Design , Modeling and Application of Microcontroller (MCU) on Engine Room Ambient Temperature Monitoring Device

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ABSTRACT

Manpower shortage in a vessel is a very common issue especially on a large vessel. There are numerous machinery and tanks installed and maintained on board ship. Almost all type of machineries work depend on the temperature settings also the starting and stopping of the alternative machineries are still lack in place due to manual monitoring of the temperature took place. The aim of this paper is to describe a simple design on a low-priced system, and application of the Microcontrollers Unit (MCU). These design were simulated using the Proteus software and then later to implement and test in the hardware models. The program has then compiled in PIC C Compilers, and were programmed into the microcontrollers using a programmer for PIC 8-bit microcontrollers. This paper will offer the developments of the temperature monitoring device system that will alert the crew when the buzzer sounds. The model function suitably by using simulator software. The vital use of the system is to reduce or to ease the task of the crew members even when there is unexpected shortage of the crew.

KEY WORDS: *PIC microcontroller ,temperature control, MCU*

NOMENCLATURE

ADC	Analogue to Digital Converter
MCU	Microcontroller unit
UMS	Unmanned Machinery System
USART	Universal Asynchronous Receive Transmitter
LCD	Liquid Crystal Display
LED	Light Emitted Diode

1.0 INTRODUCTION

The temperature monitoring device is an important device to be onboard ship. This device can be used for a ship where the Unmanned Machinery Space (UMS) had been installed where numerous parameters to be measured or observed frequently thus having this device will ease up the crew and also smoothen the operation of the ship. The device is designed in such way that when the setting temperature had been achieved, it will be sounds the buzzer. To improve the benefit of this application, it can be used in starting or stopping the engine room ventilation fan when the set ambient temperature has been achieved. This action will also improve the safety and health of the crew who had been working in the hot temperature all day long.

1.1 SIMILAR SYSTEM

The system that had similar uses onshore are the air conditioning system that is used in shopping mall or even in our house. The thermostat which acts like a temperature sensor will sense the low temperature and give signal to the relay to start the compressor and works vice versa.

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, freight on and off stacking operation, route and administration of support and purchasing of spares, however most of the temperature on the vessels are still being controlled and monitored manually by using thermometer. The temperature controller are not fully automated and still requires manual control to monitor the temperature. Most of the vessel use the manpower to start or stop the pumps or motors when the temperature increase or reduce.

1.3 PROPOSED SYSTEM

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

2.0 METHODOLOGY

A microcontroller will constantly observe the engine room ambient temperature. The sensor will be put at engine room area. Warnings will then be triggered by the MCU through its port and ultimately will activate the external peripherals that it is attached to. This warning could be some combinations of LED and buzzer. Normally engine room temperature must not exceed 55^0C otherwise it will damage some electrical equipment. If the sensor sense temperature reach 55^0C the alarm will sounded and LED will lit. It will notify the engineer on watch to solve the problem by running standby supply and exhaust fan or making a good arrangement of ventilation.

2.1 COMPONENT

The temperature sensor LM35 which has been used in the thermometer takes the input signal as the analogue signal [1]. Then this analogue signal is converted into digital signal by an analogue to digital converter (ADC) and by the direction of microcontroller consist of directed software the sensing input signal is shown in the liquid crystal display as digit format. Therefore, this circuit setup will measure the positive temperature from 2°C to 152°C. An internal analog to digital converter (ADC) of the PIC16F877 microcontroller converts the sensor output voltage to 10 bit digital number [1] [3]. Analog to digital converter (ADC) voltage measurement range is from 0 to 5 V [4]. If temperature reach above 55^0C buzzer will sounded and led lit. Else vice versa. Relay which will be used to control the buzzer. LED to turn as visual response.

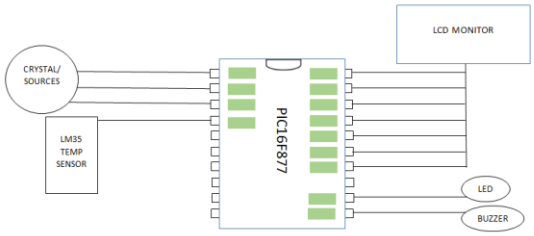


Figure 1 : Simplified schematic diagram

2.2 OPERATIONS

The operation concept is describe below
-It is just temperature monitoring device.
-If temperature reach above or equivalent to 55^0C buzzer will sounded and led lit. Else vice versa. Relay which will be used to control the buzzer. LED to turn as visual response.

Table 1 Truth table show the logic of the operation.

CONDITION	LED	BUZZER
TEMP NORMAL< 55 deg	**0**	**0**
TEMP HIGH > =55 deg	**1**	**1**

2.3 MICROCONTROLLERS

A newer device is available. Please consider the PIC16F887. 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 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. PIC16F877 features 256 bytes of EEPROM data memory, self programming, an ICD, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 additional timers, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

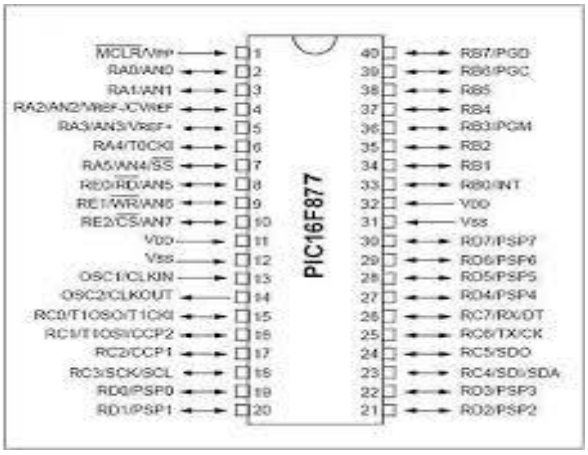


Figure 2: PIC16F877 Microcontroller Pin assignment

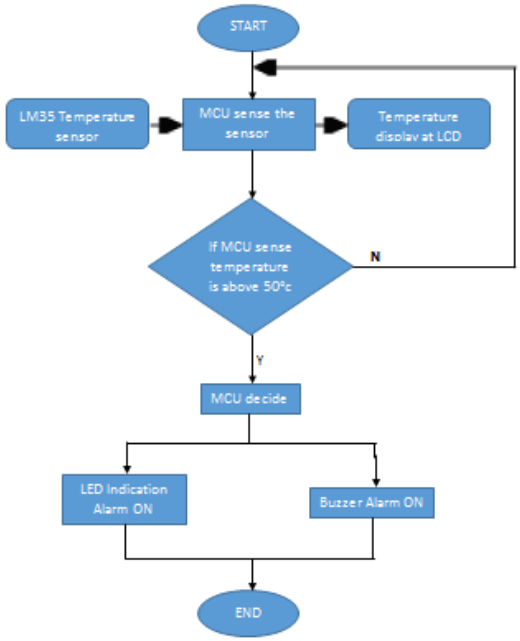
2.4 SOFTWARE

The C compiler for the PIC MCU is utilized for composing, editing, compiling, and programming the codes for the microcontroller. 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 MCU input-output ports taking into account the particular tasks. The fundamental capability of the entire system is to allow a timed with micro-second interim, to acknowledge the sensor inputs and to activate the output with enacting the buzzer and LED.

2.5 PROGRAMMING DESCRIPTION

The program used to regulate the entire process is embedded in PIC16F877 microcontroller's C language. All the codes have been compiled and tested using CCS compilers.

2.6 SYSTEM FLOW



Flowchart of the system

2.7 CIRCUIT

The circuit have four main elements: The power source section, Microcontroller segment, which comprises the system input parts And the output parts. All these module are integrated to the MCU unit.

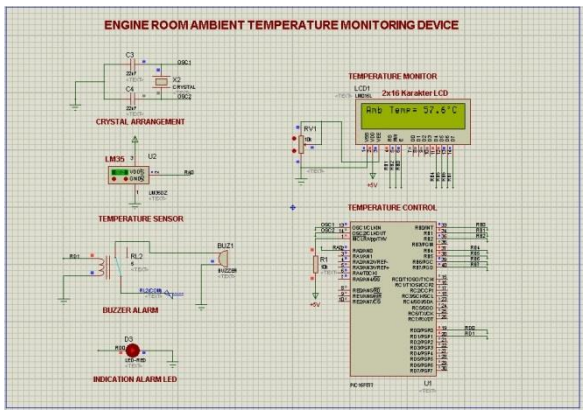


Figure 3

As in figure 3, if temperature reach above or equivalent to 55^0C buzzer will sounded and led lit.

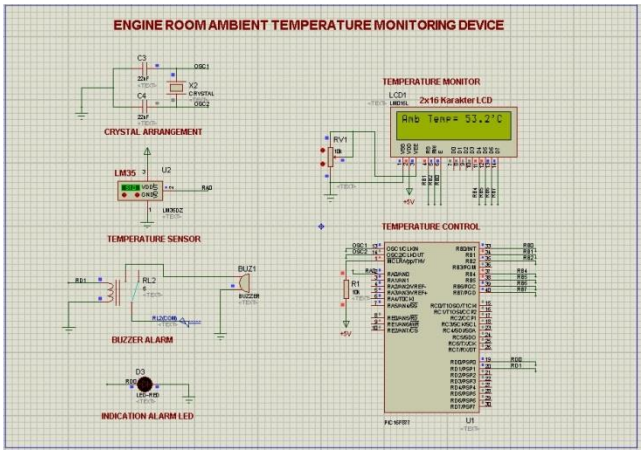


Figure 4

As per figure 4, When the temperature at normal condition which is less <55 ^{0}C, the buzzer and the Led will not react.

3.0 CIRCUIT DESIGN SIMULATION

The circuit was then replicated in software Proteus v7.6. In this software, the entire components of the circuit which is essential were carefully chosen from software library and the connections were done by lines. The program was later compiled using CCS C compiler. The output, hex file of the program is loaded into PIC microcontroller using PicKit2. Finally, the simulation is tested for all the conditions. The circuit simulation is given in Figure 3 & 4. The connection into the microcontroller separated into 4 parts of the circuit. The input from the sensor was connected to RA0 (using port A) of the microcontroller while the outputs of the system were connected to RB0 through RB7 for the display unit (LCD), and RD0 is connected to the indication alarm LED, and finally the RD1 is used to connect to the buzzer relay. All the outputs pin is connected through Port B of the microcontroller.

4.0 RECOMMENDATIONS

In this paper, the author presented the operation of ambient temperature monitoring device. Besides, it is demonstrated to utilize a savvy I/O sort MCU as the part to a circuit for temperature sensor and controls. The sensor sense and read the temperature and utilize LED signals. From the equipment circuit, only few external peripherals are used. In addition, the MCU can be reprogrammed to suit the condition on board. Every one of these components are controlled and intelligently decided by the PIC16F877- MCU and more application cases could be further explored.

5.0 CONCLUSIONS

Thus, this proposed system will ensure the occupational safety on board my minimizing the needs for the crew to frequently moving to monitor the temperature and the protection of the equipment or machines as well.
This system would be further in near future. Upcoming system could be focused on apply on more application. This system can be used to adjust the speed of the motor depending on the ambient temperature which is simultaneously reduce the load of generator and save the amount of fuel used in the generator.

ACKNOWLEDGEMENTS

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