**MU GCS**

**Secured UAV Controlling Software with Enhanced Safety Features**

**Abstract**

‘MU Ground Control Station’ (MU GCS) is a UAV(Unmanned Arial Vehicle) controlling and monitoring desktop application. Existing UAV controlling software has only telemetry data display and control system configuration capabilities but has no concern about weather condition based monitoring. Only for the bad weather, most of the small drones crash. This software has few important weather parameters providing capabilities as well as telemetry data representation. That’s why, UAV pilots can have local weather information and alert to have a safe mission. This application supports MAVLink, a secured and common communication protocol for small Drones.

* 1. **Main Features**
* Secured Mission Planning
* Supports multi-pilot controlling
* Provides different Weather parameters
* Visualizes Telemetry Data
* Supports most of the common communication protocols
* Helps to precise control
  1. **Technologies Used**
* Microsoft Visual Studio with C#
* HTML & PHP
* Java Script
* JSON
* Arduino Programming
* Mavlink Communication Protocol
  1. **Project Description:**

This project is a desktop app that enables small operators to know more about specific weather parameters, local terrain, and no fly zones within five-mile radius of their GPS locations. It has two major portions- one is software portion and another one is hardware portion. The software displays different weather parameters, maps, alerts, and few telemetry data. This software gets these telemetry data from the hardware portion which collects these data from drone via MAVLINK protocol. Which means that our desktop app supports MAVLINK protocol. By using our app, a drone operator will easily know about the condition of weather before flight. Also he/she will be able to detect the no fly zone regions to avoid any unexpected crash.

Our app can display weather parameters such as temperature, relative humidity, rain risk probability, UV index, air velocity, dew point, cloud percentage etc. It is also able to provide weather information for the next 24 hours from present time. So by using this app, a drone operator can easily choose a suitable time for drone mission. For collecting the weather information, we have used the Weather Info API of <http://weather.com> , which is a well recognized weather information providing server in the whole world. We have chosen this server because Google and some other giant companies use this same server for data reliability. Beside the weather information, the software shows some important telemetry data such as roll, pitch, yaw, latitude, longitude, altitude, vertical speed, flight mode etc. This software also contains a map which shows local terrains and route information of the GPS position of Drone. In the hardware part, we have used some sensors such as air quality sensor, UV index indicator, temperature sensor and relative humidity sensor. From the data of these sensors, our app is able to gather local weather information of any location where internet is not available. In other words, our app can work like a portable weather station as well as a portable ground control station. In any unexpected situation, drone can be triggered into Return to Home (RTH) mode from this app directly. This ensures a great security for drone and other people in the flight zone.

**Figure – 1.1: Project Overview**

* 1. **Functionality/Modules**
     1. **UAV:**

The UAV is an acronym for Unmanned Aerial Vehicle, which is an aircraft with no pilot on board. UAVs can be remote controlled aircraft (e.g. flown by a pilot at a ground control station) or can fly autonomously based on pre-programmed flight plans or more complex dynamic automation systems.

* + 1. **Telemetry Data representation**
* **Axis Rotation:** This software does both of the numerical and visual representation of UAV orientation.
* **Roll:** Roll is the rotation around the front-to-back axis of the UAV.
* **Pitch:** This is the rotation around the side-to-side axis of the UAV.
* **Heading:** Heading is the rotation around the vertical axis of the UAV. Heading is called Yaw.
* **GPS(Global Positioning System):** This software receive GPS coordinate such as latitude and longitude from the UAV via wireless transmitter and displays the original location into the map.
* **Latitude:** The angular distance of a place north or south of the earth’s equator, or of the equator of a celestial object, usually expressed in degrees and minutes. [Source: Oxford Dictionary]
* **Longitude:** The angular distance of a place east or west of the Greenwich meridian, or west of the standard meridian of a celestial object, usually expressed in degrees and minutes.[Source: Oxford Dictionary]
* **Altitude:** Altitude is the height of an object or point in relation to sea level or ground level.
  + 1. **Map View**
* **Google Map View**: This application can show the actual location of the UAV according to GPS location by the help of Google Map view. We can easily determine the actual location of our drone depending on the latitude and longitude of the GPS data from the UAV.
* **Weather Map View:** This application provides several weather condition representations on Map to observe the local and global weather condition easily.
* **No fly Zones & Local Terrains:** We can see which places are restricted for open drone fly and also local terrains into the Map of this application.
  + 1. **Weathers Parameters**

This software provides different weather parameter such as Temperature, Relative Humidity, Deo-point, Rain Risk, Visibility, Airspeed and direction and Atmospheric pressure etc according to [www.weather.com](http://www.weather.com) website and this weather information website is globally recognized as a précised weather info website.

* **Rain Risk:** It informs us the percentage of the possibility of falling Rain. An UAV pilot can decide that which time is perfect for Drone flight depending on the hourly advance rain information up to 18 hours.

* **Visibility:** This is the distance one can see as determined by light and weather conditions. Visibility is important for the pilot who controls his Drone without any Ground Control Station. Then the Drone position and orientation determined directly by the eye of the pilot.
* **Temperature & Relative Humidity (RH):** Temperature and Relative Humidity are two common and interrelated weather parameters.
* **Wind Speed and Direction:** It’s very important for a UAV pilot to know Wind speed and direction for enjoying a safe mission.This application displays this thing by the help of http://weather .com API.
  + 1. **Serial Communication:**
* **Serial Monitor:** Serial Monitor displays the numerical raw values of telemetry data.
* **Port and Baud Rate Selection:** There is an option to select specific serial port for the valid serial communication. We can select 9600 to 115200 Baud rate for particular serial communication.
* **Connection Indicator:** Connection button is colored green when serial port is connected and red when port is disconnected.
* **Start and Pause:** When connection is activated, this option allows us to start and pause data communication.
  + 1. **MAVLink:**

Micro Air Vehicle Communication Protocol shortly MAVLink is a very lightweight, header-only message marshalling library for micro air vehicles. MAVLink was first released early 2009 by Lorenz Meier under LGPL license. It can pack C-structs over serial channels with high effiency and send these packets to the ground control station. It is extensively tested on the PX4, PIXHAWK, APM and Parrot AR. Drone platforms and serves there as communication backbone for the MCU communication as well as for Linux inter process and ground link communication.

* + 1. **Microcontroller:** A microcontroller is a self-contained system with peripherals, memory and a processor that can be used as an embedded system. Most programmable microcontrollers that are used today are embedded in other consumer products or machinery including phones, peripherals, automobiles and household appliances for computer systems. Due to that, another name for a microcontroller is "embedded controller." Some embedded systems are more sophisticated, while others have minimal requirements for memory and programming length and a low software complexity. Input and output devices include solenoids, LCD displays, relays, switches and sensors for data like humidity, temperature or light level, amongst others. In this project, we have used Arduino Platform a microcontroller.
    2. **Arduino Mega:** The MEGA 2560 is designed for more complex projects. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities.