

# Microcontrollers in wireless sensor networks

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ABSTRACT: Now a day's wireless sensor networks have been gaining interact with physical in world. Whereas these can be used in different applications in medical, military, roadside, industrial etc . In the wireless sensor network reducing power is the main importance. In wireless sensor network, which are using battery operated sensors need low-power component devices to increase the life time of the sensors and also gives rise for wireless sensor networks which prolongs the life time for sensor nodes. In this we explore about the three different microcontrollers in wireless sensor and also we discussed about the characteristics of the typical wireless sensor network application. They are Microchip, AVR and MSP430 series. By comparing this we conclude which is best for the wireless sensor network. Now a day's these microcontrollers are commercially using in sensor nodes.

## 1. INTRODUCTION:

A sensor node is a node which is able for performing some processing, collecting sensor information's and communicating with other connected nodes in a sensor network and it is also called as node. These sensor nodes usually have very small computers and storage capability compared to desktop computers. This can be attributed to their use of very low power microcontrollers.

Microcontrollers perform the main task in the sensor nodes i. e. processing the data and controlling the functions of the other components. These are some of the controllers using as Digital Signal Processors, Field Programmable Gate Array and applications. So microcontrollers are more suitable for sensor nodes. The best choice for embedded systems is to use

microcontrollers because of the services providing by them, like it can connect to other devices more flexible and the power consumption is less.

Digital Signal Processing is commandeering for broadband wireless communication, but according to wireless sensor networks the communication should be simple and easy to process. Field Programmable Gate Array are not used in wireless sensor network because it should required more time and energy for the reprogrammabligng and reconfiguring to their usage. Application-specific Integrated circuits are performing as hardware where as microcontrollers are providing as softwares. So a wireless sensor network mostly uses microcontrollers. In this wireless sensor network we uses so many microcontrollers with different companies they are Microchip, Atmel etc.

There are three different typical micro controllers which are used in wireless sensor network applications . they are Microchips, AVR series & MSP430 series.

## 2. TYPICAL MICROCONTROLLERS USED IN WSN APPLICATIONS:

### 2. 1. Microchips:

PIC microcontrollers are made by microchip technologies limited. These are mainly used in industrial development due to their low cost and it has serial programming capability. The features for microchip are explained below.

#### 2. 1. 1. Interrupt structure:

In the PIC microcontroller interrupt structure is very simple but powerful, we can set the priority levels to the interrupts i. e., high or low and also these are useful for real time interrupts.

#### 2. 1. 2. Instruction set:

For the lower end PIC's it varies about 35 instructions and for higher end PIC's it varies about 80 instructions. pic micro controllers called as 8bit micro controllers because we have different PIC series for example PIC12 series size varies from 12bit and 30bits in the PIC30. in this single cycle execution with single delay cycle.

#### 2. 1. 3. Memory architecture:

PIC microcontrollers follow Harvard architecture nothing but separate code and data space. This microcontroller have number of register files which works as general purpose ram some of special purpose control registers for on chip researches. In this memory is divided in to banks.

#### 2. 1. 4. Input and output features:

For every microcontroller we have I/O ports, which are used for transceiver and analog to digital conversion interfacing. But for some of the PIC series microcontrollers have on-chip ADC, due to this we used direct for analogy data from the transducer. PIC series also having the hardware which can carry SPI out.

#### 2. 1. 5. Applicability of low power techniques:

These microcontrollers are able to operate over a wide frequency and voltage range which makes frequency scaling possible. Some of PIC series don't support frequency scaling but due to the external hardware they can support they are PIC12 and PIC16. but some PIC series supports the frequency scaling because of having the internal RC oscillator which can be used as clock. Due to this clock switching it takes time for result.

#### 2. 1. 6. Low power sleep mode:

By comparing the microcontrollers the PIC series microcontrollers are simplistic. Due to this lower end PIC's doesn't have sleep modes. But for PIC16 microcontrollers it has only one sleep mode which was placed on processor core, for PIC18 series have two sleep modes if the peripherals are running then the core is shut-off and it is vice versa for second sleep mode.

#### 2. 1. 7. Pipelining:

PIC instruction takes one machine to execute i. e. 4 clock cycles. For execution it takes two phases fetch and execute. This is a two stage pipeline.

#### 2. 1. 8. Shortcoming:

PIC microcontrollers have a small set of instruction set but these are best comparing to RISC devices. But PIC architecture doesn't have more advantages compared to RISC. They are, it doesn't have load-store architecture, due to this the memory direction refers in arithmetic and logical instructions. By comparing to RISC processor, this PIC has only a single register but for RISC typically includes 16.

## 2. 2. AVR series:

The AVR series microcontroller is also follows the Harvard architecture.

ATMega128L microcontroller is widely used in sensor nodes. The features for AVR are explained below.

### 2. 2. 1. Interrupt structure:

AVR microcontroller is a powerful interrupt structure for AVR interrupt execution is enabled for four clock cycle minimum. Then the program is executed.

### 2. 2. 2. Instruction set:

The AVR ISA is more suitable than 8-bit microcontroller. The ATMEGA128 offer 133 powerful instructions. Each instruction takes one or two 16bit words. In this instruction set arithmetic operations work on register R0-R32, but not directly on RAM.

### 2. 2. 3. Memory architecture:

The Harvard architecture type AVR is based with programs and stores data separately for performing and parallelism. Flash, EEPROM, SRAM are single integrated chip. The register file, input out registers, and SRAM are data address space.

### 2. 2. 4. I/O features:

General purpose I/O ports are bi-directional. These AVR's has a built in ADC and Analog comparators. In AVR on Chip Debugging (OCD) support through

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JTAG. The flexible communication in AVR is serial peripheral interface and a two-wire serial interface and these are analog comparators.

#### 2. 2. 5. Applicability of low power techniques:

In this the low voltage is operating down to 1.8v. in this voltage is available and also frequency scaling also provided.

#### 2. 2. 6. Low power sleeps modes:

It also fix power sleep modes they are Idle, ADC noise reduction, power-save, power-down, stand by and extended stand by.

#### 2. 2. 7. Pipelining:

In this microcontroller each instruction occupies one or two cycles and it also consists of fetch and the execute cycle. It also has single level pipeline design.

#### 2. 3. MSP430:

These types of microcontrollers are by Texas instruments. It is one of the lowest power consuming processor in the market at present. It is ideal for wireless applications and embedded systems. The features for MSP430 are explained below.

#### 2. 3. 1. Interrupt structure:

In the MSP430 microcontroller interrupt structure provides two timers and a watchdog timer. It is also a power interrupt structure. In this interrupts have fixed priority by ordering.

#### 2. 3. 2. Instruction set:

The MSP430 is a 16-bit RISC processor and it has common RISC features in ISA. In this controller it has 27 core instructions and 7 addressing modes are present. These are having three core instructions format they are operand, operands or a jump. In this both dedicated stack and stack are available.

#### 2. 3. 3. Memory architecture:

These microcontrollers are also uses same space and data as per above discussed controllers. In this the entire ROM and RAM a single 16-bit pointer is used. This processor contains 16-bit register. R0 is a program counter, R1 is a stack pointer, R2 is a status register and R3 is a special register i. e. nothing but a constant generation. R4 to R15 is for general use.

#### 2. 3. 4. I/O features:

The host of I/O features are built in msp430. for interfacing devices like radio and transducers it has 10 I/O ports. UART and SPL support are available on the type of models.

#### 2. 3. 5. Applicability of low power technique:



For low power applications the msp430 is neutral. With the help of its “supply voltage supervisor” it can sample input voltage and at each time it can set below a software programmable threshold.

#### 2. 3. 6. Low powers sleep modes:

Six different power modes are available for msp430. Wakeup time is 6micro sec with the use of digital oscillator.

#### 2. 3. 7. Pipelining:

It is not a pipelining architecture. There is no pipeline because they have different number of cycles in instruction but the positive is the most instructions run in one cycle which doesn't make the processor too down. The maximum clock frequency is slower when compared to other because of it lack of pipeline and division of instruction cycle.

#### 2. 4. Comparison between PIC and AVR microcontrollers:

In PIC microcontroller the memory architecture requires bank register to access 256 bytes of memory but for AVR no need of bank to access the data memory. PIC has only one general purpose register but AVR has 32 general purpose registers. PIC doesn't have SRAM where as AVR has SRAM that the stack is contained within SRAM in order to build the hardware stack. PIC18F and AT Mega having hardware multipliers where as AT Tiny and PIC16F don't having hardware multipliers. PIC is having high clock speed but it is divided by four to give the actual instruction rate. By comparing ATMega128L and MSP430 have rich instruction set and also it has a wide range of arithmetic

instructions sets, many addressing modes. But in PIC18 and 8051 microcontrollers are limited. But PIC16 has add with carry instructions. The MSP430 has 40 digital pins, ATmega128L has 53 pins, PIC18 has 36, and PIC16 33 and 8051 has 37.

### 3. CONCLUSION:

These microcontrollers are the central parts of any kind of sensors nodes. We have different types of microcontrollers in the present market which have almost same feature with the life of battery we can know the lifetime of the node. With the kind of memory access, instructions we known, how the execution of code is performed. The processing task can be done with more complex instructions, allowing more sleeping time to the system. It has the ability for self programming which is a useful feature. The efficient code will be generated with a well optimised version. But it doesn't deal well with the accumulator.

Finally by comparing these three different microcontrollers MSP family series microcontrollers are better than the others. Because, its work better than the older microcontrollers and it completely dominates or rectifies the problem and works.