

BORDER SECURITY ROBOT FOR EFFECTIVE SURVILLANCE AND HUMAN INTRACTION DETECTION IN BORDER REGIONS COVERED WITH DRY LEAVES

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Electrical and Electronics Engineering

By

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**DEPARTMENT OF MECHANICAL
ENGINEERING
SCHOOL OF
MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND
TECHNOLOGY (DEEMED TO BE
UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by
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March - 2021

(Format for declaration)

DECLARATION

We **VIJAY.S** (Reg No. 37140093) and **MARIA JOHN BOSCO.M** (Reg No. 37140052). Hereby declare that the Project Report entitled “**BORDER SECURITY ROBOT FOR EFFECTIVE SURVEILLANCE AND HUMAN INTERUSION DETECTION IN BORDER REGION COVERED WITH DRY LEAVES**” done by me under the guidance of **Mr.D.N.S. RAVIKUMAR** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

1. 

2. 

DATE:

PLACE:

SIGNATURE OF THE CANDIDATE



SATHYABAMA

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DEPARTMENT OF BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **VIJAY.S**(Reg no.37140093) and **MARIA JOHN BOSCO.M** (Reg No. 37140052) who have done the Project entitled “**BORDER SECURITY ROBOT FOR EFFECTIVE SURVEILLANCE AND HUMAN INTERUSION DETECTION IN BORDER REGION COVERED WITH DRY LEAVES**” under our Supervision from December 2020 to April 2021.

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Signature:

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CHAPTER-1

INTRODUCTION

The human persona non grata detection in numerous border situations could be a challenge for each country. One in every of the main issues self-addressed by the patrol systems of a rustic is that the internal security of the border areas. In ancient border patrolling systems, the military guards the border space through pre-decided routes at completely different intervals of your time. Intensive human involvement is that the major challenge for shielding long border areas. A number of the opposite challenges area unit high price of the sensors, integration of multiple varieties of sensors during a single system and adopting the appropriate communication protocols at completely different mediums. Multiple police work and detection technologies, which counterpoint one another, area unit needed for period of time observance of the border areas with high potency, precise accuracy, and minimum human support. To beat the issues self-addressed by the normal police work and a run D is with Amrita Center for Wireless Networks detection techniques, a survey has been done that highlights completely different wireless detector network primarily based border police work and human persona non grata detection strategies. The rise in human interventions leads for constructing a secure Intrusion Detection System (IDS). WSN has the potential to integrate several sensors and communicate the detected information wirelessly into a central station. The survey discusses chiefly on the hybrid WSN that consists of geophone detector node for sleuthing the persona non grata movement within the flat border areas, hydrophone detector node for sleuthing the river/pond crossing of the persona non grata, electro-acoustic transducer detector node for sleuthing the dry leaves movement of human persona non grata, Infrared detector node for sleuthing the persona non grata movement between the border areas and police work camera detector deployed on the police work tower for real time border police work purpose. An outline of the impact of WSN within the border security system is provided in Section II. Section III describes numerous WSN primarily based system architectures for border police work and persona non grata detection.

1.1OVERVIEW

The Wireless detector Network (WSN) technology has the power to capture period of time info and transmit them to different communication devices for process. WSN has been employed in several applications like disaster management, preciseness agriculture, health care, intelligent control and military police work. WSN technology eliminates human involvement in information assortment and period of time observance in dangerous environments. The smaller size and value effectiveness of WSN allows the readying of an oversized quantity of detector nodes within the police work regions. Multiple sensors utilize entry nodes for transmittal and receiving info. WSN technology will be utilized in many military-related applications like footstep detection of intruders' exploitation geophone detector, persona non grata movement detection exploitation IR sensors, and economical police work through high-quality camera sensors. Researchers are that specialize in movement detection of the persona non grata exploitation electro-acoustic transducer detector and underwater intrusion exploitation acoustic sensors like hydrophones. Wireless detector networks so give a good resolution for observance persona non grata movements and early alerts.

CHAPTER-2

LITERATURE SURVEY

1] Application of wireless sensor networks in environmental monitoring

Application of wireless detector networks in environmental observance the wireless detector networks (WSN) is one in every of the foremost vital technologies within the twenty first century. In recent years, achievements in micro-sensor technology and low-power physical science build WSN become realities in applications. During this paper, we tend to propose a system for WSN supported environmental observance. The system will monitor many environmental parameters like underground water level, atmospheric pressure, close temperature, atmospherically humidness, wind direction, wind speed and downfall and supply numerous convenient services for finish users United Nations agency will manage the information via a web site from long-distance or applications in console terminal. This paper introduces the design of WSN system, the hardware of node, information acquisition, processing with entry and information visual image. Through the employment of WSN within the environmental observance, it's attainable to alter the historically environmental observance strategies for folks.

2] Real-time wireless sensor network for landslide detection.

Period of time wireless detector network for landslide detection. Wireless detector networks area unit one in every of the rising areas that have equipped scientists with the potential of developing period of time observance systems. This paper discusses the event of a wireless detector network (WSN) to sight landslides, which incorporates the look, development and implementation of a WSN for real time observance, the event of the algorithms required which will alter economical information assortment and information aggregation, and also the network necessities of the deployed landslide detection system. The particular readying of the testbed is within the Idukki district of the Southern state of Kerala, India, a part best-known for its significant downfall, steep slopes, and frequent landslides.

3] Border surveillance and intruder detection using wireless sensor networks: A brief survey.

Border police work and unwelcome person detection victimization wireless detector networks: a short survey. Intrusion of terrorists and trespassers are adversely moving the peace and harmony within the nation. The fatalities Associate in nursing disturbances caused by the most recent Uri attack in Indian Army Camp show the need of an economical border police work and unwelcome person detection system for the effective observation and police investigation the unauthorized movement of intruders across the national borders. Typical border patrolling lacks Associate in nursing integrated multi-sensing system that coordinates numerous technologies for police work and detection of human unwelcome person movement within the completely different border scenarios: flat surface movement, river/pond crossing and dry leaves movement. This paper describes this Wireless detector Network (WSN) techniques associated with unwelcome person detection and border police work. Our future work focuses on delivering Associate in nursing improved multi-sensing system for police investigation intrusion activities to secure the national borders.

4] Low cost wireless image sensor networks for visual surveillance and intrusion detection applications.

Wireless Image Sensor Networks (WISN) where sensor nodes are equipped with miniaturized visual CMOS cameras to provide visual information is a promising technology for situation-awareness, search&rescue applications or intrusion detection applications. In this paper, we present an off-the-shelf image sensor based on an Arduino Due board with a CMOS uCamII camera. The image sensor works with raw 128×128 image and implements a simple intrusion detection mechanism based on simple-differencing technique. The total time for getting the image, encoding it, detecting intrusion and transmitting it can be less than 2.3s. We detail the performance measures and using real hardware constraints, we also show how more accurate simulation model can be built for large-scale multi-hop networked configurations.

5] An economical wireless network monitored scheme for camera based intrusion detection at unattended sites.

A cheap wireless network monitored theme for camera primarily based intrusion detection at unattended sites. Unattended locations nowadays need detection of any mal-intentional intrusion. Sensors of the pyro electrical (PIR) or Microwave reflective (MW) varieties are normally offered for police investigation intrusion by a person's. During this paper, a digital video camera is interfaced to a laptop, say an easy portable computer that has provision for wireless USB primarily based local area network association. The program developed monitors a web site seeable of the camera Associate in nursing absolutely detects an intrusion by video frame primarily based analysis. A unique and sensitive algorithmic rule for detection of motion from video frames relies on desegregation the picture element intensities in sequential finite distinction technique over a group of circular and means contour methods within the field of read of the camera. The planned technique is extremely quick compared to space picture element ways to this point offered. The detected intrusion and its location inside the scene are instantly messaged through the wireless cellular network adapter, like the "Tata Photon" employing a straightforward "Compaq" portable computer. The image itself follows the detection. Thus, this technique is cheaper than the big-ticket sensing devices supported MW or PIR.

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

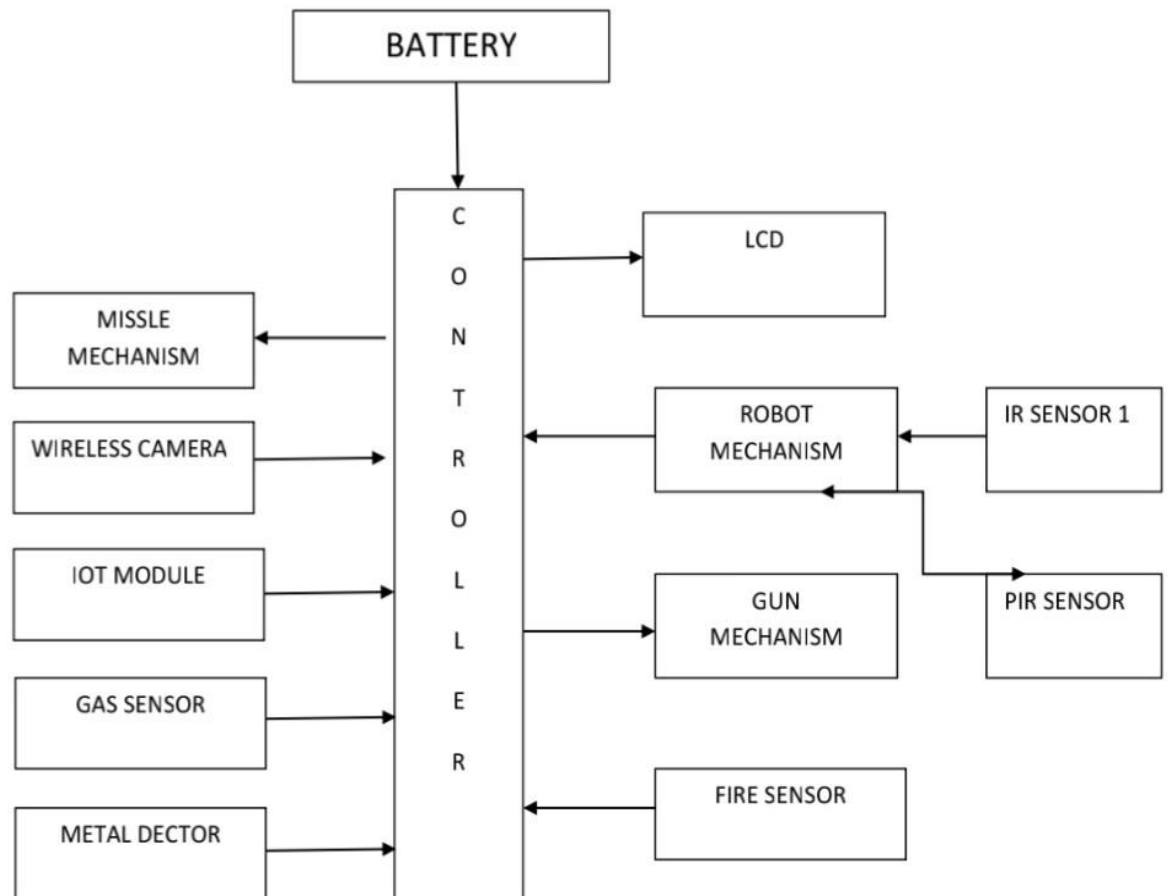
3.1 AIM

Security automaton has become one in every of the foremost necessary analysis topics over the past decades. Variety of robots are designed to safeguard human life and wealth. This paper focuses on style and implementation of mobile automaton with 3 subsystems: The obstacle rejection, face recognition and detection escape of flammable gases. Within the 1st scheme, Associate in nursing implementation of artificial neural network on field programmable analog array has been accustomed management the motion of the automaton.

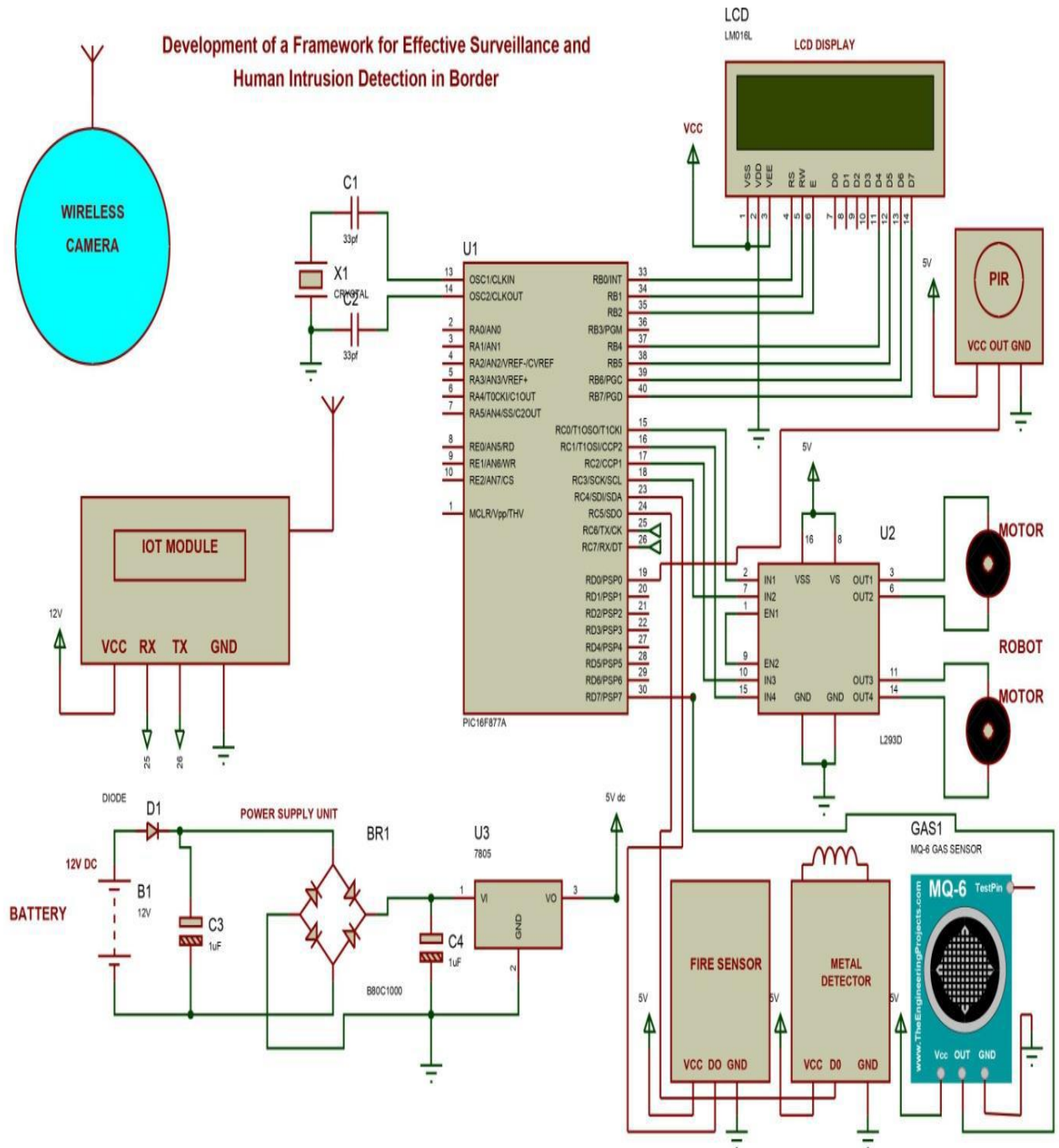
3.2 SCOPE OF THE PRESENT INVESTIGATION

This paper presents a contemporary approach for police work at remote and border areas victimization multifunctional automaton supported current 4G technology utilized in defense and military applications. This robotic vehicle has ability to substitute the soldier at border areas to supply police work. The robotic vehicle works each as autonomous and manually controlled vehicle victimization web as communication medium. This multisensory automaton accustomed observe human, bombs, harmful gases and hearth at remote and war field areas. Conventionally, wireless security automaton obsoletes thanks to restricted frequency vary and restricted manual management. These limitations a head by victimization 4G technology that has limitless vary. Manual operations are controlled by cell phones used as video camera by initializing 4G video and alter the trail of automaton in step with real time data of encompassing. This paper conjointly illustrates the experimental results of angle choice of in automatic and manual mode. This robotic vehicle is intended for intelligence operation furthermore as police work underneath sure circumstances.

BLOCK DIAGRAM



CIRCUIT DIAGRAM



3.3 HARDWARE REQUIREMENTS

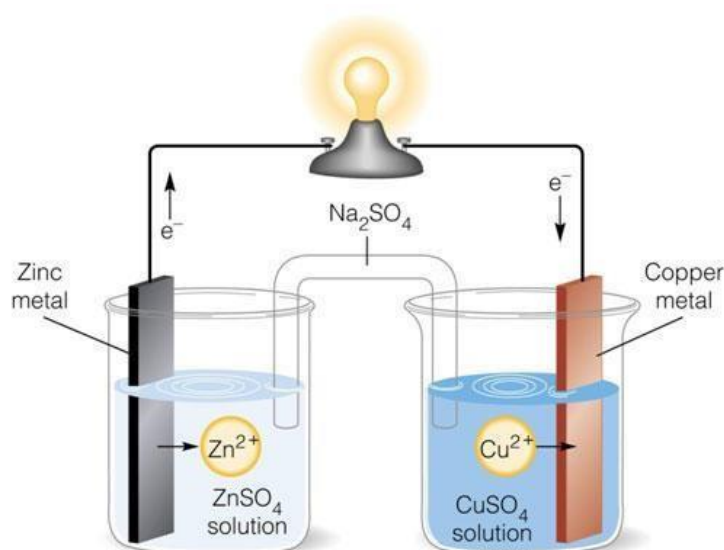
- Battery
- Pic microcontroller
- Lcd
- IR sensor
- PIR sensor
- Wireless camera
- Gas sensor
- Fire sensor
- IOT module
- Metal detector
- Missile mechanism
- Robot mechanism
- Ultrasonic sensor

CHAPTER 4

MATERIAL USED

4.1 BATTERY

An electric battery could be a device consisting of 2 or additional chemical science cells that convert hold on energy into electricity. Every cell includes a positive terminal, or cathode, and a negative terminal, or anode. The terminal marked positive is at the next electrical P.E. than is that the terminal marked negative. The terminal marked negative is that the supply of electrons that once connected to Associate in nursing external circuit can flow Associate in nursing deliver energy to an external device. Once a battery is connected to Associate in nursing external circuit, electrolytes are able to move as ions among, permitting the chemical reactions to be completed at the separate terminals then deliver energy to the external circuit. It's the movement of these ions among the battery that permits current to emanate of the battery to perform work. [1] though the term battery technically suggests that a tool with multiple cells, single cells also are popularly known as batteries.



Battery is employed to store the electricity within the type of DC (Direct current). The energy generated by electrical device is hold on within the battery that is employed to glows the sunshine throughout getting dark. Low maintenance cannula lead acid sort battery is often used for street lights. The battery is housed within a battery box that is fastened on to the pole at an acceptable height from the bottom for straightforward maintenance and replacement. Here, we have a tendency to be mistreatment 350 AH and one hundred AH battery.

Types of Batteries:

Primary Batteries

Non reversible batteries during which once the solution has been totally exhausted, energy cannot be without delay fixed and therefore the battery must be discarded. This specific category of batteries has been facing stiff competition from reversible battery section, however still holds a distinct segment market in applications like articulation radiocarpal watches electrical keys, toys and military missions. Carbon-Zinc or Leclanche batteries and Alkaline-Manganese batteries are the foremost common primary batteries in shopper applications. Primary batteries provide the very best energy densities, with the atomic number 3 based mostly cells providing quite thrice the energy than corresponding secondary batteries. These do provide Associate in Nursing initial value advantage, however within the end of the day are additional costlier than the secondary batteries as a result of their reusability once recharging that is absent in primary batteries.

Secondary Batteries:

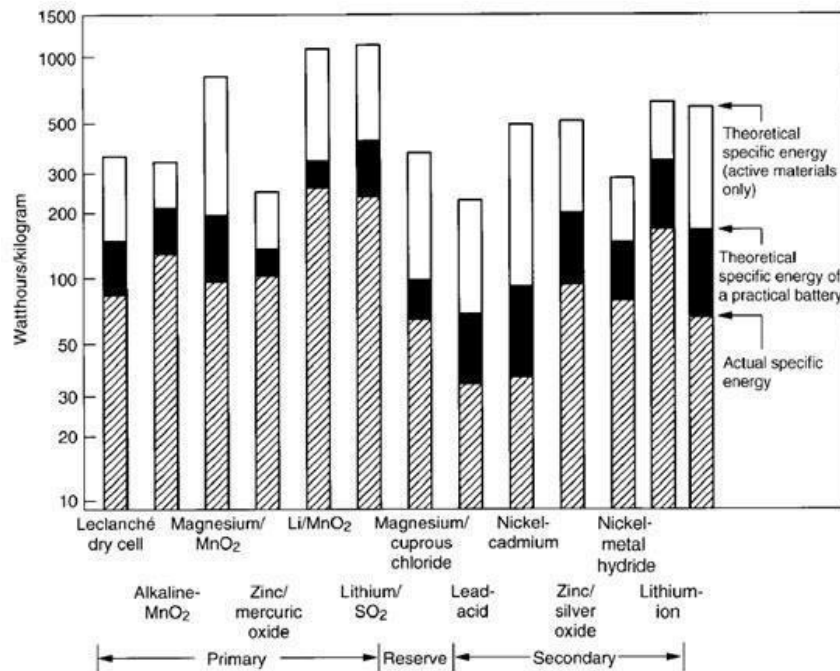
The batteries during which a reversible reaction is to blame for the generation of electricity specified they will be reverted back to the first chemical state make up the class of secondary batteries. Recharging is accomplished by passing electrical phenomenon through the battery. The oldest type of reversible battery is that the lead-acid accumulator. Lead Acid battery market is dominating primarily owing to the inaccessibility of any ready competitive resolution within the market which they provide lowest value per heat unit despite of their low specific energy.

The need to create these batteries maintenance free, the flooded battery sort evolved into 2 variants: Sealed Lead Acid or Gel cells and Valve Regulated Lead Acid (VRLA) Batteries. The flooded battery varieties are still seen in cars, UPS etc. however because of this evolution, the lead acid batteries currently cannot charge to their true potential wherever gassing and water depletion within the acid might surface. Further, these should be hold on in totally charged state alternatively salvation might cause the degradation of the battery performance. Quantity the number} of electrical power that may be delivered is usually a operate of amount of lead gift. Starter Batteries that contain additional range of finer lead plates are fitted to cranking cars with a high surge and quick discharge. Deep cycle batteries that contain additional lead are fitted to applications requiring longevity and deep discharging as within the case of golf cars and handicap chairs. Absorbent Glass Mat is another improved lead acid battery wherever solution is absorbed in a very mat of glass fibers creating the battery spill proof and increasing performance characteristics. The disposal of Lead Acid batteries poses bound environmental issues because of hazards like illness. Still it continues to and is anticipated to retain an oversized market section and firms perpetually still initiate this battery beneath totally different names like Firefly Energy, Altraverda Bipolar, and AxionPowe etc.

Nickel metal (NiCad) Batteries have a matured technology and are utilized in places wherever long service life and economy amidst troublesome environmental conditions is needed. A straightforward various to the present chemistry is that the comparatively surroundings friendly Nickel Metal binary compound (NiMH) technology that has improved specific energy ratings. Quicker charging and long period in addition to economical valuation and availableness in varied sizes create them a lovely possibility for tiny shopper product. But they appear to suffer from Memory effects thus needing periodic full discharges and additionally suffer from high self-discharge. Atomic number 3 are the foremost promising battery systems for immovableness in shopper product and wattage trains.

Placed on the highest within the chemical science potential list and provides high specific energy per unit weight. it's any divided into 3 classes, atomic number 3 particle metal, atomic number 3 particle Man and atomic number 3 particle phosphate that have their own totally different applications because of variable specific energies, discharge currents and repair lives. Alternative differing kinds of Li-Ion batteries embrace Li-Polymer and lithium-ion-polymer. value reduction, absence of too surroundings sensitive material Associate in nursing high specific

energies have LED to the increase of recognition of Li-ion batteries to such an extent that concerning thirty fourth of the batteries oversubscribed are currently Li-Ion. These circuits want protection circuits to limit voltage and current and are subject to aging albeit unbroken unused.



Another classification of batteries is on the idea of the state of solution visa Wet Cells within which the solution is in liquid state as in Leclanche cells and Dry Cells wherever the solution is within the variety of a gel or paste as within the common zinc-carbon battery. Different sorts could embrace 'Molten salt battery' that uses a liquid salt as solution and 'Reserve battery' that are activated only if the interior parts are in situ.

State-of-Charge

The amount of energy remaining within the battery is commonly measured by State-of-Charge (SoC). SoC is measured mistreatment completely different techniques starting from terribly easy Voltage technique (most inaccurate) to complicated Quantum Magnetism and resistivity qualitative analysis. Use of measuring system for lead acid battery systems is additionally common. Laptops and skilled transportable devices use Coulomb numeration technique to live

SoC. It works on the principle of measure this flowing in and out of the battery which might be virtually equal once absolutely charged. though' the performance deteriorates with age of the battery, periodic activity by full discharge and charging helps keep the program line to around a couple of percent. Capability rating is commonly such as quantity unit product that is indicative of the worth of constant current which will be equipped over Associate in nursing hour. As an example, a 50mA-Hr battery will deliver 50mA constant current for one hour.

Risks with Batteries

Batteries are liable to accidents like discharge and explosions that are caused primarily thanks to mishandling or misuse of the batteries. Whereas Associate in nursing explosion could result from misuse like throwing in a very flame, trying recharge of a cell, short circuiting, overcharging etc., discharge is principally either thanks to producing defects or the storage conditions like temperature, humidness and position. This might lead to the discharge of probably corrosive materials as within the case of a couple of batteries like Lead Acid and do injury to the instrumentation within which these are put in. Use of environmentally dangerous materials like mercury within the batteries have raised widespread concern and have demanded numerous constitutional acts of restrictions on battery materials.

4.2 PIC MICROCONTROLLER

MICROCONTROLLER (PIC 16F877A)

INTRODUCTION

PIC may be a family of changed Harvard design microcontrollers created by semiconductor device Technology, derived from the PIC1650 originally developed by General Instrument's electronics Division. The name PIC at first said "Peripheral Interface Controller". PICs are popular each industrial developers and hobbyists alike thanks to their low value, wide availableness, giant user base, in depth assortment of application notes, availableness of low value or free development tools, and serial programming (and re-programming with flash memory) capability.

FEATURES HIGH PERFORMANCE RISC CPU

PIC has solely thirty five single word directions. All are single cycle directions apart from program branches that uses two-cycle. The operative speed of PIC in DC is twenty megacycle and clock input in DC is two hundred ns instruction cycle. The PIC has 8K x fourteen words of flash Program Memory, 368 x eight bytes of knowledge Memory (RAM).

PERIPHERAL FEATURES

- Timer0: 8-bit timer/counter with 8-bit preclear.
- Timer1: 16-bit timer/counter with preclear.
- Timer2: 8-bit timer/counter with 8-bit amount register, preclear and postscaler.
- It's a Capture, Compare, PWM (CCP) module. Capture is of 16-bit and it's a most resolution of twelve.5 ns. Compare is of 16-bit and it's a most resolution of 200ns. Pulse breadth Modulation contains a most resolution of 10-bit.8-bit,
- Eight channel digitizer with ten bit every.
- It's a Synchronous interface (SSP) with SPI (Master/Slave) and I2C, USART with nine bit detection. It conjointly contains a Brown-out detection electronic equipment for Brown-out Reset (BOR).

CMOS TECHNOLOGY

PIC contains a Low power, high speed CMOS FLASH technology with a totally static style. It provides a good operative voltage vary of two.0V to 5.5V. It has Low power consumption and utilized in industrial and industrial temperature ranges.

PIN DIAGRAM

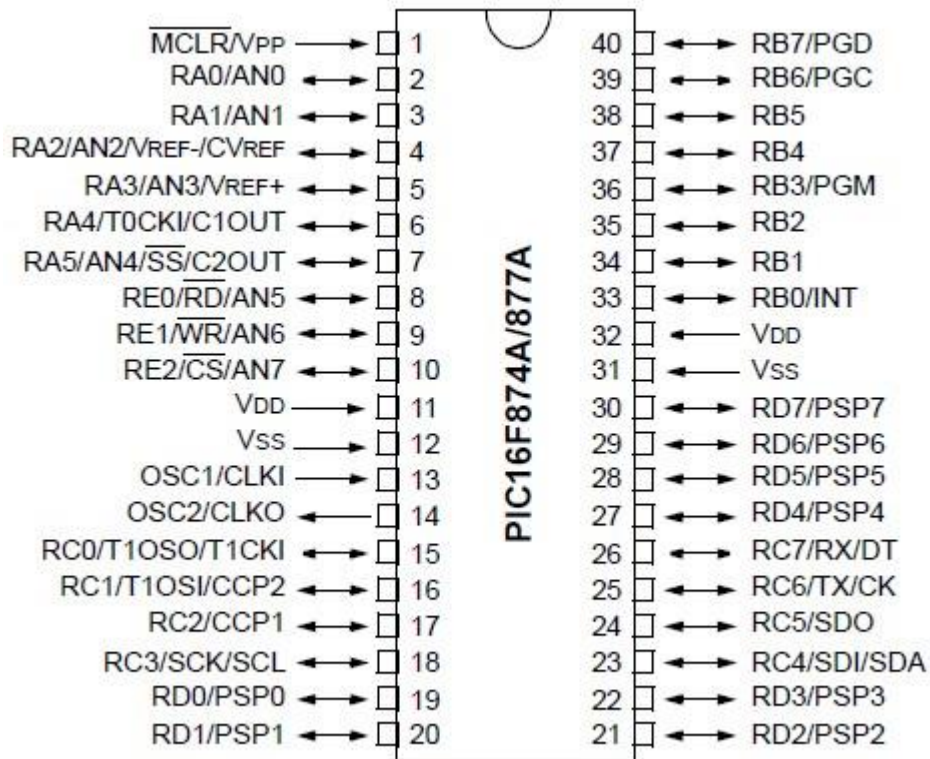
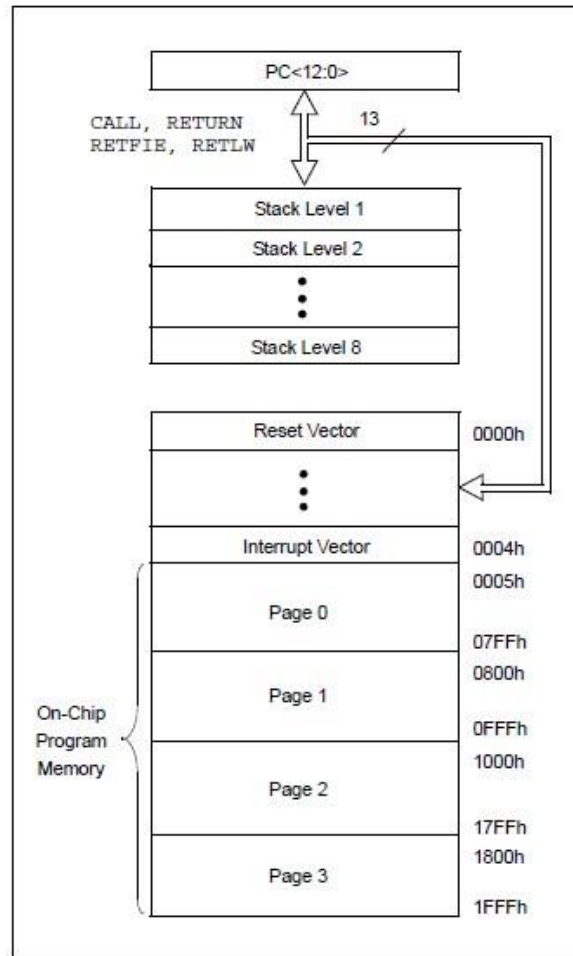


Fig.5.8. Pic16f877a Pin Diagram

MEMORY ORGANIZATION

There are a unit 3 memory blocks within the PIC16F87XA device. The program memory and therefore the information memory have separate buses in order that coinciding access will occur. The PIC16F87XA devices have thirteen bit program counter capable of addressing AN 8K x fourteen bit program memory area. The info memory is partitioned off into multiple banks

Which contain the overall purpose registers and therefore the Special operate Registers (SFRs). Bits RP1 and RP0 area unit the bank choose bits.



Program Memory Organization and Stack

RP1:RP0	Bank
00	0
01	1
10	2
11	3

Data memory-bank selection

I/O PORTS

I/O ports are multiplexed with associate alternate operate for the peripheral options on the device. In general, once a peripheral is enabled, that pin might not be used as a general purpose I/O pin.

i. PORTA AND THE TRISA REGISTER

PORTA could be a 6-bit wide, bifacial port. The corresponding information direction register is TRISA. Setting a TRISA bit (= 1) can create the corresponding orifice pin associate input (i.e., place the corresponding output driver in an exceedingly High-Impedance mode). Clearing a TRISA bit (= 0) can create the corresponding orifice pin associate output (i.e., place the contents of the output latch on the chosen pin).

ii. PORTB AND THE TRISB REGISTER

PORTB is associate 8-bit wide, bifacial port. The corresponding information direction registers is TRISB. Setting a TRISB bit (= 1) can create the corresponding PORTB pin associate input (i.e., place the corresponding output driver in an exceedingly High-Impedance mode). Clearing a TRISB bit (= 0) can create the corresponding PORTB pin associate output (i.e., place the contents of the output latch on the chosen pin).

iii. PORTC AND THE TRISC REGISTER

PORTC is associate 8-bit wide, bifacial port. The corresponding information direction register is TRISC. Setting a TRISC bit (= 1) can create the corresponding PORTC pin associate input (i.e., place the corresponding output driver in an exceedingly High-Impedance mode). Clearing a TRISC bit (= 0) can create the corresponding PORTC pin associate output (i.e., place the contents of the output latch on the chosen pin).

iv. PORTD AND TRISD REGISTER

PORTD is associate 8-bit port with Schmitt Trigger input buffers. Every pin is {individually|separately|singly|severally|one by one on associate individual basis} configurable as an input or output. PORTD is designed as associate 8-bit wide chip port (Parallel Slave Port) by setting management bit, PSPMODE (TRISE<4>). During this mode, the input buffers are TTL.

v. PORTE AND TRISE REGISTER

PORTE has 3 pins (RE0/RD/AN5, RE1/WR/AN6 and RE2/CS/AN7) that are one by one configurable as inputs or outputs. These pins have Schmitt Trigger input buffers. The Sublime Porte pins become the I/O management inputs for the chip port once bit PSPMODE (TRISE<4>) is ready. During this mode, the user should check that the TRISE<2:0> bits are set which the pins are designed as digital inputs. Also, make sure that ADCON1 is designed for digital I/O. during this mode, the input buffers are TTL.

TIMER0 MODULE

The Timer0 module timer/counter has the subsequent features:

- i. 8-bit timer/counter
- ii. Legible and writable
- iii. 8-bit software package programmable preclear
- iv. Internal or external clock choose
- v. Interrupt on overflow from FFh to 00h
- vi. Edge choose for external clock

Timer mode is chosen by clearing bit TOCS. In timer mode, the Timer0 module increment each instruction cycle. If the TMR0 register is written the increment is strangled for the subsequent 2 instruction cycles. Counter mode is chosen by setting bit TOCS. In counter mode Timer0 can increment on each raising or falling fringe of pin RA4/T0CK1.

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
RBP	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0
bit 7							bit 0

bit 7	RBP																											
bit 6	INTEDG																											
bit 5	T0CS: TMR0 Clock Source Select bit 1 = Transition on T0CKI pin 0 = Internal instruction cycle clock (CLKO)																											
bit 4	T0SE: TMR0 Source Edge Select bit 1 = Increment on high-to-low transition on T0CKI pin 0 = Increment on low-to-high transition on T0CKI pin																											
bit 3	PSA: Prescaler Assignment bit 1 = Prescaler is assigned to the WDT 0 = Prescaler is assigned to the Timer0 module																											
bit 2-0	PS2:PS0: Prescaler Rate Select bits																											
	<table><tr><th>Bit Value</th><th>TMR0 Rate</th><th>WDT Rate</th></tr><tr><td>000</td><td>1 : 2</td><td>1 : 1</td></tr><tr><td>001</td><td>1 : 4</td><td>1 : 2</td></tr><tr><td>010</td><td>1 : 8</td><td>1 : 4</td></tr><tr><td>011</td><td>1 : 16</td><td>1 : 8</td></tr><tr><td>100</td><td>1 : 32</td><td>1 : 16</td></tr><tr><td>101</td><td>1 : 64</td><td>1 : 32</td></tr><tr><td>110</td><td>1 : 128</td><td>1 : 64</td></tr><tr><td>111</td><td>1 : 256</td><td>1 : 128</td></tr></table>	Bit Value	TMR0 Rate	WDT Rate	000	1 : 2	1 : 1	001	1 : 4	1 : 2	010	1 : 8	1 : 4	011	1 : 16	1 : 8	100	1 : 32	1 : 16	101	1 : 64	1 : 32	110	1 : 128	1 : 64	111	1 : 256	1 : 128
Bit Value	TMR0 Rate	WDT Rate																										
000	1 : 2	1 : 1																										
001	1 : 4	1 : 2																										
010	1 : 8	1 : 4																										
011	1 : 16	1 : 8																										
100	1 : 32	1 : 16																										
101	1 : 64	1 : 32																										
110	1 : 128	1 : 64																										
111	1 : 256	1 : 128																										

Option Register

TIMER1 MODULE

The Timer1 module timer/counter has the following features:

- 16-bit timer/counter (Two 8-bit registers; TMR1H and TMR1L)
- Readable and writable (both registers)
- Internal or external clock select
- Interrupt on overflow from FFFFh to 0000h
- RESET from CCP module trigger

Timer1 can be enabled/disabled by setting/clearing control bit TMR1ON (T1CON<0>).

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	T1CKPS1	T1CKPS0	T1OSCEN	T1SYNC	TMR1CS	TMR1ON
bit 7							bit 0

- bit 7-6 **Unimplemented:** Read as '0'
- bit 5-4 **T1CKPS1:T1CKPS0:** Timer1 Input Clock Prescale Select bits
 11 = 1:8 prescale value
 10 = 1:4 prescale value
 01 = 1:2 prescale value
 00 = 1:1 prescale value
- bit 3 **T1OSCEN:** Timer1 Oscillator Enable Control bit
 1 = Oscillator is enabled
 0 = Oscillator is shut-off (the oscillator inverter is turned off to eliminate power drain)
- bit 2 **T1SYNC:** Timer1 External Clock Input Synchronization Control bit
When TMR1CS = 1:
 1 = Do not synchronize external clock input
 0 = Synchronize external clock input
When TMR1CS = 0:
 This bit is ignored. Timer1 uses the internal clock when TMR1CS = 0.
- bit 1 **TMR1CS:** Timer1 Clock Source Select bit
 1 = External clock from pin RC0/T1OSO/T1CKI (on the rising edge)
 0 = Internal clock (FOSC/4)
- bit 0 **TMR1ON:** Timer1 On bit
 1 = Enables Timer1
 0 = Stops Timer1

TIMER1 control register

TIMER2 MODULE

The Timer2 module timer has the following features:

- 8-bit timer (TMR2 register)
- 8-bit period register (PR2)
- Readable and writable (both registers)
- Software programmable prescaler (1:1, 1:4, 1:16)
- Software programmable postscaler (1:1 to 1:16)
- Interrupt on TMR2 match of PR2
- SSP module optional use of TMR2 output to generate clock shift

Timer2 can be shut-off by clearing control bit TMR2ON (T2CON<2>) to minimize power consumption.

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	TOUTPS3	TOUTPS2	TOUTPS1	TOUTPS0	TMR2ON	T2CKPS1	T2CKPS0
bit 7							bit 0

- bit 7 **Unimplemented:** Read as '0'
- bit 6-3 **TOUTPS3:TOUTPS0:** Timer2 Output Postscale Select bits
0000 = 1:1 postscale
0001 = 1:2 postscale
0010 = 1:3 postscale
•
•
•
1111 = 1:16 postscale
- bit 2 **TMR2ON:** Timer2 On bit
1 = Timer2 is on
0 = Timer2 is off
- bit 1-0 **T2CKPS1:T2CKPS0:** Timer2 Clock Prescale Select bits
00 = Prescaler is 1
01 = Prescaler is 4
1x = Prescaler is 16

TIMER2 control register

CAPTURE/COMPARE/PWM (CCP) MODULE

The CCP (Capture/Compare/PWM) module contains a 16-bit register that can operate as a:

- 16-bit capture register
- 16-bit compare register
- PWM master/slave duty cycle register.

Both the CCP1 and CCP2 modules are identical in operation, with the exception being the operation of the special event trigger.

ADDRESSABLE UNIVERSAL SYNCHRONOUS ASYNCHRONOUS RECEIVER TRANSMITTER (USART)

The Universal Synchronous Asynchronous Receiver Transmitter (USART) module is one of the two serial I/O modules. (USART is also known as a Serial Communications Interface or SCI.) The USART can be configured as a full-duplex asynchronous system that can communicate with peripheral devices, such as CRT terminals and personal computers, or it can be configured as a half-duplex synchronous system that can communicate with peripheral devices, such as A/D or D/A integrated circuits, serial EEPROMs, etc. The USART can be configured in the following modes:

- Asynchronous (full-duplex)
- Synchronous – Master (half-duplex)
- Synchronous – Slave (half-duplex)

Bit SPEN (RCSTA<7>) and bits TRISC<7:6> have to be set in order to configure pins RC6/TX/CK and RC7/RX/DT as the Universal Synchronous Asynchronous Receiver Transmitter. The USART module also has a multi-processor communication capability using 9-bit address detection.

TXSTA: TRANSMIT STATUS AND CONTROL REGISTER (ADDRESS 98h)

R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0	R-1	R/W-0
CSRC	TX9	TXEN	SYNC	—	BRGH	TRMT	TX9D
bit 7							bit 0

bit 7 **CSRC:** Clock Source Select bit

Asynchronous mode:

Don't care.

Synchronous mode:

1 = Master mode (clock generated internally from BRG)

0 = Slave mode (clock from external source)

- bit 6 **TX9**: 9-bit Transmit Enable bit
 1 = Selects 9-bit transmission
 0 = Selects 8-bit transmission
- bit 5 **TXEN**: Transmit Enable bit
 1 = Transmit enabled
 0 = Transmit disabled
- bit 4 **SYNC**: USART Mode Select bit
 1 = Synchronous mode
 0 = Asynchronous mode
- bit 3 **Unimplemented**: Read as '0'
- bit 2 **BRGH**: High Baud Rate Select bit
 Asynchronous mode:
 1 = High speed
 0 = Low speed
 Synchronous mode:
 Unused in this mode.
- bit 1 **TRMT**: Transmit Shift Register Status bit
 1 = TSR empty
 0 = TSR full

bit 0 **TX9D**: 9th bit of Transmit Data, can be Parity bit

RCSTA: RECEIVE STATUS AND CONTROL REGISTER (ADDRESS 18h)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R-0	R-0	R-x
SPEN	RX9	SREN	CREN	ADDEN	FERR	OERR	RX9D
bit 7							bit 0

bit 7 **SPEN**: Serial Port Enable bit

	1 = Serial port enabled (configures RC7/RX/DT and RC6/TX/CK pins as serial port pins)
	0 = Serial port disabled
bit 6	RX9: 9-bit Receive Enable bit
	1 = Selects 9-bit reception
	0 = Selects 8-bit reception
bit 5	SREN: Single Receive Enable bit
	Asynchronous mode: Don't care.
	Synchronous mode – Master:
	1 = Enables single receive
	0 = Disables single receive
	This bit is cleared after reception is complete.
	Synchronous mode – Slave: Don't care.
bit 4	CREN: Continuous Receive Enable bit
	Asynchronous mode:
	1 = Enables continuous receive
	0 = Disables continuous receive
	Synchronous mode:
	1 = Enables continuous receive until enable bit CREN is cleared (CREN overrides SREN)
	0 = Disables continuous receive
bit 3	ADDEN: Address Detect Enable bit
	Asynchronous mode 9-bit (RX9 = 1):

- 1 = Enables address detection, enables interrupt and load of the receive buffer when RSR<8> is set
- 0 = Disables address detection, all bytes are received and ninth bit can be used as parity bit
- bit 2 **FERR**: Framing Error bit
- 1 = Framing error (can be updated by reading RCREG register and receive next valid byte) 0 = No framing error
- bit 1 **OERR**: Overrun Error bit
- 1 = Overrun error (can be cleared by clearing bit CREN)
- 0 = No overrun error
- bit 0 **RX9D**: 9th bit of Received Data (can be parity bit but must be calculated by user firmware)

USART BAUD RATE GENERATOR (BRG)

The BRG supports both the Asynchronous and Synchronous modes of the USART. It is a dedicated 8-bit baud rate generator. The SPBRG register controls the period of a free running 8-bit timer. In Asynchronous mode, bit BRGH (TXSTA<2>) also controls the baud rate. In Synchronous mode, bit BRGH is ignored. Table below shows the formula for computation of the baud rate for different USART modes which only apply in Master Mode (internal clock).

SYNC	BRGH=0	BRGH=1(HIGH SPEED)
0	(Asynchronous)Baud rate= $F_{osc} / (64(X+1))$	Baud rate= $F_{osc} / (64(X+1))$
1	(Synchronous)Baud rate= $F_{osc} / (4(X+1))$	N/A

ANALOG-TO-DIGITAL CONVERTER (A/D) MODULE

The analog-to-digital (A/D) converter module has eight inputs for 40 pin devices. The A/D allows conversion of an analog input signal to a corresponding 10-bit digital number. A/D converter has a unique feature of being able to operate while the device is in SLEEP mode. To operate in SLEEP, the A/D conversion clock must be derived from the A/D's internal RC oscillator. The A/D module has four registers:

- A/D Result High Register ADRESH
- A/D Result Low Register ADRESL
- A/D Control Register 0 ADCON0
- A/D Control Register 1 ADCON1

The ADCON0 register controls the operation of the A/D module. The ADCON1 register configures the functions of the port pins. The port pins can be configured as analog

inputs (RA3 can also be a voltage reference) or a digital I/O.

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/DONE	—	ADON
bit 7							bit 0

bit 7-6 **ADCS1:ADCS0**: A/D Conversion Clock Select bits (ADCON0 bits in **bold**)

ADCON1 <ADCS2>	ADCON0 <ADCS1:ADCS0>	Clock Conversion
0	00	Fosc/2
0	01	Fosc/8
0	10	Fosc/32
0	11	FRC (clock derived from the internal A/D RC oscillator)
1	00	Fosc/4
1	01	Fosc/16
1	10	Fosc/64
1	11	FRC (clock derived from the internal A/D RC oscillator)

bit 5-3 **CHS2:CHS0**: Analog Channel Select bits

000 = Channel 0 (AN0)
 001 = Channel 1 (AN1)
 010 = Channel 2 (AN2)
 011 = Channel 3 (AN3)
 100 = Channel 4 (AN4)
 101 = Channel 5 (AN5)
 110 = Channel 6 (AN6)
 111 = Channel 7 (AN7)

Note: The PIC16F873A/876A devices only implement A/D channels 0 through 4; the unimplemented selections are reserved. Do not select any unimplemented channels with these devices.

bit 2 **GO/DONE**: A/D Conversion Status bit

When **ADON** = **1**:

1 = A/D conversion in progress (setting this bit starts the A/D conversion which is automatically cleared by hardware when the A/D conversion is complete)
 0 = A/D conversion not in progress

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

bit 0 **ADON**: A/D On bit

1 = A/D converter module is powered up
 0 = A/D converter module is shut-off and consumes no operating current

ADCON0 REGISTER

R/W-0	R/W-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
ADFM	ADCS2	—	—	PCFG3	PCFG2	PCFG1	PCFG0
bit 7				bit 0			

bit 7 **ADFM**: A/D Result Format Select bit

1 = Right justified. Six (6) Most Significant bits of ADRESH are read as '0'.

0 = Left justified. Six (6) Least Significant bits of ADRESL are read as '0'.

bit 6 **ADCS2**: A/D Conversion Clock Select bit (ADCON1 bits in shaded area and in **bold**)

ADCON1 <ADCS2>	ADCON0 <ADCS1:ADCS0>	Clock Conversion
0	00	Fosc/2
0	01	Fosc/8
0	10	Fosc/32
0	11	FRC (clock derived from the internal A/D RC oscillator)
1	00	Fosc/4
1	01	Fosc/16
1	10	Fosc/64
1	11	FRC (clock derived from the internal A/D RC oscillator)

bit 5-4 **Unimplemented**: Read as '0'

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

PCFG <3:0>	AN7	AN6	AN5	AN4	AN3	AN2	AN1	AN0	VREF+	VREF-	C/R
0000	A	A	A	A	A	A	A	A	VDD	VSS	8/0
0001	A	A	A	A	VREF+	A	A	A	AN3	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	AN3	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	AN3	VSS	2/1
011x	D	D	D	D	D	D	D	D	—	—	0/0
1000	A	A	A	A	VREF+	VREF-	A	A	AN3	AN2	6/2
1001	D	D	A	A	A	A	A	A	VDD	VSS	6/0
1010	D	D	A	A	VREF+	A	A	A	AN3	VSS	5/1
1011	D	D	A	A	VREF+	VREF-	A	A	AN3	AN2	4/2
1100	D	D	D	A	VREF+	VREF-	A	A	AN3	AN2	3/2
1101	D	D	D	D	VREF+	VREF-	A	A	AN3	AN2	2/2
1110	D	D	D	D	D	D	D	A	VDD	VSS	1/0
1111	D	D	D	D	VREF+	VREF-	D	A	AN3	AN2	1/2

A = Analog input D = Digital I/O

C/R = # of analog input channels/# of A/D voltage references

Fig.5.8.7.ADCON1 REGISTER

CODING

```
#include "pic16f877a.h"

#include <LCD.C>

#define m1_1 PIN_D4
#define m1_2 PIN_D5
#define m2_1 PIN_D6
#define m2_2 PIN_D7

#define gas_pin PIN_A0
#define flame_pin PIN_A1
#define metal_pin PIN_A2
#define pir_pin PIN_A3

#define TRIG_PIN PIN_E0
#define ECHO_PIN PIN_E1
#define led_pin PIN_E2

#define servo_pin1 PIN_C0 //camera
#define servo_pin2 PIN_C1 //Gun
#define servo_pin3 PIN_C2 //Gun
#define servo_pin4 PIN_C3 //Missile on
#define servo_pin5 PIN_D0 //Missile off

int rx_i = 0, rx_flag = 0;
char rx_data[5];

#int_RDA
void RDA_isr(void)
{
    rx_data[rx_i] = getc();

    if(rx_data[rx_i] == '*' && rx_flag == 0)
    {
        rx_i = 0; rx_flag = 1;
    }
    else if(rx_data[rx_i] == '#' && rx_flag == 1) rx_flag = 2;
    else if(rx_data[rx_i] != '#' && rx_flag == 1) rx_i++;
}

int1 auto_mode = 0;

void servoRotate0(int motor) //0 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        if(motor == 1) output_high(servo_pin1);
        else if(motor == 2) output_high(servo_pin2);
        else if(motor == 3) output_high(servo_pin3);
        else if(motor == 4) output_high(servo_pin4);
    }
}
```

```

        else if(motor == 5) output_high(servo_pin5);
        delay_us(800);
        if(motor == 1)      output_low(servo_pin1);
        else if(motor == 2) output_low(servo_pin2);
        else if(motor == 3) output_low(servo_pin3);
        else if(motor == 4) output_low(servo_pin4);
        else if(motor == 5) output_low(servo_pin5);
        delay_us(19200);
    }
}

void servoRotate90(int motor) //90 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        if(motor == 1)      output_high(servo_pin1);
        else if(motor == 2) output_high(servo_pin2);
        else if(motor == 3) output_high(servo_pin3);
        else if(motor == 4) output_high(servo_pin4);
        else if(motor == 5) output_high(servo_pin5);
        delay_us(1500);
        if(motor == 1)      output_low(servo_pin1);
        else if(motor == 2) output_low(servo_pin2);
        else if(motor == 3) output_low(servo_pin3);
        else if(motor == 4) output_low(servo_pin4);
        else if(motor == 5) output_low(servo_pin5);
        delay_us(18500);
    }
}

void servoRotatel80(int motor) //180 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        if(motor == 1)      output_high(servo_pin1);
        else if(motor == 2) output_high(servo_pin2);
        else if(motor == 3) output_high(servo_pin3);
        else if(motor == 4) output_high(servo_pin4);
        else if(motor == 5) output_high(servo_pin5);
        delay_us(2200);
        if(motor == 1)      output_low(servo_pin1);
        else if(motor == 2) output_low(servo_pin2);
        else if(motor == 3) output_low(servo_pin3);
        else if(motor == 4) output_low(servo_pin4);
        else if(motor == 5) output_low(servo_pin5);
        delay_us(17800);
    }
}

/*
void servolRotate0() //0 Degree

```

```

{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin1);
        delay_us(800);
        output_low(servo_pin1);
        delay_us(19200);
    }
}

void servo1Rotate90() //90 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin1);
        delay_us(1500);
        output_low(servo_pin1);
        delay_us(18500);
    }
}

void servo1Rotatel80() //180 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin1);
        delay_us(2200);
        output_low(servo_pin1);
        delay_us(17800);
    }
}

void servo2Rotate0() //0 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin2);
        delay_us(800);
        output_low(servo_pin2);
        delay_us(19200);
    }
}

void servo2Rotate90() //90 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin2);

```

```

        delay_us(1500);
        output_low(servo_pin2);
        delay_us(18500);
    }
}

void servo2Rotatel80() //180 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin2);
        delay_us(2200);
        output_low(servo_pin2);
        delay_us(17800);
    }
}

void servo3Rotate0() //0 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin3);
        delay_us(800);
        output_low(servo_pin3);
        delay_us(19200);
    }
}

void servo3Rotate90() //90 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin3);
        delay_us(1500);
        output_low(servo_pin3);
        delay_us(18500);
    }
}

void servo3Rotatel80() //180 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin3);
        delay_us(2200);
        output_low(servo_pin3);
        delay_us(17800);
    }
}

```

```

void servo4Rotate0() //0 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin4);
        delay_us(800);
        output_low(servo_pin4);
        delay_us(19200);
    }
}

void servo4Rotate90() //90 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin4);
        delay_us(1500);
        output_low(servo_pin4);
        delay_us(18500);
    }
}

void servo4Rotatel80() //180 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin4);
        delay_us(2200);
        output_low(servo_pin4);
        delay_us(17800);
    }
}

void servo5Rotate0() //0 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin5);
        delay_us(800);
        output_low(servo_pin5);
        delay_us(19200);
    }
}

void servo5Rotate90() //90 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)

```

```

    {
        output_high(servo_pin5);
        delay_us(1500);
        output_low(servo_pin5);
        delay_us(18500);
    }
}

void servo5Rotatel80() //180 Degree
{
    unsigned int ii;
    for(ii=0;ii<50;ii++)
    {
        output_high(servo_pin5);
        delay_us(2200);
        output_low(servo_pin5);
        delay_us(17800);
    }
}
/*
void servo_test()
{
    lcd_gotoxy(1,1);
    printf(lcd_putc,"      SERVO  1      ");

    servo1Rotate90(); delay_ms(1000);
    servo1Rotate0();  delay_ms(1000);
    servo1Rotate90(); delay_ms(1000);
    servo1Rotatel80();delay_ms(1000);
    servo1Rotate90(); delay_ms(1000);

    lcd_gotoxy(1,1);
    printf(lcd_putc,"      SERVO  2      ");

    servo2Rotate90(); delay_ms(1000);
    servo2Rotate0();  delay_ms(1000);
    servo2Rotate90(); delay_ms(1000);
    servo2Rotatel80();delay_ms(1000);
    servo2Rotate90(); delay_ms(1000);

    lcd_gotoxy(1,1);
    printf(lcd_putc,"      SERVO  3      ");

    servo3Rotate90(); delay_ms(1000);
    servo3Rotate0();  delay_ms(1000);
    servo3Rotate90(); delay_ms(1000);
    servo3Rotatel80();delay_ms(1000);
    servo3Rotate90(); delay_ms(1000);

    lcd_gotoxy(1,1);
    printf(lcd_putc,"      SERVO  4      ");

    servo4Rotate90(); delay_ms(1000);

```

```

servo4Rotate0(); delay_ms(1000);
servo4Rotate90(); delay_ms(1000);
servo4Rotate180(); delay_ms(1000);
servo4Rotate90(); delay_ms(1000);

lcd_gotoxy(1,1);
printf(lcd_putc,"    SERVO 5    ");

servo5Rotate90(); delay_ms(1000);
servo5Rotate0(); delay_ms(1000);
servo5Rotate90(); delay_ms(1000);
servo5Rotate180(); delay_ms(1000);
servo5Rotate90(); delay_ms(1000);
}

*/

void stop()
{
    lcd_gotoxy(1,1);

    if(auto_mode == 1) printf(lcd_putc,"  AUTO - STOP  ");
    else                printf(lcd_putc," MANUAL - STOP  ");

    output_low(m1_1);
    output_low(m1_2);
    output_low(m2_1);
    output_low(m2_2);
}

void forward()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc," AUTO - FORWARD ");
    else                printf(lcd_putc,"MANUAL - FORWARD");
    output_high(m1_1);
    output_low(m1_2);
    output_high(m2_1);
    output_low(m2_2);
}

void backward()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc,"AUTO - BACKWARD ");
    else                printf(lcd_putc,"MANUAL -BACKWARD");
    output_low(m1_1);
    output_high(m1_2);
    output_low(m2_1);
    output_high(m2_2);
}

void left()

```

```

{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc,"  AUTO - LEFT  ");
    else                printf(lcd_putc," MANUAL - LEFT  ");
    output_high(m1_1);
    output_low(m1_2);
    output_low(m2_1);
    output_high(m2_2);
}

void right()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc,"  AUTO - RIGHT ");
    else                printf(lcd_putc," MANUAL - RIGHT ");
    output_low(m1_1);
    output_high(m1_2);
    output_high(m2_1);
    output_low(m2_2);
}

void gun_on()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc," AUTO - GUN ON  ");
    else                printf(lcd_putc,"MANUAL - GUN ON ");

    servoRotate0(2);   delay_ms(200);
    //servoRotate90(2); delay_ms(200);
    servoRotate180(2); delay_ms(200);
    servoRotate90(2);  delay_ms(200);

    /*servoRotate0(2);  servoRotate180(3); delay_ms(200);
    servoRotate90(2);  servoRotate90(3);  delay_ms(200);
    servoRotate180(2);servoRotate0(3);    delay_ms(200);
    servoRotate90(2);  servoRotate90(3);  delay_ms(200);
    */
    servo2Rotate0();   servo3Rotate180(); delay_ms(200);
    servo2Rotate90();  servo3Rotate90();  delay_ms(200);
    servo2Rotate180();servo3Rotate0();    delay_ms(200);
    servo2Rotate90();  servo3Rotate90();  delay_ms(200);*/

    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc," AUTO - GUN OFF ");
    else                printf(lcd_putc,"MANUAL - GUN OFF");
}

void gun_off()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc," AUTO - GUN OFF ");
    else                printf(lcd_putc,"MANUAL - GUN OFF");
}

```

```

void Missile_on()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc,"A - MISSILE ON  ");
    else                printf(lcd_putc,"M - MISSILE ON  ");

    servoRotate0(4);    delay_ms(500);
    //servo5Rotate90(); delay_ms(500);
    servoRotatel80(5); delay_ms(500);
    /*
    servo4Rotate0();    delay_ms(500);
    //servo5Rotate90(); delay_ms(500);
    servo5Rotatel80(); delay_ms(500);*/
}

void Missile_off()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc,"A - MISSILE OFF ");
    else                printf(lcd_putc,"M - MISSILE OFF ");

    servoRotate0(5);    delay_ms(500);
    servoRotate90(4); delay_ms(500);
    /*
    //servo5Rotate90(); delay_ms(500);
    servo5Rotate0();    delay_ms(500);
    servo4Rotate90(); delay_ms(500);*/
}

void camera_left()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc,"  A - CAM LEFT  ");
    else                printf(lcd_putc,"  M - CAM LEFT  ");

    //servo1Rotate0();    delay_ms(500);
    servoRotatel80(1);    delay_ms(500);
}

void camera_right()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc," A - CAM RIGHT  ");
    else                printf(lcd_putc," M - CAM RIGHT  ");

    //servo1Rotatel80();delay_ms(500);
    servoRotate0(1);delay_ms(500);
}

void camera_straight()
{

```

```

    lcd_gotoxy(1,1);
    if(auto_mode == 1) printf(lcd_putc,"A - CAM STRAIGHT");
    else                printf(lcd_putc,"M - CAM STRAIGHT");

    //servo1Rotate90(); delay_ms(500);
    servoRotate90(1); delay_ms(500);
}

void auto_on()
{
    lcd_gotoxy(1,1);
    if(auto_mode == 1)
    {
        printf(lcd_putc,"      MANUAL      ");
        auto_mode = 0;
    }
    else
    {
        printf(lcd_putc,"      AUTO      ");
        auto_mode = 1;
    }
}

void sub_function()
{
    if(auto_mode == 0)
    {
        if(rx_data[0] == 'F') forward();
        else if(rx_data[0] == 'B') backward();
        else if(rx_data[0] == 'L') left();
        else if(rx_data[0] == 'R') right();
        else if(rx_data[0] == 'S') stop();
        else if(rx_data[0] == 'G') gun_on();
        else if(rx_data[0] == 'g') gun_off();
        else if(rx_data[0] == 'M') Missile_on();
        else if(rx_data[0] == 'm') Missile_off();
        else if(rx_data[0] == 'C') camera_left();
        else if(rx_data[0] == 'c') camera_right();
        else if(rx_data[0] == 'D') camera_straight();
        else if(rx_data[0] == 'A') auto_on();
    }
    else
    {
        if(rx_data[0] == 'A') auto_on();
        else if(rx_data[0] == 'S')
        {
            auto_on();
            stop();
        }
        //else if(rx_data[0] == 'a') auto_on();
    }
}

```

```

void clear_rx_data()
{
    for(rx_i = 0; rx_i < 5; rx_i++) rx_data[rx_i] = '\0';
    rx_i = 0; rx_flag = 0;
}

int16 distance = 0, time = 0;

void calculate_distance()
{
    output_high(TRIG_PIN);                // ping the sonar
    delay_us(20);                          // sending 20us pulse
    output_low(TRIG_PIN);

    while(!input(ECHO_PIN));               // wait for high state of
echo pin
    set_timer1(0);                         // setting timer zero

    while(input(ECHO_PIN));

    time = get_timer1();                   // Getting the time
    distance = time*0.028 + 1.093 ;        // Calculating the distance

    //printf("\fTime :%Lu \nDistance = %Lu \n\r",time,distance);
}

void pub_data(int condition)
{
    disable_interrupts(INT_RDA);
    //printf("AT\r\n"); delay_ms(250);
    printf("AT\r\n"); delay_ms(250);
    printf("AT+PUB=NOT\r\n"); delay_ms(250);

    if(condition == 1)    printf("GAS DETECTED\r\n");
    else if(condition == 2) printf("FIRE DETECTED\r\n");
    else if(condition == 3) printf("BOMB DETECTED\r\n");
    else if(condition == 4) printf("MOVEMENT DETECTED\r\n");

    putc(26); delay_ms(250);
    enable_interrupts(INT_RDA);
}

int1 gas_temp = 0, flame_temp = 0, metal_temp = 0, pir_temp = 0;

void test_sensors()
{
    if(!input(gas_pin))
    {
        if(gas_temp == 0)
        {
            if(auto_mode == 1)
            {

```

```

        auto_on();
        stop();
    }
    lcd_gotoxy(1,2);
    printf(lcd_putc,"  GAS DETECTED  ");
    gas_temp = 1;
    pub_data(1);
}
}
else gas_temp = 0;

if(!input(flame_pin))
{
    if(flame_temp == 0)
    {
        if(auto_mode == 1)
        {
            auto_on();
            stop();
        }
        lcd_gotoxy(1,2);
        printf(lcd_putc," FIRE  DETECTED ");
        flame_temp = 1;
        pub_data(2);
    }
}
else flame_temp = 0;

if(!input(metal_pin))
{
    if(metal_temp == 0)
    {
        if(auto_mode == 1)
        {
            auto_on();
            stop();
        }
        lcd_gotoxy(1,2);
        printf(lcd_putc," BOMB  DETECTED ");
        metal_temp = 1;
        pub_data(3);
    }
}
else metal_temp = 0;

if(input(pir_pin))
{
    if(pir_temp == 0)
    {
        lcd_gotoxy(1,2);
        printf(lcd_putc,"MOVEMENT DETECTE");

        if(auto_mode == 1)

```

```

        {
            stop(); delay_ms(1000);
            gun_on(); delay_ms(500);
            Missile_on(); delay_ms(500);
            Missile_off();
        }

        pir_temp = 1;
        pub_data(4);
    }
}
else pir_temp = 0;
}

int rotation = 0;

void main_function()
{
    int16 delays_ms = 0, left_distance = 0, right_distance = 0;

    do
    {
        if(rx_flag == 2)
        {
            disable_interrupts(INT_RDA);
            sub_function();
            enable_interrupts(INT_RDA);
            clear_rx_data();
        }
        delays_ms++;
        delay_ms(1);
    }while(delays_ms < 500);

    if(auto_mode == 1)
    {
        if(rotation == 0)
        {
            servoRotate180(1);
            rotation = 1;
        }
        else if(rotation == 1)
        {
            servoRotate90(1);
            rotation = 2;
        }
        else if(rotation == 2)
        {
            servoRotate0(1);
            rotation = 3;
        }
        else
        {
            servoRotate90(1);

```

```

        rotation = 0;
    }

    calculate_distance();

    if(distance > 75)
    {
        forward();

        //lcd_gotoxy(1,2);
        //printf(lcd_putc,"D:%03ld ",distance);
        //printf(lcd_putc," F ");
    }
    else
    {
        stop();
        servoRotate180(3); delay_ms(250);
        calculate_distance();
        left_distance = distance;
        servoRotate0(3); delay_ms(250);
        calculate_distance();
        right_distance = distance;
        servoRotate90(3);

        //lcd_gotoxy(1,2);
        //printf(lcd_putc,"L:%03ld R:%03ld
",left_distance,right_distance); delay_ms(1000);
        if(left_distance > right_distance)
        {
            //printf(lcd_putc," LS "); delay_ms(1000);
            left(); delay_ms(1000); stop();
        }
        else
        {
            //printf(lcd_putc," RS "); delay_ms(1000);
            right(); delay_ms(1000); stop();
        }
    }
}
test_sensors();
}

void main()
{
    stop();
    lcd_init();
    delay_ms(100);

    lcd_gotoxy(1,1);
    printf(lcd_putc," W E L C O M E ");

    lcd_gotoxy(1,2);
    printf(lcd_putc,"-----");

```

```
output_high(led_pin); delay_ms(500);
output_low(led_pin); delay_ms(500);
output_high(led_pin); delay_ms(500);
output_low(led_pin);

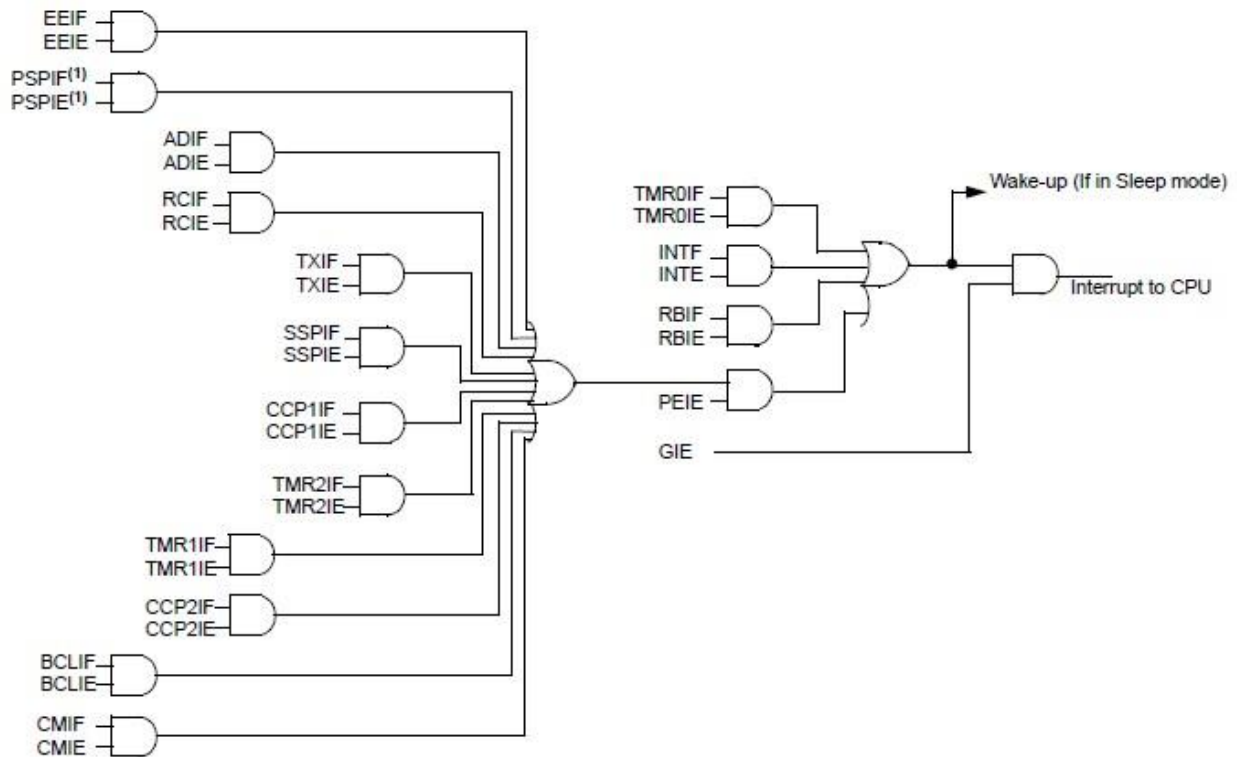
//servo_test();

enable_interrupts(INT_RDA);
enable_interrupts(GLOBAL);
clear_rx_data();

while(true)
{
    main_function();
    //servo_test();
}
}
```

INTERRUPTS

The PIC16F877A has up to fifteen sources of interrupt. The interrupt management register (INTCON) records individual interrupt requests in flag bits. It additionally has individual and world interrupt change bits. a worldwide interrupt change bit, GIE (INTCON<7>) permits (if set) all unmasked interrupts, or disables (if cleared) all interrupts. Once bit GIE is enabled, associate degree an interrupt's flag bit and mask bit square measure set, the interrupt can vector now. Individual interrupts may be disabled through their corresponding change bits in numerous registers. Individual interrupt bits square measure set, despite the standing of the GIE bit. The GIE bit is cleared on RESET. The "return from interrupt" instruction, RETFIE, exits the interrupt routine, still as sets the GIE bit, that re-enables interrupts. The RB0/INT pin interrupt, the metal port amendment interrupt and also the TMR0 overflow interrupt flags square measure contained within the INTCON register. The peripheral interrupt flags square measure contained within the Special perform Register, PIR1. The corresponding interrupt change bits square measure contained in Special perform Register, PIE1, and also the peripheral interrupt change bit is contained in Special perform Register INTCON. once associate degree interrupt is repaired, the GIE bit is cleared to disable to any extent further interrupt, the address is pushed onto the stack, and also the computer is loaded with 0004h. Once within the Interrupt subroutine, the source(s) of the interrupt may be determined by polling the interrupt flag bits. The interrupt flag bit(s) should be cleared in software system before re-enabling interrupts to avoid algorithmic interrupts. For external interrupt events, like the INT pin or PORTB amendment interrupts, the interrupt latency are going to be 3 or four instruction cycles. The precise latency depends once the interrupt event happens, relative to this alphabetic character cycle. The latency is that the same for one or 2 cycle directions. Individual interrupt flag bits square measure set, despite the standing of their corresponding mask bit, PEIE bit, or the GIE bit.



Interrupts InPIC16F877A

ADVANTAGES OF PIC MICROCONTROLLER

- PIC microcontroller's square measure consistent and faulty of PIC proportion is extremely less. The performance of the PIC microcontroller is extremely quick attributable to victimization reduced instruction set computing architecture} architecture.
- once comparison to different microcontrollers, power consumption terribly is extremely is incredibly} less and programming is additionally very simple.
- Interfacing of associate degree analog device is straightforward with none additional electronic equipment

DISADVANTAGES OF PIC MICROCONTROLLER

- The length of the program is high thanks to victimization reduced instruction set computing architecture} architecture (35 instructions)
- One single accumulator is gift and program memory isn't accessible

4.3 LIQUID CRYSTAL DISPLAY (LCD)

LCD could be a kind of show employed in digital watches and plenty of moveable computers. Digital display displays utilize to sheets of polarizing material with a liquid answer between them. An electrical current more matured the liquid causes the crystals to align in order that light-weight cannot suffer them. Digital display technology has advanced terribly quickly since its initial beginning over a decade gone to be used in lap prime computers. Technical achievements has resulted in brighter displace, higher resolutions, scale back response times and cheaper producing method.

The liquid crystals may be manipulated through associate degree applied electrical voltage in order that light-weight is allowed to pass or is blocked. By fastidiously dominant wherever and what wavelength (color) of sunshine is allowed to pass, the {lcd|liquid crystal show|LCD|digital display alphanumeric display} monitor is in a position to display pictures. A backlight provides digital display monitor's brightness.

Over the years several enhancements are created to digital display to assist enhance resolution, image, sharpness and response times.

One of the most recent such advancement is applied to glass throughout acts as switch permitting management of sunshine at the component level, greatly rising LCD's ability to show small-sized fonts and image clearly.

Other advances have allowed LCD's to greatly scale back liquid cell response times. Latency is essentially the number of your time it takes for a component to "change colors", really latency is that the quantity of your time it takes a liquid cell to travel from being active to inactive.

This is due to following reasons:

The declining prices of LCDs.

The ability to show numbers, characters and graphics. This can be in distinction to LEDs, that square measure restricted to numbers and a number of characters.

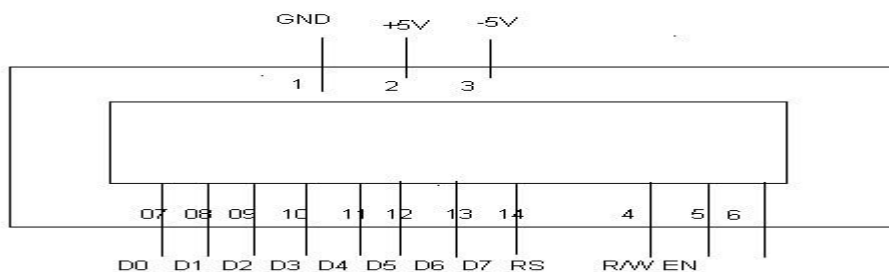
An intelligent {lcd|liquid crystal show|LCD|digital display alphanumeric display} display of 2 lines, twenty characters per line that's interfaced to the pic16f72 microcontroller.

Incorporation of a refreshing controller into the digital display, thereby relieving the central processing unit to stay displaying the info. Easy programming for characters and graphics.

Most of the digital display modules adapt to a regular interface specification. A 14-pin access is provided having eight knowledge lines, 3 management lines and 3 power lines. The connections square measure arranged get into one in every of the 2 common configurations, either 2 rows of seven pins, or one row of fourteen pins.

One of these pins is numbered on the LCD's computer circuit board (PCB), but if not, it's quite simple to find pin1. Since this pin is connected to ground, it typically encompasses a thicker PCB track, connected thereto, and it's typically connected to metal work same purpose.

PIN DIAGRAM OF LCD: -



PIN DESCRIPTIONS: -

Vcc, Vss and Vee: -

While Vcc and Vss provide +5V and ground respectively, Vee is used for controlling LCD contrast.

RS Register Select: -

There are two very important registers inside the LCD. The RS pin is used for their selection as follows.

If RS=0, the instruction command code register is selected, allowing the user to send a command such as clear display, cursor at home, etc.

If RS=1, the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W, read/write: -

R/W input allows the user to write information to the LCD or read information from it.

R/W = 1 for reading.

R/W= 0 for writing.

EN, enable: -

The LCD to latch information presented to its data pins uses the enable pin. When data is supplied to data pins, a high-to-low pulse must be applied to this pin in order for the LCD to latch in the data present at the data pins. This pulse must be a minimum of 450 ns wide.

D0 – D7: -

The 8-bit data pins, D0 – D7, are used to send information to the LCD or read the contents of the LCD's internal registers.

To display letters and numbers, we send ASCII codes for the letters A–Z, a-z numbers 0-9 to these pins while making RS=1.

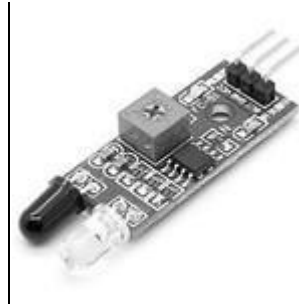
There are also instruction command codes that can be sent to the LCD to clear the display or force the cursor to home position or blink the instruction command codes.

We also use $RS = 0$ to check the busy flag bit to see if the LCD is ready to receive information. The busy flag is D7 and can be read when $R/W=1$ and $RS=0$, as follows: if $R/W = 1$, $RS = 0$. When $D7 = 1$ (busy flag = 1), the LCD is busy taking care of internal operations and will not accept any information.

4.4 IR SENSOR

What is an IR Sensor/Infrared Sensor?

Associate in nursing infrared sensing element is Associate in nursing device that emits so as to sense some aspects of the environment. Associate in Nursing IR sensing element will live the warmth of Associate in nursing object likewise as detects the motion. These styles of sensors live solely infrared light, instead of emitting it that's known as a passive IR sensing element. Usually, within the spectrum, all the objects radiate some style of thermal radiation.



IR SENSOR

These styles of radiations area unit invisible to our eyes, which might be detected by Associate in nursing infrared sensing element. The electrode is solely associate in Nursing IR light-emitting diode (Light Emitting Diode) and therefore the detector is solely associate in Nursing IR photodiode that's sensitive to IR light-weight of an equivalent wavelength as that emitted by the IR light-emitting diode. Once IR light-weight falls on the photodiode, the resistances and therefore the output voltages can modification in proportion to the magnitude of the IR light-weight received.

Working Principle

Working rule the working rule of Associate in nursing infrared sensing element is comparable to the article detection sensing element. This sensing element includes Associate in Nursing IR light-emitting diode & Associate in Nursing IR Photodiode, thus by combining these 2 may be fashioned as a photo-coupler otherwise opt coupler. The physics laws utilized in this sensing element area unit planks radiation, Stephan Ludwig Boltzmann & Wiens displacement. IR light-emitting diode is one quite transmitter that emits IR radiations. This light-emitting diode appearance almost like a regular light-emitting diode and therefore the radiation that is generated by this is often not visible to the human eye. Infrared receivers in the main discover the radiation exploitation Associate in nursing infrared transmitter. These infrared receivers area unit offered in photodiodes type. IR Photodiodes area unit dissimilar as compared with usual photodiodes as a result of they discover merely IR radiation.

Kinds of infrared receivers in the main exist betting on the voltage, wavelength, package, etc. Once it's used because the combination of Associate in Nursing IR transmitter & receiver, then the receiver's wavelength should equal the transmitter. Here, the transmitter is IR light-emitting diode whereas the receiver is IR photodiode. The infrared photodiode is tuned in to the actinic ray that's generated through Associate in nursing infrared light-emitting diode. The resistance of photo-diode & the modification in output voltage is in proportion to the actinic ray obtained. This is often the IR sensor's elementary working rule. Once the infrared transmitter generates emission, then it arrives at the article & a number of the emission can replicate back toward the infrared receiver. The sensing element output may be set by the IR receiver betting on the intensity of the response. Styles of Infrared sensing element Infrared sensing elements area unit classified into 2 varieties like active IR sensing element and passive IR sensor.

Types of Infrared Sensor

Infrared sensors are classified into two types like active IR sensor and passive IR sensor.

Active IR Sensor

This active infrared sensing element includes each the transmitter likewise because the receiver. In most of the applications, the semiconductor diode is employed as a supply. Light-

emitting diode is employed as a non-imaging infrared sensing element whereas the optical maser diode is employed as Associate in nursing imaging infrared sensing element.

These sensors run through energy radiation, received & detected through radiation. Further, it may be processed by exploitation the signal processor to fetch the mandatory info. The most effective samples of this active infrared sensing element area unit reflection factor and break beam sensing element.

Passive IR Sensor

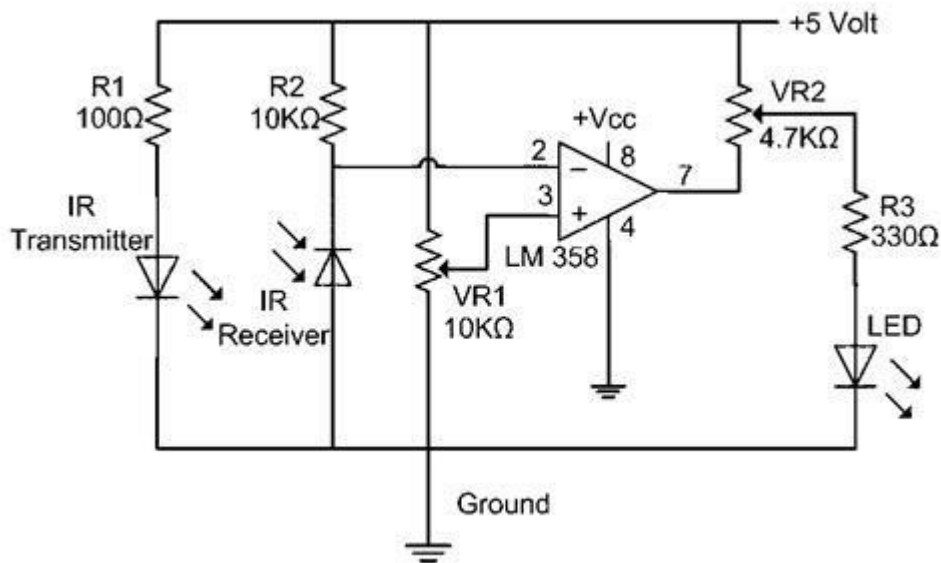
The passive infrared sensing element embraces detectors solely however they don't include a transmitter. These sensors use Associate in nursing object sort of a transmitter or IR supply. This object emits energy and detects through infrared receivers. After that, a proof processor is employed to grasp the signal to get the specified info.

The best samples of this sensing element area unit electrical phenomenon detector, bolometer, thermocouple-thermopile, etc. These sensing elements area unit classified into 2 varieties like thermal IR sensing element and quantum IR sensor. The thermal IR sensing element doesn't depend upon wavelength. The energy supply employed by these sensors is heated. Thermal detectors area unit slow with their response and detection time. The quantum IR sensing element depends on the wavelength and these sensors embrace high response and detection time. These sensors want regular cooling for specific measurements.

IR Sensor Circuit Diagram

An infrared detector circuit is one in all the fundamental And widespread detector modules in an device. This detector is analogous to human's visionary senses, which might be accustomed observe obstacles and it's one in all the common applications in period of time. This circuit contains the subsequent parts

- LM358 IC two of} IR transmitter and receiver pair
- Resistors of the vary of kilo-ohms.
- Variable resistors.
- Junction rectifier (Light Emitting Diode).



4.5 PIR SENSOR

PIR sensors square measure a lot of difficult than several of the opposite sensors explained in these tutorials (like photocells, FSRs and tilt switches) as a result of their square measure multiple variables that have an effect on the sensors input and output. To start explaining however a basic detector works, we'll use this rather nice diagram.

The PIR detector itself has 2 slots in it, every slot is formed of a special material that's sensitive to IR. The lens used here isn't very doing a lot of then we have a tendency to see that the 2 slots will 'see' out past a long way (basically the sensitivity of the sensor). Once the detector is idle, each slots observe an equivalent quantity of IR, the close quantity radiated from the space or walls or outdoors. Once a heat body sort of a human or animal passes by, it 1st intercepts one 1/2 the PIR detector, that causes a positive differential amendment between the 2 halves. Once the nice and cozy body leaves the sensing space, the reverse happens, whereby the detector generates a negative differential amendment. These amendment pulses square measure what's detected.



PIR SENSOR

PIR sensors square measure rather generic and for the foremost half vary solely in worth and sensitivity. Most of the important magic happens with the optics. This can be a fairly sensible plan for manufacturing: the PIR detector and electronic equipment is mounted and prices a couple of bucks. The lens prices solely a couple of cents and may amendment the breadth, range, sensing pattern, terribly simply.

In the diagram up prime, the lens is simply a bit of plastic, however meaning that the detection space is simply 2 rectangles. Sometimes we'd prefer to have a detection space that's a lot of larger. To do that, we have a tendency to use an easy lens like those found in a very camera: they condenses an outsized space (such as a landscape) into a tiny low one (on film or a CCD sensor). For reasons which will be apparent shortly, we'd prefer to build the PIR lenses tiny and skinny and elastic from low-cost plastic, even if it's going to add distortion. For this reason the sensors are literally Fresnel lenses.

4.6 GAS SENSOR

Description :

Sensitive material of MQ-2 gas sensing element is SnO_2 that with lower conduction in clean air. Once the target flammable gas exist, the sensor's conduction is a lot of higher together with the gas concentration rising. Please use easy electro circuit, Convert amendment of conduction to correspond sign of gas concentration. MQ-2 gas sensing element has high sensitivity to LPG, gas and H, additionally can be accustomed alkane series and different flammable steam, it's with low price and appropriate for various application. Options:

- sensible sensitivity to flammable gas in big selection
- High sensitivity to LPG, gas and H
- Long life and low price
- easy drive circuit

Application:

- Domestic gas outpouring detector
- Industrial flammable gas detector
- transportable gas detector.

Features :

- Good sensitivity to Combustible gas in wide range
 - High sensitivity to LPG, Propane and Hydrogen
 - Long life and low cost
 - Simple drive circuit
- Application :**
- Domestic gas leakage detector
 - Industrial Combustible gas detector
 - Portable gas detector

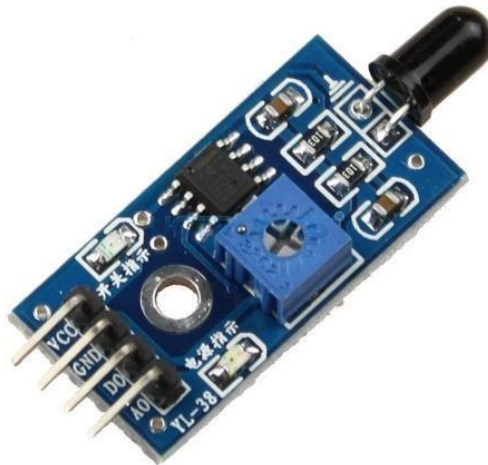


GAS SENSOR

Description :

The LM35 series square measure preciseness integrated-circuit temperature sensors, whose output voltage is linearly proportional to the astronomer (Centigrade) temperature The LM35 so has a bonus over linear temperature sensors graduated in ° Kelvin, because the user isn't needed to deduct an oversized constant voltage from its output to get convenient Centigrade scaling. The LM35 doesn't need any external standardization or trimming to produce typical accuracies of $\pm\frac{1}{4}^{\circ}\text{C}$ at temperature and $\pm\frac{3}{4}^{\circ}\text{C}$ Cover a full -55 to +150°C temperature vary. Low price is assured by trimming and standardization at the water level. The LM35's low output electrical resistance, linear output, and precise inherent standardization build interfacing to readout or management electronic equipment particularly simple. It may be used with single power provides, or with and and minus provides. Because it attracts solely sixty sixty from its offer, it's terribly low self-heating, but zero.1°C in still air. The LM35D is rated to work over a 0° to +100°C temperature vary.

Outputs 10mV per Degree that may even be browse directly on multimeter or browse in to microcontroller. For instance at thirty degree celcius it'll output 300mV at linear scale.



FIRE SENSOR

Features :

- Calibrated directly in Celsius (Centigrade)
- Linear + 10.0 mV/ C scale factor
- 0.5 C accuracy guarantee able (at +25 C)
- Rated for full -55 to +150 C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 A current drain
- Low self-heating, 0.08 C in still air
- Nonlinearity only 1/4 C typical
- Low impedance output, 0.1 W for 1 mA load

4.8 IOT SENSOR**INTRODUCTION TO IOT**

The 'Thing' in IoT may be any device with any quite built-in-sensors with the flexibility to gather and transfer knowledge over a network while not manual intervention. The embedded technology within the object helps them to move with internal states and therefore the external surroundings, that successively helps in selections creating method.

In a shell, IoT could be a conception that connects all the devices to the net and allow them to communicate with one another over the net. IoT could be a big network of connected devices – all of that gather and share knowledge concerning however they're used and therefore the environments within which they're operated.

A developer submits the applying with a document containing the standards, logic, errors & exceptions handled by him to the tester. Again, if there square measure any problems Tester communicates it back to the Developer. It takes multiple iterations & during this manner a wise application is made.

Benefits of IoT

Since IoT permits devices to be controlled remotely across the net, so it created opportunities to directly connect & integrate the physical world to the computer-based systems mistreatment sensors and web. The interconnection of those multiple embedded devices are leading to automation in nearly all fields and additionally sanctioning advanced applications. This is often leading to improved accuracy, potency and economic profit

With reduced human intervention. It encompasses technologies like good grids, good homes, intelligent transportation and good cities. The main advantages of IoT are:

- Improved client Engagement – IoT improves client expertise by automating the action. For e.g. any issue within the automotive are mechanically detected by the sensors. The driver, likewise because the manufacturer, are notified concerning it. Until the time driver reaches the station, the manufacturer can make certain that the faulty half is accessible at the station.
- Technical optimization – IoT has helped heaps in rising technologies and creating them higher. The manufacturer will collect knowledge from completely different automotive sensors and analyze them to boost their style and build them way more economical.
- Reduced Waste – Our current insights square measure superficial, however IoT provides time period info resulting in effective deciding & management of resources. For instance, if a manufacturer finds fault in multiple engines, he will track the factory of these engines and might rectify the problem with producing belt.

Nowadays, we have a tendency to square measure encircled by scores of IoT enabled devices that square measure incessantly emitting knowledge and communication through multiple devices. Moving ahead, let's discuss the desired hardware for building associate degree IoT application. {We will|we'll|we square measure going to} additionally scrutinize the IoT devices that we have a tendency to are mistreatment in our day to day life.



IOT HARDWARE

Now you'd be questioning what's the desired hardware for making ready AN IoT resolution. The solution to the present question is, you'll 1st need sensors which will sense the surroundings, then you need a foreign dashboard to observe your output and show it during a clearer & conceivable type. At last, you may need a tool with the potential of serving & routing. The key task of the system would be sleuthing specific conditions and taking actions consequently. One issue to stay in mind is securing the communication between the devices and therefore the dashboard.

Some of the common sensors that you just area unit enclosed by area unit accelerometers, temperature sensors, magnetometers, proximity sensors, gyroscopes, image sensors, acoustic sensors, light-weight sensors, pressure sensors, gas RFID sensors, humidness sensors & small flow sensors.

Nowadays we tend to even have several wearable devices like smartwatches, shoes & 3D glasses. This can be the most effective example of a sensible resolution. 3D glasses change television's brightness and distinction in line with your eye and your smartwatches keeps track of your daily activities and fitness.

But I feel the foremost vital device that has staggeringly contributed to IoT area unit the cell phones. Mobile apps have vastly contributed to revolutionizing the technology world. Cell phones area unit already incased with applications and sensors that reveals ample data concerning its user. It's Geo-location data, it will sense and trace light-weight condition, the orientation of your device and tons additional data. It conjointly comes with multiple property choices like Wi-Fi, Bluetooth and cellular that helps them to speak with different devices. Thus, thanks to these default qualities of cell phones, it's the core of the IoT scheme. Today, Smartphone will move with smartwatch and fitness band to any ease and enhance the user expertise.

IoT uses multiple technologies and protocols to speak with devices supported the necessities. The key technologies & protocols area unit Bluetooth, wireless, NFC, RFID, radio protocols and Wi-Fi-Direct.

IoT applications area unit flourishing across all industries & market. The IoT includes a multitude of growth over varied industries. It spans over all teams of users, from World Health Organization those that people who} are attempting to scale back & conserve energy in their home to massive organizations who need to boost their business operations. IoT has not solely

proven itself helpful in optimizing essential applications in several organizations, however even have boosted the thought of advanced automation that we've unreal a decade before. Let's perceive the capabilities of IoT across completely different industries and appearance however they're revolutionizing them.

4.9 METAL SENSOR

The LMP91300 may be a complete analog side (AFE) optimized to be used in industrial inductive proximity sensors. The LMP91300 directly converts the RP of the external LC tank into a digital worth Post-manufacturing configuration and activity is totally supported. The temperature dependence of the sensing element is digitally remunerated, exploitation AN external temperature sensing element. The LMP91300 provides programmable thresholds, programmable temperature compensation and programmable oscillation frequency vary. Thanks to its programmability, the LMP91300 may be used with a good form of external inductors and its detection thresholds may be adjusted to the specified detection distances an indoor transformer permits the device to work with a offer from vi.5V to 40V. The output may be programmed to drive AN external semiconductor device in either NPN or PNP mode out there in 4mm × 5mm 24-terminal WQFN and a pair of.05mm × 2.67mm 20-terminal DSBGA packages, the LMP91300 operates from -40°C to +125°C



METAL DETECTOR

4.10 ULTRASONIC SENSOR

Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to listen to. They then expect the sound to be mirrored back, and distance supported the time needed. This can be the same as however associated ranging|radiolocation|measuring instrument measuring system|measuring device} measures the time it takes an electromagnetic wave to come when touch an object.

While some sensors use a separate sound electrode and receiver, it's conjointly potential to mix these into one package device, having associate inaudible component alternate between emitting and receiving signals. This sort of sensing element are often factory-made during a smaller package than with separate components that is convenient for applications wherever size is at a premium.

While radiolocation and inaudible sensors are often used for a few of a similar functions, sound-based sensors square measure promptly available—they are often had for simply a handful greenbacks in some cases—and in sure things, they will sight objects additional effectively than radiolocation.

For instance, whereas radiolocation, or perhaps light-based sensors, have a troublesome time properly process clear plastic, inaudible sensors haven't any drawback with this. In fact, they're unaffected by the color of the fabric they're sensing.

On the opposite hand, if associate object is created out of a cloth that absorbs sound or is formed in such the simplest way that it reflects the sound waves far from the receiver, readings are going to be unreliable.

If you would like to live the particular distance from your sensing element, this could be calculated supported this formula:

$$\text{Distance} = \frac{1}{2} T \times C$$

(T = Time and C = the speed of sound)

At 20°C (68°F), the speed of sound is 343 meters/second (1125 feet/second), however this varies betting on temperature and humidness.

Especially custom-made inaudible sensors also can be used underwater. The speed of sound, however, is 4.3 times as quick in water as in air, therefore this calculation should be adjusted considerably.



ULTRASONIC SENSORS

What are Ultrasonic Sensors Used For?

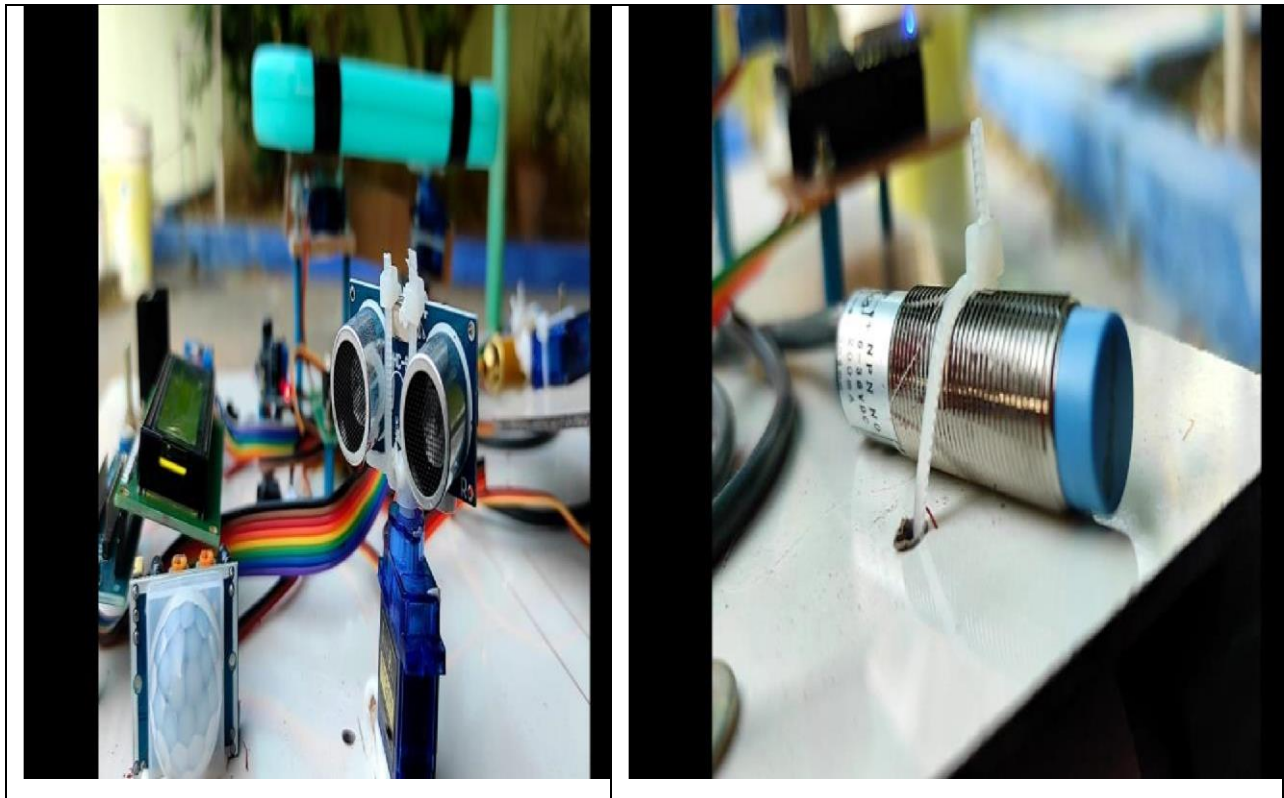
So wherever will we have a tendency to use these sensors? Golem navigation involves mind, in addition as plant automation. Water-level sensing is another smart use, and may be accomplished by positioning one sensing element higher than a water surface. Another aquatic application is to use these sensors to “see” very cheap of a body of water, traveling through the water, however reflective off very cheap surface below.

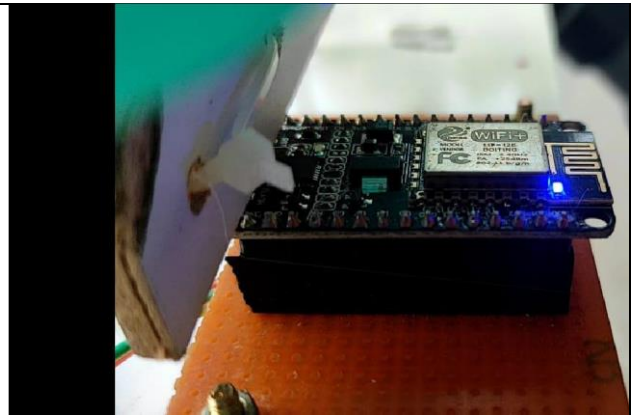
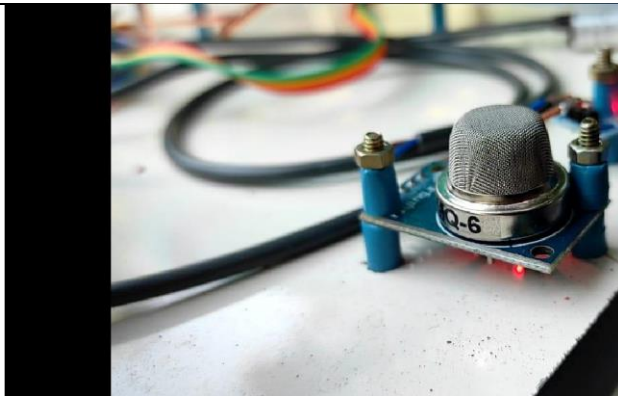
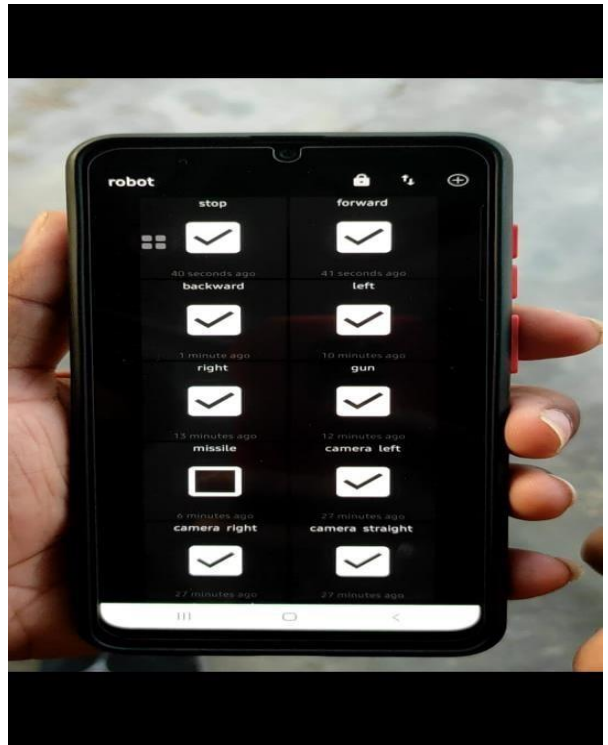
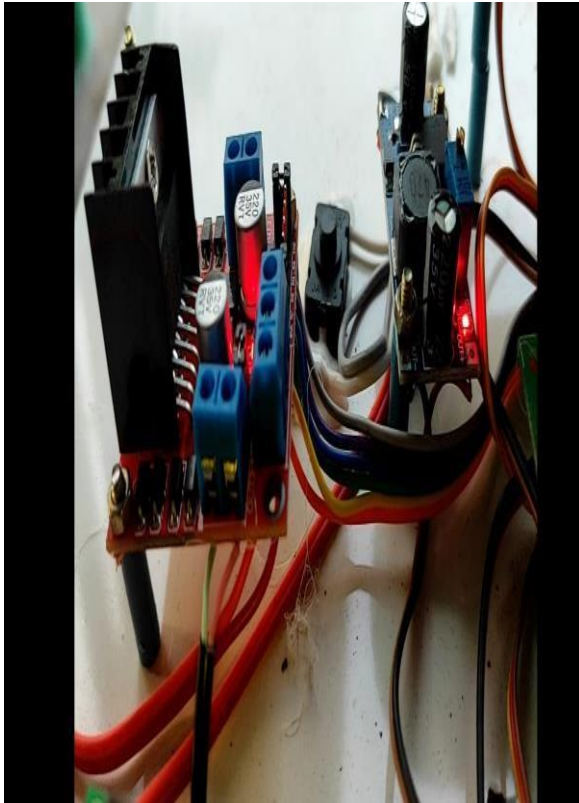
Though it'd not be straightaway obvious, if organized properly inaudible sensors will even live fluid flow rates. Within the simplest case, associate electrode and a receiver (separate during this configuration) square measure aligned with the flow of a fluid. Since sound is traveling through a moving medium, the speed of sound relative to those components are going to be accumulated or reduced by the rate of the fluid. This could be applied to flow within pipes by orientating these 2 components at associate angle to every alternative, hard the effective rate increase supported the pure mathematics relations between the 2.

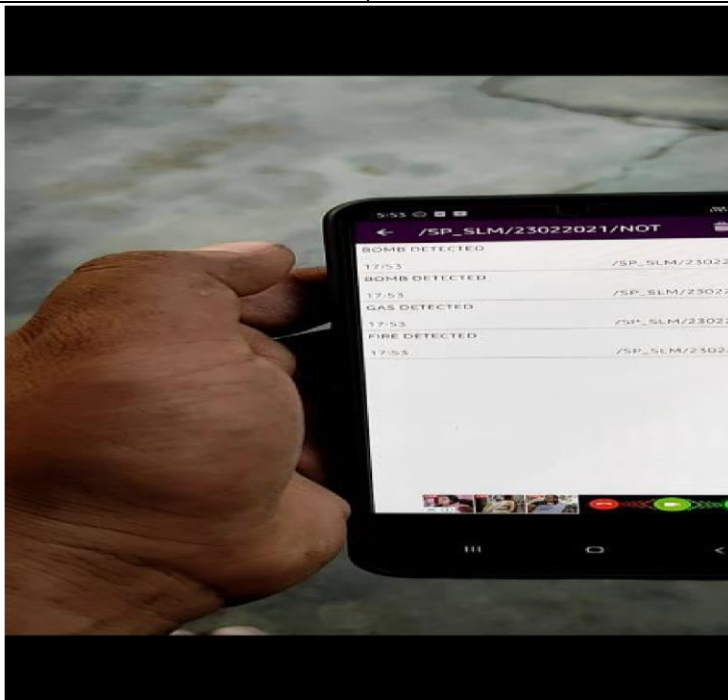
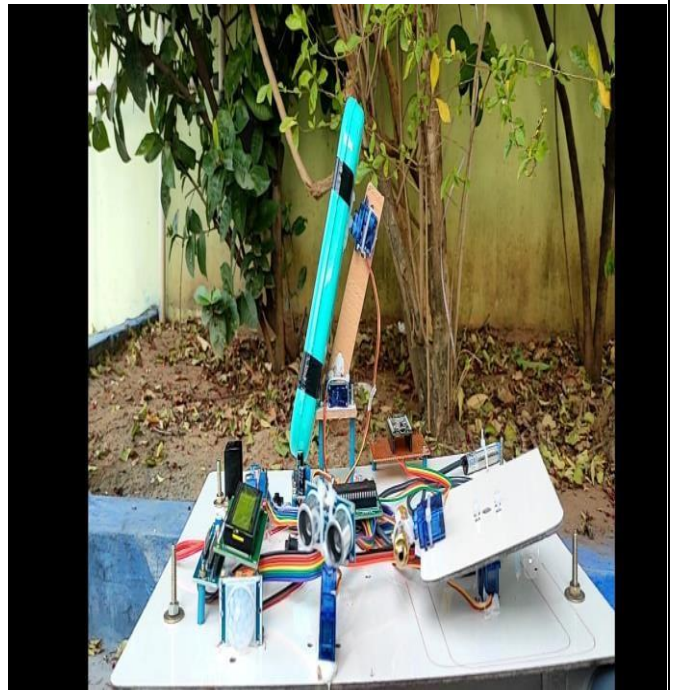
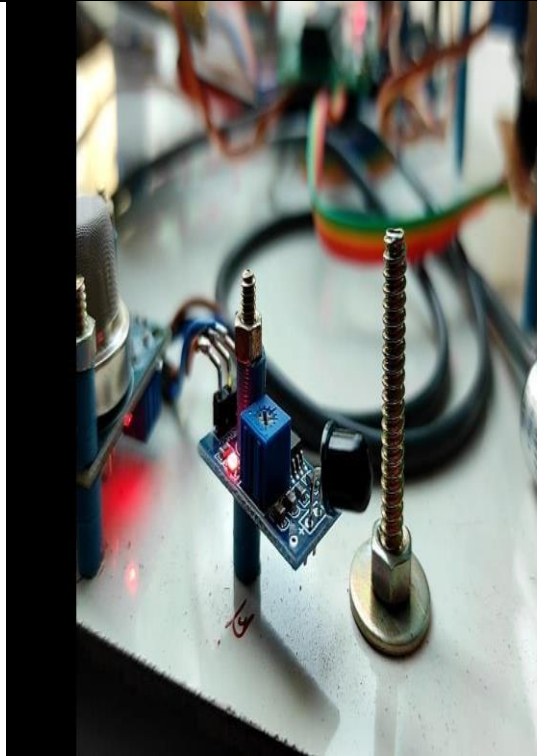
Flowrate accuracy are often accumulated by mistreatment information from multiple inaudible components, giving results correct to among a fraction of a %.

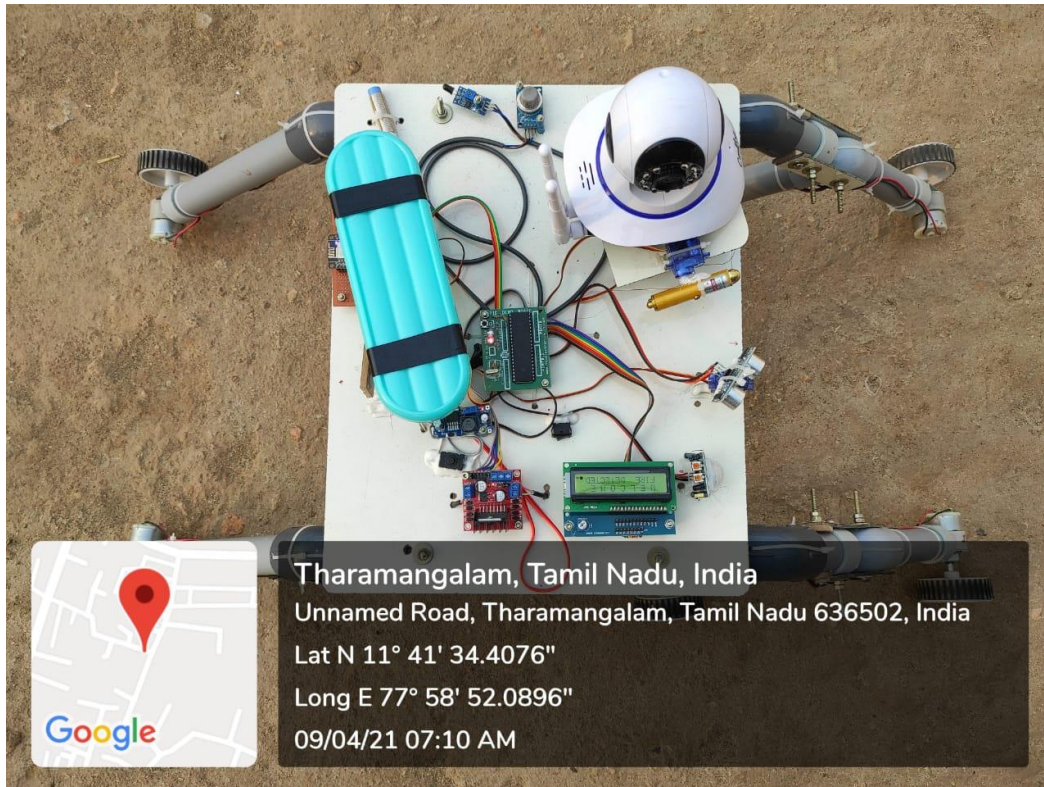
CHAPTER 5

RESULTS









CONCLUSION

This paper brings insight into developing an integrated multi-sensing system for human intrusion detection and surveillance. The determination of multiple predefined thresholds for human intruder detection helps in integrating the camera sensor for effective border surveillance. This assures the efficiency of the developed detection system, which makes it a better solution for human intruder detection and surveillance. The future work includes developing and implementing the proposed system to a real environment.

6.1 FUTURE SCOPE

The future work includes developing and implementing the proposed system to a real environment similar to a dry leaves covered border region. A real-time border surveillance system incorporated with efficient wireless communication technologies for better monitoring and controllability can be included as future work.

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