WATER LEVEL INDICATOR AND CONTROLLER

Abdul Kudus Redha bin Amirullah [a], Zamzami bin Zahari [b], Mohd Khairil Ridzwan bin Ali [c]

[a]) *ACSU 41A STUDENT*

[b]) *ACSU 41A STUDENT*

[c]) *ACSU 41A STUDENT*

ACSU41A: Malaysian Maritime Academy

Melaka, Malaysia

*Corresponding author:

kuduslorenzo92@yahoo.com, khairilridzwan89@gmail.com, afw4961@gmail.com

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ABSTRACT

The water level indicator system is a very important system onboard seagoing ship. In every ship,there are several cases which lack of manpower lead to the failure of the system. So to minimize the rate of failure,some automation system are invented by using *microcontroller* as part of the design to increase the proficiency and *efficiency* of the system. In this paper, we want to show a system design which are suited to be installed to the most of the ships. These design were simulated using the *Proteus software* and then later to be realize if we had the hardware related for this control system. The program has then compiled in *PIC C Compilers*, and were programmed into the *microcontroller* using a programmer for PIC 8-bit *microcontrollers*. This paper will give advance developments of the water tank levels indicating and monitoring system that will alert the crew in charged through signals and audible alarms. Functioned test of the system can be made by using software. The main purpose of the system is to reduce or to ease the task of the crew members' even there is an unexpected shortage of crew members when ships lay up or when ship in off hired status.

KEY WORDS: *Proteus software, PIC C compilers, microcontroller, efficiency*

NOMENCLATURE

PICC C	PIC C Compiler
MCU	Microcontroller Unit
HL	High Level
NL	Normal Level
LL	Low Level
LLL	Low Low Level
UMS	Unmanned machinery space
OM	Online Monitoring
LCD	Liquid Crystal Display
PDPL	Dual In Line Package
SBP	Secondary Booster Pump.
PP	Primary Pump
AI	Alarm Indication

1.0 INTRODUCTION

Unattended Machinery Space, or UMS class vessels is a way of operating automatically controlled by the machinery of a vessel. A new topic has been included covering the operations management and safety, which reflects changes in the seagoing engineer's duty. Modernized maintenance management is another new subject turning out to be more vital as a result of the wide utilization of unattended machinery spaces.

Thus, in technology adopted nowadays is greatly improved by time thru time. Similar than with any other machinery that we created to cope with every machine adequate by the Marpol Regulation and standardised. In various systems boiler water control is included two step control. It is difficult to achieve a steady state. The process during the time that energy is switched into or out of the process (dead band). If the system has a low demand capacity and a high energy supply capacity, then the switching cycle can be very fast and lead to instability.

1.1 Similar system

This section refers to some researcher's work that is related to the tank controls on ships. The system proposed by [1]a method of monitoring the water level and temperature monitoring system for some industrial arrangements. It could monitor the entire system remotely, due to it, users could save their important time in their busy periods while working on other machinery.

1.2 Current System

Current Automation and Controls covering numerous parts of the vessel operation that incorporates the plant operation, power administration operation on the auxiliary engines, assistant on machine operations, route and administration of support and purchasing of spares [2], however most of the tanks on the vessels are still being controlled and monitored manually by using analogue switches. The tank controls are not realiable as we know that most of the float switch may become faulty and stuck in one position and still requires some manual controls on the tanks. Most of the vessels uses the limit or float switches to activate or deactivate the pumps or motors on board.

1.3 Proposed System

A modest, inexpensive, configurable, easy to be operated electronic control system is proposed to deliver a beneficial assistant and backing up the ship crews.

This control system are to be used to lesser the manpower in engine room watch keeping situation. By depend on the sensor at the tank and special configuration set in MCU, we can know from Online Monitoring (OM) system the water level indication at the remote control panel station.

2.0 METHODOLOGY

A Microcontroller will constantly observe the main tank fluid levels and all the indication will show on the LCD screen, audible alarm and lamp indication will turn on; sensors will be attached to the main tank. The Sensors will be acting as the switches [2].the MCU will then decide on the next course of action. Warnings will then be triggered by the MCU through its ports and will activate the external peripherals that it is attached to. This warning could be some combinations of LEDs and buzzers and alarm indication shows at LED. This system could be realized by using lesser amount of mechanisms, the controllers also offers great performances with dense sized and low price MCU [2]. If the liquid level in the main tank get low level the primary pump will automatically be activated, when its reach low-low level,it will trigger an audible alarm then the booster pump which have bigger capacity then primary pump will start simultaneously with primary pump to pump the liquid to the reservoir tank. The motor will be controlled by the MCU through a relay.

2.1 Component

The components of the system consist of (1) PIC16F84A, this Microcontroller come with only 18-pins. The Plastic Dual In line Package (PDLP) that would perform as the brain of the system, (2) 3watt470r resistor to be used to on the switch and the led , (3) light emitting diodes (LEDs) to turn as visual response, (4) Buzzer which function as the audible alarm response aids, and (5) Sensors(switch push to on) that is installed to the main tanks , (6) Motor/Pump that will be activated when needed, (7) Relay which will be used to control the Pump/Motor and the Buzzer.(8) LCD screen which can be visual source status of pump running and water level status.Figure 1 illustrates the schematic diagram of the system design.

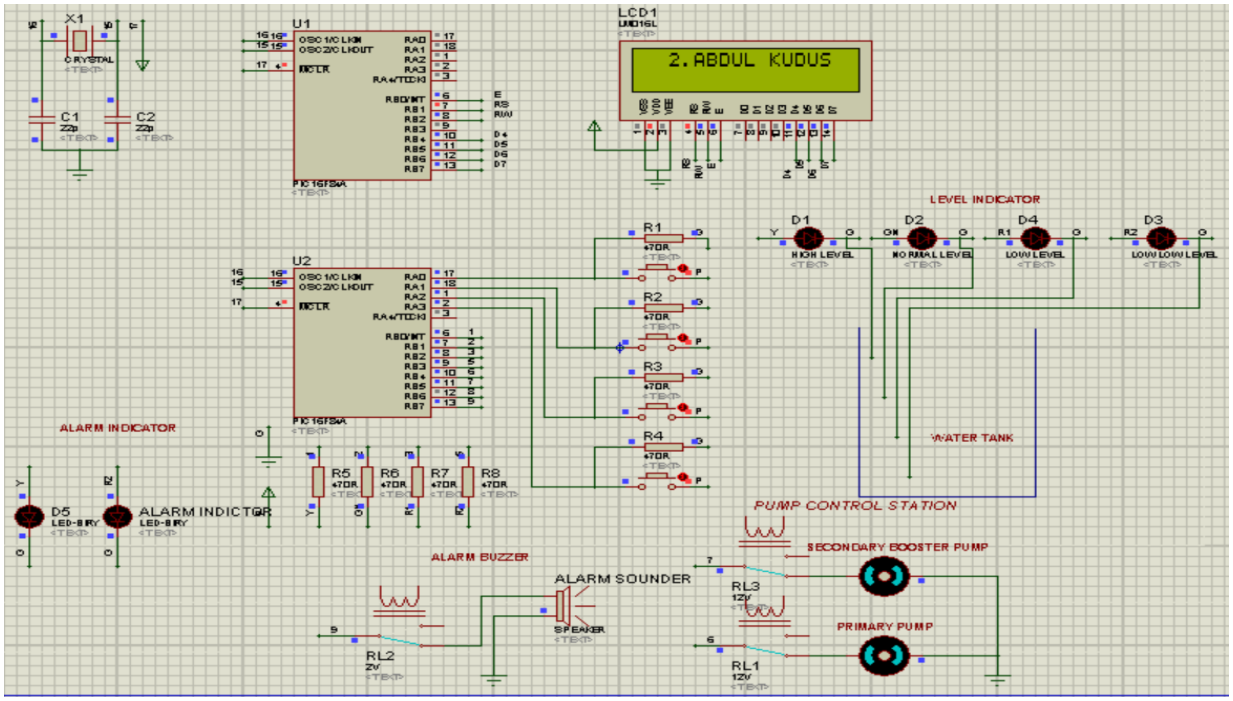

Figure1: Complete system of Water level indication and controller

2.2 Operations

The operation concept is described below:

- When liquid reaches High (HL) level in the main tank, all LED, NL, LL and LLL will be off, the Alarm will be triggered show HL, and Alarm to be sound and alarm lamp indication HL will be triggered.
- When the level is at Normal (NL) position, LED NL will be light up and the rest is off, the Alarm and the Pump will be OFF.
- When the liquid level is sensed by the sensor at the Low level (LL) position, only LED L a will be ON, the motor will be ON until the level of the main tank reaches Normal (NL) position.
- When the liquid level reaches Low Level (LLL), only LED LLL will be ON, the Alarm will be triggered and the Secondary Booster Pump will start simultaneously with Primary Pump and I'll stop after reach normal level (NL).

2.3 Microcontrollers

PIC16F84A (Figure 2), is used for this system. , it has the ability to function with good power consumption without other sophisticated modules to be attached and very easy to be programming. Similar to a human being, the main CPU act as a brain and the PIC is same to our autonomic nervous system [3]. Hence, it is recommended that 8-bit PIC16F84A microcontroller which is sufficient enough to act as the central control of the system

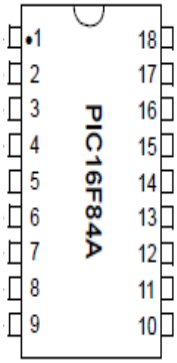

Figure 2:PIC16F84A

Table 1: Truth Table FOR MCU 2

Input Ports				Output Ports								
S1 A0	S2 A1	S3 A2	S4 A3	HL B0	NL B1	LL B2	LLL B3	P.PUMP B4	S.PUMP B5	AI LLL	AI H	BUZZER B7
1	0	0	0	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
0	1	0	0	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
0	0	1	0	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
0	0	0	1	OFF	OFF	OFF	ON	ON	ON	ON	OFF	ON
1	1	1	1	ON	ON	ON	ON	ON	ON	ON	ON	ON

2.4 Software

PICC for MCU," is utilized for composing, editing, compiling, and programming the codes for the microcontroller. By using this microcontroller we can see that the system is arrange following sequence on demand. These compiler, which empowers the microcontroller to be customized in high level programming languages. The algorithm of the codes will decide the state of the parts by actuating the microcontrollers input - output ports taking into account the particular tasks. The fundamental capability of the entire system is to allow a timed with micro-seconds interim, to acknowledge the sensor inputs, and to activate the outputs with enacting the Alarm or the Motor. Thus the system created will be working as per command in compiler and any changes can be amend again in coding compiler. Exposing the system inside the arrangement will make us familiarize with the main component and either by hardware or software. Therefore, tracing back the trouble shooting will be recognize early at future times.

2.5 Programming Description

By using 2 MCU the program used to regulate the entire process is embedded in PIC16F84A microcontroller's C. MCU1 were used for display monitor. This program indicates on how the control of boiler water is showing their function during the system working on demand.

Some of the component inside the system are used only when the sensor is triggered that value added into the system is no enough i;e low-low level alarm. That only activated when the system on demand is no enough to catch up with the output.. So it will activated one more pump to supply more to achieve the equilibrium system on demand. The rest is all work in normal working condition.

2.6 System Flow

The level of liquid from the water tank are sense by the sensors which are attached to the tank will then sense the current level of the tank, and send the signal to the Microcontroller Unit. The first MCU is set for displaying all the water level status and also shows motor /pump status which are running or not. The second MCU2 are set to control the pump, led tank indicator and the buzzer.MCU2 then will intelligently decide on the next course of action, either activating the Motor automatically or triggering the Alarm to allow the person in charge on the vessel to take further action [2].

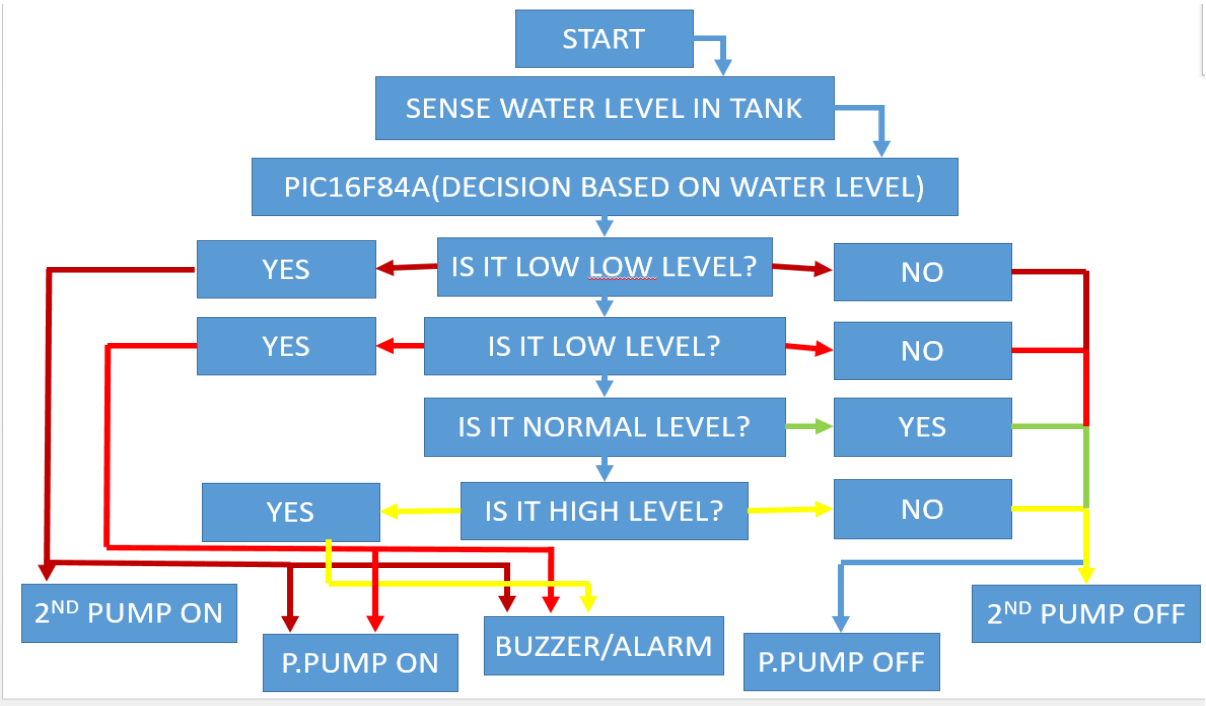

Figure 3: Flowchart of the system

2.7 Circuit

The circuit have six main elements: the LCD display which show water level indication and motor/pump status, microcontroller segment, which comprises the system input parts, and the output parts [2]. All these modules are integrated to the MCU unit. Pump/Motor control station, which are start and stop depend on the water level. Alarm Sounder segment, which allow audible alarm present. The alarm indicator and local led segment indication which where the alarm status whether high or low-low level of water shows in control panel.

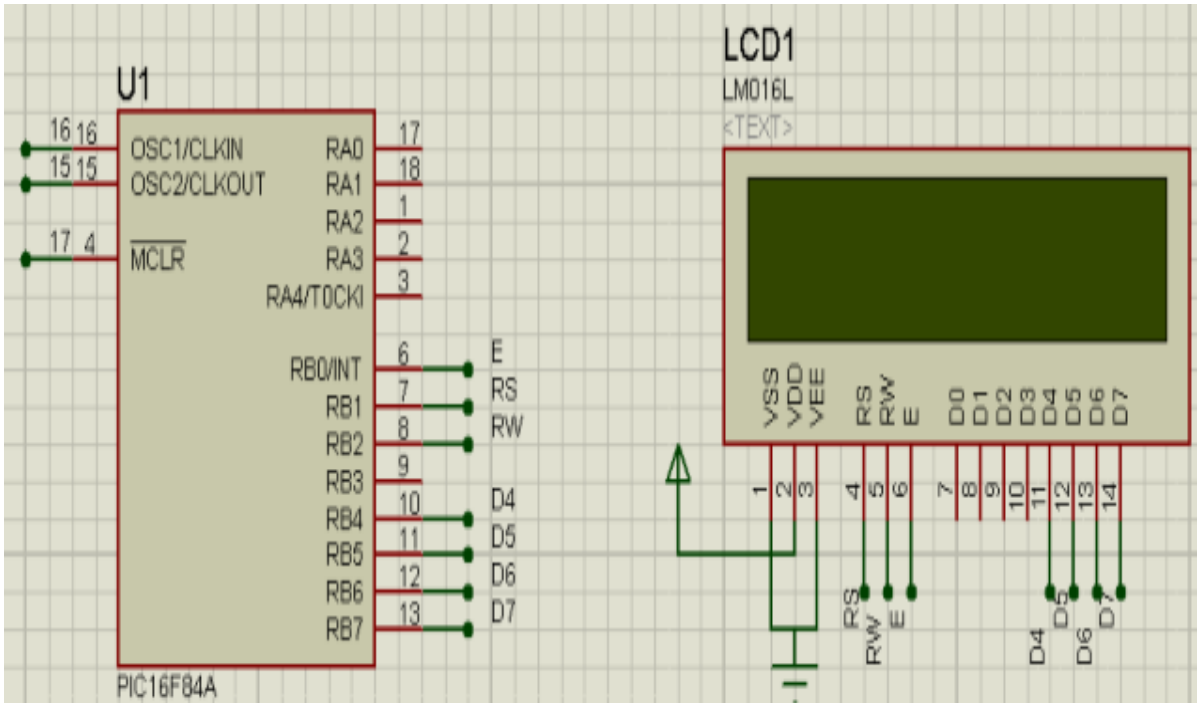

Figure 4 :LCD with MCU 1 show indication of water level,alarm and running motor.

LCD screen shown in figure 4 are connected with MCU 1 which can shows running status of motor/pump. Alarm will be display when LLL,LL and HL sensor/switch are triggered. In addition,for connecting the LCD unit only,we need the entire input and output of the MCU PIC 16F84A ,so that's the reason in this project we are using 2 units of MCU.

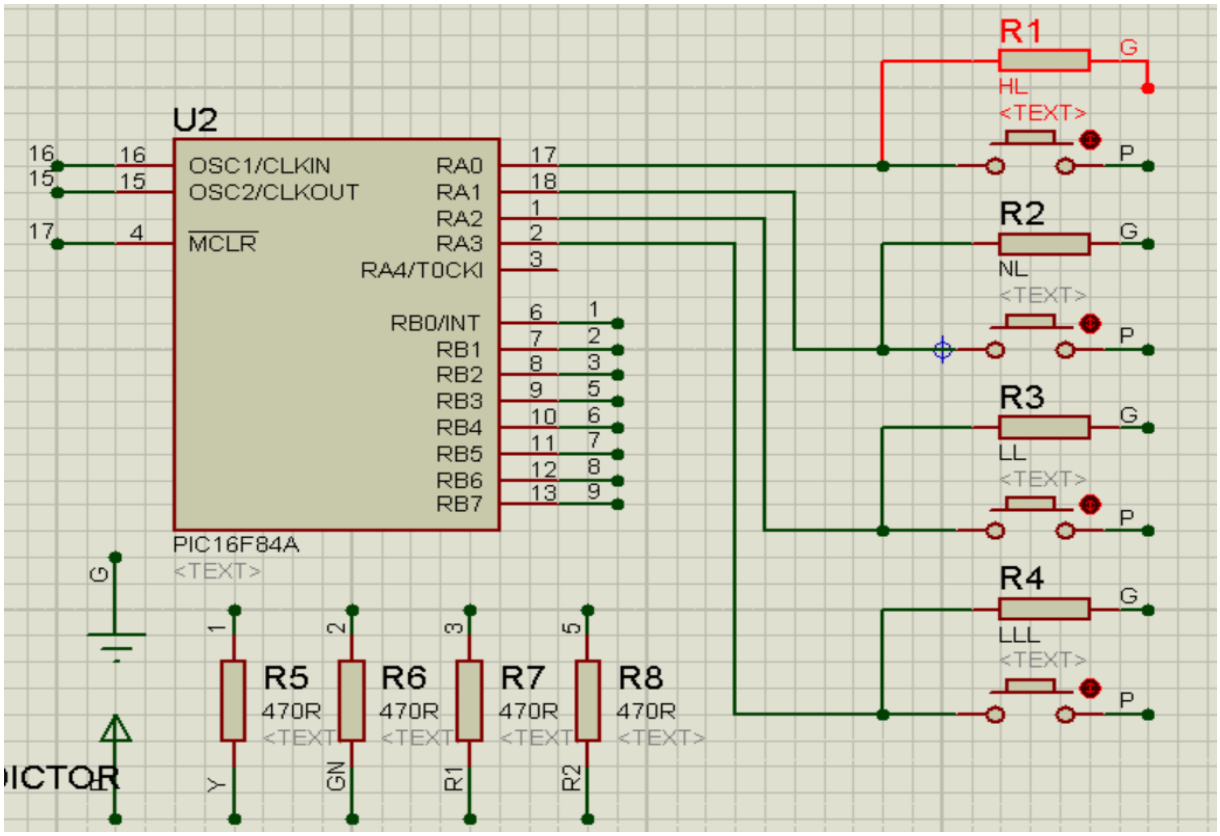

Figure 5: MCU 2 which control switching unit

From figure 5 we can see all 5 input switch are connected from port A,while all output syste are connected from port B.

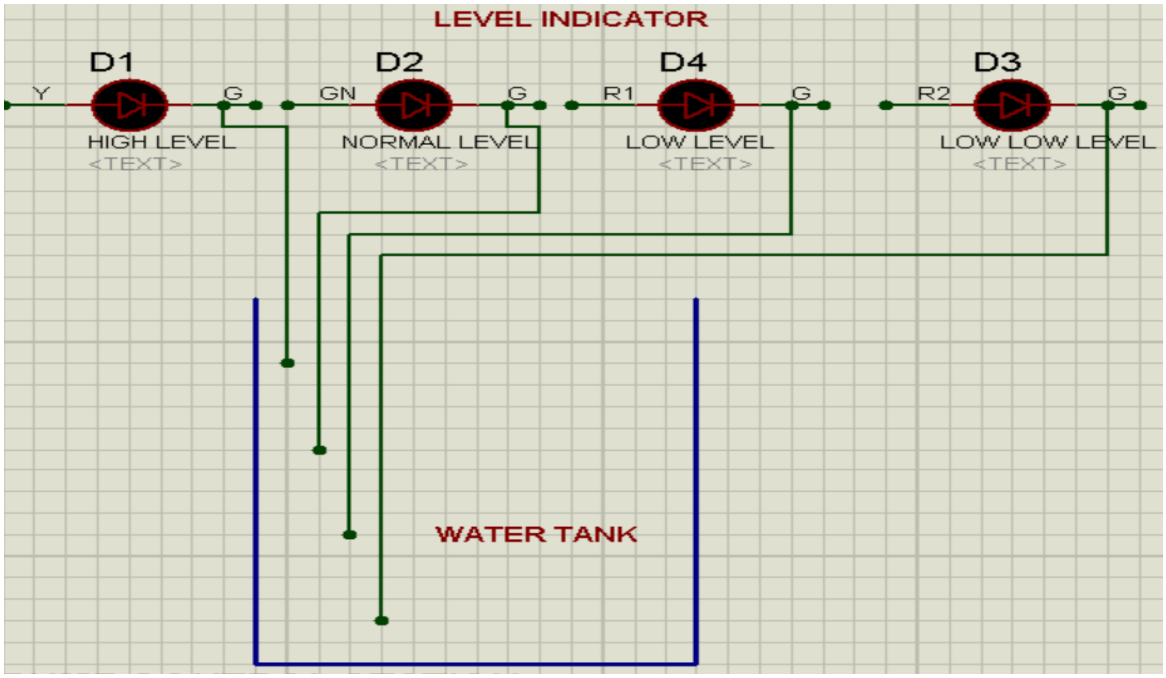

Figure 6: LED for water level indicator

As in figure 6, the Led for water level indicaton are shown,this LEDs can be install at the control panel which can show all the indication of water level inside tank.

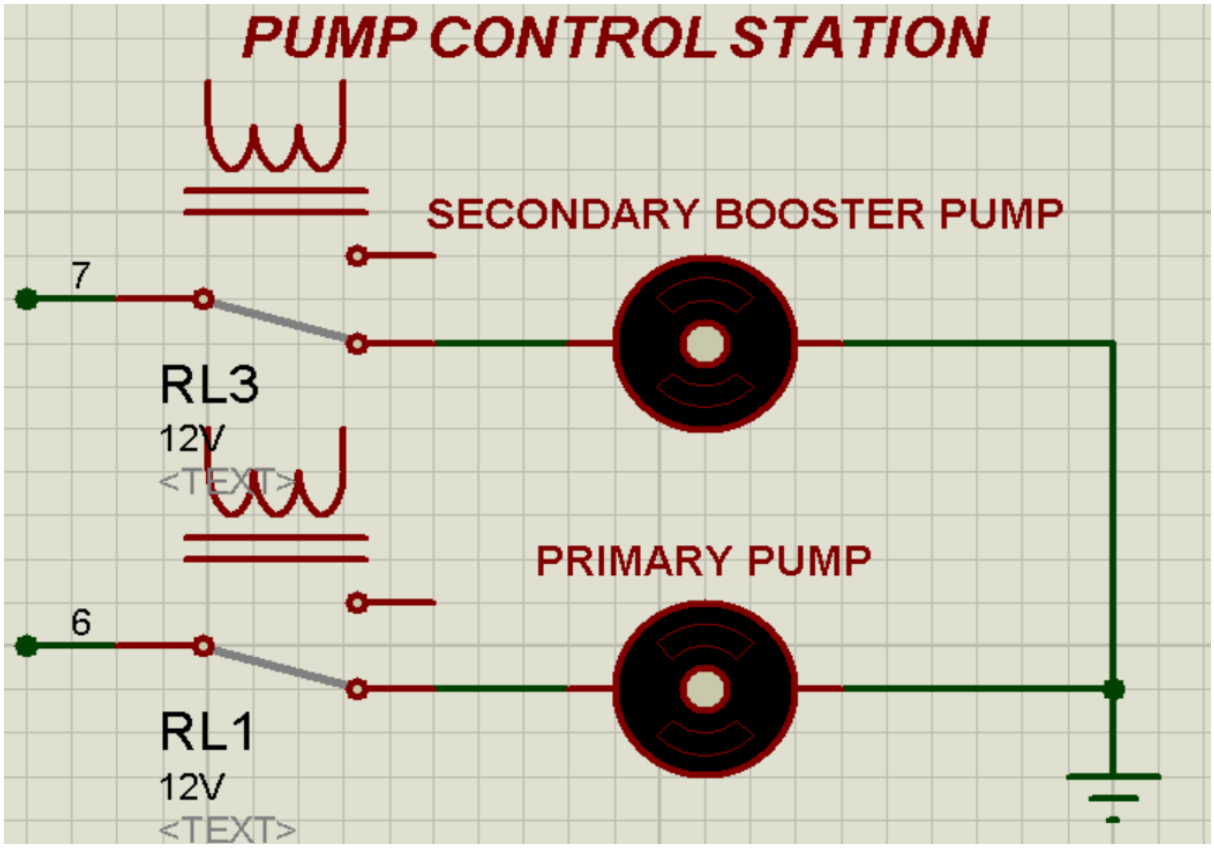

Figure 7: pump control station

Pump control station consist of 2 units of pump. Primary pump (PP) will start running whenenver water tank reach LL level. Secondary Booster Pump (SBP) will be start if the water tank level reach LLL which indicate the level are drop too fast , this SBP which have bigger capacity from primary pump will start together with PP which allow the water level reach Normal Level(NL) on time.

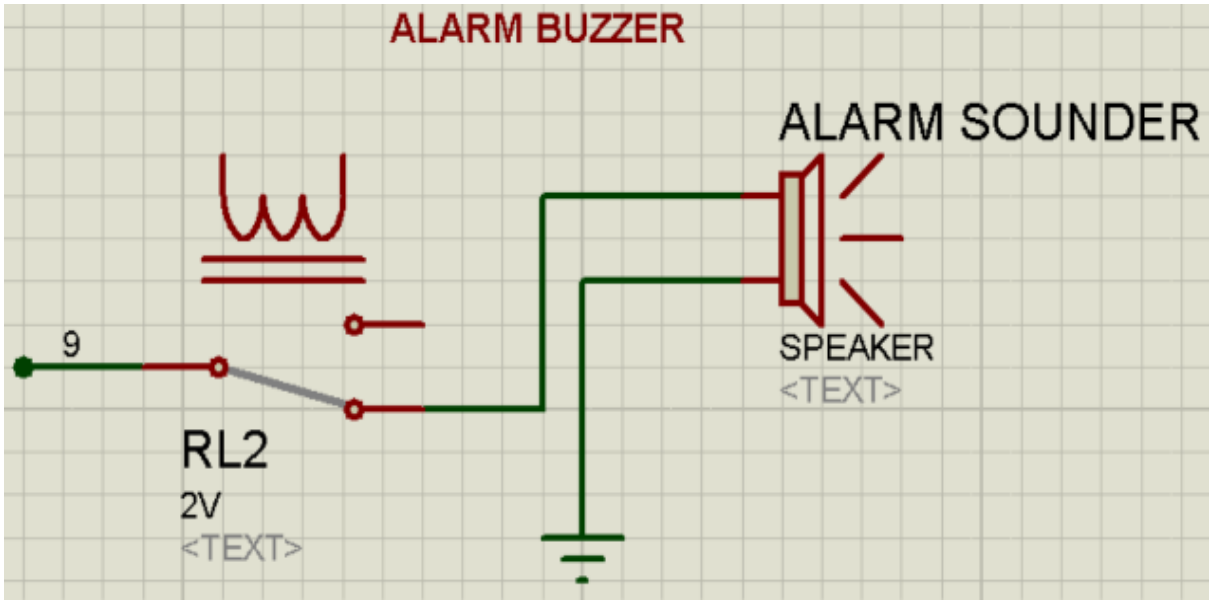

Figure 8:Alarm Buzzer which supply audible notification.

Alarm Sounder as shown above can be installed also at control panel which may alert all the crew whenever alarm rise. There is only 2 level that can be trigger this alarm buzzer HL and LLL.

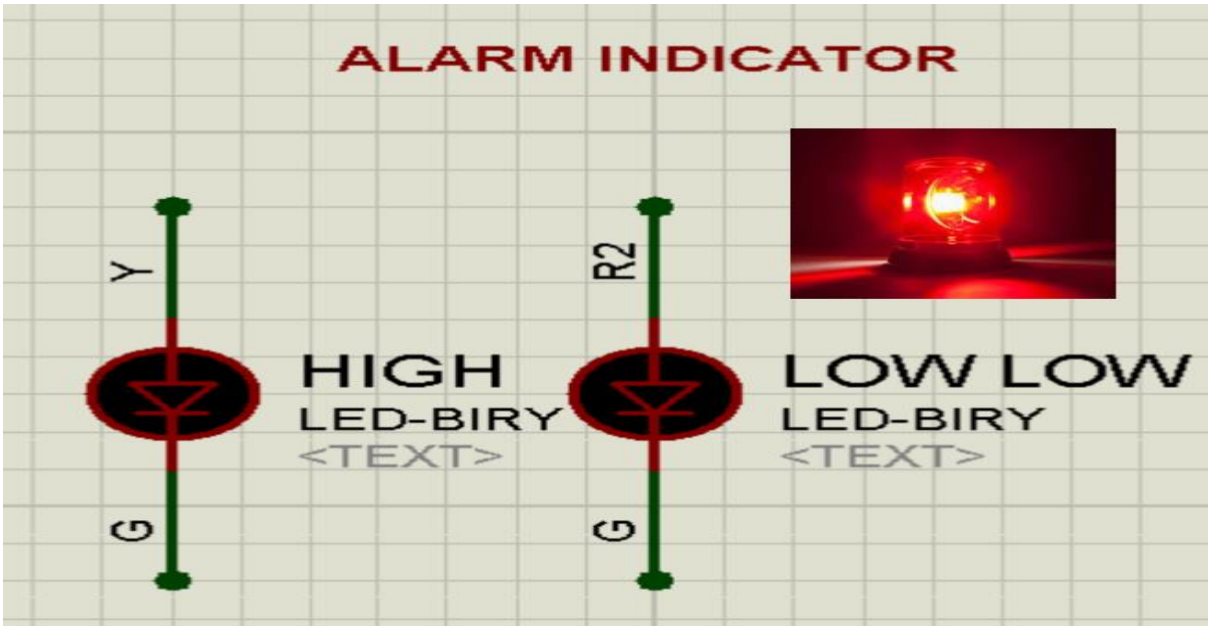

Figure 9:LED blinking that shows visible type of alarm

Corresponding to figure 8,this figure 9 show the same function for the water level system. LED represent the blinking light that install at the Control Panel which added as the visual aids for alarm indication which can be seen in a distance.

3.0 CIRCUIT DESIGN SIMULATION

The circuit was built by using software Proteus v7.6. The entire components of the circuit which are essential were carefully chosen from the software library and the connections were done by lines. The program was later compiled using C compiler. The output, hex file of the program is loaded into PIC microcontroller using the PicKit2. Finally, the simulation is tested for all the conditions. The circuit used for simulation is given in Figure. 4. The connection to the microcontroller separated into 3 parts of circuits. The inputs from the sensors were connected to RA0 till RA4 pins (using Port A MCU 2) and RB3 MCU2 is connected to the alarm (figure 5), RB9 is used to connect to the Pump/Motor relay (figure 7). While the input MCU 1 were connected Port A (RA0-RA4) are used for display units (LCDs), All the output pin whichever not mentioned is connected through (Port B) of the controller for both MCU 1 and MCU 2.

4.0 RECOMMENDATIONS

In this paper, the author presented the operation of water level indication and controller. Besides, it is demonstrated the usage of MCU which are been sets with special coding for the system to function complex operation. This circuit controlled the water level of a water tank, and utilized LED diode & LCD screen for signals and indication. From the circuit, almost all external peripherals are used, means that to upgrade the system we can use another type of MCU which may support extra I/O port. It will lessen the cost by adding the more I/O port compared to this system that used two sets of MCU. In addition, this project can be installed to the OM that have onboard sea going ships so that all crew onboard can awae the status and water level indication on the current time.

5.0 CONCLUSION

Thus, this proposed system will ensure the workload onboard are lesser by optimizing the system function for the crew from frequently check the tank level, but we may not fully 100% depend on this systems, we need to check the water level sometimes if we see the pump status shows running all the time or any abnormal situation which are shown at LCD Screen.

By using MCU also we can set the whole system to the online monitoring system which may have onboard ship. By follow this method, this system reliable to be fully operational. This is one of the criteria from normal ship to become UMS ship and we can suggest owner of the ships to change from normal to UMS ship so that the minimum crew onboard can be lesser thus can reduce the cost to hire extra crew.

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