Design, Modelling and Application of Microcontroller (MCU) on Marine Watertight Door

Mohd Zul Azman,[a] Mohd Hisyamudin,[b] Thevandran [c]

[a,b,c] Malaysian Maritime Academy, Melaka, Malaysia

[a] zulmk86@gmail.com
[b] hisyam5977@gmail.com
[c] theven8355@gmail.com

ABSTRACT

In all Merchant Ship, to prevent water spilled to compartment in any weather condition, it is compulsory to fix with weather tight and watertight doors. Water tight door have to design carefully to have optimum function of safety. Normally on basic watertight doors, its design by hinged and operated manually without any power aid. In some severe condition, manual operate watertight door may bring harm to the personnel who operate it.

In this paper, author proposes a sliding watertight door with electromotor controlled by microcontroller and simulated on Proteus software and compiled with PIC c compiler and programmed into the microcontroller using a PIC 8 bit microcontroller programmer. This design of microcontroller was tested and simulated and found functioning well.

KEYWORDS: PIC microcontroller, motor rotation control,

NOMENCLATURE:

MCU	Microcontroller
O	Open Door
C	Close Door
ST	Stop Operation
Buzz	Buzzer Activation
LED	Light Emitting Diode
LCD	Liquid Crystal Display

1.0 INTRODUCTION

Water tight as defined in SOLAS bring the meaning of potential to prevent the passage of water in any direction. There is 4 type of watertight door which is type A, type B, type C, and type D and classified to 2 two either hinged type or sliding type.

Power operated is a modern design of watertight door. It may design with hydraulic and electrical power operated.

This project based on the type C- sliding door with electromotor operation. Type C is the type where the watertight door should always keep closed and only allows to be opened on sufficient time for personnel passing through the compartment [1].

1.1 SIMILAR SYSTEM

This section refers to some researchers work that is related to sliding door on land. Sliding door is used in the industrial and commercial environments to allow easy access to enter the room. One of the main advantages to having sliding door is the convenience that comes with it. Sliding door is widely used in school, hall, auditorium, hospital and outlet.

1.2 PROPOSED SYSTEM

Electric sliding door is proposed to provides advance beneficial effect to the watertight door in term of efficiency and conceivability by eliminate the need of manually opening and closing actions using energy or force.

2.0 METHODOLOGY

Design of the watertight door is based on electromotor to powered the sliding door to open or close.

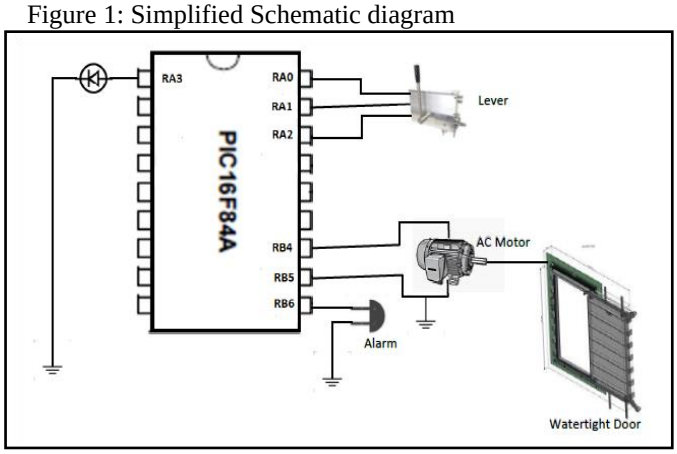
It consists of three option switch which is open, close and stop to operate the door. By the input from the switch, microcontroller will send the signal to push-pull four channel driver with diodes to lead the direction of electro motor. On input of open switch, the microcontroller will send signal to push-pull four channel driver with diodes and it define as clockwise direction and lead the electro motor to turn accordingly. On input of stop, microcontroller will send block all the components from operation. On input of close switch, the microcontroller will send signal to push-pull four channel driver with diodes and it define as anticlockwise direction and lead the electro motor to turn accordingly. Also from the input of the switch, the microcontroller will send the signal to red LED and Buzzer as aid and alert of the operation. All of this operation has been programmed in microcontroller so that the watertight door will successfully operate [2].

2.1 COMPONENT

The microcontroller project which the author purpose consist of:

1. PIC16F84A – PDLP (Plastic In Line Dual Package) 18 pins microcontroller as the brain of the system.
2. Push-pull four channel driver with diodes as component to control and run motor on bi-direction.
3. Electro motor as main component to power up the sliding door
4. 3-way switch as selector to operate the door
5. Buzzer as an alert for safety during operation
6. Relay to control the buzzer
7. Light Emitting Diode (LED) to turn as visual response.
8. Liquid Crystal Display (LCD) to define the operation of the door.

Figure 1: Simplified Schematic diagram



2.2 OPERATIONS

The function of the system as below:

- When lever directed to open position, the push-pull four channel driver with diode will send signal to electro motor to turn on clockwise direction, thus the door is powered to open and LCD will display OPEN
- When lever directed to close position, the push-pull four channel driver with diode will send signal to electro motor to turn on anticlockwise direction, thus the door is powered to close and LCD will display CLOSE
- When lever directed to stop position, all component including electromotor, buzzer and red LED will stop and LCD will display STOP
- During the open and close operation, red LED and buzzer will activated.

INPUT PORTS			OUTPUT PORTS				
OPEN	STOP	CLOSE	MOTOR CLOCKWISE	MOTOR ANTI CLOCKWISE	LED RED	BUZZER	LCD
0	1	0	0	0	0	0	1
1	0	0	1	0	1	1	1
0	0	1	0	1	1	1	1

Table 1: Truth Table

2.3 MICROCONTROLLER

The main brain of this system is using PIC16F84A which belonged to midrange family of the PICmicro® microcontroller devices [3]. PIC stands for Peripheral Interface Microcontroller and was created in 1993 by General Instruments Microcontrollers to perform several tasks which is controlled by software and programmed [4].
PIC16F84A is programmed with 68bytes data memory(RAM), contains of 1K words of program memory which it can translate to 1024 instructions, with 14 bit program each and 64 bytes of data EEPROM [3].
PIC16F84A comes with thirteen GPIO pins independently configured as digital input and/or output for each pins. Maximum 25mA can be absorbed or supply by each pin and assembled as 2 group known by port A and port B [4].
PIC16F84A mostly used in security system and up serial communication with other devices which be the root of author to choose this version of PIC for this project [4].

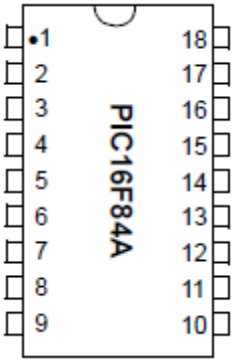


Figure 2 : PIC16F84A Microcontroller Pin assignment (PDLP)

2.4 SOFTWARE

During the introduction of microcontroller, binary language as machine language was used to programme and its was complicated where its end with the idea of assembler by the designers [5].
With PIC compiler, by using word which is familiar to human, to write a high level language program resulting 10 time easier compared to writing the same program in assembler [6].
PIC Compiler can be advantageous as it may programe different microcontroller in same family, easier to read and understand the writing program, can use readymade library without spending time writing much codes and for different target micros can use the same source code [6].

2.5 PROGRAMMING DESCRIPTION

The program used to regulate the entire process is embedded in PIC16F84A microcontroller's C language. All the codes have been [Pick the date] 3 compiled and tested using CCS compilers.

2.6 SYSTEM FLOW

By the input signal of open, stop and close, microcontroller will process the action by the data programmed and giving signal for output. If the input signal is open, microcontroller will define the action to give output signal to relay to turn the electro motor in clockwise direction, red LED and buzzer will activate and LCD will display OPEN. By signal of stop, the microcontroller will define the action as all output of relay and motor, buzzer and red light with zero action and LCD will display STOP. And by input signal of stop, the microcontroller will define the action as the output of relay to turn the electromotor to anticlockwise direction, and red light and buzzer will activate and LCD will display CLOSE.

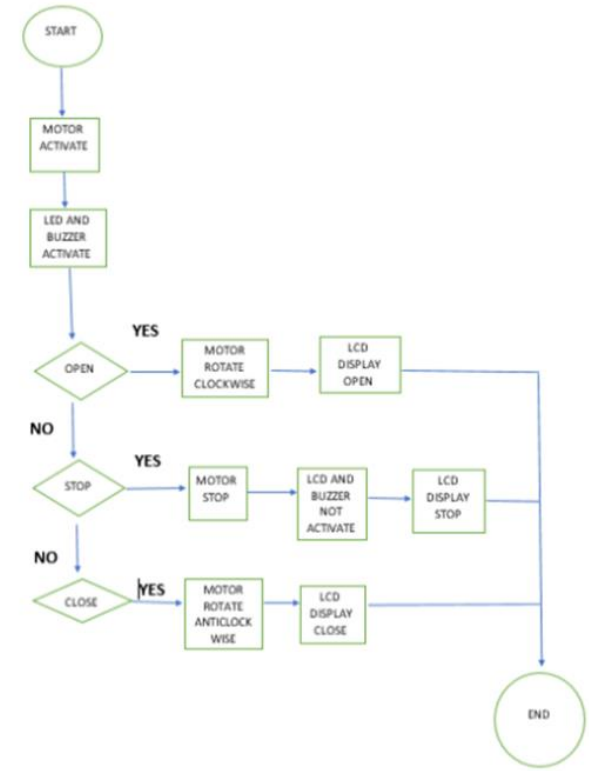


Table 1, shows the logic of the operations

2.7 Circuit

Design of this circuit consist of power, microcontroller which programmed to control the data from input and send to output. MCU been integrated with all of this section.

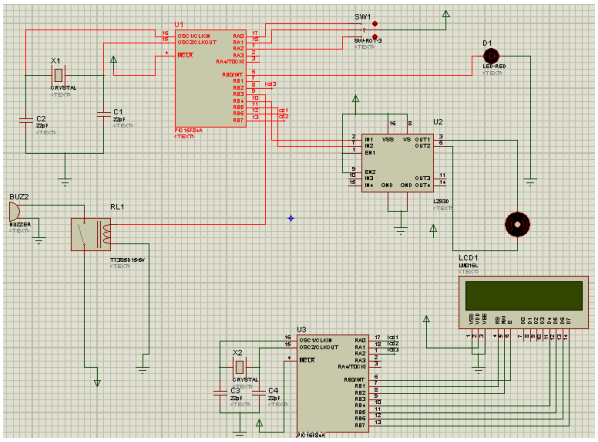


Figure 4 : Input & Outputs

As in figure 4, all the 3 input switch are connected using the Port A, and all the output of the system are connected using the Port B including the display units (LED) and buzzer.

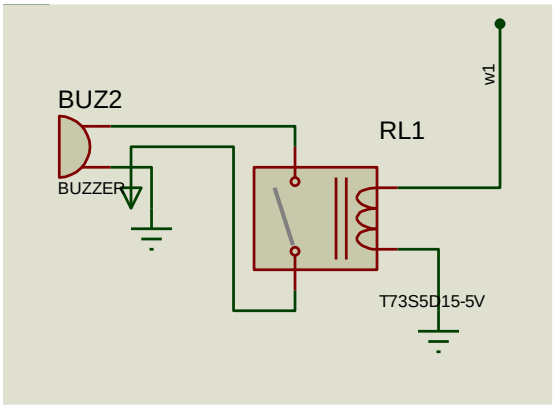


Figure 5 : Alarm Circuit

When lever directed to open or close position, the buzzer will automatically trigger by the MCU, as caution for the surrounding people to be aware of the movement of opening and closing of the sliding water tight door. The MCU will be connected to the buzzer through a relay as in figure 5.

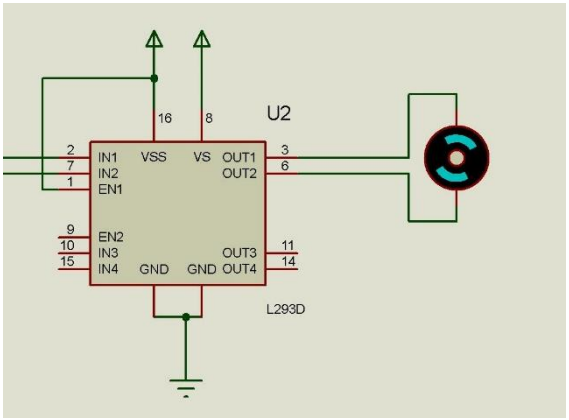


Figure 6 : Motor

The motor, will start automatically to turn clockwise to open the door and anticlockwise to close the door and eventually stopped automatically when door touch the limit switch that connect to stop button.

The circuit will successfully achieve the task when it may open and close the doors in safely with all the safety precaution available.

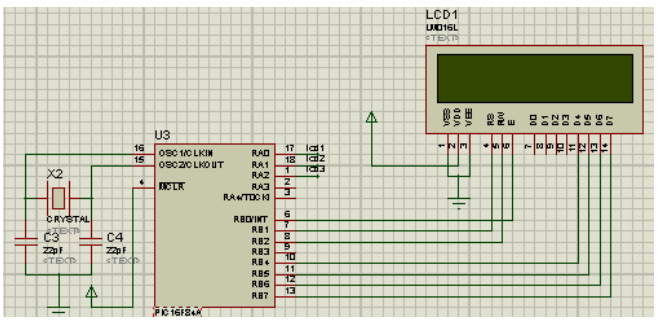


Figure 7 – LCD

The LCD will activate during open, close and stop. Where during any input of main microcontroller, it will send signal

to LCD microcontroller to display the operation of the door as open door, close door or stop.

3.0 CIRCUIT DESIGN SEMULATION

This circuit was firstly created with proteus 7.6. All the component was choose by the research and finalize as seriously as build an actual circuit, especially on the main component. All the component was connected to the microcontroller with wire and been maintain as tidy as possible so that the virtual circuit its self may define the how the actual system can be. The CCS C compiler was used to compiled the program. The HEX file then was upload to the proteus microcontroller and been tested several time for all the purpose of the system.
The input to the system is connected to the pin A0 to A3 in port A, while all the output is on the port B, which the output for red LED is connected to pin B0, the output for relay and motor is connected to pin B4 and B5 and output of the buzzer is connected to pin B6

4.0 CONCLUSION

The system which is the design and construction of watertight door was designed considering some factors such as efficiency, compatibility, conceivability and also durability. By using this method operating the door would be possible in almost any conceivable situation and limiting. Also opening and closing the door is more effortless to operate in case of critical situation.

For an improved, effective system to implemented and achieved, the following suggestion should be considered for further work. Using a sensor is recommended to achieve new functionality. For instance, a sensor will detect amount of water that ingress and send signal to motor to close the door. This system offers an independent solution for safety.

ACKNOWLEDGEMENTS

The author is grateful to Malaysia Maritime Academy (ALAM) for supporting this article

References

[1] m. insight, "marineinsight.com," [Online]. Available: https://www.marineinsight.com/marine-safety/watertight-doors-on-ships-a-general-overview/.

[2] S. Thorat, "learnmech.com," [Online]. Available: https://learnmech.com/automatic-pneumatic-sliding-door-using-sensors-and-controllers/.

[3] Microchip, "PIC16F84A Data Sheet," 18-pin Enhanced FLASH/EEPROM 8-bit Microcontroller, pp. 1-6, 2001.

[4] m. Lab, "microcontrollerslab.com," [Online]. Available: https://microcontrollerslab.com/pic16f84a-microcontroller-introduction-and-features/.

[5] S. Z. Nasir, "TEP," The Engineering Projects, 19 February 2016. [Online]. Available: https://www.theengineeringprojects.com/2016/02/pic-c-compiler.html.

[6] J. Main, "BestMicrocontrollerProjects.com," [Online]. Available: https://www.best-microcontroller-projects.com/pic-compiler.html.