In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:
```
df = pd.read_csv("timestamp%2Caltitude_m%2Clatitude%2Clongitude%2Cbattery_vo.csv
```

In [3]:
```
#Displaying original file data to clean up
df
```

Out[3]:

	timestamp	altitude_m	latitude	longitude	battery_voltage	flight_mode
0	0	0.2	13.3490	74.7421	12.6	MANUAL
1	1	5.1	13.3492	74.7423	12.5	AUTO
2	2	10.3	13.3494	74.7425	12.4	AUTO
3	3	14.8	13.3496	74.7427	12.2	AUTO
4	4	20.1	13.3498	74.7429	12.1	NaN
5	5	25.3	13.3500	74.7431	0.0	AUTO
6	6	NaN	13.3502	74.7433	11.9	AUTO
7	7	35.2	13.3504	74.7435	11.8	AUTO
8	8	40.1	13.3506	74.7437	11.8	AUTO
9	9	5000.0	13.3508	74.7439	11.7	AUTO
10	10	50.1	13.3510	74.7441	11.6	HOVER
11	11	49.8	13.3510	74.7441	11.5	HOVER
12	12	49.9	13.3510	74.7441	11.5	UNKNOWN
13	13	49.7	NaN	NaN	11.4	HOVER
14	14	48.2	13.3507	74.7438	11.3	RETURN
15	15	46.1	13.3504	74.7435	25.5	RETURN
16	16	44.0	13.3501	74.7432	11.1	RETURN
17	17	-5.5	13.3498	74.7429	11.0	RETURN
18	18	40.3	13.3495	74.7426	10.9	RETURN
19	19	38.1	13.3492	74.7423	10.8	RETURN
20	20	0.1	13.3490	74.7421	10.7	LANDED

In [4]:
```
ALT_MIN = 0
ALT_MAX = 120
```

In [5]:
```
#THIS IS NOISE REMOVAL:

invalid_mask = (df['altitude_m'] < ALT_MIN) | (df['altitude_m'] > ALT_MAX)
print(f"\nNumber of altitude readings outside {ALT_MIN}-{ALT_MAX} m:", invalid_m
```

```
Number of altitude readings outside 0-120 m: 2
```

In [6]:
```
df_clean = df[~invalid_mask].copy()
```

In [7]:
```
#HANDLING MISSING VALUES:

df_clean['altitude_m'] = df_clean['altitude_m'].ffill()
df_clean['altitude_m'] = df_clean['altitude_m'].fillna(df_clean['altitude_m'].me
```

In [8]:
```
df_clean['latitude'] = df_clean['latitude'].ffill()
df_clean['longitude'] = df_clean['longitude'].ffill()
```

In [9]:
```
df_clean['flight_mode'] = df_clean['flight_mode'].ffill()
```

In [10]:
```
df_clean['battery_voltage'] = df_clean['battery_voltage'].ffill()
```

In [11]:
```
#SAVING CLEAN DATA TO A FILE NAMED CleanData.csv

df_clean.to_csv("CleanData.csv", index=False)

CleanData = pd.read_csv("CleanData.csv")

print("\n=== CLEAN DATA FILE (First 10 Rows) ===")
CleanData.head(10)
print("\nINFO OF CleanData FILE: \n")
CleanData.info()

#ROWS REMOVED
print(f"\nRows before cleaning: {df.shape[0]}")
print(f"Rows after cleaning: {df_clean.shape[0]}")
print(f"Rows removed: {df.shape[0] - df_clean.shape[0]}")
```

```
=== CLEAN DATA FILE (First 10 Rows) ===

INFO OF CleanData FILE:

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 19 entries, 0 to 18
Data columns (total 6 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   timestamp        19 non-null     int64
 1   altitude_m       19 non-null     float64
 2   latitude         19 non-null     float64
 3   longitude        19 non-null     float64
 4   battery_voltage  19 non-null     float64
 5   flight_mode      19 non-null     object
dtypes: float64(4), int64(1), object(1)
memory usage: 1.0+ KB

Rows before cleaning: 21
Rows after cleaning: 19
Rows removed: 2
```

In [12]:
```
print("\nAfter cleaning, any nulls?")
print(df_clean.isna().sum())
```

```
After cleaning, any nulls?
timestamp          0
altitude_m         0
latitude           0
longitude          0
battery_voltage    0
flight_mode        0
dtype: int64
```

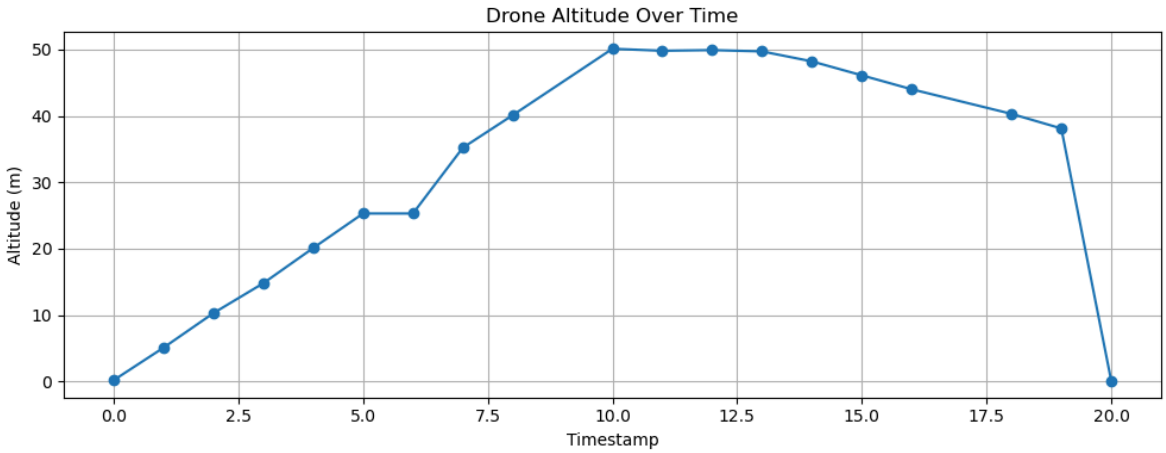
In [13]:
```
alt_mean = df_clean['altitude_m'].mean()
alt_max = df_clean['altitude_m'].max()
alt_min = df_clean['altitude_m'].min()
```

In [14]:
```
bat_mean = df_clean['battery_voltage'].mean()
bat_min = df_clean['battery_voltage'].min()
bat_max = df_clean['battery_voltage'].max()
```

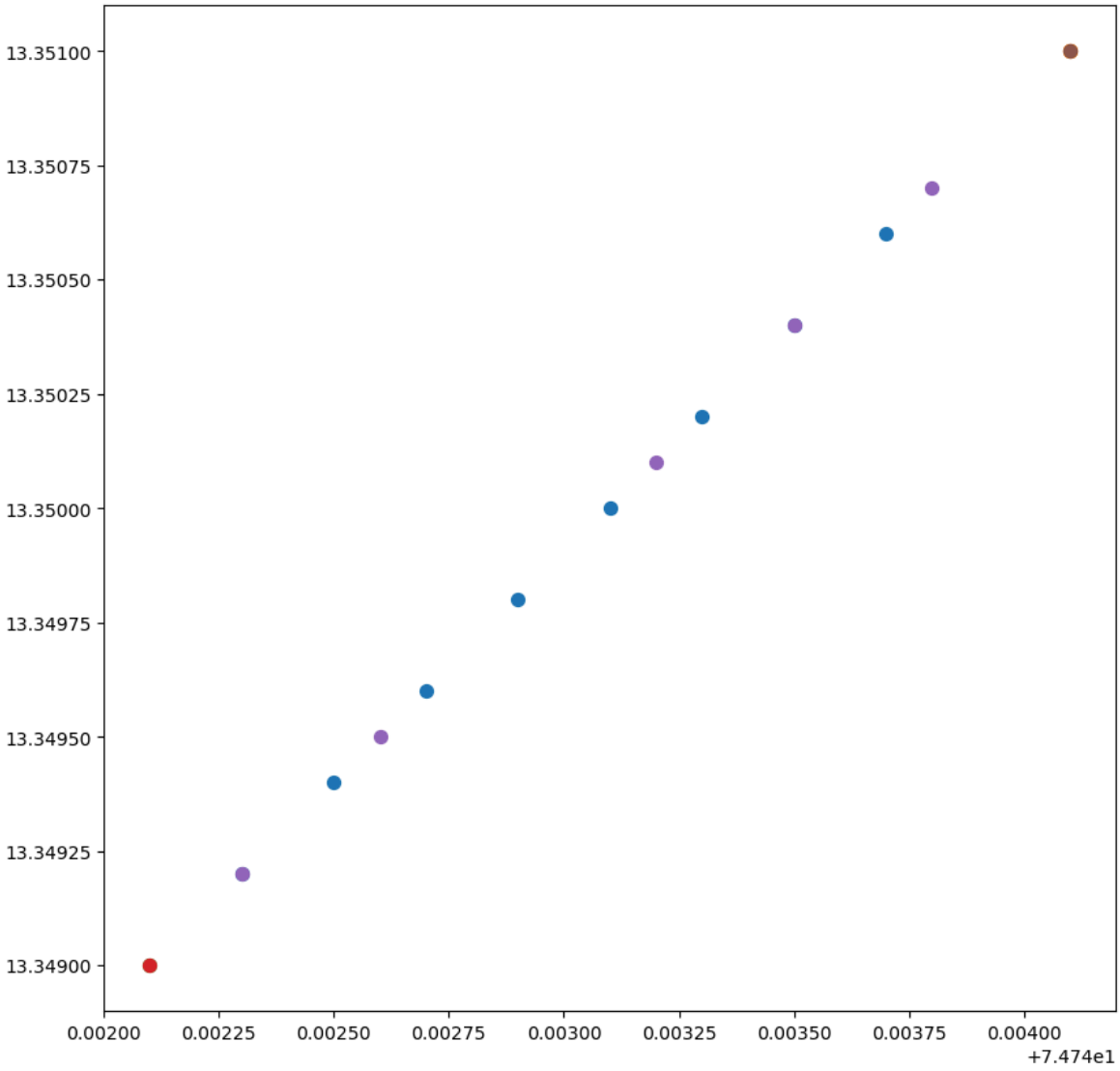
In [15]:
```
print("\n=== STATISTICS ===")
print(f"Altitude → mean: {alt_mean:.2f} m, min: {alt_min:.2f} m, max: {alt_max:.
print(f"Battery  → mean: {bat_mean:.2f} V, min: {bat_min:.2f} V, max: {bat_max:.
```

```
=== STATISTICS ===
Altitude → mean: 31.19 m, min: 0.10 m, max: 50.10 m
Battery  → mean: 11.77 V, min: 0.00 V, max: 25.50 V
```

In [16]:
```
plt.figure(figsize=(10, 4))
plt.plot(df_clean['timestamp'], df_clean['altitude_m'], marker='o')
plt.title("Drone Altitude Over Time")
plt.xlabel("Timestamp")
plt.ylabel("Altitude (m)")
plt.grid(True)
plt.tight_layout()
plt.show()
```



In [17]:
```
plt.figure(figsize=(10, 10))
for mode, group in df_clean.groupby('flight_mode'):
    plt.scatter(group['longitude'], group['latitude'], label=mode, s=50)
```



In [22]:
```
print(df_clean.shape)
print(df_clean[['latitude', 'longitude', 'flight_mode']].head(10))
```

```
(19, 6)
    latitude  longitude flight_mode
0    13.3490    74.7421      MANUAL
1    13.3492    74.7423        AUTO
2    13.3494    74.7425        AUTO
3    13.3496    74.7427        AUTO
4    13.3498    74.7429        AUTO
5    13.3500    74.7431        AUTO
6    13.3502    74.7433        AUTO
7    13.3504    74.7435        AUTO
8    13.3506    74.7437        AUTO
10   13.3510    74.7441       HOVER
```

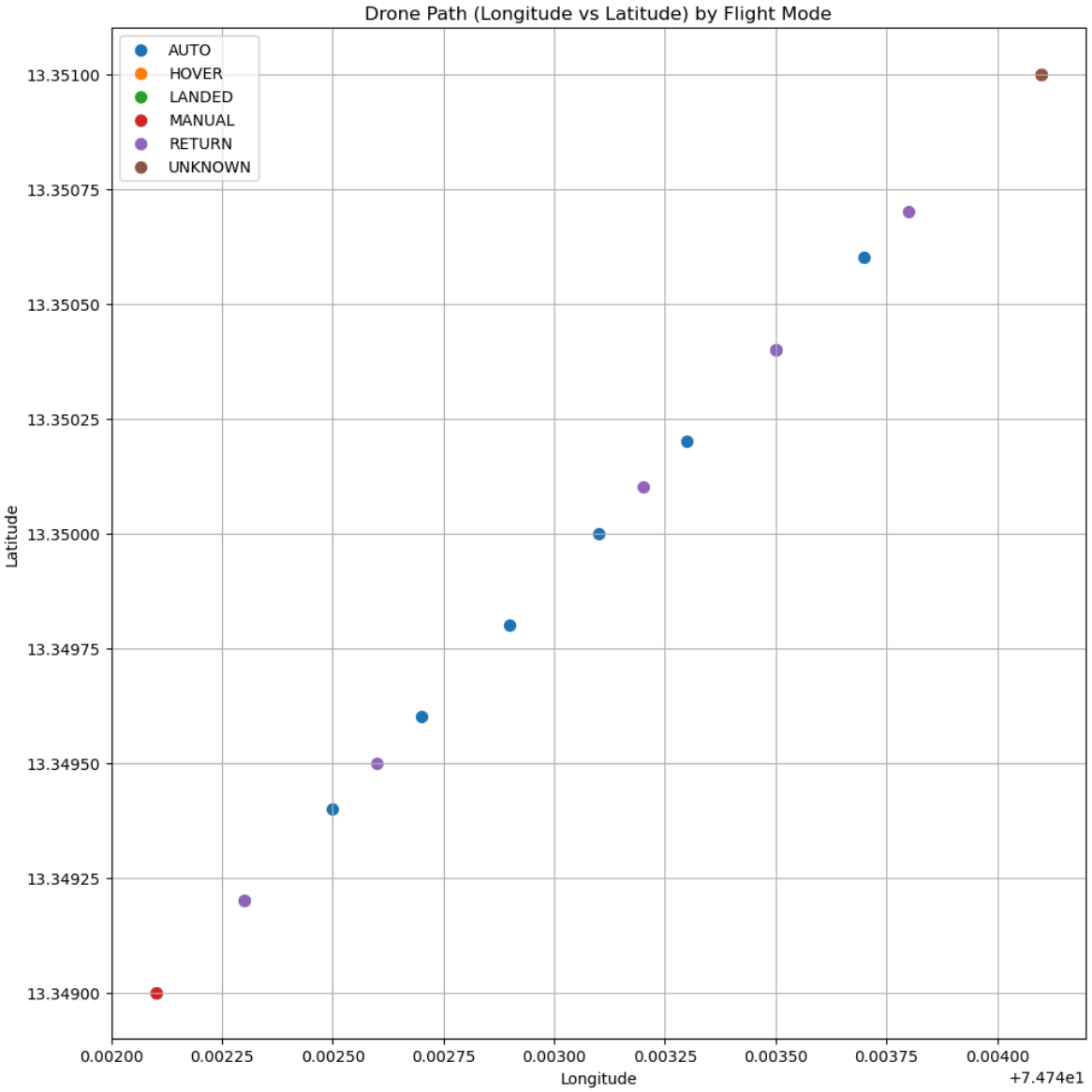
In [19]:
```
plt.figure(figsize=(10, 10))

# Plot longitude vs latitude grouped by flight mode
for mode, group in df_clean.groupby('flight_mode'):
    plt.scatter(group['longitude'], group['latitude'], label=mode, s=50)

plt.title("Drone Path (Longitude vs Latitude) by Flight Mode")
plt.xlabel("Longitude")
plt.ylabel("Latitude")
```

```
# Add legend only if data exists
if df_clean['flight_mode'].notna().any() and df_clean['flight_mode'].nunique() >
    plt.legend()

plt.grid(True)
plt.tight_layout()
plt.show()
```



In [20]:
```
#bruh
```