FIRE FIGHTING HYPERMIST AUTOMATION SYSTEM

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ABSTRACT

In marine industries, we are exposing plenty of risk which can damage the ship, machinery even injured and fatality of personnel life. One of the risks that we might be face is fire on board. Mostly fire will start from the machinery spaces because there plenty of combustible material and fire risk activity. There are plenty equipment for fighting the fire onboard which need the knowledge and manpower for work on it. There also a fixed fire fighting on board which focusing of the area which have high risk of fire starting. One of them is Hypermist Fire Fighting System. Some of the ship will have Unmanned Machinery System(UMS) which the engine room will unmanned at UMS Period. Duty personnel only rely on the UMS alarm system which fix at common area at accommodation. At this time, any fire can be start due to continuous running of the engine. The aim of this paper is to describe the simple program on a low-priced system using a microcontroller unit (MCU) as a central brain. This design is plot using the Proteus Software and later will be do the prototype for testing the functionality. The coding is complied at PIC C Complier, then were program into microcontroller using a programmer for PIC 8-bit microcontroller. This paper also will introduce the efficiency of the fire monitoring which will give alarm and automatic distinguish system with the input received. The main objective by this system is to make the fast respond if have any fire emergency especially when engine room in UMS condition. It will give also the Tank Level Monitoring for the hypermist tank which will reduce the load work of the personnel to check and monitor the level of the tank every time.

KEY WORDS:
Hypermist Fire Fighting System, Tank Level Monitoring, PIC Microcontroller, MCU

NOMENCLATURE

UMS	Unmanned Machinery Space
LLALARM	Low Level Alarm
SS	Smoke Sensor
SF	Flame sensor
SLL	Water Low Level Sensor
SHH	Water High Level Sensor
MCU	Microcontrollers
LED	Light Emitting Diode
PDLP	Plastic Dual in Line Package

1.0 INTRODUCTION

Fire is the most dangerous emergency on board ship .It is a chemical reaction between Heat, Fuel and Oxygen. Some part of engine room, there a rich of supply for the fire started. One of the duties for watch keeper is to make the fire safety round. This manual fire monitoring practice need the manpower. All ship will use the fire detector system as a first sign for give the warning about the fire. The efficiency of a fire system is basically defined by the ability of the system to detect hazards(detector coverage) and the ability of the system to mitigate hazards [1]. Automatic fire safety system is basically some type of programmable electronic devices that can be used to identify the hazard or attacks [2]. Mostly, all the ship will fit for UMS system which engine room is remain unmanned for the certain period. One of the systems which fight the fire is by Hypermist system. In contact with the fuel, the pressurized water vaporizes and its is converted to steam, this method consumes much energy lowering the fire temperature and the pressurized water expends approximately 1700 times extracting the air from the flames. These systems require water consumption 6 to 10 times lower than a traditional sprinkler system [3]. It wills very useful for fighting the fire in that area which produce a high temperature and heat. For example, on top of the generator prime mover. Hypermist will draw the water from their own tank which always must be ready in emergency used. Most vital is the quantity of the water inside the tank. It must be to keep always full with the feeding system working fine. With the Automatic Monitoring Level System, the water will be always full in the tank without any closely monitor by ship personnel.

1.2 Current System

There are several type of fixed fire fighting system install on board ship. Such as High Expansion Foam, Carbon Dioxide Flooding system and Hypermist System. For deal with Hypermist system, they should fix with two type of sensor which flame detector and smoke detector. For current system, the two sensor will give the pre-warning alarm for the person to act of it. Operator will decided to activated the hypermist manually depend on the situation and location. For the hypermist tank, the level of the water needs to check at least once per week which have listed on weekly routine. The feed pump will start manually if the level of the tank is low level. Eventhougth, there have low level alarm installed, but still need to adding manually. This produce will take time and need manpower. Moreover, due to nature of human, it can be forgotten and mischeck. The most Vital is during emergency which no body will have time to look at the water level of the hypermist tank.

1.3 Proposed System

A automation system which use the microcontroller as a brain for programmable of the sensor and equipment is suggested in order to speed up the emergency action in case of fire in covered area. Its will beneficiary help personnel on board in term of monitoring and safety of the ship and life.

2.0 METHODOLOGY

A Microcontroller is used on the hypermist automation system. Two type of sensor are fixed in order to sense any occur of smoke and flame for the Hypermist Automatic system for fighting the fire. Two sensors it's fixed to sense the possibility of fire which flame sensor and smoke sensor. The signal will be sent to MCU and MCU will decide for the action. Pre-warning alarm will be sound together with LED if any of sense is activated.

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 function as the brain of the system,(2) 2 units of Light Emitting Diodes(LEDs) to give visual warning, (3) 2 units of Buzzer to give sound warning and (4) Level Sensor that fixed at Hypermist Tank, (5) Motor which run the Feeding Pump and Booster Pump, (6) Relay to control the motor and buzzer, (7) Flame and Smoke Sensor as the detection of fire.

Figure 1 illustrates the schematic diagram of the system design.

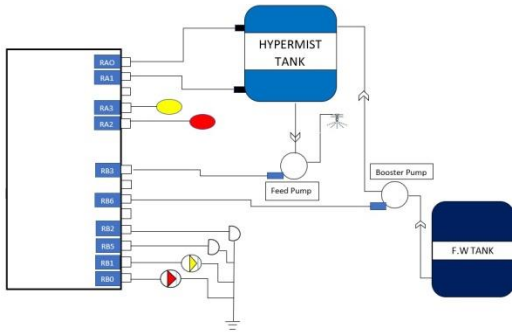

Figure 1: Simplified Schematic diagram

2.2 OPERATIONS

There have 2 systems are controlled by Microcontroller.

1.Hypermist Detection System

The operation concept is described below:

- If there are present of smoke in the area, The Smoke Sensor(SS) is activated, which will turn ON the Led Yellow(LEDY) and Fire Alarm(FIREALARM) as a warning for personnel.
- Same goes if there are present of flame in the area, The Flame(SF) is activated which will turn ON the Led Red(LEDR) and Fire Alarm(FIREALARM) as a warning for personnel.
- If both smoke and flame are present at that area, both sensor (SS and SF) will activated which will turn ON both Led(LEDY and LEDR), Fire Alarm(FIRE ALARM) and Booster Pump(BOOSTERPP) for extinguishing the fire.

2. Tank Monitoring Level

The operation concept is described below:

- If the Water level reach the low level, Low Level Sensor(SLL) will be activated which will trigged the Low Level Alarm(LLALARM) and start the Feeding Pump(FEEDPP) for pump in the water into tank.
- The water will be adding until its reach the high level. At that time, High Level Alarm (SHH) will be activated which will cause The Feeding Pump(FEEDPP) to stop.

Table 1, shows the logic of the operation.

Table 1 : TRUTH TABLE

INPUT				OUTPUT					
SMOKE SENSOR (SS) RA3	FLAME SENSOR (SF) RA2	LOW LEVEL (SLL) RA1	HIGH LEVEL (SHH) RA0	LED RED (LEDR) RB0	LED YELLOW (LEDY) RB1	FIRE ALARM (FIREALARM) RB2	LOW LEVEL ALARM (LLALARM) RB7	BOOSTER PUMP (BOOSTERPP) RB4	FEED PUMP (FEEDPP) RB6
0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	1	0	0	0
0	1	0	0	1	0	1	0	0	0
1	1	0	0	1	1	1	0	1	0
0	0	1	0	0	0	0	1	0	1
0	0	0	1	0	0	0	0	0	0

2.3 Microcontroller

In our project, we use one of the PIC family microcontrollers. The PIC16F84A (Figure 2) is an 8 bit microcontroller which contains 1K words of flash program memory, 68 bytes of data RAM and 64 bytes of date EEPROM [4]. It will acts as brain which all the input from sensor will send to it thus send the signal output as a coding create. It's manufactured by Microchip Technology. Its use high speed technology with low power consumption and wide operating voltage range. The EEPROM Data retention is up to more 40 years and have 10 million typical erase/write cycle's memory typical [5].

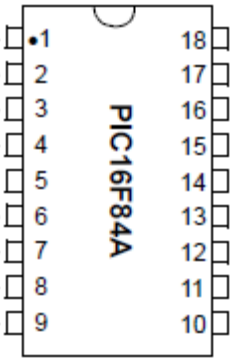

Figure 2 : PIC16F84A Microcontroller Pin Assignment(PDLP)

2.3 Software

The 'C Compliler for the PIC MCU' is used for create, editing, compiling and programming the codes for microcontroller. This programmer which will translates one program computer into another. The source code written in a high level language is translated into a machine code that microcontroller understand and operate with the coding instruction. In this program, all input and output will be defined and the instruction is given as our project description.

2.4 System Flow

There two of the system which control by the microcontroller. First system is The Hypermist Detection system and the second system is The Hypermist Tank Monitoring Level.

In the First system, its work by sensing the condition of the area whether any present of smoke (detected by Smoke Sensor) or any present of flame(detected by Flame Detector). It sends out the signal to microcontroller.

The MCU then will intelligently decide on the next course of action, either to activating the alarm in order to give prewarning to personnel and activating the motor automatically.

Figure 3 is about the The Hypermist Automation System.

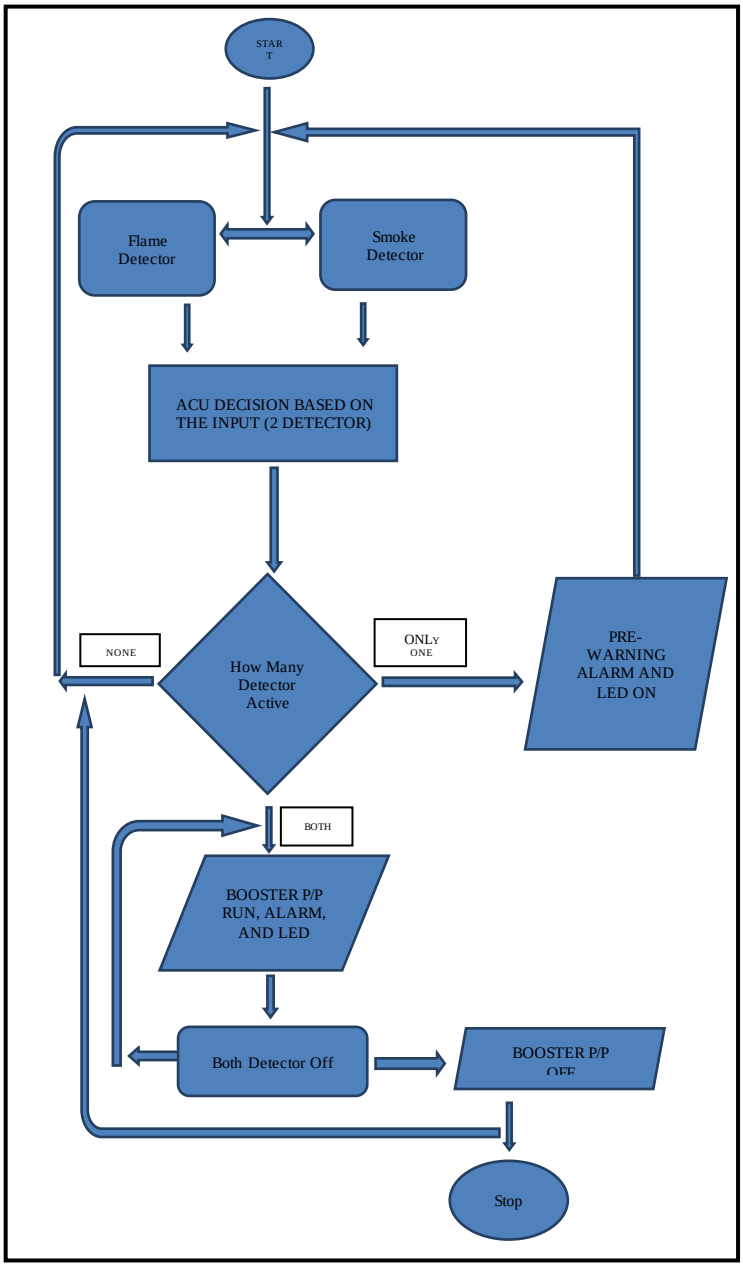

Figure 3 : Flowchart of Hypermist Automation System

On the 2nd System, The Water Level will be sense by 2 sensor level which High Water Level and Low Water level. If the water level in the tank trigger the Low Level Switch, it will send the signal to microcontroller. The MCU will give the command for activation of Low Level Alarm and start the Feed Water Pump for filling up purpose. The Feed Pump will stop if the High Level Switch at tank activated.
Figure 4 is about Tank Monitoring Level System.

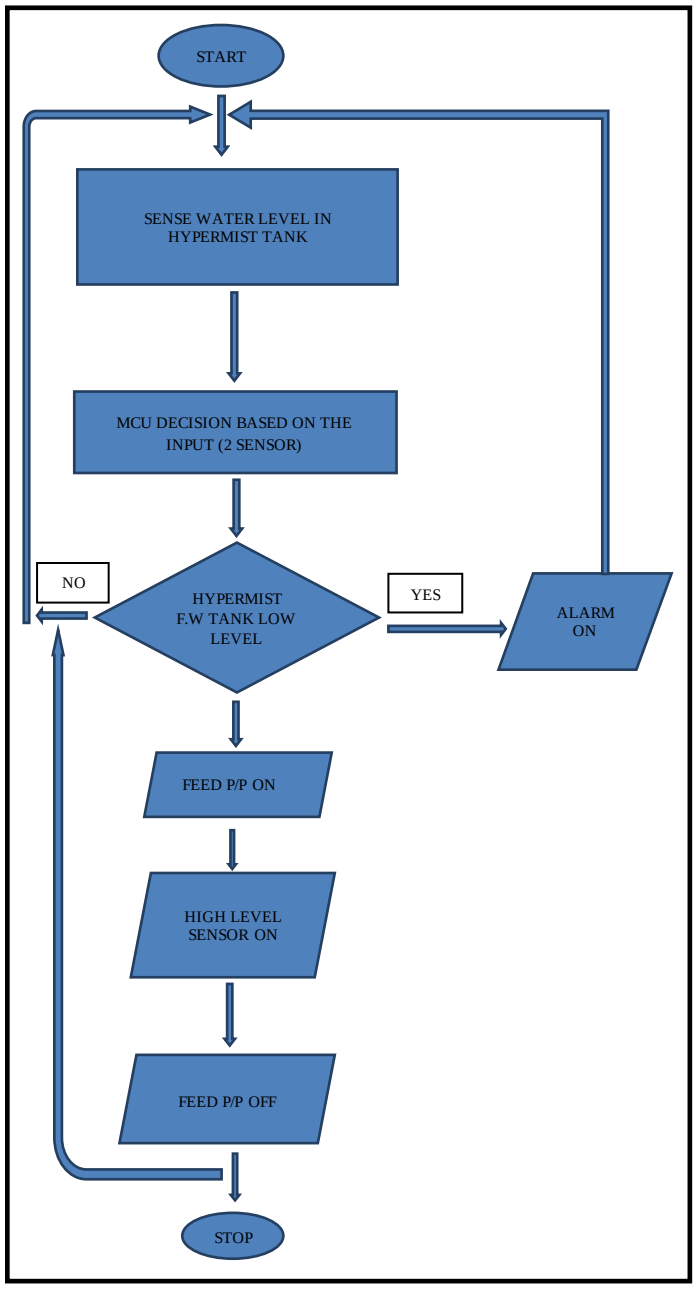

Figure 4 : Flowchart of Tank Monitoring Level

2.5 Project Circuit
Our Project consist of System 2 systems.

1. Hypermist Automation System
2. Tank Monitoring Level.

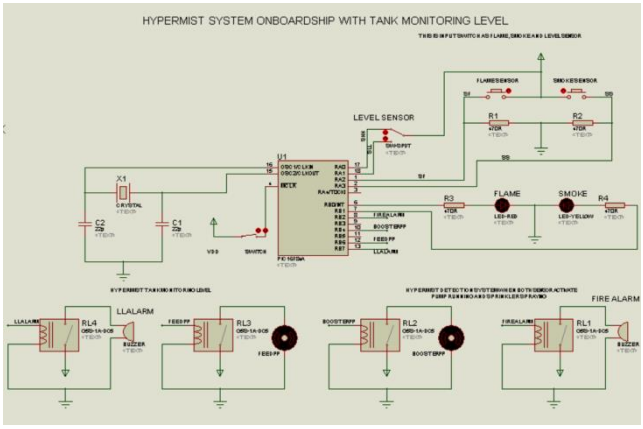

Figure 5 : Overall Hypermist System Onboard ship with Tank Monitoring Level System

As a figure 5, its is overall of the system which consists of flame sensor and smoke sensor for detection purpose. 2 colours of LED which give the visual aid of warning which each sensor have it own colour. Power section gives electrical power to the sensor, pump, buzzer and the microcontroller.

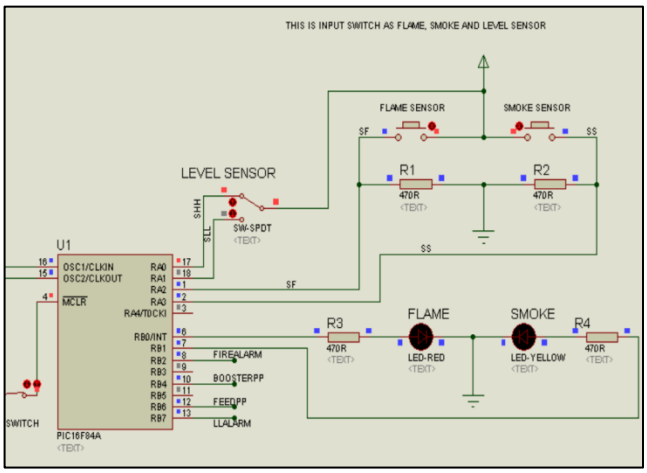

Figure 6 : Input and Output

As a figure 6, 2 units of input sensor for Hypermist Automation System (Flame&Smoke) and 2units input sensor for Water Monitoring Level (High&Low Level). Total 4 units Input sensor are connected using Port A. All output for the both system are connected using Port B which LED, Alarm and Pump.

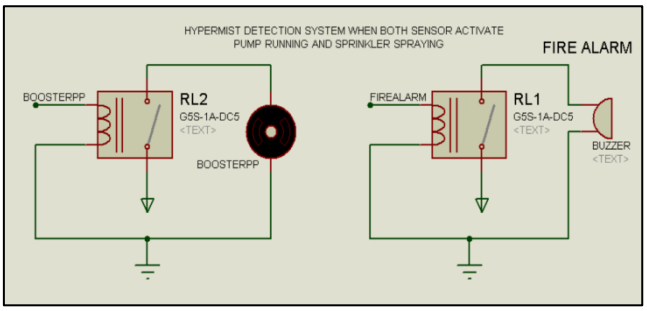

Figure 7 : Booster Pump and Fire Alarm Circuit

When one of the sensor(Flame or Smoke) got detected, Fire Alarm will activated as a pre-warning. It will keep ON until both of the sensor are normal.
If both are sensor are activated, Booster Pump will start to extinguishing the fire.

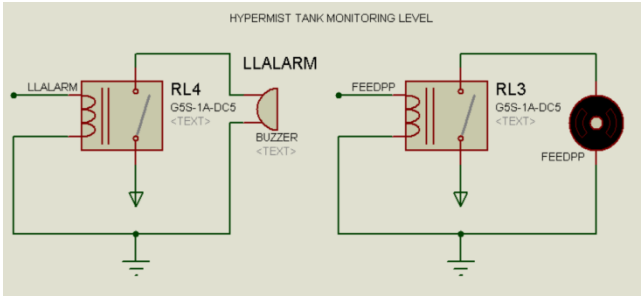

Figure 8 : Feed Pump and Low Level Alarm (Tank Monitoring Level System)

As a figure 8, The output of Hypermist Tank Monitoring Level which consist of Low Level Alarm and Feed Water Pump. As the Low Level sensor is trigged, Low level Alarm will sounded and Feed Water Pump will start for filling the Hypermist Tank.
Feed Water Pump will stop and alarm will Off, if level the tank reach High Level Alarm.

3.0 CIRCUIT DESIGN AND CCS C COMPILER CODING

The circuit is design at Proteus v7.6 which the entire components of the circuit are chosen from the software library and the connection were done by the line. The coding are create at CCS C Compiler Software. The coding then loaded into PIC Microcontroller using PicKit2. Finally, the simulation is tested for all the conditions. The circuit used for simulation is given in figure 5. The connection to the microcontroller separated into 3 parts of circuit. The inputs from the sensor were connected to RA0 until RA3 pins (using Port A) of the microcontroller. The output of the system are connected to RB0 and RB1 (for LED), RB2(Fire alarm), RB4(Booster Pump), RB6(Feed Pump) and RB7(Low Level Alarm). All the output connection show as figure 6.

Figure 9 below is the coding of the system.

ON LED.c

```
#include  <16f84a.h>
#use delay(clock=4000000)

#define SF pin_a2
#define LEDR pin_b0
#define SS pin_a3
#define LEDY pin_b1
#define FIREALARM pin_b2
#define BOOSTERPP pin_b4
#define SHH pin_a0
#define FEEDPP pin_b6
#define SLL pin_a1
#define LLALARM pin_b7

main()

{ // start here


    for (;;) // for looping

       {
          if  ((input(SF) == 1) || (input(SS) == 1))      // WHEN ONLY ONE OF THE SENSOR ACTIVATED
              output_high(FIREALARM);                     // FIRE ALARM WILL SOUNDED
          else output_low(FIREALARM);


          if  ((input(SF) == 1))                          // SENSOR FLAME ACTIVATED
              output_high(LEDR);                          // LED RED WILL LIGHT UP
          else  output_low(LEDR);
```

ON LED.c

```
          if  ((input(SF) == 1))                          // SENSOR FLAME ACTIVATED
              output_high(LEDR);                          // LED RED WILL LIGHT UP
          else  output_low(LEDR);

          if  ((input(SS) == 1))                          // SENSOR SMOKE ACTIVATED
              output_high(LEDY);                          // LED YELLOW WILL LIGHT UP
          else  output_low(LEDY);

          if  ((input(SF) == 1) && (input(SS) == 1))      // WHEN BOTH FIRE SENSOR ACTIVATED
              output_high(BOOSTERPP);                     // BOOSTER PUMP WILL START TO SUPPLY WATER TO THE SPRINKLER
          else output_low(BOOSTERPP);

          if  ((input(SLL) == 1))                         // WHEN HYPERMIST TANK LOW LEVEL SENSOR ACTIVATED
              output_high(LLALARM);                       // ALARM WILL SOUNDED  // LED RED WILL LIGHT UP
              delay_ms (1000);
              output_low(LLALARM);
              delay_ms (1000);

          if  ((input(SLL) == 1))                         // WHEN HYPERMIST TANK LOW LEVEL SENSOR ACTIVATED
              output_high(FEEDPP);                        // LED RED WILL LIGHT UP

          if  ((input(SHH) == 1))
              output_low(FEEDPP);


       }

}
```

Figure 9 : Coding of The System

5.0 CONCLUSION

The fire born accidents are mostly occurred without proper adequate monitoring, detection procedure and device extinguishing even if the industrial sector using effective steps and the application model of diverse methods and steps [6]. For that problem occurs, this proposed Automatically System for Hypermist Fire Fighting is important to fix at all type of ship. It will early trigger and fight the fire more fast that a human act. The important thing is to prevent of other compartment to get fire especially at the place which have a big source of fire and explosion such as fuel tank and cargo tank. Fire is the biggest risk of the marine carrier, so we cannot take it easy for handle it. Further improvement to be introduce to make our working place as safety as possible.

This system also will reduce the human error factor in term of monitoring of the water level on Hypermist FW Tank. Sometime, personnel take easy as they think everything will be going fine.

This system can be improved on next future. On this project, it's only focused on the risk area, but in future it can be fix at every part of engine room. Thermal camera also can be fixed to advance monitor of the environment condition. The water pressure also can be manipulated depend on the condition of the fire. We aim also to reduce as much as possible the personnel in term fighting of the fire by introduced the robotic component for fire fighting.

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