Functional Requirements:

1.1 Drone Dispatch and Routing

R.1
The system shall dispatch drones from a static Drone Service Point and require them to return to the same service point after completing deliveries.

R.1.1
After being dispatched, a drone shall fly to one or more medical dispatch drop-off points and deliver medication.

R.1.2
Each drone shall perform deliveries within its maximum allowed flight distance.

R.1.3
A delivery shall be explicitly represented in the flight path by two identical consecutive positions indicating a hover.

1.2 Drone Availability

R.2
The system shall verify the availability of each drone before assigning it to a delivery.

R.2.1
Drone availability shall consider date and time constraints.

R.2.2
A drone shall only be returned as available if it can satisfy *all* delivery requirements in a dispatch request.

1.3 No-Fly Zones and Regions

R.3
The system shall prevent drones from entering restricted or no-fly zones.

R.3.1
Restricted areas shall be defined as closed rectangular regions specified by four vertices.

R.3.2
Restricted regions shall have a minimum width of 0.00015 degrees.

R.3.3
If a region definition is not closed, the system shall treat it as invalid.

1.4 Flight Movement Rules

R.4
Drone movement shall follow a predefined set of movement constraints.

R.4.1
Drone movement shall consist of horizontal and vertical motion.

R.4.2
When flying vertically, the drone shall not change latitude or longitude.

R.4.3
When flying horizontally, the drone shall move exactly 0.00015 degrees per step.

R.4.4
Horizontal movement shall be restricted to one of 16 compass directions.

R.4.5
The 16 valid directions shall be spaced 22.5 degrees apart.

R.4.6
Angular deviations of up to $\pm 10^{-12}$ degrees shall be considered valid.

1.5 Geographic Calculations

R.5
The system shall represent locations using latitude and longitude coordinates.

R.5.1
Latitude and longitude shall be measured in degrees.

R.5.2
Distance between two locations shall be calculated using Euclidean distance.

R.5.3
Locations shall be treated as points on a plane rather than on the surface of a sphere.

R.5.4
The system shall define a distance tolerance of 0.00015 degrees.

R.5.5
If two points are within the tolerance distance, they shall be considered “close”.

1.6 REST API Functional Requirements

R.6
The system shall expose REST endpoints under `/api/v1/` as specified.

R.6.1
The system shall provide endpoints for geometric calculations:

- `/distanceTo`
- `/isCloseTo`
- `/nextPosition`
- `/isInRegion`

R.6.2
The system shall provide static query endpoints:

- `/dronesWithCooling/{state}`
- `/droneDetails/{id}`

R.6.3
The system shall provide dynamic query endpoints:

- `/queryAsPath/{attribute}/{value}`
- `/query`

R.6.4
The system shall provide availability and routing endpoints:

- `/queryAvailableDrones`

- `/calcDeliveryPath`
- `/calcDeliveryPathAsGeoJson`

1.7 Authentication and Identity Verification

R.7
The system shall verify the identity of delivery requesters using One-Time Password (OTP) verification.

R.7.1
The system shall generate a cryptographically secure 6-digit OTP.

R.7.2
Each OTP shall be valid for a maximum of 5 minutes.

R.7.3
An OTP shall be single-use and invalidated after successful verification or expiry.

R.7.4
The system shall deliver OTPs to the user's registered email address.

R.8
The system shall verify delivery recipients using facial recognition.

R.8.1
The system shall compare a stored reference image with a live capture.

R.8.2
A delivery shall only be unlocked if facial similarity exceeds a defined threshold.

Measurable Quality Attributes (Non-Functional Requirements):

2.1 Security

Q.1
The system shall prevent OTP replay attacks.

Q.2
The probability of guessing a valid OTP within its lifetime shall be less than 1 in 1,000,000.

Q.3
Facial recognition shall reject non-matching faces below the similarity threshold.

Q.4
Authentication services shall operate independently from delivery logic.

2.2 Reliability and Correctness

Q.5
Geometric calculations shall produce deterministic results for identical inputs.

Q.6
Routing calculations shall never exceed a drone's available moves.

Q.7
The system shall correctly reject invalid input data with appropriate HTTP status codes.

2.3 Performance

Q.8
OTP generation and verification shall complete within acceptable response times.

Q.9
Facial recognition verification shall complete within a time suitable for real-world delivery scenarios.

2.4 Robustness

Q.10
The system shall return HTTP 400 for syntactically invalid requests.

Q.11
The system shall return HTTP 404 for non-existent resource identifiers.

3. Qualitative Requirements

These requirements capture design intent and system qualities that are harder to quantify but still testable indirectly.

3.1 Maintainability

QL.1
The system shall be modular, with separate services for authentication, facial recognition, and delivery logic.

QL.2
Each service shall have a single, clearly defined responsibility.

3.2 Scalability and Extensibility

QL.3
The system shall support future integration with hospital systems and drone fleet controllers.

QL.4
Authentication mechanisms shall be extendable to support additional factors such as authenticator apps or liveness detection.

3.3 Trust and Safety

QL.5
The system shall establish a secure chain of trust from delivery request to delivery collection.

QL.6
Only authorized users shall be able to request deliveries and collect medication.

4. System-Level Requirements

S.1
The system shall support end-to-end medical delivery workflows from request to completion.

S.2
The system shall operate correctly in safety-critical medical delivery scenarios.

S.3
The system shall log relevant operational and security events for audit purposes.