REAL-TIME DRONE APPLICATION

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About the Project: (Abstract)

The system is designed to be used in situations where the location of a target vehicle needs to be tracked continuously and accurately, such as in law enforcement or military operations.

The drone is equipped with a tracking system that uses a combination of GPS, sensors, and cameras to track the target vehicle. Once the target is located, the drone deploys an electromagnet that is designed to attach to the vehicle's metal frame.

Once attached, the electromagnet provides real-time updates on the vehicle's location and movement, allowing the drone operator to track the vehicle's movements in real-time. This information can be used to plan and execute follow-up actions, such as intercepting the vehicle or coordinating with ground units to apprehend the occupants.

Overall, this real-time drone application provides a powerful tool for law enforcement and military operations that require precise and continuous tracking of target vehicles. With its sophisticated tracking system and advanced electromagnet, this system is designed to provide accurate and reliable data, helping operators make informed decisions and take decisive action.

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Introduction

Drones have become increasingly popular in recent years, and their potential uses are rapidly expanding. One area where drones have proven particularly useful is in tracking moving vehicles. However, traditional methods of tracking a vehicle from a drone can be difficult and often require the use of specialized equipment. In this paper, we propose a real-time drone application that uses a tracking system to deploy an electromagnet onto a moving vehicle. The magnet can then be used to track the vehicle's location, making it an ideal solution for law enforcement, security, and transportation applications. The system is designed to be easy to use and can be operated remotely, making it ideal for situations where time is of the essence. In the following sections, we will provide a detailed description of the system's components and how they work together to track vehicles in real-time.

Background

The integration of drones with tracking systems has been an emerging technology trend in recent years. These drones are equipped with a variety of sensors, including GPS and other advanced technologies, that allow them to track and locate vehicles in real-time.

These drones have the potential to revolutionize a variety of industries, such as logistics, transportation, and security. By providing real-time data analysis and autonomous navigation capabilities, these drones can improve the efficiency and productivity of businesses while reducing costs and risks.

Moreover, with the advancements in drone technology, the capabilities of these systems are expected to expand even further, enabling them to take on more complex tasks and operate in challenging environments. This has the potential to open up new opportunities for the use of drones in fields such as emergency response, construction, and agriculture.

Overall, the integration of drones with tracking systems represents a promising technology that is poised to transform various industries by providing real-time and accurate data to decision-makers.

Problem Definition

The conventional approaches to tracking moving cars from a drone can be challenging and frequently need for the usage of specialised tools. A quick and trustworthy tracking system is essential in circumstances where time is of the essence, such as in law enforcement, security, and transportation applications. An effective and efficient solution to this issue is what the proposed real-time drone application with a tracking system and electromagnet promises to offer. The device can follow a moving vehicle's location in real time by attaching an electromagnet to it, making it the perfect answer for circumstances when conventional tracking techniques would not be reliable. This system's objective is to offer a quick, dependable, and simple method for tracking moving cars from a drone in real time.

Objective

The objective of this real-time drone application is to provide a fast, efficient, and reliable system for tracking moving vehicles in real-time using a drone equipped with a tracking system and electromagnet. The system is designed to be easy to use and can be operated remotely, making it ideal for situations where time is of the essence, such as law enforcement, security, and transportation applications. The key features of the system include real-time tracking, ease of use, and the ability to track vehicles from a safe distance. By achieving these objectives, the system can provide a significant improvement over traditional tracking methods, allowing for faster and more efficient responses to situations that require the tracking of moving vehicles.

Methodology/Procedure

The proposed real-time drone application with a tracking system and electromagnet consists of the following components:

1. Drone: The system uses a drone to track the moving vehicle. The drone is equipped with a tracking system and an electromagnet for deploying onto the vehicle.
2. Tracking System: The tracking system is used to locate the moving vehicle and track its movement in real-time. The system can use various sensors such as GPS, cameras, and radar to track the vehicle.
3. Electromagnet: The electromagnet is used to attach to the moving vehicle and track its location. The magnet can be deployed onto the vehicle using a mechanism on the drone.
4. Control System: The control system is used to operate the drone and the tracking system remotely. It provides a user interface for the operator to control the drone and monitor the vehicle's location in real-time.

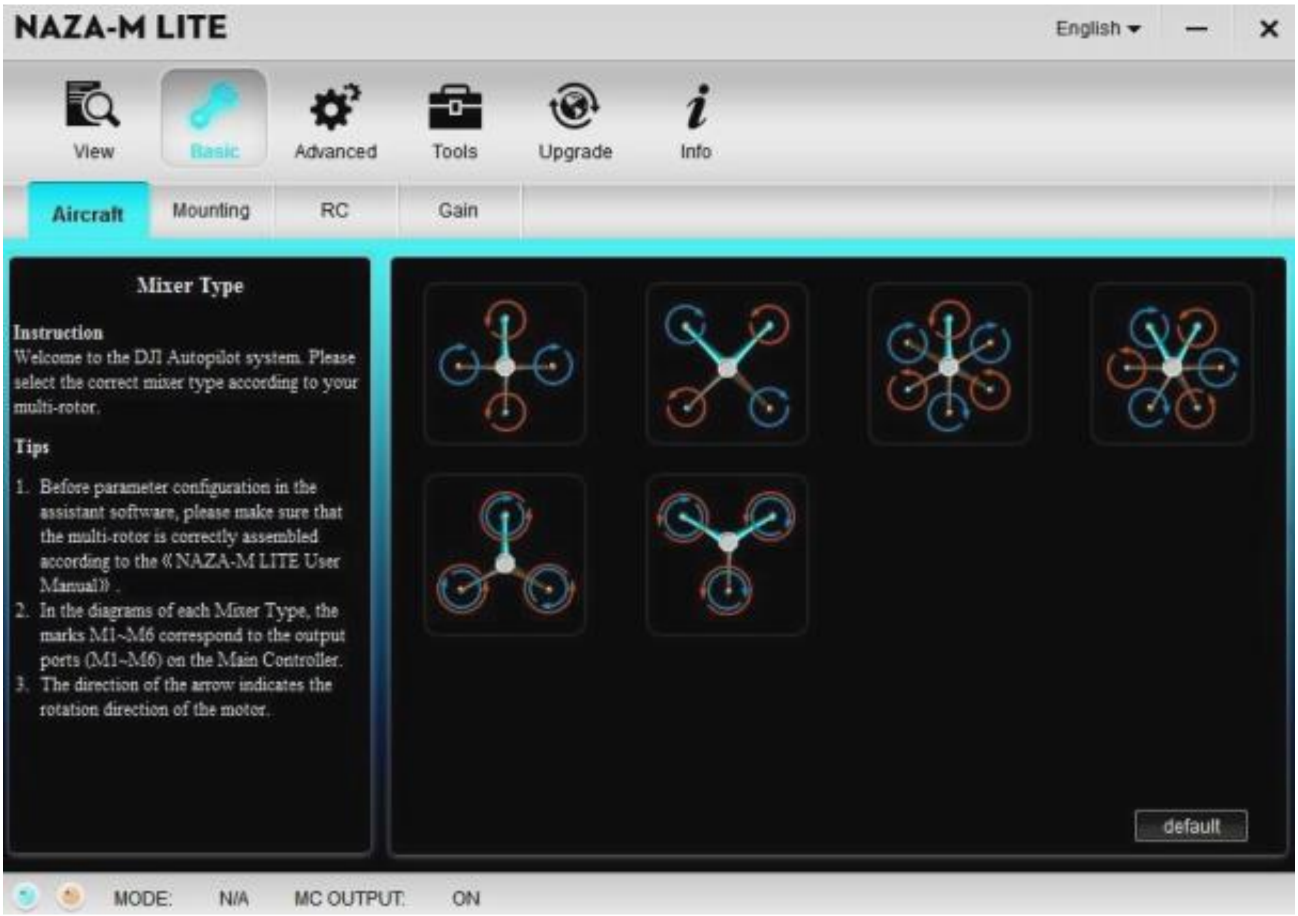
The procedure for using the system is as follows:

1. Deploy the drone and activate the tracking system.
2. Locate the moving vehicle (as of now manually performed).
3. Deploy the electromagnet onto the vehicle using the mechanism on the drone.
4. Use the tracking system to monitor the vehicle's location in real-time.
5. Control the drone and the tracking system remotely using the control system.
6. Retrieve the drone and the electromagnet after the tracking is complete.

The system can be used in various situations, including law enforcement, security, and transportation applications, where fast and efficient tracking of moving vehicles is essential.

- Drone Configuration

    i. Aircraft



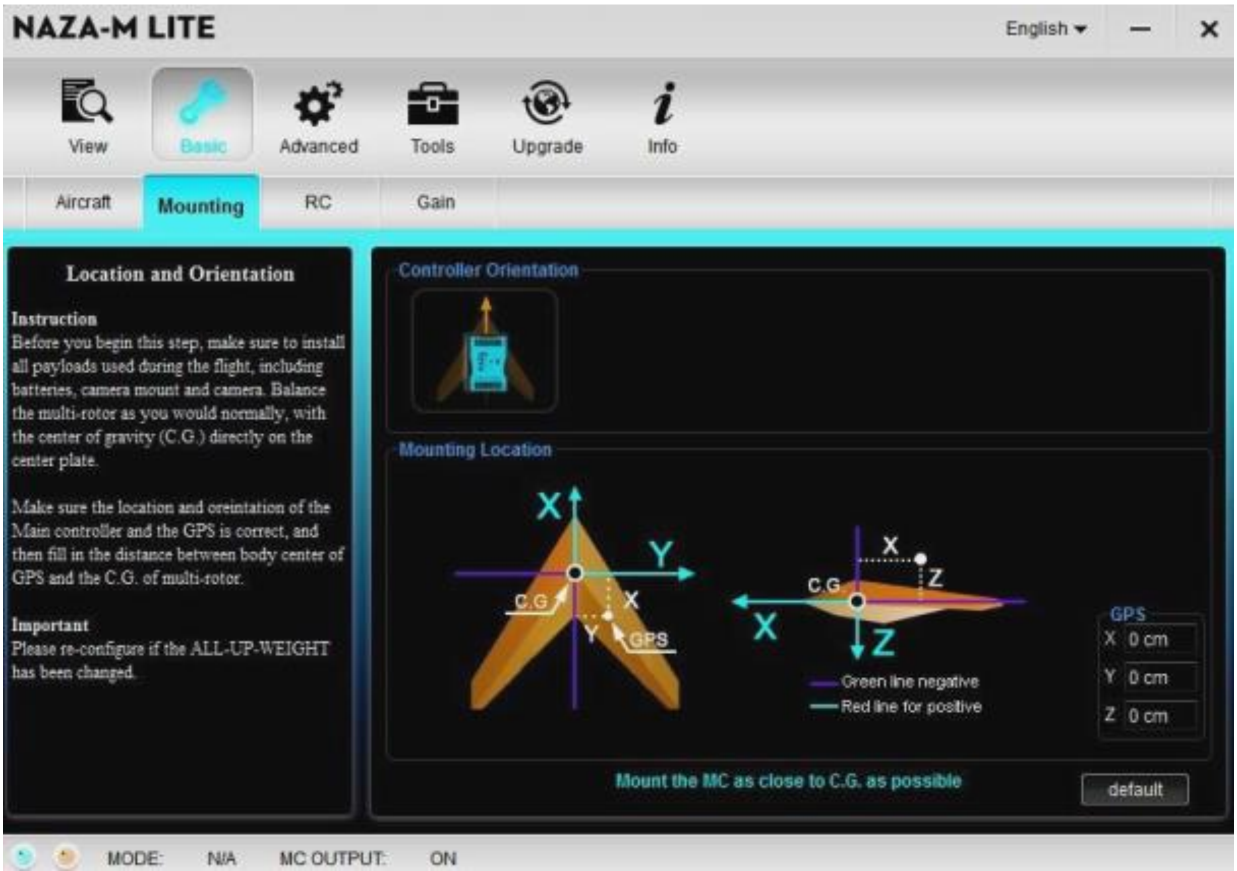
In the diagrams of each Mixer Type, the marks M1~M6 correspond to the output ports (M1~M6) on the Main Controller (MC).

The direction of the arrow indicates the rotation direction of the motor.

Make sure the rotation direction of each motor is the same as the diagram shows. If not, swap over any of two wire connections of the incorrect motor to change its rotation direction.

Make sure the type of propeller matches the rotation direction of the motor. Blue propeller is at Top; Red propeller is at Bottom.

ii. Mounting

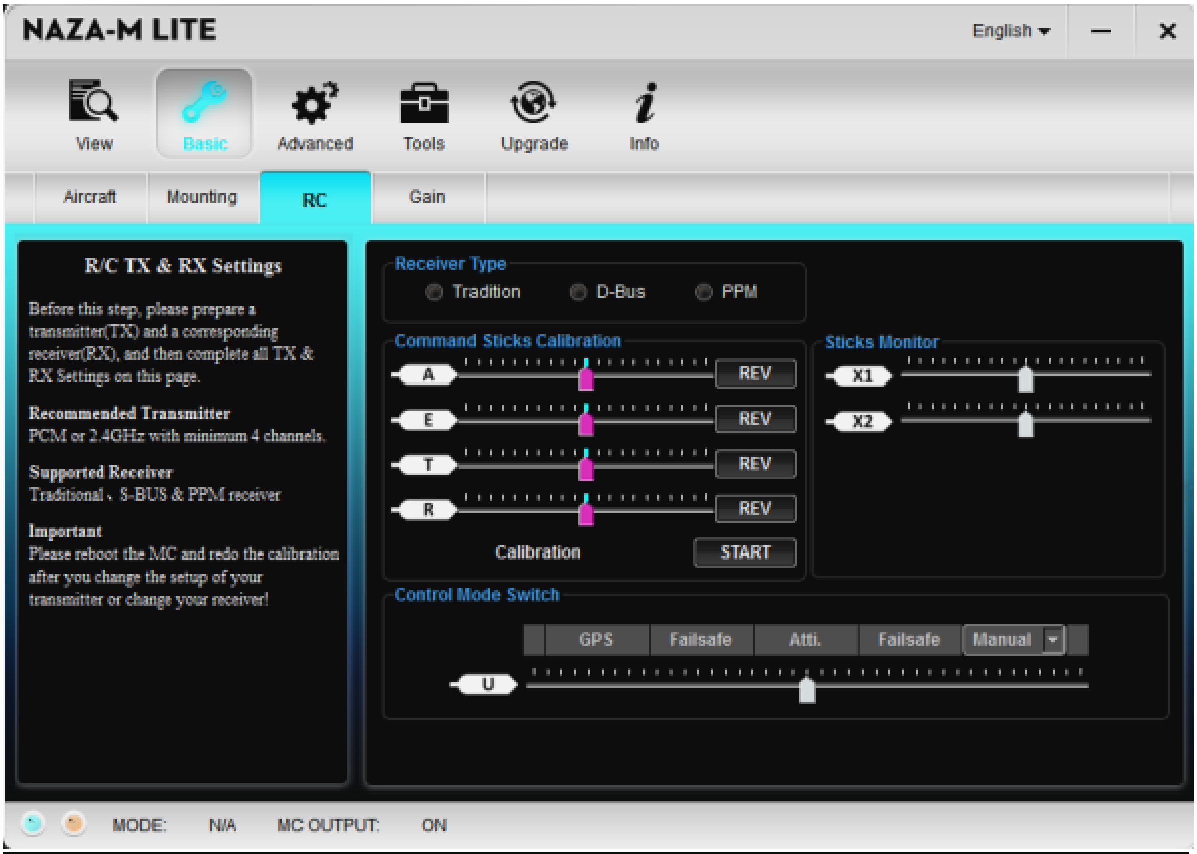


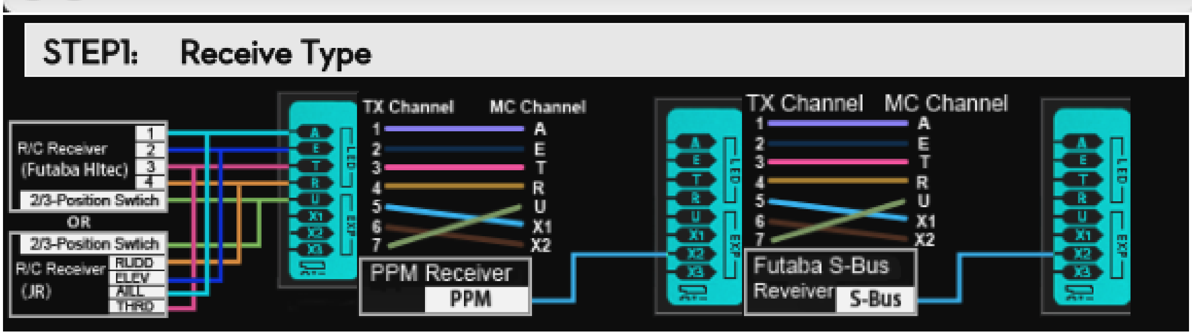
Install all payloads that will be used during the flight, including batteries, camera mount and camera. Balance the multirotor as you would normally, with the centre of gravity (C.G.) directly on the centre plate. Fill in the distance between body centre of GPS and the C.G. of multi-rotor in X, Y & Z axles as showed in the figure.

Make sure the MC ESC ports is pointing to the aircraft nose direction, otherwise serious damage will occur to your aircraft.

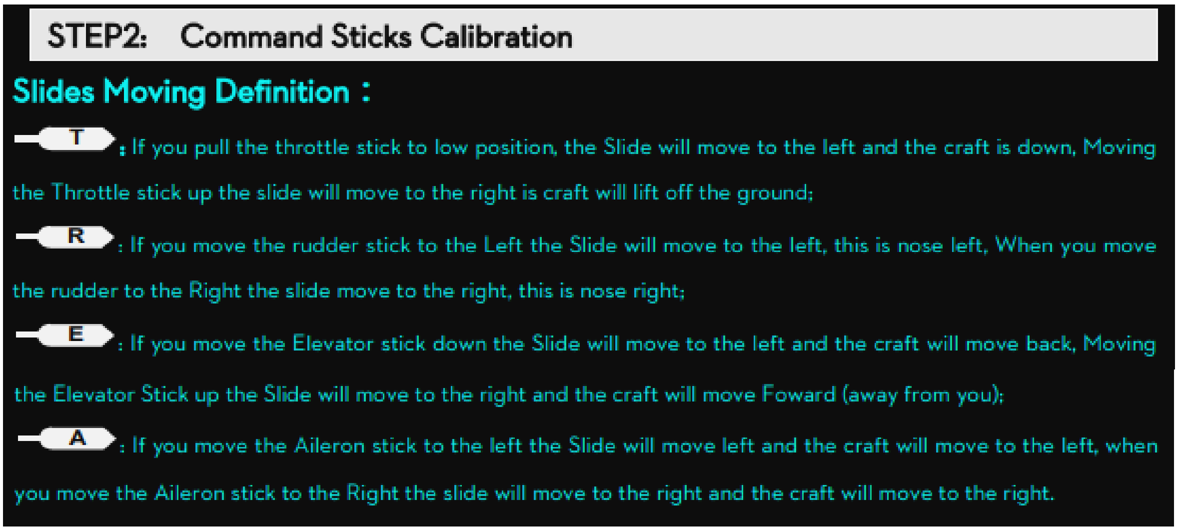
When MC mounted, try your best to mount the MC at the centre of the frame, and do not mount the MC upside down. Make sure MC is parallel to the aircraft horizon.

iii. RC



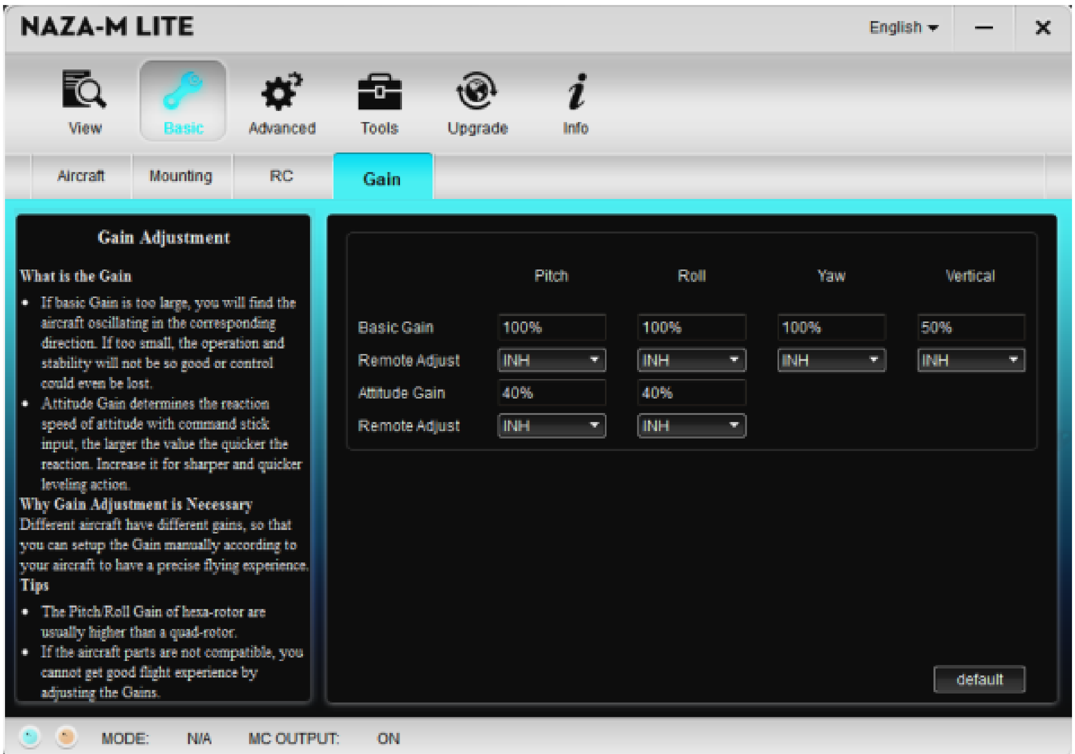


Choose the type of receiver connection that you have installed. Connect your receiver to the main controller in accordance with the connection diagram.



1. Set endpoints of all channels to default values (100%) and set all trims and sub-trims of sticks to 0 on your transmitter first. Keep all curves' settings as default since the end-point of transmitter sticks will be recorded here.
2. Click the START button, and move all of the sticks throughout their complete range several times.
3. After you do this, click the FINISH button when you have finished the above procedures.
4. If the slides are moving opposite from your stick movements direction, click the reverse button REV/NORM beside.

iv. Gain



Usually, the default parameters are ready to go. However, different multi-rotors have different gains because of different Motor KV ratings, ESC and propeller sizes. If the gain is set too high, you will find the multi-rotor will be oscillating in the corresponding direction (About 5~10Hz). If the Gain is too low, the multi-rotor will likely to be hard to control. So, you can still setup the basic Gain of Pitch, Roll, Yaw and Vertical manually according to your multi-rotor to have a wonderful flying experience. We suggest you to change 10% to 15% of the parameter at a time.

For the gains of the Pitch and Roll, if you release the Pitch or Roll stick after giving a command, the multi-rotor should go back to a hovering state. If the reaction of multi-rotor in this procedure is too soft (large delay), please increase the basic gain slowly (10%-15% each time) after you release the stick until vibration begins. Then decrease the gain a little until vibration just disappears. Now the gain is perfect, but the reaction of the attitude change is slow. Follow the Procedure at the end of this section to tune the attitude gains.

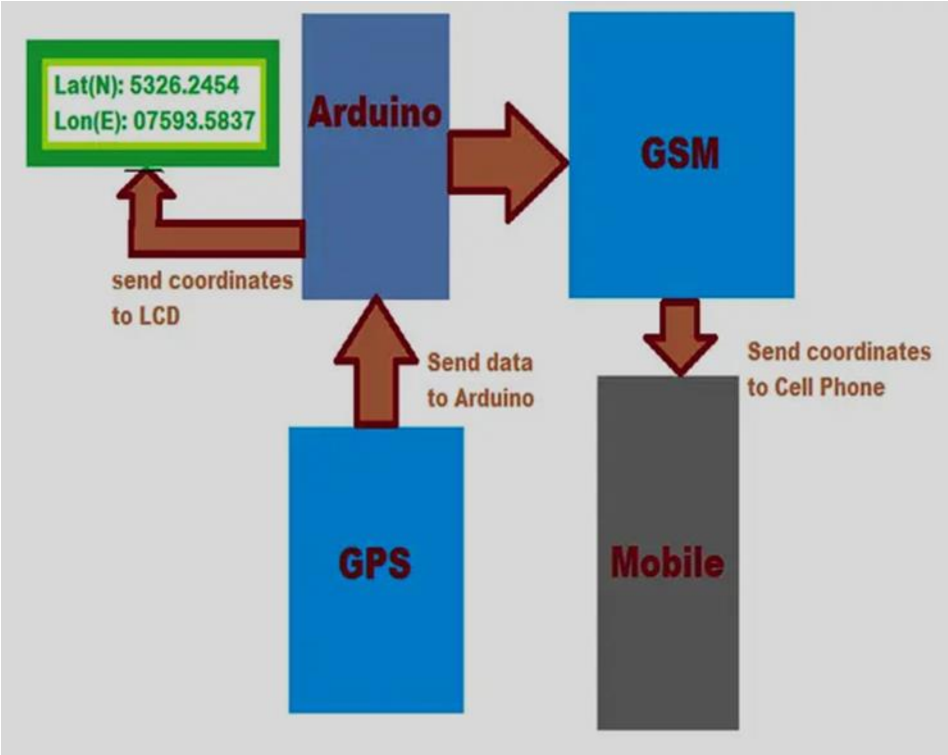
The way of tuning the Yaw gain is the same as the way of adjusting the Tail Gyro. If you want fast stick reaction speed, increase the gain, otherwise decrease the gain. However, the spin of multi-rotor is produced by the counter torque force, and the magnitude of which is limited. Therefore, large gain will not produce tail vibration like helicopter, but severe reaction at the start or stop of motors, which will affect the stabilization of the other directions.

You will use two methods to judge if the Vertical gain is good enough: 1) The multi-rotor can lock the altitude when the throttle stick is at centre position; 2) The change of altitude is small during the flight along a route. You can increase the gain slowly (10% each time) until the vibration emerges along the vertical direction or the reaction of throttle stick is too sensitive, then decrease 20% of the gain. Now it is a suitable Vertical gain.

Attitude gains determine the reaction speed of attitude from command stick, the Larger the value the quicker the reaction. Increase it for sharper and quicker levelling action after command stick released. Unstable shaking flying and the control feeling will be stiffness and rigid if the value is too high; and sluggish levelling action and slow braking if too small.

- Working of the Tracking System

  GPS and GSM-based vehicle tracking systems are commonly used to monitor the location, speed, and other parameters of vehicles in real-time. Here's how they work:



GPS-Based Vehicle Tracking

1. GPS Receiver: The GPS receiver is installed in the vehicle and receives signals from GPS satellites orbiting the Earth.
2. Position Calculation: The GPS receiver calculates the position of the vehicle based on the signals received from multiple GPS satellites. It can determine the latitude, longitude, and altitude of the vehicle.
3. Data Transmission: The GPS receiver transmits the position and other data to a central server via a wireless communication network.
4. Data Processing: The server receives the data and processes it to generate location information, speed, and other vehicle parameters.
5. Monitoring: The vehicle location and other parameters can be monitored in real-time using a web-based interface or mobile app.

GSM-Based Vehicle Tracking

1. GPS Receiver: Similar to GPS-based tracking, the system includes a GPS receiver that calculates the position of the vehicle.
2. Data Transmission: The GPS data is transmitted to the central server via a GSM-based cellular network.
3. Data Processing: The server receives and processes the data to generate location information, speed, and other vehicle parameters.
4. Monitoring: The vehicle location and other parameters can be monitored in real-time using a web-based interface or mobile app.

In addition to real-time monitoring, GPS and GSM-based vehicle tracking systems can also provide historical data on vehicle movement and allow for geofencing, which is a virtual boundary that can be set up to trigger alerts when a vehicle enters or exits a specified area.

Overall, GPS and GSM-based vehicle tracking systems are useful tools for monitoring the location and movement of vehicles in real-time, which can be valuable for fleet management, logistics, and security applications.

Results and Discussion

The drone and the GPS tracking system with the electromagnet are in working condition individually but we were unable to perform enough testing due to the limited time frame and we look forward to finish the job as soon as possible. We were also encouraged to work on this project even beyond the Engineering Clinics Session this semester by our guide and we will definitely invest in this potential idea for tracking systems.

Further discussions follow as- Potential results are increased efficiency in tracking and monitoring vehicles, which can lead to cost savings and improved decision-making. By using a drone to drop an electromagnet on a vehicle and track its location in real-time, organizations can more easily monitor their assets and make informed decisions about logistics and resource allocation.

Another potential result is improved safety and security, as a drone with a tracking system can help organizations quickly detect and respond to potential security threats or emergencies. For example, a drone equipped with a GPS and electromagnet system could be used to track stolen vehicles or locate missing persons in disaster situations.

However, it's important to note that there are also limitations and challenges associated with this method of tracking. For example, the accuracy of the GPS signal may be affected by environmental factors such as buildings or trees, and manually dropping an electromagnet onto a vehicle may not be practical or feasible in all situations.

Furthermore, regulatory restrictions and privacy concerns may also impact the use of drones for tracking vehicles. Organizations will need to ensure that they are complying with relevant regulations and policies, and that they are taking appropriate measures to protect the privacy of individuals.

In summary, the use of a drone with GPS and an electromagnet for tracking vehicles has the potential to yield a variety of benefits, including increased efficiency and improved safety and security. However, it's important to carefully consider the limitations and challenges associated with this method of tracking and to take appropriate measures to address them.

Future Scope

The future scope for drones with tracking systems is quite broad, as these systems are becoming more sophisticated and capable of providing more features and functionality. Here are some potential areas of growth for these systems:

1. Enhanced Tracking Capabilities: One area of growth for drone tracking systems is in enhanced tracking capabilities. This could include the use of advanced sensors, such as lidar or radar, to improve tracking accuracy and reliability.
2. Autonomous Navigation: Another area of growth for drone tracking systems is in the development of autonomous navigation capabilities. With advances in artificial intelligence

and machine learning, drones could become more capable of navigating and tracking targets autonomously, without the need for human intervention.
3. Real-time Data Analysis: As drone tracking systems become more sophisticated, there is a growing opportunity for real-time data analysis. This could include the use of advanced algorithms and analytics to provide real-time insights into drone movements and behaviours, as well as the ability to identify potential threats or hazards.
4. Integration with Other Technologies: Drone tracking systems could also be integrated with other technologies, such as augmented reality or virtual reality, to provide more immersive and interactive tracking experiences.
5. Expanded Applications: As drone tracking systems become more capable, there is a growing opportunity for expanded applications in fields such as search and rescue, disaster relief, and law enforcement.

Overall, the future scope for drones with tracking systems is quite broad, and there are many potential areas of growth and innovation in this field.

Conclusion

In conclusion, GPS and GSM-based vehicle tracking systems and drones with tracking systems have promising future scopes as they continue to evolve and become more sophisticated. These systems are becoming more capable of providing real-time data analysis, autonomous navigation, and expanded applications in various fields such as logistics, security, and emergency response. With continued advancements in technology and increasing demand for these systems, we can expect to see further developments and innovations in these areas in the coming years.

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iv. https://www.sciencedirect.com/science/article/pii/S0140366420300189
v. https://dl.djicdn.com/downloads/naza-m%20lite/en/NAZA-M%20LITE_User_Manual_v2.00_en.pdf

Codes in Appendix

Appendix A: Source Code

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
char str[70];
char *test="$GPGGA";
char logitude[10];
char latitude[10];
int i,j,k;
```

```
int temp;
int Ctrl+z=26;    //for sending msg
void setup()
{
  lcd.begin(16,2);
  Serial.begin(9600);
  lcd.setCursor(0,0);
  lcd.print("GPS Besed Vehicle ");
  lcd.setCursor(0,1);
  lcd.print("Tracking System");
  delay(10000);
}
void loop()
{
  if (temp==1)
  {
    for(i=18;i<27;i++)          //extract latitude from string
    {
     latitude[j]=str[i];
     j++;
    }
    for(i=30;i<40;i++)          //extract longitude from string
    {
    logitude[k]=str[i];
     k++;
    }
    lcd.setCursor(0,0);        //display latitude and longitude on 16X2 lcd display
    lcd.print("Lat(N)");
    lcd.print(latitude);
    lcd.setCursor(0,1);
    lcd.print("Lon(E)");
    lcd.print(logitude);
    delay(100);
    Serial.println("AT+CMGF=1");    //select text mode
    delay(10);
    Serial.println("AT+CMGS="9610126059"");  // enter receipent number
    Serial.println();
    Serial.print("Latitude(N): ");             //enter latitude in msg
    Serial.println(latitude);                  //enter latitude value in msg
    Serial.print("Longitude(E): ");            //enter Longitude in Msg
    Serial.println(logitude);                  //enter longitude value in msg
    Serial.write(Ctrl+z);                      //send msg  Ctrl+z=26
    temp=0;
    i=0;
    j=0;
    k=0;
    delay(20000);                        // next reading within 20 seconds
```

```
  }
}
void serialEvent()
{
  while (Serial.available())            //Serial incomming data from GPS
  {
    char inChar = (char)Serial.read();
    str[i]= inChar;                  //store incomming data from GPS to temparary string str[]
     i++;
     if (i < 7)
     {
      if(str[i-1] != test[i-1])         //check for right string
      {
        i=0;
      }
     }
    if(i >=60)
    {
     temp=1;
    }
  }
}
```

Appendix B: ESP Code

AT+CMGF=1

AT+CMGS=”9610126059”

>COORDINATES

Ctrl+z

In programming we used these commands for sending SMS using GSM:

```
Serial.println(“AT+CMGF=1”);    // for selecting text mode

Serial.println(“AT+CMGS=”9610126059””);  // Add user mobile number

Serial.println(“Latitude: ”);     // write Latitude in message

Serial.println(latitude);           // write Latitude array in SMS

Serial.println(“Longitude: ”);

Serial.println(longitude);

Serial.write(26);    //  send SMS
```