LPG Leakage Sensing with Automatic Drone

Mrs.Vaishali Thorat, Shubh Mishra, Shubham Wakte, Mahesh Dhole

Department of Electronics and Telecommunication Engineering of D.Y. Patil School of Engineering Academy Ambi, Talegaon, Pune, Maharashtra, India.

Abstract

Nowadays the home safety detection system plays an important role for the security of people and basically in home appliances the security must be cured. So the security of the home appliances must be the LPG gas cylinder available at home must be checked regularly whether it has some leakage somewhere. This Project is about creating a prototype of automatic quad copter for examining the gas leakage in home or any industrial area with collecting data and other parameters to sustain and complete the exploration with maximum efficiency.

Keywords: Air Inspection, Arduino, Pollutant, LPG, Gas sensing, Drone

1. Introduction

Problem statement

Since the last few years there has been a tremendous rise in the demands of liquefied petroleum gas (LPG) and natural gases. In order to meet this access amount of demand for energy and to replace oil or coal due to their environmental disadvantage. LPG and natural gas since they are inflammable gases so they burn so easily, cleanly and does not affect the environment. These gases are mostly used on a large scale for industrial work, heating, home appliances and motor fuel.

The resources used at home must be taken care as the safety precaution arises.Nowadays most of the women in India are working in co-operative, private, government sectors. So most of the time no one is available at home to take care or see whether the gas is getting leaked or not. So we have proposed a system which can be the solution for most of these leakage problems occurring in day to day life.

Objectives

This Project is about creating a prototype of an automated quad copter for examining the gas leakage with collecting data and other parameters to sustain and complete the exploration with maximum efficiency. In system we are using a gas sensor MQ6 which will detect the leakage LPG gas. This sensor senses the amount of leakage gas present in the surrounding atmosphere, if this gas leakage is in large amount and if collected at a large quantity in the surrounding than it itself predicts to that particular location of leakage.

Future scope

Drone Inspection by Unmanned Aerial Vehicles as it is fastest growing preferred method of visual survey across large range of industries. Drone inspection is best alternatives to any other visual survey and blue-chip companies are beginning to realize this and understood the benefits of including this method of inspection within their annual maintenance and repair budgets. This inspection method is reducing heavy costs of traditional methods of access but also has a heavy impact with risks associated with manned working at height.

Drones continue to improve the processes across industry reaching into the realms of science fiction. Drone inspection methods can vary from standard outputs to 3D models with high definition mesh overlays allowing the user to evaluate an asset from the comfort of his/her desk.

Drone makers and developers breach the norms on day to day basis with continuous funding pots available to develop services they can offer such as drone inspection, aerial survey, autonomous flight paths, remote sensing, search and rescue and many other highly charged areas that were once difficult or risky to approach using the traditional methods.

Drone inspection can offer multitude of assistance to those that adopt the technology, providing numerous remedies to what were once pain points within the inspection and survey market.

Unmanned Aerial Vehicle

An unmanned aerial vehicle (UAV) (or un-crewed aerial vehicle or Drone) is an aircraft without a human on boarding and a type of unmanned vehicle. UAVs are a component of an unmanned aircraft system (UAS); which include a UAV, a ground-based controller, and a system for communications between the two. The flight of UAVs may operate with various degrees of autonomy either under remote controlled by a human operator or autonomous by onboard computer.

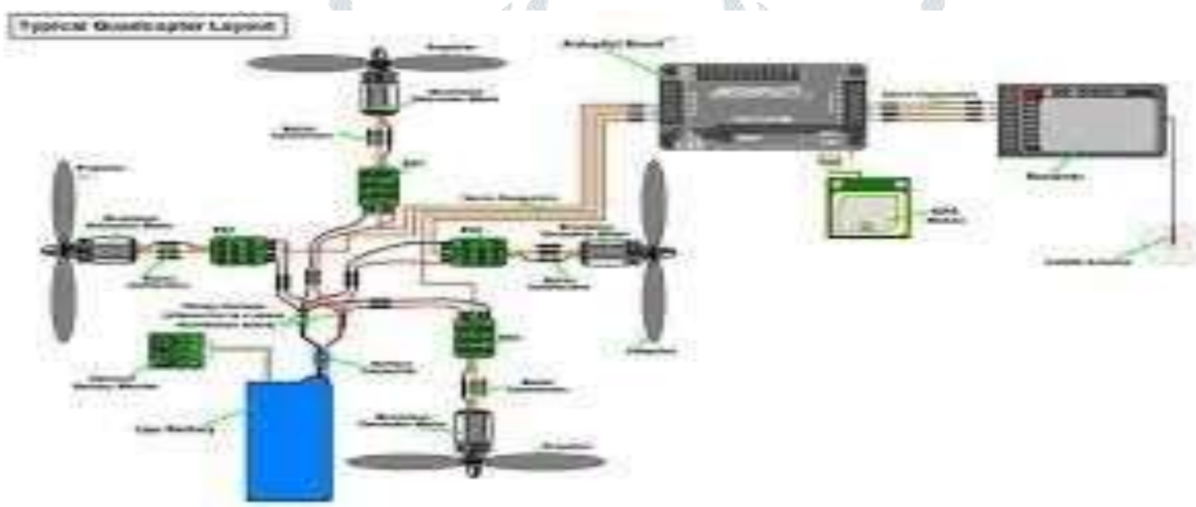
Compared to crewed aircraft, UAVs were mainly used for missions to "dull, dirty or dangerous" for humans. They originated mostly in military application, their use is rapidly increasing to commercial, scientific, recreational, agricultural, and other applications, such as policing and surveillance, product deliveries, aerial photography, smuggling and drone racing.

Literature Review

In recent Past the leakages have been doing much damages and also causing lot of death tolls. So we proposed a system which can detect the leakages and alert us. The developed system will keep the track on various home appliances such as LPG cylinders, wired circuit, etc. The system uses MQ6 gas sensor to detect inflammable gas leakage and LM35 temperature sensor which will sense sudden rise in temperature in surrounding than above the room temperature. This makes it easy for both the Commercial as well as domestic sector to keep the track on problems faced on a daily basis. This system effectively tracks the problems that arise in day to day life.

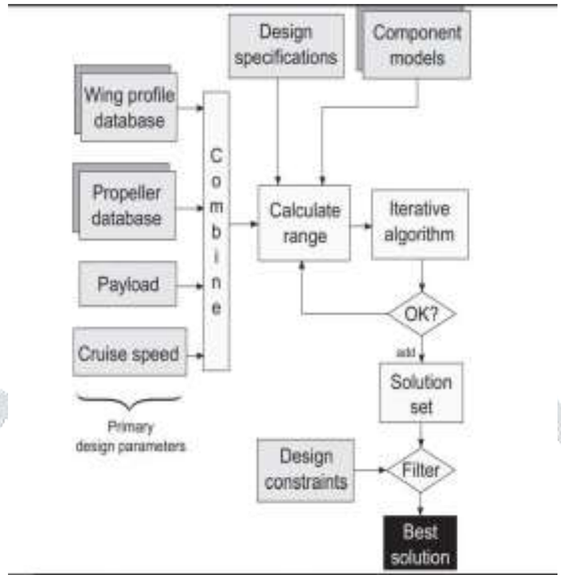
Use of these UAVs equipped with off-the-shelf sensors to check air pollution monitoring tasks. The UAVs is led by a proposed Pollution-driven UAV Control (PdUC) algorithm, which is based on a chemo taxis met heuristic and a local particle swarm optimization strategy. Simultaneously, they allow automatically performing the monitoring task of specified areas using UAVs. Experimental result show that, while using these PdUC, an implicit priority guides the construction of pollution map by targeting on areas where the pollutants' concentration is higher. This way, precise maps can be built in a faster manner when compared to other strategies. The PdUC plan is compared against various levels of mobility models through simulation, showing that it achieves better performance. In particular, it is used to find the most polluted areas with more efficiency and it projects a higher coverage within the time bounds defined by the UAV flight time.

Methodology



Layout of Quad copter

Flowchart



Main Components

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - lighton a sensor, a finger on a button, or a Twitter message - and turn it intoan output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the micro-controller on the board. To do so you usethe Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Usage

1. Prototyping: Arduino is a stable open source electronics platform, with many libraries and a large community. You will find a lot of hardware that you can directly plug in, and immediately use it with an Arduino library. When you need to test something before creating your own PCB with a custom micro-controller and hardware interfaces, Arduino is the way togo!

2.3D printers: You may have heard about 3D printers using Arduino Mega boards with a RAMPS 1.4 shield. This combination is great as it allows you to control 5 stepper motors and many servo motors. Arduino completely fits the end-product need in this case.

3. Robotics: Arduino is a nice and stable platform to interface all the hardware from your robot. In my robotics start-up we are currently building a 6 axis robotic arm powered by Arduino,and it works great! With a computer (Raspberry Pie) being the brain of the robot for huge computation,

you can simply use an Arduino board to control all the motors (outputs) and sensors (inputs)

Working

The 14 digital input/output pins can be used as input or output pins by using pin Mode(), digital Read() and digital Write() functions in arduino programming. Each pin operates at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50 KOhms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

Serial Pins 0 (Rx) and 1 (Tx): Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.

External Interrupt Pins 2 and 3: These pins can be configured to triggeran interrupt on a low value, a rising or falling edge, or a change in value.

PWM Pins 3, 5, 6, 9 and 11: These pins provide an 8-bit PWM output by using analog Write() function. SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK): These pins are used for SPI communication. In-built LED Pin 13: This pin is connected with an built-in LED, whenpin 13 is HIGH – LED is on and when pin 13 is LOW, it's off. Along with 14 Digital pins, there are 6 analog input pins, each ofwhich provide 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using anAREF pin with analog Reference() function. Analog pin 4 (SDA) and pin 5 (SCA) are also used for TWIcommunication using the Wire library. Arduino Uno has a couple of other pins as explained below: AREF: Used to provide reference voltage for analog inputs with analogReference () function.

Reset Pin: Making this pin LOW, resets the microcontroller

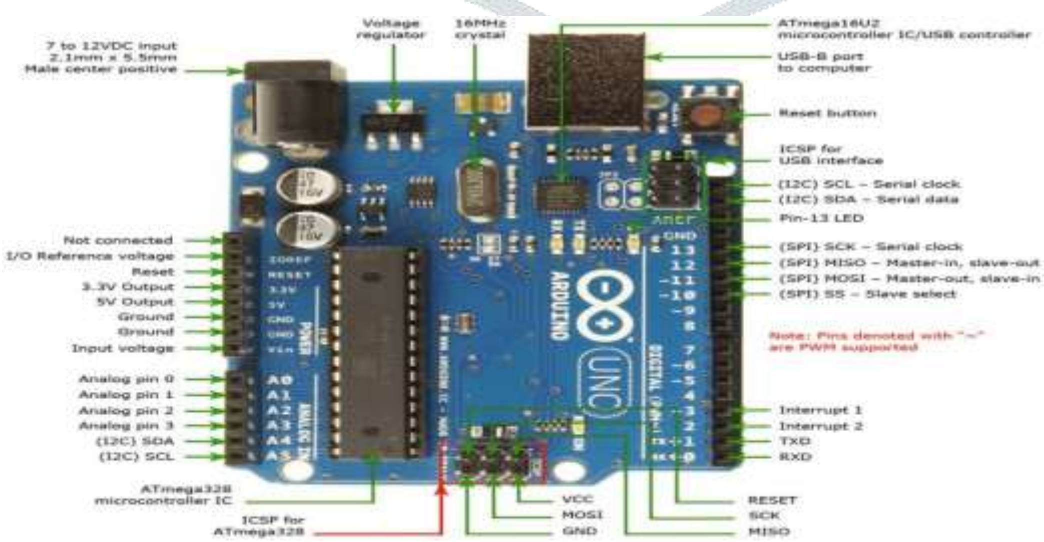


Fig: Arduino Pinout

Flight Controller

A flight controller (FC) is a small circuit board of varying complexity. Its function is to direct the RPM of each motor in response to input. A command from the pilot for the multi-rotor to move forward is fed into the flight controller, which determines how to manipulate the motors accordingly. A FPV Drone Flight Controller, or FC, is the heart of a quad copter andcontrols most onboard electrical components with the assistance of an Arduino-like microprocessor and an array of sensors. This article will provide information regarding the different types of FC's and the range of possible feature integrations so that you can choose the most suitable flight controller for your application. Flight controllers are continuously evolving with their processors becoming faster to keep up with evolving flight controller software's. Flight controllers are usually titled to include the main microprocessor's (usually an STM electronics, 32-bit microprocessor) model as this gives the pilot a basic idea ofthe flight controllers capabilities. The most common microprocessor models used are the STM32 F1, F3, F4 and F7 chips. Essentially, the higher the number after the 'F', the faster the microprocessor will be and the more functionality it will have. For any pilot purchasing a flight controller, it is currently recommended to purchase one with an F4 or F7 processor as they are easily fast enough to run the latest FC firmware's. Unfortunately, the F1 is becoming too slow to run the latest FC firmware's and is not recommended to purchase as it will soon become unsupported. F3 boards can currently run the latest flight controller firmware's although the microprocessor is consequently slower than an F4 to F7 at reading and responding to sensor inputs. This reading and response time is respectively known as the gyro update frequency and the PID loop frequency.

Firmware

To program a FPV Drone Flight Controller, it is connected via micro USB to the computer and flashed with firmware specific to the chosen FC configurator software. The firmware configures the board with the program and settings required to manage and control the quad copter. The USB interface allows connection between the FC and its configurator enabling the user to modify and change the board settings including the rates, PID's, receiver configuration, failsafe setup and flight modes. For all FC's, it is recommended to flash the latest firmware available as it will usually have improved flight characteristics and a reduced quantity of software issues. An FC can be flashed with firmware for use with the configurators: Beta flight, Clean flight and occasionally, Race flight or KISS (if compatible). All configurators have specific benefits to them and an individual's preferred configuration is subjective. As a general recommendation,use Race flight or KISS with your flight controller if it is listed as compatible. Otherwise, use Beta flight which is the most common configurator as its open source nature provides compatibility with mostFC's.

Hardware

An FPV Drone Flight Controller is mounted to a drone frame using four equally spaced mounting holes. Currently, 30.5mm by 30.5mm spacing between hole diameters is the standard on a 220 sized quad copter. 20mm by 20mm spacing is also quite common on 70-130 sized quad copters. The mounting holes are usually 3mm in diameter. Smaller mounting patterns also exist although they are used almost exclusively for sub 70mm quad copters. Many flight controllers actually use mounting holes larger than 3mm diameter to allow insertion of rubber grommets which assists in isolating the FC from motor vibration. In regards to connecting external components to the FPV Drone Flight Controller, they can be purchased with solder pads, pin header holes, plugs, or a combination of the three. Solder pads are the most useful, compact and preferred connection as it allows neat, low profile, external componentry connections to be made. Pin header holes are also common on FC's although, to reduce weight and connection profiles, pilots will usually solder wires directly to the holes rather thansoldering on header pins and connecting wires using a servo plug. Plugs are not the most prevalent FC connection method although they allow external components to be quickly disconnected. Due to motor vibrations, thin soldered wires can eventually fray and snap off from solder pads or pin holes. To prevent this, hot gluing solder joints is a safe option to prevent loss of circuitry during flight. Solder pad FC's are recommended for most applications however the use of connectors can also be useful for small, tight or modular setups.

Gyros

A gyro is a microchip, secondary to the main processor, which senses the angular velocity or the speed at which a quad copter rotates in the roll, pitch and yaw axis. Using calculus mathematics and gyro inputs, the FPV Drone Flight Controller can estimate the distance a quad copter has rotated and whether its rotation is accelerating or decelerating. This is the onlysensor required for the quad copter to fly in acre mode (the quad copter stays in the same position when sticks are centered) although certain FC software's will also use the accelerometerin acre mode to stabilize a quad copter in a crash, enabling quick recovery

Accelerometers

An accelerometer is another separate sensor chip and can detectthe acceleration of a quad copter in the roll, pitch or yaw axis. Because the accelerometer can also detect the constant acceleration of gravity, the FPV Drone Flight Controller is able to use this information to calculate the quad copter's precise angle from the horizon. This is used for flying a quad copter in horizon/self-leveling mode which is the flight mode most beginners start with.

PID

The backbone of a FPV Drone Flight Controller is the PID control loop in the software used to maintain quad copter stability during flight. PID stands for 'proportional, integral andderivative' which are calculus terms related to the magnitude, area, and gradient of a curve respectively. Tuning these three P,I, and D gains properly drastically increases the stability and responsiveness of a craft. When flying a quad copter, a quick roll input, as an example, could be telling the craft to move from a flat hover to a set point angle of e.g. 45 degrees to the right. Ideally in this scenario, the quad copter would instantaneously roll 45 degrees to match the stick input however this is not the case. What actually happens is thequad copter rolls right past 45 degrees, rolls left back past 45 degrees, rolls right back past 45 degrees, and continues to follow this pattern, overshooting the 45 degrees mark less and less each time until the mark is reached. A PID loop analyzing the gyro and/or the accelerometer data controls this process such that a well-tuned loop will appear as if the quad instantaneously rolls 45 degrees to the right when commanded by a stick input. PID tuning is quite complex so it is recommended to leave PIDs at their default if you are unfamiliar with them and the tuning process.

Additional Sensors

FC's can also have a variety of other sensors apart from the gyro and accelerometer to enable more telemetry data and flight capabilities. Some common additional sensors include:

1. GPS. A GPS antenna allows for a quad copter to identifyits rough position, height and ground speed. This provides the quad copter with the ability to autonomously return to a set 'home point' if instructed to or if the transmitter disconnects from the quad copter mid-flight. GPS data can also be displayed on an on-screen display (OSD). Whilst uncommon for racing and freestyle, this is a popular feature for long range quad copters as the GPS can display the direction and distance to the home point on the OSD.

2. Barometer. A barometer provides altitude data to the FCby measuring the air pressure. Whilst relatively without purpose for racing and freestyle quad copters, it is also useful for long range pilots as it provides altitude readings with greater accuracy than a GPS. Thebarometer also allows a quad copter to enable an altitudehold mode allowing it to maintain a constant height during flight.

3. Current sensor. A current sensor is useful for all quad copter applications as it allows the flight controller to calculate and display the instantaneous current draw and battery consumption on an OSD. This gives pilots aprecise indication of the ideal time to land and is asuperior battery capacity measurement than battery voltage (which fluctuates under load).

Fig: Flight Controller

Conclusion

We conclude that with this research work that for safety purposes we can still need enhancement and development. And our proposed method for this project is also one of the step towards it.

REFERENCES

1. LPG Leakage Detection and Prevention System with GSM Alert.
2. Using UAV-Based Systems to Monitor Air Pollution in Areas with Poor Accessibility: Journal of advanced transportation.
3. GSM Based Smart Home Automation Using Sensors.
4. Autonomous robots for harsh environments: a holistic overview of current solutions and ongoing challenges.
5. A Survey of Motion Planning Algorithms from the Perspective of Autonomous UAV Guidance.
6. Vehicle Routing Problems for Drone Delivery.
7. Evolution of space drones for planetary exploration.
8. Autonomous Exploration and Data Gathering with a Drone.
9. A Study on Flight Stabilization of Drones by Gyro Sensor and PID Control.
10. A study on smart drone using quad copter and object tracking techniques.
11. Using UAV-Based Systems to Monitor Air Pollution in Areas with Poor Accessibility.
12. Design and Control of an Unmanned Aerial Vehicle for AutonomousParcel Delivery with Transition from Vertical Take-off to Forward Flight.

Biographies:

Vaishali V. Thorat Completed Bachelor of Engineering(Electronics and Telecommunication Engineering) in 2005, DYPIET Pimpri Pune 18. Masters of Technology in Electronics Engineering 2012,BVDUCOE, Pune 44. Pursuing Phd from Himalayan University, Itanagar, Arunachal Pradesh. Currently working As a Assistant Professor in D.Y.Patil School Of Engineering Academy Ambi,Talegaon, Pune, Maharashtra, India.

Shubham Watke B.E. E & TC in D.Y.Patil School Of Engineering Academy Ambi,Talegaon, Pune,Maharashtra,India.

Shubh Mishra B.E. E & TC in D.Y.Patil School Of Engineering Academy Ambi,Talegaon, Pune,Maharashtra,India.

Mahesh Dhole B.E. E & TC in D.Y.Patil School Of Engineering Academy Ambi,Talegaon, Pune,Maharashtra,India.