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Power Management in 8051 based Embedded System

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***Abstract*— Power management is the feature available in most of the embedded systems and some other electrical or electronics units, like display of a mobile handset or monitor of a personal computer, which automatically turns off the device or put it in low powered stand-by mode for power saving. This mechanism not only prolongs the battery life of portable units but also reduces the heat dissipation, which prolongs the life of the machine, reduces the maintenance overhead, as less cooling is necessary, and also protects the environment.**

With the increasing use of microcontrollers in all sorts of applications, low power has become an very important parameter when designing microcontroller based system. Today's microcontroller designs are often battery or signal wire powered applications replacing passive or mechanical components. Common for them all is the requirement of very low power consumption but with enough power to fill the specification of the product. The project presented here is uses power management feature of 8051 microcontroller which automatically turns off the device or put in mow powered standby mode for power saving. This mechanism not only prolongs the battery life of portable units but also reduces the heat dissipation, which prolongs the life of system, reduces the maintenance overheads, as less cooling is necessary, and also protects the environments.

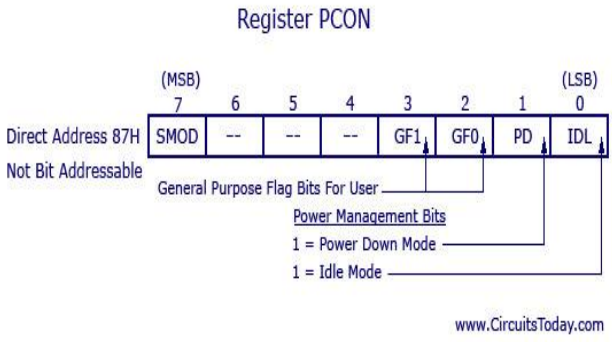
INTRODUCTION

With the increasing use of microcontrollers in all sorts of applications, low power has become an very important parameter when designing microcontroller based system. Today's microcontroller designs are often battery or signal wire powered applications replacing passive or mechanical components. Common for them all is the requirement of very low power consumption but with enough power to fill the specification of the product. The project presented here is uses power management feature of 8051 microcontroller which automatically turns off the device or put in mow powered standby mode for power saving. This mechanism not only prolongs the battery life of portable units but also reduces the heat dissipation, which prolongs the life of system, reduces the maintenance overheads, as less cooling is necessary, and also protects the environments [1].

POWER SAVING MODES

This article is specially targeted to low power consumption modes. Low-power modes typically range from a light sleep or standby mode, through deep-sleep, to off. Each of these mode is working separately according to designed by that particular silicon vendor. But most of them are common to some kinds of level in which CPU, I/O or some peripheral are switched according to need.

Well this mode basically includes saving energy during idle time of processor and during power down time of processor. These are utmost importance in making power saving devices.



The purpose of resistor PCON bit is:

- SMOD Baud rate is twice as much higher by setting this bit
- GF1 General-purpose bit (available for use).
- GF0 General-purpose bit (available for use).
- PD By setting this bit the microcontroller enters the Power Down mode
- IDL By setting this bit the microcontroller enters the idle mode.

By setting bit 0 or bit 1 of PCON resistor, Processor might be placed in idle mode or power down mode. As some of the details of interrupt and timer are necessary to understand the concepts of idle and power down modes, detailed discussions on these issues were reserved for this chapter. We will now take a closer look at these two power saving modes of 8051 and then discuss other related details of the power management issues of 8051 [3]

Normal mode

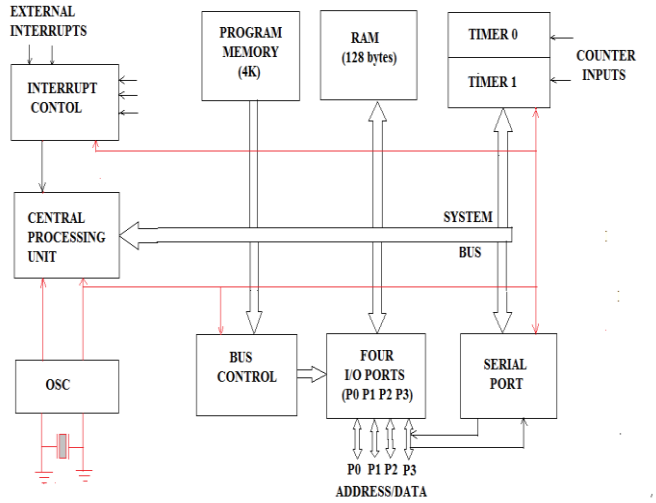


Fig.1 Normal operation of 8051

For normal operations, the oscillator clock input is distributed to various parts of the 8051 microcontroller as shown in Fig. 1[1].

Idle mode

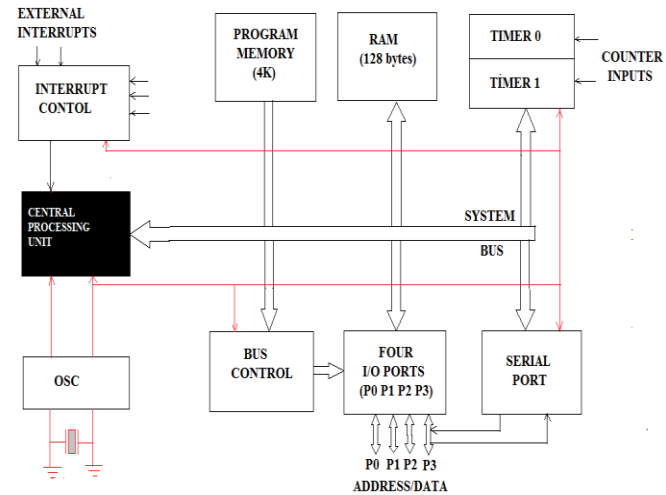


Fig.2 Idle mode with CPU frozen.

If 8051 is placed in the idle mode by setting bit 0 of PCON as 1, then its CPU stops working as the CPU clock input is frozen. This is illustrated in Fig. b by a dark shade within CPU and by the detection of its clock connection with the oscillator block. Since clock pulse is not available to CPU, fetching and execution of instructions will not take place. The other components like Timer/Counter, Interrupts and serial ports remain active, since they receive clock input. To exit from idle mode, hardware reset input or an interrupt (external or timer or serial interrupt) to be applied.

Power down Mode

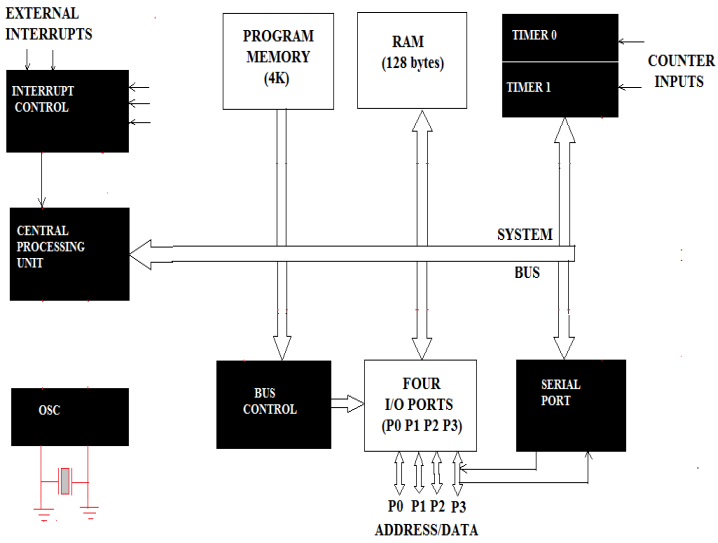


Fig.3 Power-down mode with oscillator frozen

As described earlier, the processor would enter in power down mode when bit 1 of PCON is set. In this mode, the on on hip oscillator itself is frozen, and all peripherals, like Timer/Counter, serial and other interrupts including the CPU, become inactive. Content of internal RAM is not disturbed, and port pins continue to output the data as before. Power consumption is reduced to 100 micro A; The Vcc input may be reduced to as low as 2V during this power down mode. All interrupts become non functional during power down mode, and therefore, unlike the idle mode described in the previous section, it is not possible to bring back the processor to its normal operational mode through some external or internal interrupt [1].

Table I. Comparison between Idle And Power Down Mode [1]

Parameter	Idle Mode	Power Down Mode
Evoked By Setting	PCON.0	PCON.1
Terminated By	Any Enabled Interrupt or Hardware Reset	By Hardware Reset Only
Power Consumption	5 mA	0.1mA
Condition of SFRs after Exit	Remain Unchanged	Initialised Respective Reset Value
Condition of Internal RAM	Unchanged	Unchanged
Condition of Ports during Sleep	Unchanged	Unchanged
On Chip Oscillator	Remains Active	Goes Inactive

Schematic Diagram

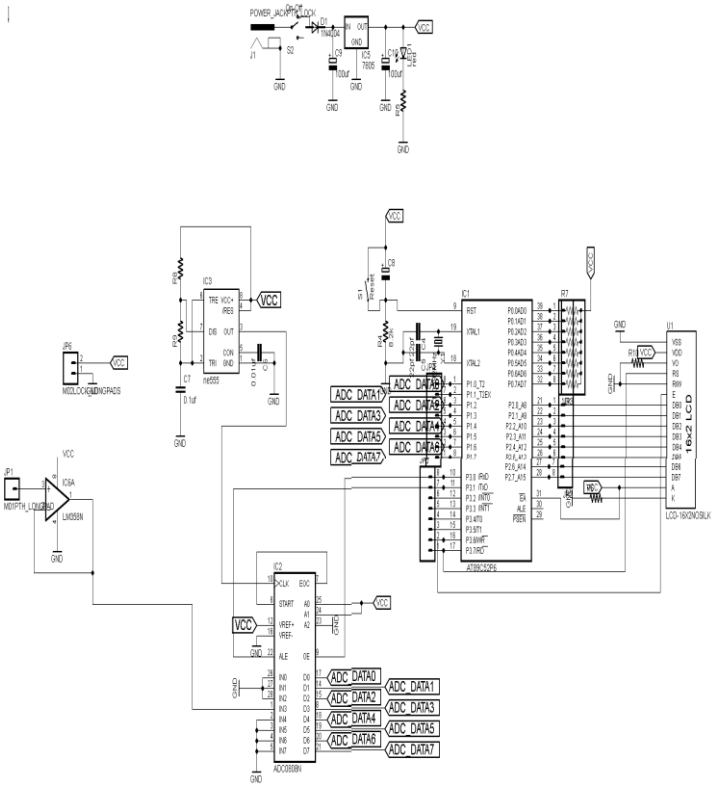


Fig.4 Schematic Diagram 8051 based embedded system

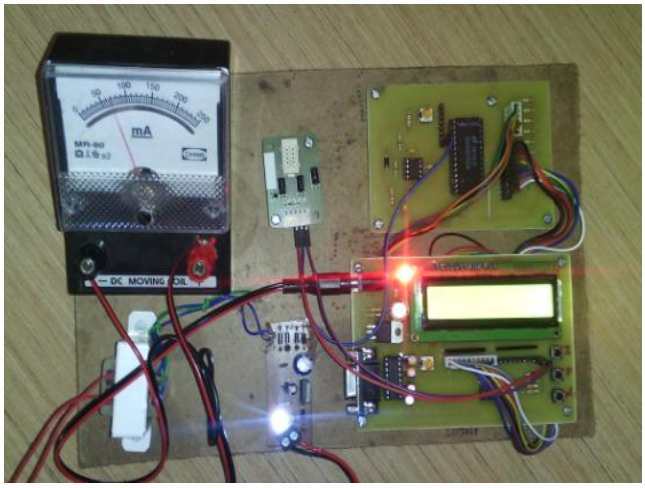


Fig.5 Experimental Setup

RESULT DISCUSSION

For the purpose of comparison, we assume that in all the three cases, the key to generate the random number would be activated once in 30 sec. Therefore, in all the 3 cases, the maximum power consumption would take place only during those 5 sec. of display activation [1].
Following readings were recorded during program execution.
Normal mode: 70 mA
Idle Mode: 65 mA
Power Down mode: 55mA

CONCLUSION

The main purpose of the project work is to estimate the power saving in 8051. This development kit is useful for interfacing humidity sensor with 8051. This can be used for various industrial applications.

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