Hypermist System On Marine Vessel

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ABSTRACT

Fire onboard vessels is a very dangerous incident that can possibly cost human lives and property damage. Currently, there are numerous firefighting systems installed onboard vessels. Each of the common firefighting systems is connected to either smoke or flame detector in which the system can accurately detect fire and reduce fire exponentially .The aim of this paper is to create a system that increases the system accuracy and consistency in detecting the fire onboard ship with the application of the microcontrollers unit (MCU) based system. These designs were simulated using the Proteus software and then later implemented and tested in the hardware models. The program was then compiled in PIC C Compilers, and were programmed into the microcontroller using a programmer for PIC 16-bit microcontrollers. This paper will offer the improvement on the current fire detection system using both smoke and flame detector to detect fire onboard ship. The model functioned suitably by using simulator software.

KEY WORDS: *PIC microcontroller, Fire detection system, MCU*

NOMENCLATURE

CPU	*Central Processing Unit*
LED	*Light Emitting Diode*
MCU	*Microcontrollers*
UMS	*Unattended Machinery Space*
SMS	*Short Message System*
LDR	*Light Dependent Resistor*

1.0 INTRODUCTION

Fire Fighting systems are important for safeguarding the vessel and its machineries that are flammable and of toxic material. The main function of fire protection system is to protect human life, and thereafter the property and vessel. The primary way of fire extinguishing is the fire detection system. The rate at which the fire is detected is very important as the chance of extinguishing the fire increases at a faster and accurate detection, hence reducing the property damage. Intelligent fire detection systems are used in areas of the vessel where frequent physical inspection is impractical. The automated fire detection system hence initiates both audible and visual alarm upon fire detection onboard. The fire detector can detect fire by either the flame or smoke at the area it is installed.

1.1 Similar System

This section refers to some researcher's work that is related to the fire detection system onshore. The system proposed by a method of detecting fire by two sensor which detect fire by smoke and flame sensor. The system is always on standby and ready to be operated remotely, due to it, users could save their scarce time in their busy periods. Another Microcontroller based system embedded on oven was suggested by [3] to monitor and control the temperature automatically.

Another comparative paper shows the improvement of water level observing framework with an incorporation of GSM module to caution the individual in-control through Short Message Service (SMS). The water level is observed and its information sent through SMS to the proposed expert mobile telephone after achieving the basic level [4].

Another similar paper presents the development of water level monitoring system with an integration of GSM module to alert the person-in-charge through Short Message Service (SMS). The water level is monitored and its data sent through SMS to the intended technician mobile's phone upon reaching the critical level.

1.2 Current System

Current Automated system will be detecting fire by sensors fitted onboard which will be activated by both flame and smoke. This will trigger audible and visible alarm and causes the fire pump to start automatically. This automated system is more accurate and responds to fire in timely manner.

1.3 Proposed System

A system accurate, consistent and simple in its operation by electronic control system is proposed to enhance the safety of ship's crew.

2.0 METHODOLOGY

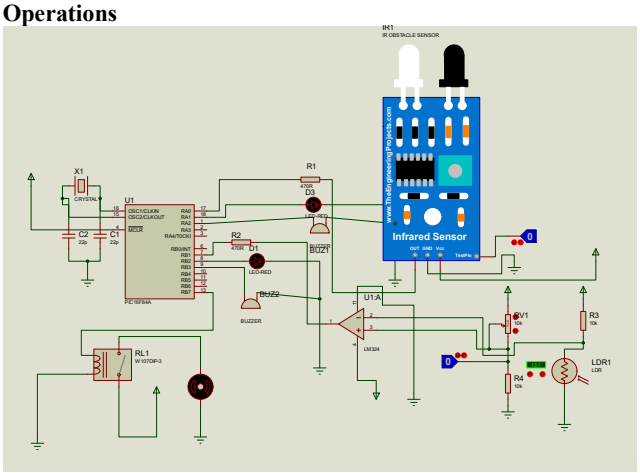
A Microcontroller will constantly observe the output of the Infrared and LDR sensors. The Sensors will be acting as switches to activate the audible and visual alarm. However, the pump will not start automatically. A secondary sensor is also constantly observed by the MCU which is the Light Dependent Resistor. At a given value of LDR, the circuit is now complete and the pump will automatically run. This system's circuit will only be complete at the activation of both sensors. However, audible and visual warnings are triggered by the MCU at either one of the sensor. This system will use lesser amount of mechanism at a higher accuracy and consistency rate. The motor will be controlled by the MCU through a relay [5]

2.1 Component

The components of the system consist of (1) PIC16F84A [6], this Microcontroller consists of 18-pins only. The MCU that would perform as the brain of the system, (2) Infrared Obstacle Sensor to be used to detect smoke in the vicinity , (3) light emitting diodes (LEDs) to turn as visual response, (4) Buzzer which functions as the hearing response aid, and (5) Light Dependent Resistor to detect flame intensity , (6) Motor that will be activated when needed, (7) Relay which will be used to control the Motor . Figure 1 illustrates the schematic diagram of the system design.

Figure 1: Schematic diagram

2.2 Operations



The operation concept is described below:

- When the infrared obstacle sensor detects smoke in the vicinity, it will trigger the audible and visual alarm.
- At a given value of the light dependent resistor, it will trigger the audible and visual alarm.
- When both sensors are activated, the motor will be turned ON.
- Either one of the activated sensor will only trigger the audible and visual alarm only. (Interlocked)
- The motor can only turn on with both sensor activated.

Table 1, shows the logic of the operations.

Table 1: Truth Table

INPUT		OUTPUT				
LDR	INFRARED	LDR		INFRARED		MOTOR
		BUZZ	LIGHT	BUZZ	LIGHT	
0	0	OFF	OFF	OFF	OFF	OFF
1	0	ON	ON	OFF	OFF	OFF
0	1	OFF	OFF	ON	ON	OFF
1	1	ON	ON	ON	ON	ON

2.3 Microcontrollers

PIC16F84A (Figure 2), is used for this system. This MCU is used as the brain of the system, it has the ability to function without other sophisticated modules to be attached. PIC is a family of reduced instruction set computing (RISC) microcontrollers manufactured by the Microchip Technology which is the resultant from the PIC1650 that is formerly developed by General Instrument's Microelectronics Division. PIC is the integrated circuit which was frequently used to develop in controlling exterior devices and lightening the load from the main CPU in the system. Matched to a human being, the main CPU acts as the brain and the PIC acts as the autonomic nervous system. Hence, it is recommended that 8-bit PIC16F84A microcontroller which is sufficient enough, to act as the central control of the system.

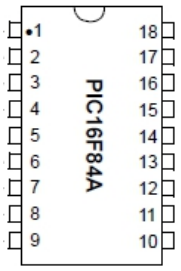


Figure 2 : PIC16F84A Microcontroller Pin assignment (PDLP)

2.4 Software

The "C compiler for the PIC MCU," is utilized for composing, editing, compiling, and programming the codes for the microcontroller. This compiler, which empowers the microcontroller to be customized in high level programming languages, together with PicKit2 programmer. 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.

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 compiled and tested using CCS compilers.

2.6 System Flow

This system works by sensing the smoke from the Infrared

Obstacle Sensor and the flame from the light dependent resistor(LDR) and sends the signal to the Microcontroller Unit. The MCU will then intelligently decide on the next course of action, triggering the audible and/or visual alarm and/or activating the Motor automatically, allowing the crew to take necessary action.

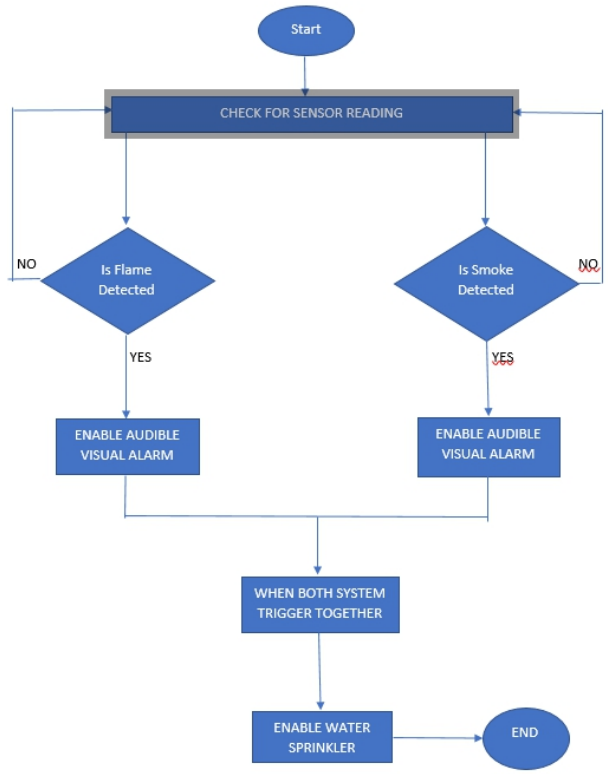


Figure 3: Flowchart of the system

2.7 Circuit

The MCU unit integrates the four main elements: the power source section, microcontroller segment which comprises the system input parts, and the output parts.

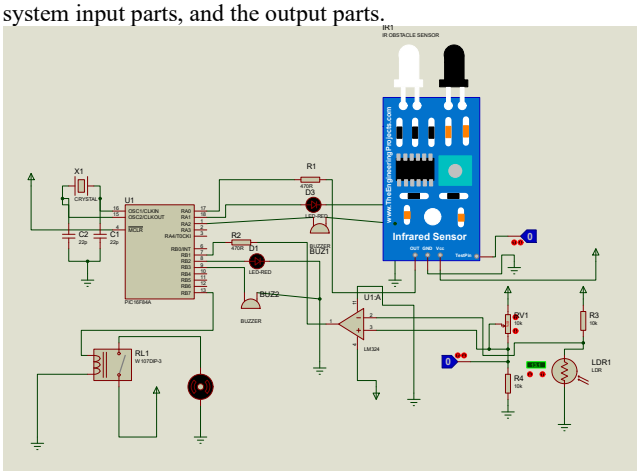


Figure 4 : Input & Outputs

As in figure 4, 1 input and 2 output sensors are connected using the Port A, 1 input and 3 output sensors of the system are connected using the Port B including the motor.

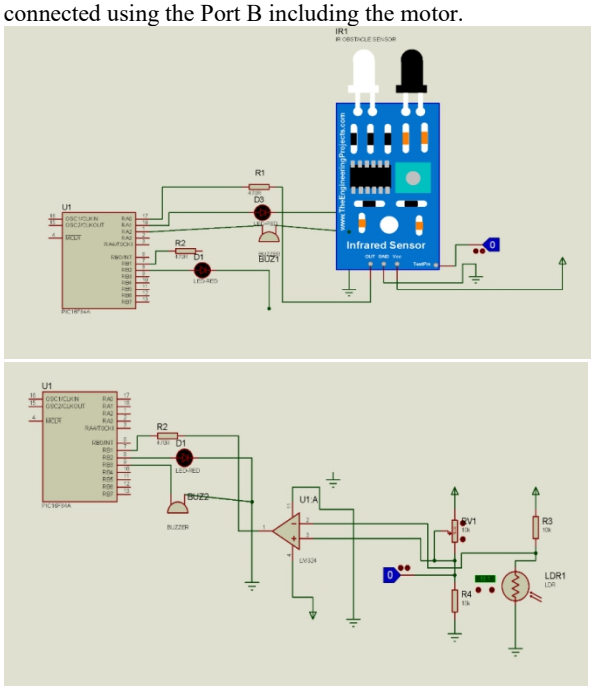


Figure 5 : Alarm Circuit (LDR & INFRARED)

When the infrared obstacle sensor detects smoke and/or light dependent resistor value increases, it will trigger the audible and visual alarm. And this will seek attention of the crew of the vessel for safe evacuation.

Both inputs of the sensor will activate the output of the relay which will trigger the motor and put off the fire.

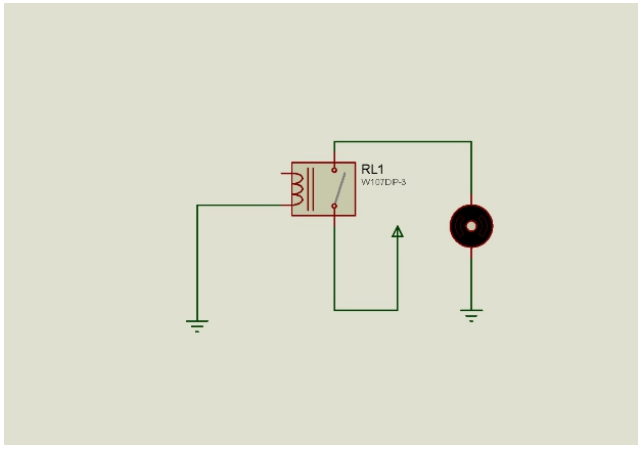


Figure 6 : Fire Pump Circuit

The fire pump or Motor, will start automatically when it detects smoke and flame simultaneously.

3.0 CIRCUIT DESIGN SIMULATION

Using Proteus v7.6 software the circuit was then replicated. By using the software library the entire components of the circuit which is essential were carefully chosen and the connections were done by lines. The program was then compiled using CCS 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 connections to the microcontroller were separated into 3 parts of circuits. The inputs from the sensors were connected to RA0 and RB1 pins of the microcontroller while the outputs of the system were connected RA1, RA2, RB2 AND RB3 connected to audible and visual alarms, and finally the RB7 is used to connect to the AC Motor relay (figure 6).

4.0 RECOMMENDATIONS

In this paper, the author presented the operation of the fire detection system. It is demonstrated to utilize a number of I/O sort MCU as the part to a circuit for the smoke and flame detector. This circuit will activate under flame and smoke sensor which leads to audible and visual alarm. However, only few external peripherals are used. In addition, the MCU could be reprogrammed to suit the regular regulation changes on board. Every one of these components are controlled and intelligently decided by the PIC16F84A - MCU and more application cases could be further explored.

5.0 CONCLUSIONS

In the end, this proposed system is designed to be more accurate and consistent in detecting fire. Thus, this will minimize the loss of lives by allowing crew to take a faster decision in the event of fire while preventing property damage.
This design could be further improve in near future with the integration of Liquid Crystal Display(LCD), allowing crew to allocate the position of the alarm in order for the command team take action accordingly.

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