Experiment – 5

Title: Design and develop On/Off controller using microcontroller.

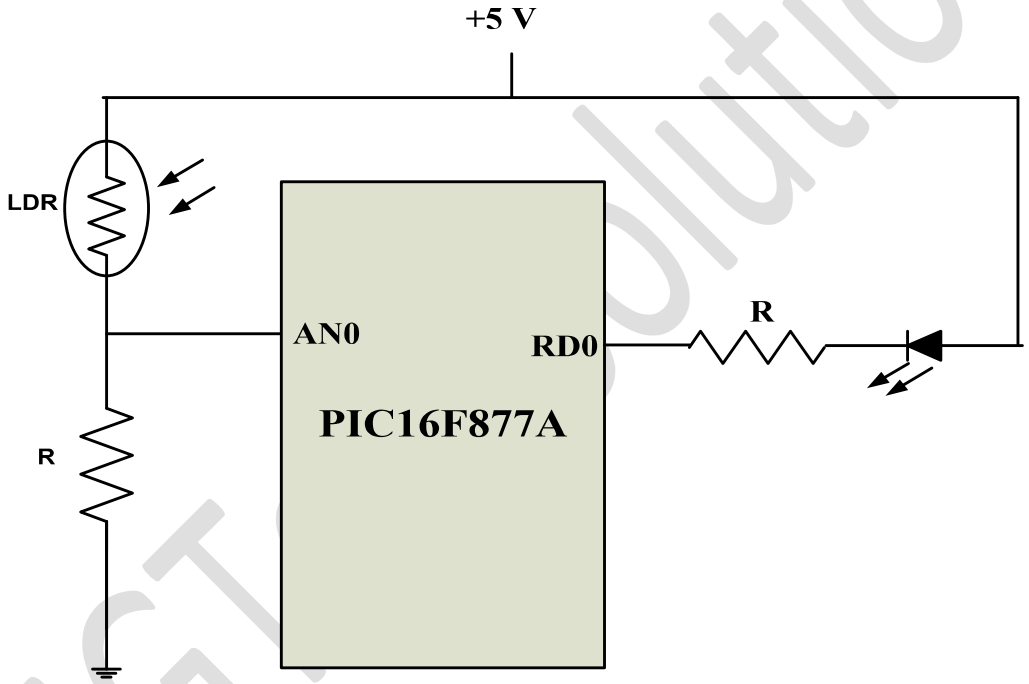
Aim: To Design and develop On/Off controller using PIC.

Objectives:

- To study concept of On/Off controller.
- To study MPLAB IDE software.
- To study use of ADC to interface sensors.

Software Used: MPLAB IDE

Block Diagram:



R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0
ADCS1	ADCS0	CHS2	CHS1	CHS0	GO/$\overline{\text{DONE}}$	—	ADON
bit 7							bit 0

bit 7-6 **ADCS1:ADCS0:** A/D Conversion Clock Select bits
00 = Fosc/2
01 = Fosc/8
10 = Fosc/32
11 = FRC (clock derived from the internal A/D module RC oscillator)

bit 5-3 **CHS2:CHS0**: Analog Channel Select bits
000 = channel 0, (RA0/AN0)
001 = channel 1, (RA1/AN1)
010 = channel 2, (RA2/AN2)
011 = channel 3, (RA3/AN3)
100 = channel 4, (RA5/AN4)
101 = channel 5, (RE0/AN5)(1)
110 = channel 6, (RE1/AN6)(1)
111 = channel 7, (RE2/AN7)(1)

bit 2 **GO/$\overline{\text{DONE}}$:** A/D Conversion Status bit
If ADON = 1:
1 = A/D conversion in progress (setting this bit starts the A/D conversion)
0 = A/D conversion not in progress (this bit is automatically cleared by hardware when the A/D conversion is complete)

bit 1 **Unimplemented**: Read as '0'

bit 0 **ADON**: A/D On bit
1 = A/D converter module is operating
0 = A/D converter module is shut-off and consumes no operating current

Figure: ADCON0 REGISTER

U-0	U-0	R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
ADFM	—	—	—	PCFG3	PCFG2	PCFG1	PCFG0
bit 7							bit 0

bit 7 **ADFM:** A/D Result Format Select bit
1 = Right justified. 6 Most Significant bits of ADRESH are read as '0'.
0 = Left justified. 6 Least Significant bits of ADRESL are read as '0'.

bit 6-4 **Unimplemented:** Read as '0'

bit 3-0 **PCFG3:PCFG0**: A/D Port Configuration Control bits:

PCFG3: PCFG0	AN7(1) RE2	AN6(1) RE1	AN5(1) RE0	AN4 RA5	AN3 RA3	AN2 RA2	AN1 RA1	AN0 RA0	VREF+	VREF-	CHAN/ Refs(2)
0000	A	A	A	A	A	A	A	A	VDD	VSS	8/0
0001	A	A	A	A	VREF+	A	A	A	RA3	VSS	7/1
0010	D	D	D	A	A	A	A	A	VDD	VSS	5/0
0011	D	D	D	A	VREF+	A	A	A	RA3	VSS	4/1
0100	D	D	D	D	A	D	A	A	VDD	VSS	3/0
0101	D	D	D	D	VREF+	D	A	A	RA3	VSS	2/1
011x	D	D	D	D	D	D	D	D	VDD	VSS	0/0
1000	A	A	A	A	VREF+	VREF-	A	A	RA3	RA2	6/2
1001	D	D	A	A	A	A	A	A	VDD	VSS	6/0
1010	D	D	A	A	VREF+	A	A	A	RA3	VSS	5/1
1011	D	D	A	A	VREF+	VREF-	A	A	RA3	RA2	4/2
1100	D	D	D	A	VREF+	VREF-	A	A	RA3	RA2	3/2
1101	D	D	D	D	VREF+	VREF-	A	A	RA3	RA2	2/2
1110	D	D	D	D	D	D	D	A	VDD	VSS	1/0
1111	D	D	D	D	VREF+	VREF-	D	A	RA3	RA2	1/2

A = Analog input D = Digital I/O

Figure: ADCON1 REGISTER

Procedure:

- Make necessary connections to connect LDR Sensor and LED to PIC target board.
- Switch on the power.
- Start MPLAB IDE software PC and write a program for on / off controller.
- Perform the configuration settings and build it.
- Connect the PICKit3 programmer to the Target board.
- Program the .hex file into the PIC.
- Reset the microcontroller and observe the output.

Program:

```
#define _XTAL_FREQ 16000000
#include <xc.h>
void ADC_init(void);
unsigned int ADC_READ(void);
void main(void)
{
unsigned int ADC_result;
ADC_init();
TRISD0 = 0;                 //RD0 as Output PIN
while(1)
{
ADC_result=ADC_READ();
if(ADC_result > 500)
{
RD0 = 0;                    // LED ON
}
else
{
RD0 = 1;                    // LED OFF
}
}
}

void ADC_init(void)
{
TRISAbits.TRISA0=1;             // AN0 set as analog i/p
```

```
TRISAbits.TRISA1=1;              // AN1 set as analog i/p
ADRESH=0;
ADRESL=0;
PIR1bits.ADIF=0;                 //ADC flag clear
ADCON1=0X8E;                     //MAKE AN0 as analog port
ADCON0=0x40;                    //Select Chanel 0, conversion clock = FOSC / 8
}
unsigned int ADC_READ()
{
ADCON0bits.ADON=1;                                          //ADC ON
__delay_ms(2);                                              //2ms delay
ADCON0bits.GO=1;                                            //start a/d conversion
__delay_us(1);
while(PIR1bits.ADIF==0);
__delay_us(1);
ADCON0bits.ADON=0;                                          //ADC Off
PIR1bits.ADIF=0;
return (((unsigned int)ADRESH)<<8)|(ADRESL);
}
```

Applications: (Write applications of On/Off controller here)

Result: Design and development of On/Off controller using PIC is studied and tested successfully.

Teacher's Sign

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