MAN OVERBOARD DETECTION AND SAFETY SYSTEM

-Safety & Security in Transport Sector-

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ABSTRACT---Worldwide, the ocean cruise industry has an annual passenger compound annual growth rate of 6.63% from 1990 - 2020. Growth strategies to date have been driven by larger capacity new builds and ship diversification, more local ports, more destinations and new on-board/on-shore activities that match demands of consumers. A total of 13 new ships with passenger capacity of 33,379 will be added in 2018.

Man overboard is a situation where in a ship's passenger falls out at sea from the ship, no matter where the ship is sailing, in open seas or in still waters in port. A seafarer has to be very careful while being onboard, as it can never be taken for granted that a person cannot fall off the ship due to bad weather, swell in the sea, accidents, and due to negligence during.

Many cases has been found where the person died because of being unnoticed after overboarding or the rescuer came after a long span of time within which either he was drowned or died due to other reasons.

The proposed system consists on an IR Opto Coupler which consists of a light emitting and light detecting plate with no connection in between and an LPS. The basic principle is that any breakage in this circuit will raise the alarm after which measures can be taken accordingly along with real time tracking of the passenger.

Installation of such system will just require projections at certain intervals on the ship. This can be achieved at minimal cost. By this installation the 'Man Overboard' can be brought to notice making the rescue easy.

Keywords

1. ***Overboard Detection***
2. ***Infrared Opto Coupler***
3. ***Cruise Accidents***
4. ***Real time tracker***
5. ***PIC Microcontroller***

1. INTRODUCTION

The aim of the paper as explained in the abstract is to make a system that facilitates the detection of 'Man Overboard'. Man Overboard is a situation that is commonly encountered on cruise ships. Many travelers are unaware of the unsafe conditions which may occur at the sea (Rolling and Pitching**)** tend to fall overboard. The fact that the person is missing is discovered after considerable time being lost and hence, their recovery becomes difficult and usually the life of the individual is lost.

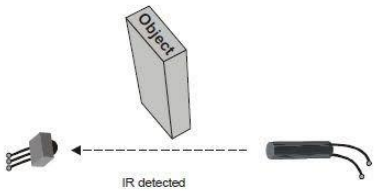
In a report for the Cruise Lines International Association, a trade group representing the cruise lines, the cruise industry consulting firm G.P Wild reported that, in any given year roughly 19 people go overboard while being in a cruise ship.

The main problem encountered by any individual after being overboard is the lack of being unnoticed and the danger of the creatures that are present in the sea. Usually this problems tend to occur in the cruise ships because the passengers onboard don't have any proper training and experience and usually they have a tendency to lean on the railings and hence they fall be overboard.

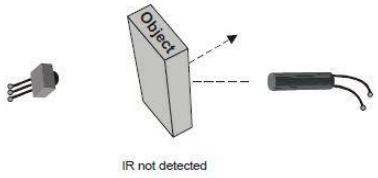
The basic principle on which the whole installation is based on is that the Infra Red Opto Coupler or an Infra Red Opto Isolator is a component that transfers electrical signals between two isolated circuits using light. Whenever this light is there, the circuit is connected and hence the system is complete.

Our aim is that whenever a person falls overboard, he will break one of these circuits which will be installed alongside the ship and hence an alarm will be triggered leading to quick response and rescuing of the individual.

In other words principal focus of this paper this paper proposes and instant response motion detection system which can be conveniently installed on board . motion sensors that follow the basic principle of the Infra Red Opto Coupler or Isolator are installed along the circumference of the vessel the main function of these sensors is to detect anything that moves across them the sensors are so installed the during an overboard situation victim goes across the sensors and the alert system connected to the sensors is activated which in turn sounds an alarm this way we can recognize any case of man overboard instantly on the Deck and required actions necessary for the recovery and safety of the overboard sailor can be initiated .this kind of quick response system will significantly reduce the fatalities due to man overboard as the accident is detected well within the time and the rescue operations are initiated immediately hence precious human lives can be saved and the safety on ships is notable enhanced.



To increase the efficiency of this system and to reduce the chances of man overboarding we are installing along with this a Local Positioning System which will basically work as stated below –



The basic idea behind installation of a Local Positioning system on the ship along with the Infra Red Opto-Isolator is to increase the accuracy in case of Man Overboarding situations whose chance are more to occur on a cruise ship. As a result every member present on the deck would be under observation from the Captain's chamber.

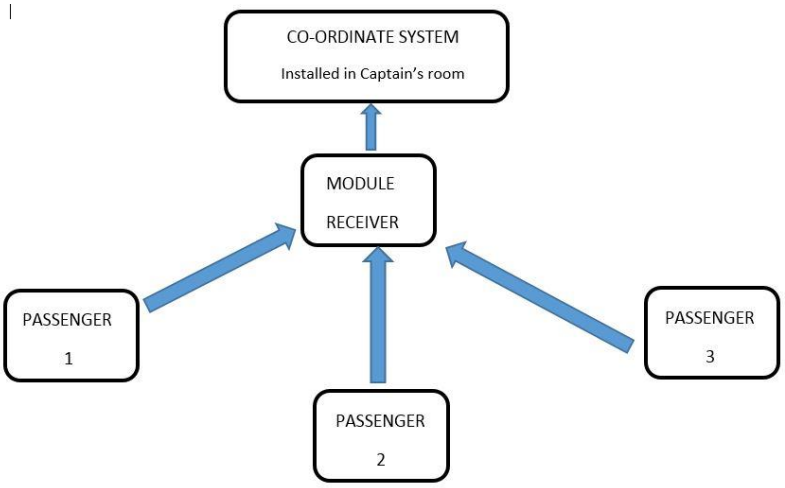
The basic idea behind the working of a Local Positioning System is to install a positioning system whose area would be confined to the open areas on the deck and all accident prone areas on the ship.

A local positioning system (LPS) is a navigation system that provides location information in all weather, anywhere within the coverage of the network, where there is an unobstructed line of sight to three or more signaling beacons of which the exact position on a confined area is known.

This particular idea of the Local Positioning system would be having a facility of real time tracking of the individuals present onboard the ship.

The basics applied here is the use of the coordinate system on the open areas of the deck and those areas that are prone to accidents of Man Overboarding.

The flow chart for the proposed idea is below –



2. WORKING

2.1 - Working and Circuitry of the IR Opto-Coupler

Every set of sensors in this Opto Coupler consists of three pairs of transistors each consisting of an infrared transmitter and a receiver mounted along suitably defined section of ships circumference especially in those sections where possibilities of Man Overboarding is more. These transducer pairs are separated by a well-defined length determinable based on the components specification. Each transmitter has a corresponding independent receiver, both the components are connected to a regulated 5 volt dc driver supply when the supply is on both the system's transducers driven to active state .

Active state when a potential of 5 Volt is maintained across the terminals of both the components they are driven to a dynamic state or on state which is known as active state.

The activated pair is placed in a straight line along the ship's circumference with the components optimally oriented in space. The said straight line is tangential or parallel to the tangents of the ship's circumference, when all the above conditions or states are satisfied infrared transmitter emits a beam of infrared radiation of certain predetermined frequency lying within the range of infrared frequencies. This emitted beam falls on the infrared receiver through an opening slit and hence keeps the receiver conducting in the active state.

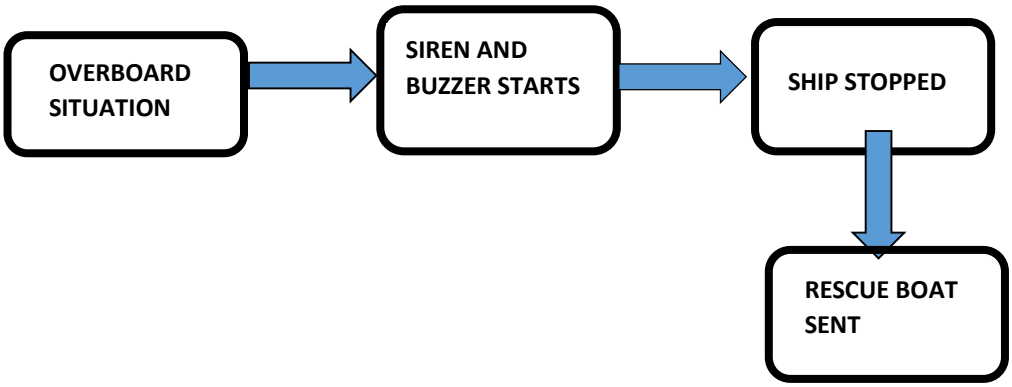
The above process is exactly similar in all the transducer pairs. When the components are functioning they are capable of detecting any obstruction of movement that interrupts the falling path of the infrared beam. As soon as the beam is obstructed the receiver stops to conduct and an output is generated which is fed into the Processing Unit consisting of a PIC microcontroller and other associated circuitry.

Reception of output from sensors and processing operation

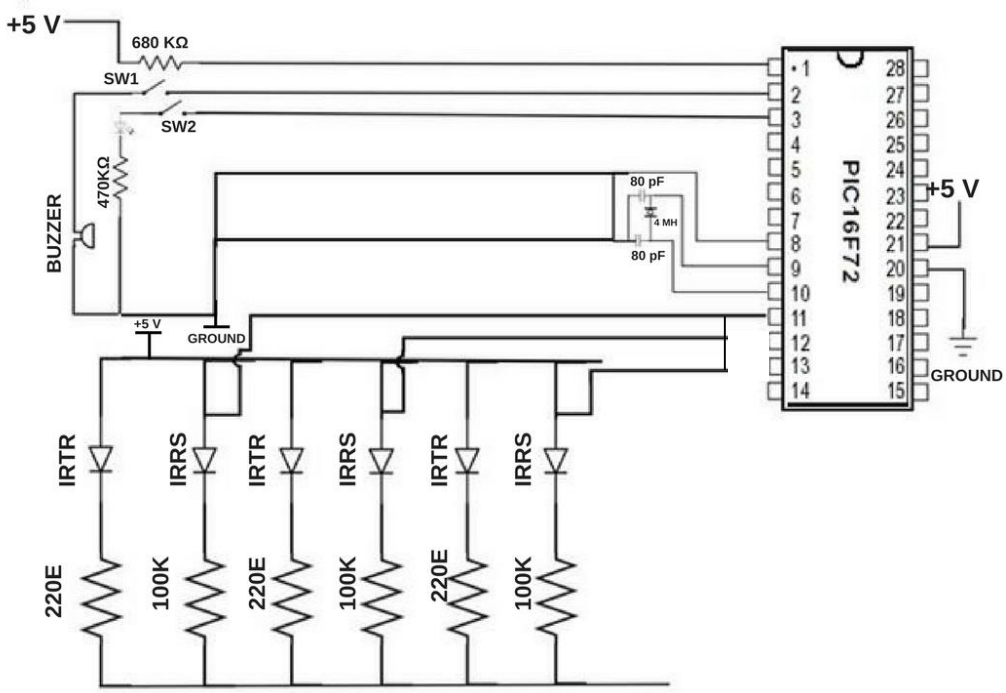
The output signal from sensors is taken as input by the pic microprocessor, further the input is processed and the corresponding output based on the program is generated this output from the sensor is fed into the alert system drive which then drives a set of transducers like LED or burgers.

Flow chart for the proposed working is as below :

DURING OVER BOARD SITUATION -



Circuit Diagram and working for Infra Red Opto- Coupler Detector



Working of alert system

The output from the receiver is given as input to pin 11 of the IC this drives the pin to 2 High State the output from pin 2 is taken as input to the driver response circuit this consists of a buzzer and an LED .when triggered buzzer is switched on and an LED emits visible light.

After the recognition of the accident the security system can be reset to the normal state by pressing the reset button.

Design and construction

- IR emitter
- IR receiver
- Resistors

- Capacitors
- Crystal oscillators
- BUZZER
- LED
- SPDT switches
- PIC 16F72 microcontroller
- 5 V regulated power supply

Microcontroller and support hardware setup

Hardware description:

Vcc and GND: The pin 20 is Vcc. it is given 5 V and pin 8 is GND i.e. it is given 0 V for powering up microcontroller.

Crystal (XTAL1-XTAL2): The pin number 9 and 10 are used to connect the 4 MHz quartz crystal. The 4 MHz quartz crystal is connected to XTAL1and XTAL2 also need two capacitors of 33 pF value. One side of each capacitor is connected to the ground.

Circuit base

Basic circuit must be made on a PCB with 28 pin 10 base or ZIP socket for PIC microcontroller and berg strips extensions for ports. Construct and connect fixed +5V regulated supply power supply to the PIC controller board.

Software:

Download free version of MPLAB IDE development tools (compiler) from the web site www.microchip.com. Install the software MPLAB on the system. Create a project to execute the C program. Alter program is written in C, hex code (*.hex file) must be generated by building target. Get the help from www.microchip.oom to create project, build target and to generating hex file.

Programming

The hexadecimal code (hex file) must be burned to the 16172 PIC microcontroller to do specific task. For this a programmer is necessary. Buy USB burner/ programmer with software and with suitable driver for your system as the laptops are provided with USB ports. After programming the microcontroller chip is placed on the 28 pin IC base/ ZIP socket of the development board. Verify the working of project for your task using measuring instruments .

Sensor, buzzer and LED connections:

Three sensors signals i.e., burglar signal to RCO, fire signal to RC1 and day/ night light signal to RC2 are connected respectively of port C. A buzzer is connected to RAO in series with push to off switch SW1, a night light (LED) is connected to the RAI in series with push to off switch SW2.

The various signals connected to PIC controller are shown in the following table.

	Inputs			**Outputs**	
Ports	RC0	RC1	RC2	RA0	RA1
Signals	Overboard	Overboard	Overboard	Buzzer	LED

Circuit connections and programming

PIC Microcontroller 16F7 2 is used to build integrated security system. A regulated DC +5V supply must be used to provide voltage to PIC 16F72 controller. The C program is written to do the following operation.

Program

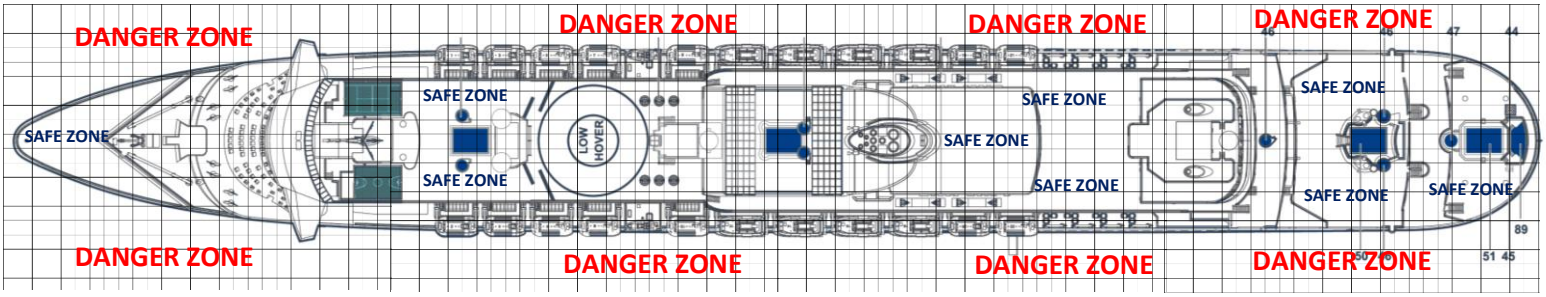
#include <htc.h>

```
void main (void)
{
TRISA =0;            //port A output
PORTA =0x00;
        While (1)
        {
         TRISC=0;
          PORTC=0X0F;
          TRISC=1;//PORTC input
If (RC0==0)       //BUZZER
{
RA0 = 1;  //BUZZER
}
```

2.2 - Working for the LOCAL POSITIONING SYSTEM FOR REALTIME TRACKING

A local positioning system (LPS) uses the radio propagation parameters in a Wi-Fi Module to establish a mobile station's position. The mobile station which here is to be installed upon in the captain's room receives pilot channel signals from at least three distinct base stations which here are the passengers present upon the ship's open and accident prone areas and records the PN chip offset of the pilot channel signals. The LPS time difference of arrival triangulation approach requires no additional signal detection capabilities. Base stations send out pilot channel signals that arrive at a mobile station with a particular phase and at least a predetermined minimum strength. The mobile station reports back the "visible" pilot channel signals, their phases and signal strength to the LPS which uses a location non-linear system or the co-ordinate system to determine the present position of the passenger and hence a real time tracker will be obtained. The LPS of the present invention provides the benefit of using existing equipment to provide GPS-like positioning capabilities. The LPS requires no additional signal detection capabilities, and only requires a minor modification to the existing wireless systems. No additional hardware is needed other than the standard Wi-Fi system, which is to installed in all passenger's body making the LPS cost effective.

The confined area, i.e the area of the ships deck would be programmed in such a way that whenever a sensor leaves the grid, an alarm gets triggered.



So here the safe area is the one enclosed by the coordinate system. As soon as any body moves out of the enclosed area, the captain gets informed by the screen present on his cabin and hence forth the measures are taken accordingly.

The idea is to create a total grid or coordinate system that will be acting both on and outside the ship's deck and nearby waters.

The total area on the deck has been marked with safe zone area and the chances of overboarding are less in these places. The area nearby the ship, i.e the area of the nearby waters has been marked as the danger zone.

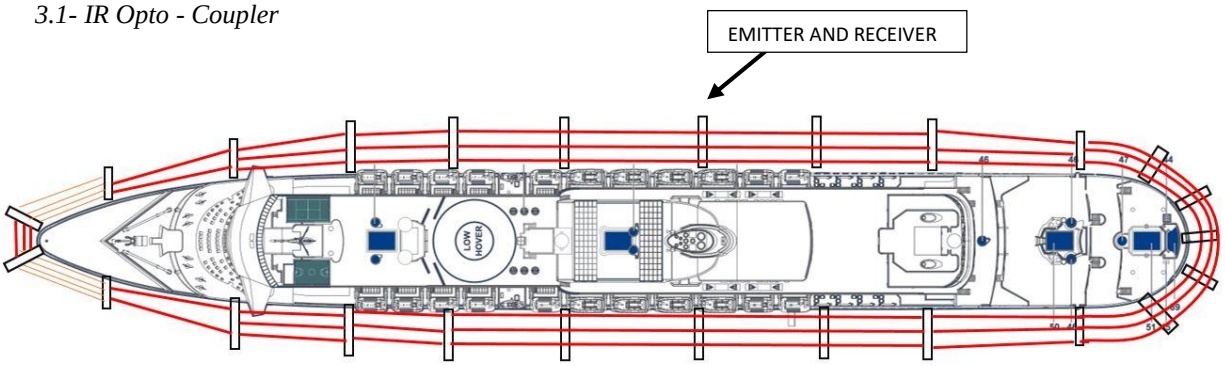
Whenever a person having the node/tags is approaching the edges of the sea he will be alerted by the nearby speakers and the beacon would start flashing.

To carefully implement this case, the deck area/safe zone should be kept within a loop by the programming and when a person will approach the ends this loop would get finished and this will flash the alarms as a warning.

In case of overboarding situations, the person is sure to fall in the nearby waters whichwould already be under the coordinate system and in this way the exact location of the person relative to the ship would be known resulting in quick rescuing of the man.

3. **WORKING**

3.1- IR Opto - Coupler

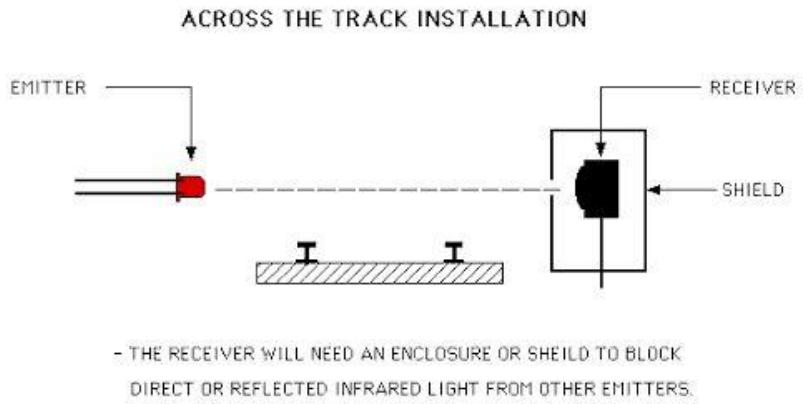


The construction of the Infra Red Opto Coupler on the ship is as shown above in the diagram –

As marked by the arrow, the rectangular boxes will consist of both the Emitter and the receiver

The concentration of these rays would be in maximum numbers in those areas of the hull where the chances of the accidents are more.

The image below depicts the across the track installation of the Isolator –



An increase in concentration of these rays would result in more accuracy of the setup. The setup would be done in such a manner that the sensitivity of these rays would only be broken if it passes through a muscular figure or a human figure as because chances of breakage of the circuit are there even if water passes through the rays. The frontal part where the rays are shown in lighter shade depicts the position for accident prone areas and as a result the concentration of Infrared Isolators are more in this area which as a result increases the sensitivity of the system.

3.1.1 - In Comparison to the LDR security system

In LDR system there is a possibility of less sensitivity in day time as shown in the graphs. In LDR system the efficiency of the setup is more in night time than in day time but in our case i.e in the case of IR Opto coupler there is lesser chances of mistakes as we are using the INFRA RED Rays to work with. They have same efficiency all the day.

Real time position tracker

The Local Positioning system is another aspect of the project in which we will be basically designing a Local Positioning System which will be installed n the ship's own server.

The main principle to be worked upon with is the basic co-ordinate system i.e each and every person on board would be marked as nodes in the co-ordinate system which will over the ship. These co-ordinates would be defining the presence of every person.

Real time tracking of each and every person will be available for all those people who will be present on and near the open areas of the ship.

CONCLUSION

The aim of successfully making a 'Man Overboard Detection and Safety System' has been achieved by the joint efforts of the authors. The problem for the passengers being drowned before getting rescued had been taken special care with. The tags that will be attached to the human body and which will act as the node to receive the signal from the passenger during distress. It has been observed this project is having greater efficiency and more cost effectiveness than any other projects of the same kind and also the installation on the ships gets easy in this case.

In this particular project chances of mistakes are very less than any other methods, and since due to greater efficiency and quicker response time of the integrated system, the chances of survival of the person in distress gets exponentially high than the other cases.

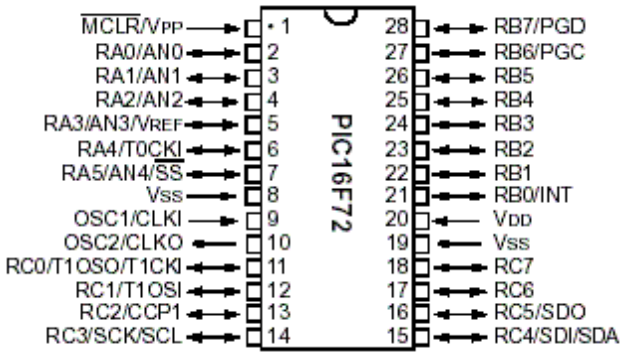
References

1. Cruise Market Watch
2. Market watch.
3. Byron H. Chen, Maria E. Palamara ; Lucent Technologies Inc. 2004

Appendix – 1

PIC Micro controller

PIC, stands for peripheral interface controller (PIC). PIC microcontroller is an amazingly powerful fully featured processor with internal RAM, EEROM FLASH memory and peripherals. One of the smallest ones occupies the space of a 555 timer but has a 10-bit ADC, 1k of memory, 2 timers, high current I/O ports, a comparator, a watch dog timer and many more features.



At present PIC microcontrollers are widely used for industrial purpose due to its high performance ability at low power consumption. It is also very famous among hobbyists due to moderate cost and easy availability of its supporting software and hardware tools like compilers, simulators, debuggers etc. A PIC Microcontroller can control outputs and react to inputs e. g. you could

drive a relay or read input buttons. With the larger PIC devices, it’s possible to drive LCDs or seven segment displays with very few control lines as all the work is done inside the PIC Microcontroller. Built in ADC can read analogue signal levels so you don’t need to add an external device e.g. it can read an LM35 temperature sensor directly with no interface logic. In this project PIC 16F72 microcontroller is used. PIC microcontroller is an amazingly powerful fully featured processor with internal RAM, EEROM FLASH memory and peripherals. One of the smallest ones occupies the space of a 555 timer but has a 10-bit ADC, 1k of memory, 2 timers, high current I/O ports, a comparator, a watch dog timer and many more features.

Overview of PIC Microcontroller 16F72

This powerful (200 nanosecond instruction execution) yet easy-to program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC architecture into an 28-pin package and is upwards compatible with the PIC16C5X, PIC1606X, PIC1607X devices. The PIC16F72 features 6 channels of 8-bit Analog-to-Digital (A/D) converter with 2 additional timers, capture / compare/PWM function and the synchronous serial port. All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

The PIC16F72 has ports A, B and C. Port A has 6 pins (RA0, RAl, RAE, RAS, RA4 and RAB). Port A pins may be made Analog / Digital inputs or Digital outputs. Port B (pins 21 to 28) and C (pins 11 to 18) can be used as digital input or output.