ADC

WHY ADC?

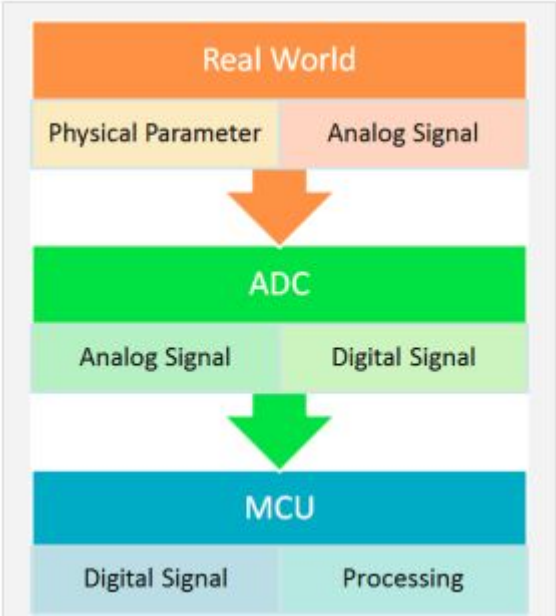
Real life data is analog.

microcontroller processes digital.

Benefits of analog as compared to digital.

Process

1. Analog signal from sensor.
2. Converted from analog into digital.
3. Digital data processed by microcontroller.



Features

1) clock speed 50KHz to 200KHz
2) 8 channel (PA0 - PA7)
3) 10 bit resolution
4) interrupt on ADC conversion completion
5) 0 - Vcc ADC input voltage range
6) ADC start - auto triggering or interrupt.
7) 2 modes : single conversion and free running.

Resolution

10 bit resolution.

implies what?

ADC prescaler

Why we need them?

50 Khz to 200 Khz

some predefined 2,4,8,16,32,64,128.

F_ADC = F_CPU / prescaler defined.

There is a tradeoff between frequency and accuracy. More the frequency, less will be the accuracy.

Registers

The ADC has only four registers.

1. **ADC Multiplexer Selection Register – ADMUX** : For selecting the reference voltage and the input channel.
2. **ADC Control and Status Register A – ADCSRA** : As the name says it has the status of ADC and is also used for controlling it.
3. **The ADC Data Register – ADCL and ADCH** : The final result of conversion is here.

24.9.1 ADMUX – ADC Multiplexer Selection Register

Bit	7	6	5	4	3	2	1	0	
(0x7C)	REFS1	REFS0	ADLAR	–	MUX3	MUX2	MUX1	MUX0	ADMUX
Read/Write	R/W	R/W	R/W	R	R/W	R/W	R/W	R/W	
Initial Value	0	0	0	0	0	0	0	0	

Table 24-4. Input Channel Selections

MUX3...0	Single Ended Input
0000	ADC0
0001	ADC1
0010	ADC2
0011	ADC3
0100	ADC4
0101	ADC5
0110	ADC6
0111	ADC7
1000	ADC8(1)
1001	(reserved)
1010	(reserved)
1011	(reserved)
1100	(reserved)
1101	(reserved)
1110	1.1V (V_{BG})
1111	0V (GND)

Table 24-3. Voltage Reference Selections for ADC

REFS1	REFS0	Voltage Reference Selection
0	0	AREF, Internal V_{ref} turned off
0	1	AV_{CC} with external capacitor at AREF pin
1	0	Reserved
1	1	Internal 1.1V Voltage Reference with external capacitor at AREF pin

24.9.2 ADCSRA – ADC Control and Status Register A

Bit	7	6	5	4	3	2	1	0	
(0x7A)	ADEN	ADSC	ADATE	ADIF	ADIE	ADPS2	ADPS1	ADPS0	ADCSRA
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial Value	0	0	0	0	0	0	0	0	

ADEN - ADC enable

ADSC - ADC start conversion

ADATE - ADC auto trigger enable

ADIF - ADC interrupt flag

ADIE - ADC interrupt enable

ADPS - ADC prescaler select bits

Table 24-5. ADC Prescaler Selections

ADPS2	ADPS1	ADPS0	Division Factor
0	0	0	2
0	0	1	2
0	1	0	4
0	1	1	8
1	0	0	16
1	0	1	32
1	1	0	64
1	1	1	128

resolution of 10 bits, so the result is in 10 bits.

broken into ADCL and ADCH.

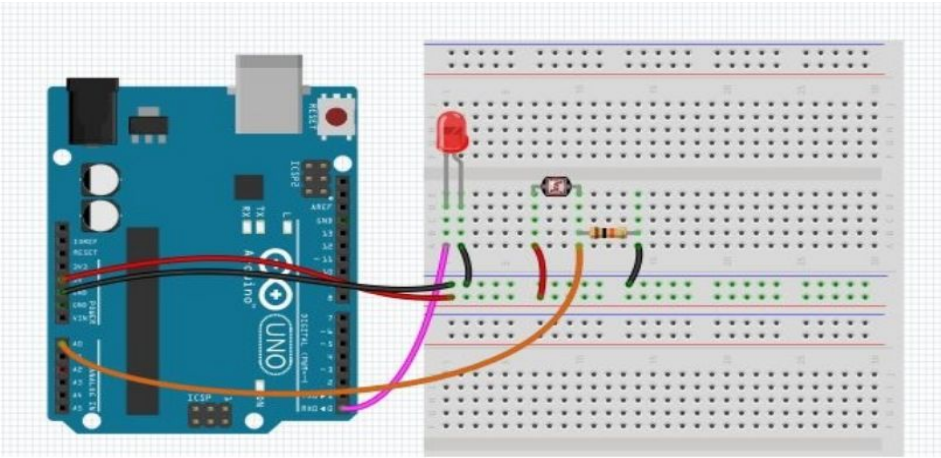
ADCH holds the two most significant bits and rest all are stored in ADCL.

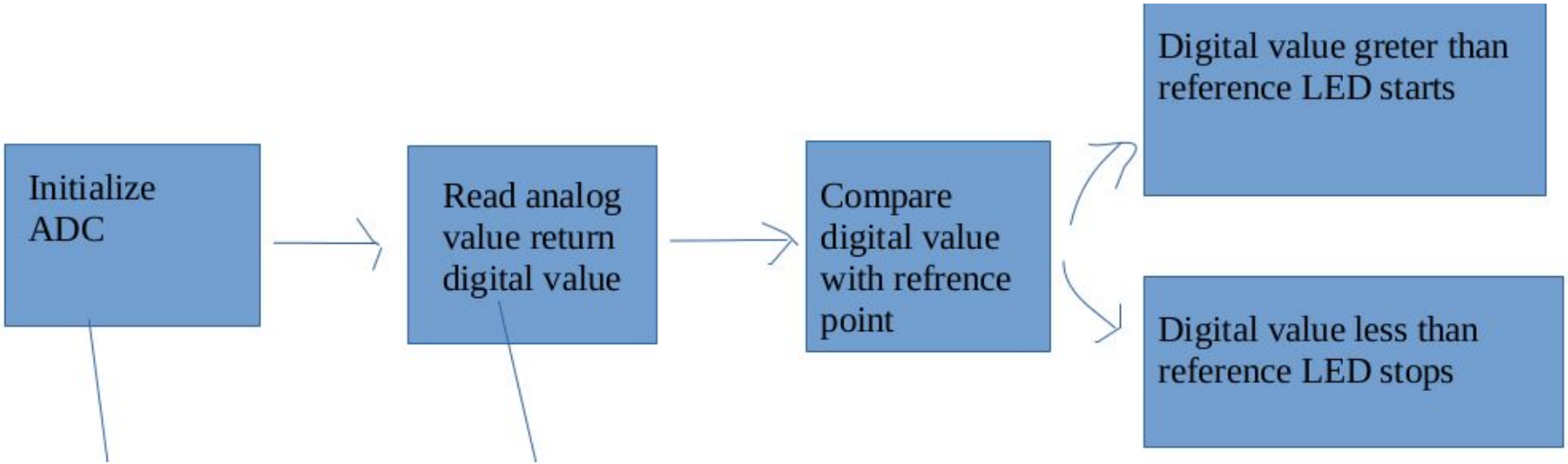
Hands on

LDR : As light decreases, resistance of LDR increases.

Connections : LDR 5V, A0 through a resistor.

LED on D0.




Initialize ADC
Read analog value return digital value
Compare digital value with refrence point
Digital value greter than reference LED starts
Digital value less than reference LED stops

Pseudo code

void adc_init()

{

Set the reference voltage in ADMUX.

in ADCSRA, enable ADEN

set a prescaler of 128 as 16000000/128 = 125000

}

adc read(){

Write ADSC 1

start infinite loop till ADSC is 1

return the value

}

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