1 Overview

Our project’s aim is to use a quadrotor for automated cargo or mail delivery, among other transportation issues that may be a suitable feat for a quadrotor, given its flight capabilities and advantages over other transportation vehicles. Such advantages include, but are not limited to:

- Reduced power consumption
- Ability to pass through tight spaces
- Doesn’t require transportation infrastructure to be built beforehand
- Can reach places that might be difficult to reach using other transportation methods
- Environment friendly
- High maneuverability

Our product shall be able to autonomously follow a flight mission that can be set by the user using our simple and straight-forward Graphical User Interface.

In addition to the autonomous flight capabilities, we provide a manual flight mode that allows the user to manually control the quadrotor using a cheap and easy to find gamepad.

The gamepad gives full control on the superior flight capabilities of this conqueror of the skies that shall soon prevail over other flying vehicles.

It should be noted that the manual control is somehow difficult to master. The user shall need substantial flight practice to get the hand of flying a quadrotor.

It is advised not to fly the quadrotor in weather conditions that are not optimal, especially windy/rain weather conditions are not preferred.
2 Installation

The product comes with a pre-uploaded code on the Arduinos. So the user does not need to compile or upload the machine codes to the Arduinos.

2.1 Xbee Explorer Driver

Xbees can communicate through RS232 Serial Port. We are providing USB port instead of RS232. For this purposes Virtual COM Port must be created before. If you create a similar port before, you can skip this step.

First step to use Xbee Explorer is creating Virtual COM port (VCP). VCP provides the USB device to appear as an additional COM port available to PC. Then USB device works in the same way as it would work like a standard COM port. To create VCP you should download VCP driver. You may find this driver from FTDI website at below.

http://www.ftdichip.com/Drivers/VCP.htm

Next step plug-in the usb explorer with Xbee, then from the device manager of the computer shows that Xbee is FT232R USB UART. Right click and update software with VCP driver. Then Xbee Explorer is ready to use.

2.2 Gamepad

Gamepads usually don’t need their drivers to be explicitly installed by the user, since most of them are automatically recognized by most operating systems. Nevertheless the user should make sure they are recognized and run properly, since they make up the gist of the user interface.

2.3 PHP server

The user should have a php server in its local machine in order to run the graphical user interface correctly. PHP can be downloaded from this site http://php.net/manual/en/install.php
3 System Guide

The user can operate the quadrotor using a simple interface that runs on a web browser. The interface uses PHP to interact with the Google API.

3.1 User interface

Figure 1 Screenshot of the UI
The user interface has three main panels that make up the quintessential user interface of our product. The main panel on the left contains a map that shows the current location of the quadrotor. It is also used for mission planning purposes, by allowing the user to select the flight path.

The panel on the right is the control panel. It contains the buttons that are used to interact with the quadrotor. The most important buttons are the ones at the bottom, labeled as Automatic Flight Mode and Manual Flight Mode.

- Reset Center of View
  This button is used to reset the view of the map to the initial location.

- Center View to Quadrotor
  This button has a purely interface related functionality, it is used to center the view of the google maps panel to the current location of the quadrotor.

- Take off
  The functionality of this button is self-explanatory. It is used to elevate the quadrotor from an initial starting point to a certain height.

- Landing
  This button’s functionality is self-explanatory as well. It serves the purpose of landing the quadrotor safely on the ground automatically without needing the user to regulate the throttle levels.

- Emergency Landing
  Similar functionality to the Landing button, with the exception that the emergency landing is done far more aggressively. It is meant to use in cases where the quadrotor reaches the threshold distance from the commanding station and if the user fears that communication may be lost as a result.

- Automatic Flight Mode
  As it can be understood from the label, It starts the automatic flight mode. Beforehand the user must make sure that at least one coordinate has been chosen from the map. Details are given on the section below.
Manual Flight Mode

This button activates the manual flight mode. In this mode the user directly commands the quadrotor using a gamepad. Details are given in the sections below.

The bottom panel of the GUI consists of a simple console, which is used to print important information, such as the current mode of operation and the coordinate of the waypoints.

3.1.1 Manual Flight Mode Operations

The manual flight mode is activated by clicking on the Manual Flight Mode button on the GUI. This flight mode is made possible by using a simple gamepad. Before starting the flight, it must be made sure that the gamepad operates correctly.
Each of the labelled button’s functionality is listed below:

1. Moving the LEFT stick to the left sends a YAW COUNTER CLOCKWISE command to the quadrotor.
2. Moving the LEFT stick to the right sends a YAW CLOCKWISE command to the quadrotor.
3. Moving the LEFT stick up sends an INCREASE THROTTLE command to the quadrotor by increments of 1.
4. Moving the LEFT stick down sends a DECREASE THROTTLE command to the quadrotor by increments of 1.
5. Moving the RIGHT stick to the left sends a ROLL TO THE LEFT command to the quadrotor.
6. Moving the RIGHT stick to the right sends a ROLL TO THE RIGHT command to the quadrotor.
7. Moving the RIGHT stick up sends a PITCH FORWARD command to the quadrotor.
8. Moving the RIGHT stick down sends a PITCH BACKWARDS command to the quadrotor.
9. Pressing the button labeled as 9 has the same function as 1.
10. Pressing the button labeled as 10 has the same function as 2.
11. Pressing the button labeled as 11 has the same function as 3.
12. Pressing the button labeled as 12 has the same function as 4.
13. Pressing the select button labeled as 13, disarms the motors of the quadrotor.
14. Pressing the start button labeled as 14, arms the motors and makes the quadrotor start.
15. Pressing the button labeled as 15, sends the calibration values of the magnetometer and gyroscope sensors.
16. Pressing the button labeled as 16 sends a standard command that indicates that the quadrotor shall not yaw or pitch or roll in any direction.
17. Pressing the button labeled as 17 sends an INCREASE THROTTLE command to the quadrotor by increments of 10. Should be used wisely, because pressing it for a long time might cause the quadrotor to flip because of the sudden increase in throttle.
18. Pressing the button labeled as 18 sends a DECREASE THROTTLE command to the quadrotor by increments of 10. Should be used carefully, because pressing it for too long might cause the quadrotor to lose stability because of the sudden decrease in throttle.

The buttons that have not been labeled remain unused and pressing them would have no effect on the flight.
3.1.2 Automatic Flight Mode

Before starting the automatic flight mode, the user must select the path by choosing the waypoint coordinates on the map. Currently there exists a limit on the number of waypoints that constitute the path. This limit is 16. In future releases this limit might be increased. The user can choose the waypoints by simply clicking on the interactive Google map on the main screen of the GUI. After having chosen the waypoints, each waypoint’s coordinates will appear on the console.

When the user presses the automatic flight mode button on the control panel, these coordinates will be sent to the quadrotor via the xbee communicators. After having processed the coordinates the quadrotor will slowly take off and follow each point in order. When having reached near the last waypoint it will land and the flight will be over.

![Screenshot of the console](image)

*Figure 2 Screenshot of the console*