AIRCRAFT FIRE PROTECTION SYSTEM FOR CLASS "A" FIRE

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*Abstract :*Fire protection system plays an important role in maintaining and monitoring the safety of all kind of environments and situations in an aircraft. But as we know, the usability of most existing fire protection system is limited by the fact that it is not cost effective. Subsequently, it is not affordable for us to build an exact replica so we had to take a different approach. The system has three main functions, 1) detection 2) monitoring and 3) suppression. The detection system operates as the fire detector. It includes fire and smoke sensors. The present work focus on the design and implementation of a fire alarm system using the microcontroller which operates the entire system.The detectors are placed in parallel in different levels and any signal from each detector at any level is monitored using monitoring system. The appliance system has components like buzzer for alarming and motorized sprinkler to extinguish the fire. The entire system is controlled by microcontroller which is programmed in the desired way by using C-Programming. When the sensors form each level detects the presence of both smoke and fire individually, the main buzzer operates causing it to show the current readings in the control panel LCD display. Then it triggers the sprinkler motor to sprinkle water through a tubing to extinguish the fire.Results shows that the proposed prototype is effective in both detection and suppression of fire based on the feedback of sensor node and the sprinkler system.

IndexTerms **- Keil u Vision, LM35 temperature sensor, MQ5 smoke detector, 8051 micro controller**

I.INTRODUCTION

Confirmed Fire on board an aircraft, especially when it is in flight, represents one of the most feared hazards in aviation. Fire in the air can ultimately lead to loss of control, either as a result of structural or control system failure, or again as a result of crew incapacitation; Fire on the ground can take hold rapidly and lead to significant casualties if evacuation and emergency response is not swift enough.Smoke or Fumes, whether they are associated with Fire or not, can lead to passenger and crew incapacitation and will certainly raise concern and invite a response. Finally, a Post-Crash Fire, following an aircraft accident, accounted for approximately half of all fatalities in the period 1999 - 2007 (UK CAP 776).Fire protection systems are installed on aircraft to detect and protect against an outbreak of fire. You will find these systems near the engines and in the fuselage.These systems monitor the conditions which could lead to a fire and are comprised of smoke detectors, heat sensors near engines or hydraulic systems and visible and audible warnings in the cockpit.The chance of a fire in small general aviation or experimental type aircraft are very remote but at least the engine compartment should have some form of detection as this is the area where heat, air and a combustible fluid are together in close proximity.

II.METHODOLOGY

System Overview

The system consists of three major sections i.e. the detection system, the monitoring system and finally the suppression system.We present a prototype for automatic detection and suppression of fire present in the aircraft. The Prototype includes sensor node and controller node. In the sensor node, temperature and smoke sensors are integrated with an ARM cortex microcontroller which acts as the heart of the whole system while an LCD display, a buzzer along with indication lights and a motor is integrated in the controller node.The sensor node is used to sense the presence of fire/smoke and the sensed data is sent

to controller node which displays it on the LCD display and initiate an audio-visual alarm and finally suppress the fire using a motorized sprinkler system.

2.2 LM35 Temperature Sensor

The LM35 series are precision based integrated-circuit temperature sensors with an output voltage linearly proportional to the centigrade scale. This sensor is fully rated from -55 ºC to +150 ºC and with the linear scale factor of 10mV/ºC. It operates from 4 to 30 V, has less than 60 µA drain current and has low self-heating (0.08 ºC in still air). The control circuitry or the interfacing of LM35 is really easy due to the low output impedance, linear output and precise inherent calibration. The LM35 series is available in hermetic TO transistor packages, while the LM35C, LM35CA and LM35D are available in TO-92 transistor package. The LM35D is also available in an 8 lead surface-mount small outline package and a plastic TO-220 package.

2.3 MQ-5 Smoke Detector

It is an electrochemical cell based sensor that can detect smoke, Alcohol, LPG, CO, CO_2. It operates on 5 Volt DC supply. It gives digital signal output (5V) whenever gas is detected and 0V when gas is not detected.Sensitive material gas sensor is SnO_2, which with lower conductivity in clean air. MQ-5 gas sensor has high sensitivity to Methane, Propane and Butane, and could be used todetect both Methane and Propane. The sensor could be used to detect different combustible gas especially Methane, it is with low cost and suitable for different application. It is high sensitivity to LPG, natural gas, town gas and small sensitivity to alcohol, smoke.Fast response,simple drive circuit,stable and long life.

2.4 Relay

Relay is one of the most important electromechanical devices highly used in industrial applications specifically in automation. A relay is used for electronic to electrical interfacing i.e. it is used to switch on or off electrical circuits operating at high AC voltage using a low DC control voltage. A relay generally has two parts, a coil which operates at the rated DC voltage and a mechanically movable switch. The electronic and electrical circuits are electrically isolated but magnetically connected to each other, hence any fault on either side does not affects the other side.Two terminals are used to give the input DC voltage also known as the operating voltage of the relay. Relays are available in different operating voltages like 6V, 12V, 24V etc. The rest of the three terminals are used to connect the high voltage AC circuit.

2.5 8051 Microcontroller

A micro controller is an integrated circuit or a chip with a processor and other support devices like program memory, data memory, I/O ports, serial communication interface etc. integrated together. The Microcontroller 8051 version that we used in this system is AT89C51RD2/ED2 which is a high performance CMOS Flash version of the 80C51 CMOS single chip 8-bit microcontroller. It contains a 64-Kbyte Flash memory block for code and for data. The 64-Kbytes Flash memory can be programmed either in parallel mode or in serial mode with the ISP capability or with software. The programming voltage is internally generated from the standard VCC pin.

2.6 Piezo Buzzer

For alarm purposes a lot of electric bells, alarms and buzzers are available in the market that has got different prices and uses. The buzzer being used in this project is a 5-12 V buzzer and has got enough alarm sound to be used in a fire alarm system. Louder buzzer would have been evenbetter but then their operating voltages are high as we had a supply of maximum up to 12V available with us on the board.

2.7 DC Motor

DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore the current in the rotor is switched by the commutatorto also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque.DC motors have a rotating armature winding but non- rotating armature magnetic field and a static field winding or permanent magnet. Different connections of the field and armature winding provide different inherent speed/torque regulation

characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control.

2.8 Liquid Crystallized Display

LCD is as well another output appliance here. It is used to display character in the ASCII code form which the data for characters is sent by the controller to the LCD which should be in 8-bit ASCII representation. The characters that will be displayed on the LCD panel should be the ones that are available in the LCD datasheet characters' table. Most of the LCDs are using the Hitachi driver. The system is using the LCD to preview the current temperature value and presence of smoke and fire.Normally available LCD in the market for normal displays in the electronics projects is 2x16 pin LCD. Talking about its specifications, it has got 8 data pins, 3 control pins, and rest 5 pins for GND and VCC connections. Its display and light intensity is also adjustable which makes it suitable to adjust for the day and night time use for better display.

III.APPENDIX

C-language code of system

```
#include<stdio.h>
#include<reg51.h>
#include "lcd.h"
#include "adc.h"
sbit gas=P2^1;
sbit buzzer=P2^7;
sbittemp_red=P2^5;
sbittemp_green=P2^4;
sbitgas_red=P2^3;
sbitgas_green=P2^2;
sbitsprink=P2^6;
sbitfire_red=P3^1;
main()
{
unsigned char temp[5];
unsignedint temp1;
buzzer=0;
sprink=0;
temp_green=1;
temp_red=0;
gas_red=0;
gas_green=1;
fire_red=0;
init_lcd();
lcdcmd(0X80);
lcdstr("  A/C FUSELAGE  ");  //delay(1000);
temperature();
while(1)
    {
 temp1=temperature();
```

```
sprintf(temp,"%u",temp1);
lcdcmd(0Xcd);
lcdstr(temp);
lcdstr("");
lcdcmd(0Xc0);
lcdstr(" TEMPERATURE:");
if(temp1>=85)
        {
buzzer=1;
temp_green=0;
temp_red=1;
if(gas==1)
            {
lcdcmd(0X80);
lcdstr(" FIRE DETECTED  ");
fire_red=1;
gas_red=1;
gas_green=0;
sprink=1;
}
else {
lcdcmd(0X80);
lcdstr("HIGH TEMPERATURE");
            }
  }
else if(gas==1)
      {
buzzer=1;
gas_red=1;
gas_green=0;
sprink=0;
temp_green=1;
temp_red=0;
fire_red=0;
lcdcmd(0x80);
lcdstr(" SMOKE DETECTED ");
       }
else{
buzzer=0;
sprink=0;
temp_green=1;
temp_red=0;
```

```
gas_red=0;
gas_green=1;
fire_red=0;
lcdcmd(0X80);
lcdstr("  A/C FUSELAGE  ");
        } //delay(500);
  }
}
```

IV.RESULT AND DISCUSSION

Result

The aim of the project was to implement an automatic aircraft fire protection system and the goal was met. The microcontroller unit responds to the instructions as encoded by the programmer used i.e. KeiluVision to the necessity of the application as well as triggers an audio-visual alarm upon a critical situation. The aim of the application to suppress the fire in case of an emergency was also achieved.

.Discussion

The development of technology has been affecting the overall quality of aviation industry. The dependency on technology even to carry out daily activities and technology has made it easier to carry out any task required in day-to-day operation. It seems as if it was impossible to live without technology in this century. With the development of technology, the concept of implementing fire monitoring system in aircrafts has changed drastically during the last decade. The advancement of technology has not only played a significant role in the development of positive aspects but has also played an important role in the development of negative aspects. This project depicts a simple application project demonstrating a fire detection and extinguishing system. The movements and the temperature are detected by installing sensors at different places. The temperature of the premises where the sensors are installed can be known at any time before reaching the critical limit set by the user. As this project was a fire detection and suppression system demonstration project, a few sensors and LEDs were used. The project can be extended by increasing the number of sensors used along with an increase in the number of installation places. The remote management of electronic devices can also be extended with the use of different real electronic devices. The project was completed within the projected time with the expected result. However, there were many hardware and software errors experienced during the development of the application. There were many bugs in the software as well as connection errors in the hardware, which came along with the development of the application and which was solved individually. Despite reading the datasheet of the sensors before using them, the microcontroller was burnt out by accidentally connecting the wrong pins. Accidentally, the ground connection and the power supply were interchanged which burnt down the microcontroller and a new microcontroller had to be ordered. Similarly, there were some hardware errors while connecting the sensors and the led with the microcontroller. Many connection errors were faced during the project time which did not lead to the damage of any hardware unit except the microcontroller was fixed up later.

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