Multi-Operational Unmanned Flying Object (UFO)

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Abstract— As the military operations concerned surveillance, law enforcement and search and rescue operations are very critical. In past aircraft and helicopter were used for this types of operations. However recently unmanned flying objects (UFOs) are becoming more popular and an excellent resource for surveillance missions. This project is to create an UFO that is light weight, inexpensive and easy to manufacture. The drone is designed as quad copter that includes two cameras and a detector with a wireless transmission system that provide live feed from cameras and detector to ground stations. It will be used in the applications areas like military applications, weather monitoring and many other detection based applications. The idea will be implemented through simulation and testing.

Key words: Unmanned Flying Object, UFO

I. INTRODUCTION

Recently, the significance of the small-size unmanned flying object (UFO) has grown enormously due to its heightened necessity in missions such as surveillance in military operations, rescue operations in disaster sites, the acquisition of visual information, in many of the detector based applications etc, where manned or regular-sized aerial vehicles are likely to fail to accomplish the above-mentioned operations even they fulfill all the operational capabilities. As per the above mentioned applications are concerned, the unmanned flying object (UFO) committed to such missions requires the capability of vertical takeoff and landing , as well as the ability to achieve rapid and stable motion in all the directions. To satisfy all of the above requirements, the rotary wing type object is selected. Rotary wing aircraft, otherwise known as 'rotorcraft', can be categorized into several types depending on the number of rotors installed in the system. The most widely known type is the conventional helicopter, which includes one main rotor and one tail rotor.

The very important advantages of multi-rotor flying objects include hovering, and mobility capabilities. Spontaneously, it can be believed that increasing the number of rotors will require more power to operate, meaning that a UAV with a lower number of rotors will require less power than one with more rotors. The most widely known type of multi-rotor UAV is probably the quad-rotor type UFO, which is the main focus of this paper, due to its instantaneous stability. In addition, in order for a UAV to crash into obstacles in urban areas, one of the vision-based collision avoidance methods, optical flow, is introduced and applied to the system to avoid a significant monetary and time loss. By applying the collision avoidance and optical flow techniques, the UFO is able to perform autonomous avoidance of collision. This paper is organized in following manner. First, the quad-rotor UFO is introduced, as well as its dynamic model, along with an analysis of its operation and stability.

II. LITERATURE SURVEY

The development of unmanned aerial vehicles (UAVs) has been growing significantly over the last decade. UAVs have been expanding from military applications into civilian purposes like aerial photography, field surveillance, and disaster relief. However, most are often found to be expensive and difficult to deploy. To address these issues, this project sought to implement a lightweight drone capable of performing surveillance while communicating in real time to the user. Before the team could establish project specifications, we conducted extensive background research to gain a deeper understanding of the current technological advancements within the drone industry.

Though modern-day technology is quickly advancing and improving unmanned aerial vehicles (UAVs) and drones, developments in this field began decades ago, even before the first manned airplane flight occurred in 1903. The first and most primitive designs centered on balloons. The first attempts began in France in 1782 by the Montgolfier brothers1. These attempts continued through the years, one of which was developed by Charles Perley in February 1863, two years after the Civil War began. A novelty put together by Douglas Archibald in 1883, the concept was successfully applied during the Spanish-American War in 1898. A corporal captured hundreds of images through a kite with a camera attached, with a long shutter release attached to the string 4.

The General Atomics MQ-1 Predator is an UAV built by General Atomics and used primarily by the United States Air Force (USAF) and Central Intelligence Agency (CIA). The CIA and Pentagon began experimenting with unmanned reconnaissance aircraft in early 1980s. After the investigation period from Jan 1994 to June 1994, the Predator took its first successful flight on 3rd July 1994.

Fig. 1: USAF MQ-9 Reaper and MQ-1 Predator

The General Atomics MQ-9 Reaper is the first hunter-killer UAV designed for long-endurance and high

altitude surveillance. It was developed by General Atomics Aeronautical Systems (GA-ASI) primarily for the United States Air Force (USAF).

In the last two decades, UAV research and development has continued to focus on military surveillance and attack applications. However, recently UAVs have become more popular in the civilian sector as well. The applications of these drones have been broad. These include disaster relief, crop dusting, and mapping new geographic areas. These UAVs have also functioned as toys controlled by smart phones. The surge in the popularity of drones in the civilian sector demonstrates that they still have the potential for growth and further developments.

III. BLOCK DIAGRAM & DESCRIPTION

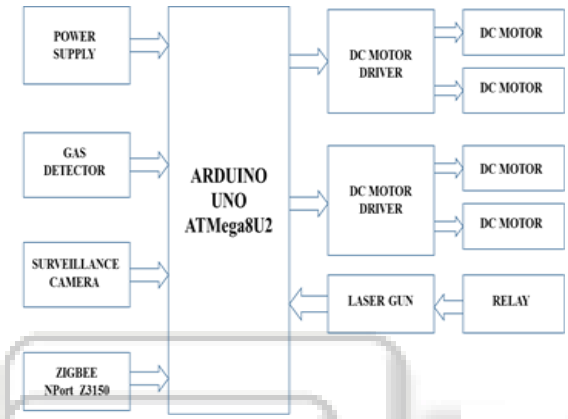

Fig. 2: System Block Diagram

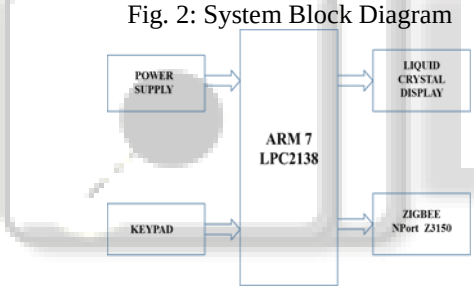

Fig. 3: Flight Controller block Diagram

The circuit diagram of the project "MULTI-OPERATIONAL UNMANNED FLYING OBJECT (UFO)" mainly consist of ARDUINO UNO ATMega8U2 microcontroller based design. The detailed description of each block and its application can be given in details as below.

The main blocks are:

- Power Supply
- Arduino Microcontroller
- Gas Detector
- Surveillance Camera
- Zigbee
- DC Motor Driver (Speed Controller) & Brushless DC Motor
- Relay & Laser Gun
- ARM controller
- Liquid Crystal Display
- Keypad

A. *Power Supply:*

Power supply is the first and the most important part of our project for our project we require +12v regulated power supply with maximum current rating 500 mA. Virtually every piece of electronic equipment, e.g., computers and their peripherals, calculators, TV and hi-fi equipment, and instruments, is powered from a DC power source, be it a battery or a DC power supply.

B. *Arduino Microcontroller:*

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. The Arduino project was started in Italy to develop low cost hardware for interaction design. The Arduino hardware comes in several flavors. In the United States, Sparkfun is a good source for Arduino hardware.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started

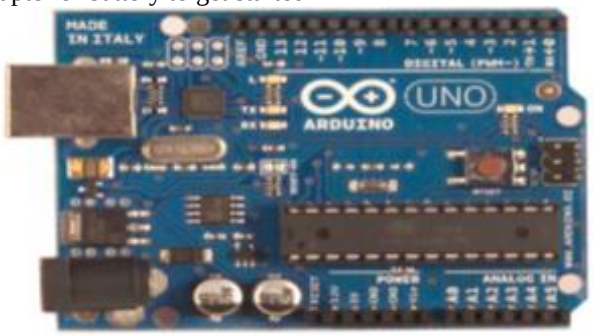

Fig. 4: Arduino Microcontroller Board

C. *Gas Detector:*

Many industrial processes produce flammable gases and vapors which can burn when mixed with air, sometimes violently. Typical examples include:

1) Removal of flammable materials from tanks and pipes in preparation for entry, line breaking, cleaning, or hot work such as welding.
2) Evaporation of flammable solvents in a drying oven.
3) spraying, spreading and coating of articles with paint, adhesives or other substances containing flammable solvents.
4) Manufacture of flammable gases.
5) Manufacture and mixing of flammable liquids.
6) Storage of flammable substances.
7) Solvent extraction processes.
8) Combustion of gas or oil.

D. *Surveillance Camera:*

One of the most important sensors that is often used in UAVs is a camera. There are many different types of cameras and they can be configured on the UAV in several different ways. There are some systems that have space for external cameras like the GoPro, but for most of the UAVs the cameras are built-in. Most of the built-in cameras are printed circuit board (PCB) cameras that connect directly to a microcontroller. The PCB board is fairly small because it doesn't need all of the extra functions of a normal digital

camera. For most of the commercial UAVs, the cameras are HD quality, which provides high quality video footage for the user. The use of high quality cameras also affects the system overall because it has additional requirements like higher transmission rate, a better processing memory, and more memory space.

E. ZIGBEE:

It offers full wireless mesh networking capable of supporting more than 64,000 devices on a single network. It's designed to connect the widest range of devices, in any industry, into a single control network. The ZigBee specification enhances the IEEE 802.15.4 standard by adding network and security layers and an application framework. The ZigBee Feature Set is designed to support smaller networks with hundreds of devices in a single network.

Some of the characteristics of ZigBee include:

1) Global operation in the 2.4GHz frequency band according to IEEE 802.15.4
2) Regional operation in the 915 MHz (Americas) and 868 MHz (Europe).
3) Frequency agile solution operating over 16 channels in the 2.4GHz frequency
4) Incorporates power saving mechanisms for all device classes

F. DC Motor Driver & Brushless DC Motor;

1) DC Motor Driver (Speed controller):

This motor controller would prevent the motor from breaking or burning, and it would also prevent a short circuit from happening. Since the motors chosen for the project were small and did not need huge amounts of current to operate, the speed controller could actually have a low amp value. For the project the Mystery 12A Brushless Speed Controller was chosen. As its name suggests, it allows up to 12 amps of current to flow. This speed controller has some safety functions like reducing power if the temperature goes above 120°C and reducing power or shutting off as a low current protection. This speed controller will be connected to the motors on one of their ends, and to the battery and the Arduino UNO on the other.

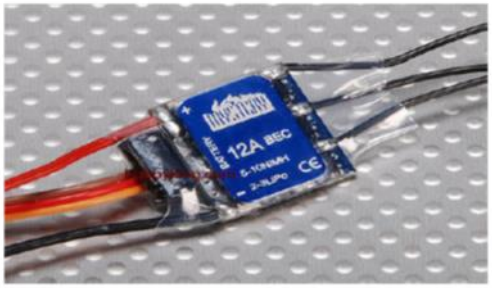

Fig. 5: Motor Speed Controller

2) Brushless DC Motor:

The motor is the device that converts electrical power output from the battery into mechanical power. The mechanical power then turns the propellers and generates the force needed by the robot to fly. This motor also creates a torque that rotates the robot either in a clockwise or counter clockwise direction. As mentioned before, this torque is cancelled by the torque generated by one of the other motors which produces a torque of the same magnitude but opposite direction. 4 DC brushless motors were implemented into the design. This type of motor has 2 constants which are important. These are the Km and the Kv values. Km is known as the motor constant and it is a ratio of the motors torque and the square root of the resistive power loss. Kv is known as the motor's velocity constant and it measured in RPM (revolutions per minute) per volt. This last constant is the ratio of the unloaded motor's RPM to the peak voltage output. In other words, if a motor has a Kv value of 1500 RPM/volt and a supply of 9 volts, the nominal speed would be 13,500 RPM.

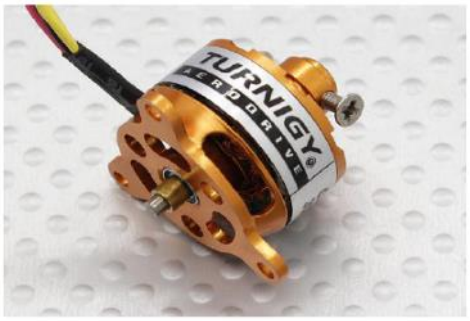

Fig. 6: Brushless DC Motor

G. Relay & Laser Gun:

1) Relay:

A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used in many applications because of their relative simplicity, long life, and proven high reliability. Relay contain a sensing unit, the electric coil, which is powered by AC or DC current. When the applied current or voltage exceeds a threshold value, the coil activates the armature, which operates either to close the open contacts or to open the closed contacts. When a power is supplied to the coil, it generates a magnetic force that actuates the switch mechanism. The magnetic force is, in effect, relaying the action from one circuit to another.

2) Laser Gun:

It is used for targeting an object. It is a one of the application used for protecting purpose.

H. Arm Controller:

The LPC2138 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with 32 kB, 64 kB, 128 kB, 256 kB and 512 kB of embedded high speed Flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. Wide range of serial communications interfaces and on-chip SRAM options of 8/16/32 kB, they are very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit 8 channel ADC(s), 10-bit DAC.

I. Liquid Crystal Display:

LCDs are the most popular electronic display device, except one-the CRT. LCD flat full color panels are now challenging the CRT as displays for television and

computers. While even a tiny LED display consumes a few milliwatts of power, the LCD consumes just microwatts of power. Hence, the LCDs are over 1000 times more efficient at their job than the LEDs.

J. Keypad:

Keypad 4×4 is used for loading the numeric into the microcontroller. It consists of 16 buttons arranged in a form of an array containing 4 lines and 4 columns.

The keyboard is actually used as follows:

1) Four microcontroller pins should be defined as outputs, and four pins should be defined as four inputs. In order the keypad to work properly, pulled-down registers should be placed on the microcontroller's input pins, thus defining logic state with no button is pressed.
2) Then the output pins are set to logic 1, and input pins logic gate is read. By pressing any key, logic 1 will appear on some input pin.
3) By combining zeros and ones on the output pins it is determined which button is pressed.

IV. Conclusion

While looking out for the flying objects as the area of interest, we studied the various aspects of the Unmanned Aerial Vehicle in past. We studied all the components that are to be used in this project. The thorough study we carried out. In order to better understand the potential for using Unmanned Aerial Vehicle in various application areas, many of the different concepts are referred. We concluded that the use of UFOs in conflict situation is still too complex and hard to separate from military uses. More research and analysis is needed on how to integrate aerial observation and data collection into needs and damage assessments, Search and Rescue and many other application areas.

References

[1] "The selection and use of flammable gas detectors" by Health and Safety Executive.
[2] Andrew Gallagher, Steven Guayaquil, Walter McIntyre, Arianna Niro, Antonio Pizzi, Arman Uygar and Professor Taskin Padir, "Surveillance UAV", Worcester Polytechnic Institute, 2014.
[3] Ralph E Locher, "Introduction to power supplies", National Semiconductors, Nov'1988.
[4] Texas Instruments, "L293, L293D quadruple half-h drivers", Dallas, Texas, Nov'2004.
[5] Krishna Nand Gupta, Prashant Agrawal and Mayur Agarwal, "Motor driver L293D",
[6] "Relays" by Natinao plastic heater sensor and control Co., Toronto, Canada.
[7] W. Durfee, "Arduino Microcontroller Guide", University of Minnesota, 2011
[8] "Arduino Uno", by Impatto zero policy of lifegate.
[9] Dr. Gleb V. Tcheslavski, "DC motors", ELEN 3441 fundamentals of power engineering, 2008
[10] Andrew N. Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide", Morgan Kaufmann Publishers, 2004
[11] Harish G. Narula, "Embedded Processors", Tech-Max Publications, Pune, Jan'2015
[12] "LPC2131/2132/2134/2136/2138 Single-chip 16/32-bit microcontrollers", by Philips Electronics, Netherland, 2005.
[13] Nisha Ashok Somani and Yask Patel, "Zigbee: A Low Power Wireless Technology for Industrial Applications", by International Journal of Control Theory and Computer Modeling (IJCTCM), May 2012.
[14] "Keypad 4×4Manual" by Mikroelektronica, Software and hardware solutions for electronic world.
[15] Associate Professor Kwoh Chee Keong, "Computer Peripherals", School of Computer Engineering Nanyang Technological University Singapore, McGraw-Hill 2011.

