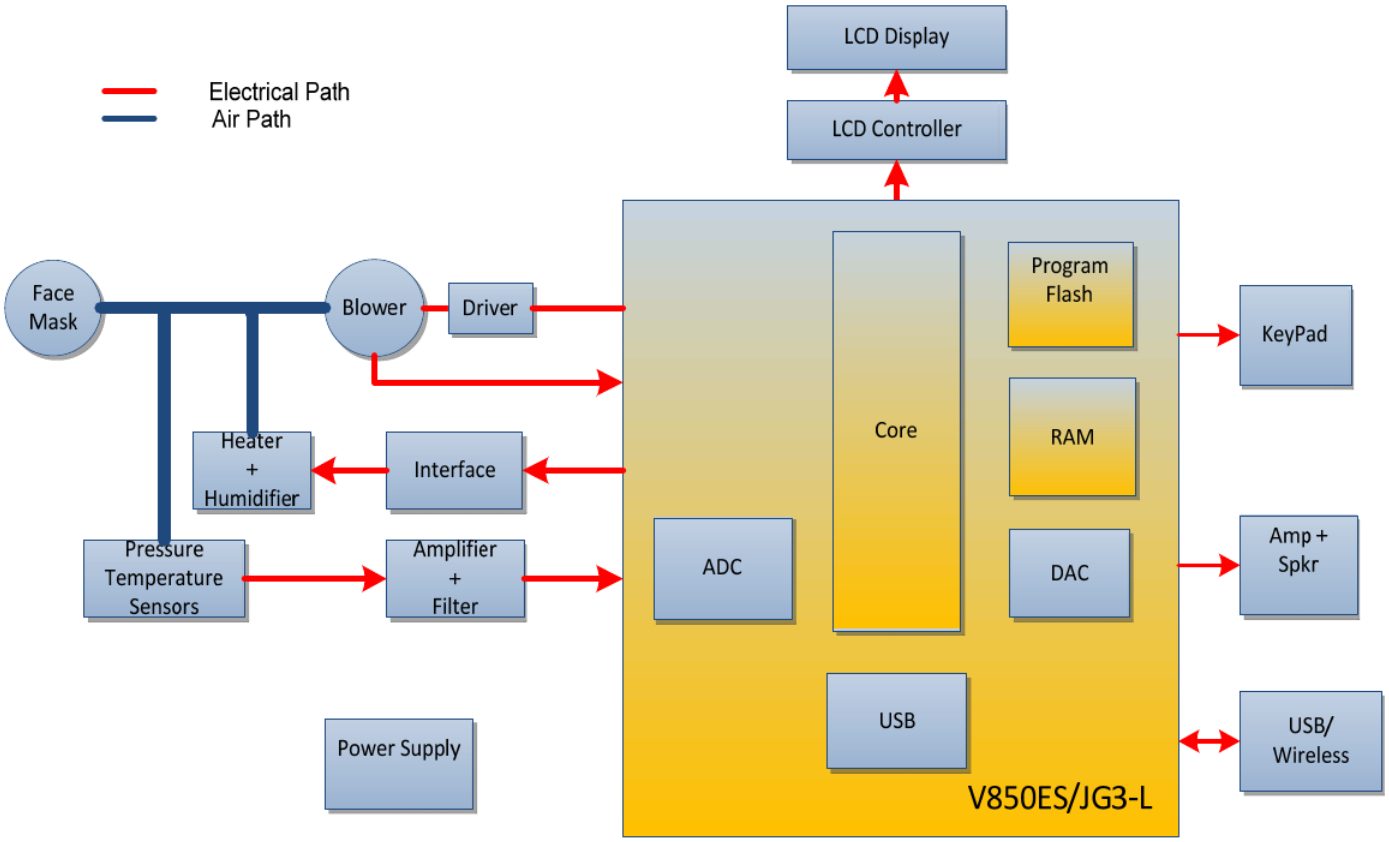
2 Equipments, Hardware Required

The list of equipments, components required are:

1. ARM ViARM 2378 Development board
2. PC with KEIL loaded
3. flashmagic

3 BiPAP: Background Information

The BiPAP medical equipment is essential in every ICU and a support system for severe ashthmetic and other patients with respiratory impairments. [There are many BiPAP machines available in the market. Respirionics is one of them. They use AT91M55800-33ai Atmel AT91 series of 16/32 bit microcontrollers for this purpose. The reader could go through the service manual of the above BiPAP to get an idea to understand the microprocessor interfacing].



3.1 Purpose of the BiPAP and its Principle of Operation

3.1.1 Objective of BiPAP

The purpose of BiPAP is to assist the patient to breath easily. This means the effort by the patient to squeeze the lung muscles (alveolus) to exhale the CO2 could be reduced by creating artificially outside the mouth by fitting a mask and sucking the air out (by a vaccum pump). This is during a exhalation. During inhalation, the patient has to expand the lung muscles (alveolus), to suck the outside air for oxygen. Again the patient could be helped by increasing the O2 pressure between his face and the face mask. The cycle of expiration thus ensues.

3.1.2 Principle of Operation

Observe that the job of BiPAP is to ease the patient with the work of squeezing and expanding the muscles. In order to achieve the above, th BiPAP has to first '*understand*' the inhale/exhale cycle timings, ie., it has to track the inhalation / exhalation cycle. In the practical implementations, this is done by having the sensors, which senses the pressure inside the mask, accordingly triggering the motor which either acts as a compressor pump or vaccum pump.

4 Problem Definition

4.1 Problem Definition

1. Track the inhalation / exhalation cycle.
2. Within the inhalation interval, the motor runs a compressor pump, pumping oxygen. Within the exhalation interval, the motor runs a vaccum pump.
3. The inhalation / exhalation cycle is a varying per every respiration cycle, and is assumed deterministic (periodic with period of 4 respiratory cycles).
4. Each repiratory cycle time, typically is $T_{rsp}^{av} = \frac{60}{18} = 3.33$ secs.
5. The periodic variations are (all in secs): $T_{rsp}(n) = 3.33$, $T_{rsp}(n+1) = 4$, $T_{rsp}(n+2) = 3.33$, $T_{rsp}(n+3) = 2.66$ with 50% duty cycle.

4.2 Solution Format

1. Use the potentiometer current to emulate the pressure sensor output.
2. Draw the graph of the potentiometer current versus time line graph of compressor / vaccum pump.
3. Implement ADC to convert the potentiometer current into digital signal representing the exahalation / inhalation to trigger the (vaccum / compressor) pump motor.
4. Implement serial communication to pass the data to the PC.