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**Invoice No.:** SGI/ANU/START-UP/ AI DRONE-PATENT-02/2026

**Vendor. A STARTUP:** SRJX RESEARCH AND INNOVATION LAB LLP

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**Our Ref.:** ANU/AI DRONE-PATENT-02/2026

To

**SRJX RESEARCH AND INNOVATION LAB LLP**

PLOT No-3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR,

AVINAB BIDANASI, CUTTACK- 753014

Description	Fee. (INR)
1. Professional fee towards providing general advisory on different intellectual property rights to start ups, providing information on protecting and promoting IPR to start ups in other countries, drafting Complete Specification and preparing and filing other documents such as Form-1, Form-2, Form-3, Form-9 and Form 18A, reporting to client the filing of the Patent Application No. <b>202631013668</b> dated 9 <sup>th</sup> <b>FEBRUARY 2026</b> .	NIL
2. Government Fee for filing the Patent Application.	INR 18,820/-
3. Miscellaneous expenses including charges for typing, phone, Print outs, photocopy, stamp fee, postal charges, conveyance etc.	INR 1000/-
Total	<b>INR 19,820.00</b> <b>(excluding taxes)</b>
<b>Rs. NINETEEN THOUSAND EIGHT HUNDRED TWENTY ONLY (excluding taxes)</b>	
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Sr. No.	App. Number	Ref. No./Application No.	Amount Paid	C.B.R. No.	Form Name	Remarks
1	202631013668	TEMP/E-1/16062/2026-KOL	8320	1774	FORM 1	ARTIFICIAL SUPER-INTELLIGENCE (ASI) BASED NEUROMORPHIC AUTONOMOUS DRONE SYSTEM
2	E-106/697/2026/KOL	202631013668	0	----	FORM28	----

TransactionID	Payment Mode	Challan Identification Number	Amount Paid	Head of A/C No
N-0001862563	Online Bank Transfer	0902260002343	8320.00	1475001020000001

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1	E-12/331/2026/KOL	202631013668	2500	1860	FORM 9	Full	

TransactionID	Payment Mode	Challan Identification Number	Amount Paid	Head of A/C No
N-0001863654	Online Bank Transfer	1002260032580	2500.00	1475001020000001

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1	E20263008675	202631013668	8000	1865	FORM 18A	Full	

TransactionID	Payment Mode	Challan Identification Number	Amount Paid	Head of A/C No
N-0001863669	Online Bank Transfer	1002260034717	8000.00	1475001020000001

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(54) Title of the invention : ARTIFICIAL SUPER-INTELLIGENCE (ASI) BASED NEUROMORPHIC AUTONOMOUS DRONE SYSTEM

(51) International classification	:G08G5/21, G06N3/02, G06N3/045, G08G5/72, G08G5/50, G01S17/86, G01S17/93, G05D1/00	(71)Name of Applicant : <b>1)SRJX RESEARCH AND INNOVATION LAB LLP</b> Address of Applicant :PLOT NO-3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR, CUTTACK- 753014, ODISHA, INDIA Orissa India
(31) Priority Document No	:NA	(72)Name of Inventor : <b>1)JENA, Soumya Ranjan</b> <b>2)GOWDA, Shankar B N</b> <b>3)SAHUKAR, Yamini Prasanna</b>
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(57) Abstract :

The present invention discloses an autonomous neuromorphic drone system (100) and its method. The system comprises an aerial platform (102), a neuromorphic sensor suite (104), a neuromorphic processing unit (106), a neuromorphic reflex control module (108), a cognitive mission control module (110), a safety governor module (112), and a flight controller (114). The aerial platform includes an airframe, a propulsion system and at least one electronic speed controller. The neuromorphic sensor suite (104) comprises one or more event-based vision sensor (116) configured to generate asynchronous event data representing pixel-level brightness changes with associated timestamps, and at least one inertial measurement unit (IMU) (118) configured to generate motion and orientation data. The neuromorphic processing unit (106) operatively coupled to the neuromorphic sensor suite (104). The flight controller (114) is configured to receive validated and safety bounded control commands from the safety governor and to generate motor control signals to the propulsion system.

No. of Pages : 60 No. of Claims : 16

**FORM 2**

THE PATENTS ACT, 1970

[39 of 1970]

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THE PATENTS RULES, 2003

**COMPLETE SPECIFICATION**

(Section 10; Rule 13)

10

**ARTIFICIAL SUPER-INTELLIGENCE (ASI) BASED NEUROMORPHIC  
AUTONOMOUS DRONE SYSTEM**

15

**SRJX RESEARCH AND INNOVATION LAB LLP**

PLOT NO-3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR,

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25

The following Specification particularly describes the invention and the manner in which  
it is to be performed.

## FIELD OF INVENTION

The present invention relates to Unmanned aerial vehicles, more particularly relates to an artificial super-intelligence (ASI) based neuromorphic autonomous drone.

### 5 BACKGROUND

Conventional “AI drones” largely depend on frame-based cameras and GPU/CPU-style processing. This creates a heavy pipeline where entire images are captured at fixed frame rates, then moved through memory, then processed by deep networks. In real deployments, this approach wastes energy because most pixels are redundant across frames, yet the drone still pays the compute cost. The result is higher battery drain, heat generation, and reduced flight time, especially in small or low-cost drones that cannot carry large compute modules.

A second major limitation in prior art is latency and control instability. Traditional perception-to-control loops often introduce delays (camera exposure + frame transfer + inference + control computation). Even small delays degrade stability during high-speed flight, close-proximity navigation, and rapid obstacle avoidance, increasing crash probability. Many existing perception systems employ batch-based processing pipelines, which introduce latency that may limit suitability for reflex-like control.

Earlier systems also struggle in challenging visual conditions. Frame-based vision degrades in low light, high dynamic range scenes (bright sky + dark ground), glare, smoke, dust, and flickering LEDs. Many computer vision models trained on clean datasets fail when the environment shifts.

A persistent problem in prior art is over-dependence on connectivity and cloud compute. Many “smart drone” architectures assume remote processing, continuous streaming, or cloud-based mapping/analytics. In disaster zones, forests, indoor sites, border regions, or remote infrastructure corridors, connectivity can be intermittent or absent. When

connectivity drops, the drone loses key functions, leading to mission failure or unsafe behavior.

5 Prior inventions also show weaknesses in GPS-denied, GPS-degraded, and adversarial navigation scenarios. Standard consumer drones rely heavily on GPS, magnetometers, and simple sensor fusion. In dense urban spaces, indoor environments, under bridges, and near interference sources, these sensors can fail. Additionally, GPS spoofing/jamming threats are increasingly discussed in drone contexts. While some prior patents address spoofing detection, they often focus on a narrow detection module rather than end-to-end autonomy  
10 and safe fallback behaviors.

Another key issue is that earlier learning-based drones are typically static after deployment. Models are trained offline and then frozen. When the drone encounters new terrains, wind turbulence patterns, payload shifts, sensor drift, or unseen obstacles, performance can  
15 degrade sharply. Online learning is rarely used because uncontrolled updates can destabilize flight and create unsafe outcomes. Your invention directly targets this by introducing a Safety-Constrained Self-Adaptation Engine: the drone can adapt on-device, but all updates pass through a safety governor that enforces hard flight-envelope constraints, geofencing, and minimum separation margins. This bridges the gap between  
20 adaptability and safety, which prior art usually treats as a trade-off.

Earlier inventions also face a swarm scalability problem. Many swarm systems rely on high-bandwidth communications, centralized coordination, or continuous video sharing, which does not scale well in bandwidth-limited environments and increases power use.  
25 Centralized coordination also creates single points of failure.

Finally, prior art often lacks an integrated approach for fail-safe autonomy and graceful degradation. Existing drones may have return-to-home, battery failsafes, or obstacle sensors, but these are frequently separate modules that do not consider AI uncertainty,

sensor reliability, and mission risk together. When sensors partially fail or models become uncertain, many systems either continue dangerously or abruptly abort.

The main prior-art problems your invention targets are: (1) high power and low flight time due to frame-based compute, (2) latency that harms stability and collision avoidance, (3) poor robustness in low light and complex lighting, (4) dependence on connectivity, (5) vulnerability in GPS-degraded and adversarial environments, (6) lack of safe on-device adaptation, (7) swarm coordination inefficiency and fragility, and (8) inadequate integrated fail-safe intelligence.

Therefore, there is a need for a system for an artificial super-intelligence (ASI) based neuromorphic autonomous drone to overcome the above mentioned drawback.

## **OBJECTS OF THE INVENTION**

Unmanned aerial vehicles (UAVs) have progressed from remotely piloted machines to sensor-rich, software-defined platforms that support surveying, inspection, precision agriculture, disaster response, environmental monitoring, and public safety. As these use cases expand, the expectations from drones also shift: instead of short, human-guided flights, many missions demand reliable autonomy—continuous perception, safe navigation, and intelligent decision-making with minimal operator workload. This transition exposes a core problem: real-world environments are highly dynamic, uncertain, and often hostile to conventional autonomy pipelines, especially when drones must fly close to obstacles, under poor visibility, or with limited communication.

A major constraint in today’s intelligent drones is the energy and latency cost of traditional “sense–think–act” loops built on frame-based sensors and von Neumann computing. Standard cameras deliver full frames at fixed rates regardless of whether the scene changes, producing redundant data that must be stored, moved, and processed repeatedly. Deep learning inference on CPUs/GPUs can be accurate but is power-hungry, generates heat, and competes directly with the battery budget needed for propulsion. The result is a practical

trade-off: either carry heavy compute and sacrifice flight time, or keep compute light and accept weaker autonomy. In high-speed or cluttered flight, even small delays between sensing, perception, and motor control can destabilize flight, reduce obstacle-avoidance performance, and increase crash risk.

5 Reliability issues become more severe outside controlled test conditions. Drones operate in low light, glare, rain, dust, smoke, vibration, and rapidly changing backgrounds that can degrade vision models trained on curated datasets. Many deployments also face intermittent connectivity (forests, mountains, disaster zones, dense urban corridors), making cloud-dependent perception and planning unreliable. Navigation sensors such as  
10 GPS and magnetometers can be affected by multipath, interference, or deliberate spoofing, and these vulnerabilities are amplified in swarms where coordination requires fast local decisions and graceful degradation when one or more agents receive corrupted signals. These gaps motivate a new class of edge-first intelligence that is fast, energy-efficient, and resilient under uncertainty.

15 Neuromorphic engineering provides a biologically grounded approach to address these challenges. Instead of processing complete images at fixed frame rates, neuromorphic sensors—most notably event-based vision sensors—emit asynchronous “events” only when brightness changes occur. This produces sparse data with very high temporal resolution, reducing redundancy at the source. Spiking neural networks (SNNs) and  
20 neuromorphic processors operate in an event-driven manner, where computation is triggered by relevant change rather than constant polling. In principle, this yields lower latency, reduced memory movement, and improved energy efficiency—qualities that map directly to drone needs: rapid reflex-like responses for collision avoidance, stable control loops, and always-on perception without exhausting battery life. Neuromorphic approaches  
25 also align well with sensor fusion and adaptive control, because spiking dynamics can naturally represent time, motion, and temporal patterns.

The present invention “Artificial Super-intelligence Based Neuromorphic Drone” builds upon these neuromorphic benefits and extends them toward a more ambitious autonomy objective. In practical engineering terms, “super-intelligence” can be treated as a  
30 performance target rather than a claim of human-level general intelligence: the drone

should achieve superior mission effectiveness compared to conventional autonomy stacks by being faster to react, more adaptive to novel conditions, more robust to sensor degradation, and more capable of operating with limited infrastructure. The background motivation is therefore to create a drone architecture that combines neuromorphic reflexes (instantaneous perception-to-control loops), higher-level reasoning (mission planning, risk-aware decisions, fail-safe behavior), and continual adaptation (learning from environmental interaction within safety constraints). If executed well, such a system can enable low-cost drones to perform tasks that currently require expensive platforms or intensive human piloting—especially in disaster response, remote monitoring, and safety-critical inspection—while improving reliability, energy efficiency, and operational autonomy.

Accordingly, the present invention seeks to overcome the drawbacks by providing:

- an Artificial Super-Intelligence (ASI)–based neuromorphic drone capable of high-autonomy operation with minimal human intervention.
- Ultra-low-latency perception-to-control (“reflex”) flight control using spiking neural networks (SNNs) for stable navigation in dynamic environments.
- Reduced onboard computation power consumption by adopting event-driven neuromorphic sensing and processing, thereby improving flight time and thermal efficiency.
- Robust obstacle detection and collision avoidance under low light, glare, flickering illumination, smoke, dust, and fast motion conditions.
- Multi-sensor fusion (event camera + IMU + optional radar/ultrasonic + GPS/RTK) for accurate state estimation and reliable navigation.
- GPS-denied and GPS-degraded navigation, including resilience against spoofing/jamming through anomaly detection and fallback guidance modes.
- Safety-Constrained Self-Adaptation Engine that allows on-device learning while ensuring flight safety and preventing unstable model updates.
- Two-loop architecture separating high-frequency reflex control from higher-level mission planning for predictable and safe autonomy.

- Energy-efficient swarm/cooperative intelligence, allowing multiple drones to coordinate via compact neuromorphic embeddings instead of heavy video streams.
- Fail-safe operations including health monitoring, fault detection, graceful degradation, safe landing, and return-to-home under failures.
- 5 • A low-cost, lightweight, and development-friendly system architecture utilizing modular hardware and open/autonomous interfaces for scalable deployment.
- Support for diverse real-world missions, including search and rescue, surveillance, agriculture, inspection, environmental monitoring, and indoor autonomous flight, with high reliability.

10

### **SUMMARY OF THE INVENTION**

The present invention relates to an Artificial Super-Intelligence (ASI)-based, neuromorphic autonomous drone system that combines event-driven sensing, spiking  
15 neural network (SNN) processing, and safety-constrained decision intelligence to deliver high-speed, low-power autonomy on a compact, low-cost UAV platform. Unlike conventional AI drones that depend on frame-based cameras and GPU/CPU inference (which increases energy use, heat, weight, and latency), the present invention uses a neuromorphic pipeline in which computation is triggered only by meaningful  
20 environmental change. The result is a drone capable of “reflex-like” responses for stabilization and obstacle avoidance, while simultaneously executing higher-level mission planning and adaptive behaviors without requiring continuous cloud connectivity.

In one embodiment, the drone integrates event-based vision sensors (dynamic vision sensors), inertial measurement units (IMU), optional low-power radar/ultrasonic ranging,  
25 GPS/RTK (where available), and onboard health telemetry (battery, motor current, temperature, vibration). The event sensor generates asynchronous spikes that represent pixel-level changes, allowing the drone to perceive motion and edges at micro-temporal resolution while suppressing redundant background data. These events are fused with IMU and ranging data to form a time-stamped spatiotemporal representation of the drone’s local

environment. This representation is processed by an SNN-based perception stack that produces fast estimates of relative motion (ego-motion), obstacle proximity, free-space direction, and dynamic object cues—enabling safe navigation in low light, glare, flickering illumination, smoke, and rapidly changing scenes.

5 The invention further provides a two-loop intelligence architecture. The first loop is a neuromorphic reflex control loop operating at high frequency for attitude stabilization, collision avoidance, and micro-trajectory corrections. This loop directly maps raw neuromorphic sensory streams to control outputs (motor commands) using spiking networks and/or neuromorphic hardware accelerators, minimizing delay and power  
10 consumption. The second loop is a cognitive mission loop that performs goal selection, path planning, task scheduling, and risk assessment. This higher layer may use lightweight conventional models (e.g., tiny neural networks, rule systems, or neuro-symbolic logic) but is bounded by a safety governor so that mission decisions cannot violate flight envelope, geofencing, or collision constraints.

15 A key feature is the Safety-Constrained Self-Adaptation Engine that enables on-device learning while preventing unsafe updates. Instead of relying only on offline training, the drone can adapt to new terrains, lighting, wind patterns, payload shifts, or sensor drift through neuromorphic online learning mechanisms (e.g., spike-timing dependent plasticity or controlled weight updates). To ensure reliability, all adaptation passes through a “digital  
20 safety envelope” that enforces invariant constraints (minimum separation distance, maximum roll/pitch/yaw rates, battery reserve thresholds, no-fly zones, and safe return-to-home rules). When environmental uncertainty rises (for example, heavy vibration, partial sensor failure, GPS anomalies, or spoofing suspicion), the system automatically transitions to conservative modes, increases sensor redundancy, reduces speed, and prioritizes safe  
25 landing or extraction.

The present invention also describes swarm and cooperative intelligence in an energy-efficient manner. Each drone can exchange compact event-summaries or compressed spiking embeddings rather than streaming full video, reducing bandwidth and enabling

coordination in low-connectivity regions. Swarm behaviors—such as cooperative mapping, distributed search patterns, perimeter monitoring, or multi-angle target verification—are performed through decentralized negotiation with local consensus rules. If a node behaves abnormally (e.g., due to spoofed navigation signals or compromised  
5 sensing), trust scoring and behavioral consistency checks isolate the affected drone and reassign tasks, increasing resilience.

The present invention provides a low-cost, easy-to-deploy, neuromorphic autonomous drone system that achieves superior real-time performance through event-driven perception, ultra-low-latency control, safety-bounded adaptation, and optional swarm  
10 cooperation. It is particularly useful for applications requiring long flight time, robust autonomy, and reliable operation in challenging environments—such as disaster response, forest and wildlife monitoring, powerline and pipeline inspection, precision agriculture, traffic and infrastructure surveillance, indoor navigation in GPS-denied spaces, and search-and-rescue missions where rapid reaction and energy efficiency are critical.

15 An embodiment of the present invention describes an autonomous neuromorphic drone system (100), comprising an aerial platform (102) including an airframe, a propulsion system comprising one or more motors, and at least one electronic speed controller; a neuromorphic sensor suite (104), comprising: at least one event-based vision sensor (116) configured to generate asynchronous event data representing pixel-level brightness  
20 changes with associated timestamps, and at least one inertial measurement unit (IMU) (118) configured to generate motion and orientation data; a neuromorphic processing unit (106) operatively coupled to the neuromorphic sensor suite (104) and configured to: receive the asynchronous event data and the motion and orientation data, perform event-driven processing using a spiking neural network (SNN), and generate real-time environment  
25 perception outputs including at least one of ego-motion estimation, obstacle proximity estimation, free-space direction identification, and collision risk indication; a neuromorphic reflex control module (108) configured to: receive the environment perception outputs, and generate immediate flight control commands for stabilization and collision avoidance based on the event-driven processing; a cognitive mission control

module (110) configured to: determine mission-level objectives including at least one of goal selection, path planning, task scheduling, energy management, and risk assessment, and generate higher-level flight intent commands; a safety governor module (112) operatively coupled to the neuromorphic reflex control module (108) and the cognitive mission control module (110), the safety governor module being configured to: validate flight control commands and flight intent commands against predefined flight-envelope constraints, enforce safety limits including at least one of maximum attitude limits, velocity limits, altitude limits, geofence constraints, obstacle clearance thresholds, and battery reserve thresholds, and trigger a safe operating mode including at least one of hover, speed reduction, return-to-home, controlled descent, and landing upon detection of a fault or elevated risk condition; and a flight controller (114) configured to receive validated and safety-bounded control commands from the safety governor and to generate motor control signals to the propulsion system, wherein: the system operates using an event-driven perception-to-control pipeline in which computation is triggered by asynchronous sensory events rather than periodic frame-based image acquisition; and the neuromorphic reflex control module (108) configured to operate at a higher control frequency than the cognitive mission control module (110) to provide ultra-low-latency stabilization and collision avoidance independently of mission-level planning.

According to an embodiment of the present invention, the event-based vision sensor (116) comprises a dynamic vision sensor configured to output pixel-level events including spatial coordinates, polarity, and timestamp information.

According to another embodiment of the present invention, the neuromorphic processing unit (106) performs event aggregation including time-window accumulation, noise filtering, and spatiotemporal feature extraction prior to spiking neural network inference.

According to yet another embodiment of the present invention, the spiking neural network is configured to estimate relative motion using event-driven visual odometry.

According to yet another embodiment of the present invention, at least one additional ranging sensor selected from the group consisting of radar, lidar (Light Detection and Ranging), ultrasonic sensor, optical flow sensor, and barometric altimeter.

5

According to yet another embodiment of the present invention, the neuromorphic reflex control module (108) directly maps spiking neural network outputs to roll, pitch, yaw, and throttle adjustments, wherein the neuromorphic reflex control module (108) configured to operate independently of the cognitive mission control module (110) during transient  
10 obstacle detection events, wherein the neuromorphic reflex control module (108) configured to execute at a control frequency greater than 100 Hz.

According to yet another embodiment of the present invention, the cognitive mission control module (110) configured to perform dynamic waypoint re-planning based on  
15 obstacle density and sensor confidence levels, wherein the cognitive mission control module (110) configured to evaluate mission feasibility based on at least one of battery state, environmental complexity, and navigation reliability.

According to yet another embodiment of the present invention, the safety governor  
20 continuously enforces a predefined flight envelope including maximum attitude angles, angular rate limits, and minimum obstacle clearance thresholds, wherein the safety governor performs anomaly detection by comparing GPS-derived position data with inertial and event-based odometry estimates, wherein the safety governor automatically transitions the drone into a conservative flight mode upon detection of elevated uncertainty,  
25 wherein the conservative flight mode includes reduced speed and increased obstacle avoidance margins.

According to yet another embodiment of the present invention, a safety-constrained self-adaptation engine configured to update model parameters based on operational data

collected during flight, wherein parameter updates are validated against safety metrics prior to deployment, wherein unsafe parameter updates are rejected and a previously validated model state is restored, wherein adaptation includes at least one of sensor calibration adjustment, control gain tuning, and bounded synaptic weight modification in the spiking  
5 neural network.

According to yet another embodiment of the present invention, the neuromorphic processing unit (106) configured to supports navigation in GPS-denied environments using event-based odometry and inertial fusion.  
10

According to yet another embodiment of the present invention, the system that detects GPS spoofing or jamming by identifying inconsistencies between global navigation data and locally estimated motion, wherein the system reduces reliance on corrupted navigation sources and shifts to a fallback guidance mode.  
15

According to yet another embodiment of the present invention, a swarm coordination module configured to exchange compact spiking embeddings with at least one additional drone, wherein the exchanged information includes hazard maps or local obstacle grids, wherein the swarm coordination module assigns trust scores to participating drones based  
20 on behavioral consistency, wherein a drone with reduced trust score is isolated from mission-critical coordination decisions.

According to yet another embodiment of the present invention, the neuromorphic processing unit (106) comprises a dedicated neuromorphic accelerator or FPGA-based event-processing fabric.  
25

According to yet another embodiment of the present invention, event-driven computation reduces redundant data processing relative to frame-based image acquisition.

According to yet another embodiment of the present invention, the system that is configured to operate independently of continuous cloud connectivity.

According to yet another embodiment of the present invention, perception-to-control latency is reduced by processing asynchronous events in the absence of frame buffering.

Another embodiment of the present invention describes a computer-implemented method for controlling an autonomous neuromorphic drone system, the method comprising:

5 receiving, from at least one event-based vision sensor, asynchronous event data representing pixel-level brightness changes including associated timestamps; receiving inertial motion data from at least one inertial measurement unit (IMU) (118); processing the asynchronous event data and the inertial motion data using a neuromorphic processing unit (106) executing a spiking neural network (SNN) to generate real-time perception

10 outputs including at least one of ego-motion estimation, obstacle proximity detection, free-space direction identification, and collision risk estimation; generating, by a neuromorphic reflex control module (108), immediate flight stabilization and collision-avoidance commands based on the real-time perception outputs; generating, by a cognitive mission control module (110), higher-level mission commands including at least one of waypoint

15 planning, route adjustment, task scheduling, battery-aware mission modification, and risk evaluation; validating, by a safety governor module (112), the flight stabilization commands and the higher-level mission commands against predefined flight-envelope constraints including at least one of attitude limits, velocity limits, altitude limits, geofence boundaries, obstacle clearance thresholds, and battery reserve thresholds; modifying or

20 overriding commands that violate the predefined flight-envelope constraints to produce safety-bounded control commands; transmitting the safety-bounded control commands to a flight controller (114) configured to generate motor control signals for a propulsion system of the drone; wherein: the processing of sensory data is event-driven such that computation is triggered by asynchronous sensory events rather than periodic frame-based

25 image acquisition; and the neuromorphic reflex control module (108) operates at a higher control frequency than the cognitive mission control module (110) to provide ultra-low-latency stabilization independently of mission-level planning.

According to another embodiment of the present invention, a process for safety-constrained autonomous navigation of a neuromorphic drone, comprising: collecting operational flight data including event-based perception data, inertial measurements, control outputs, and safety margin indicators; performing bounded parameter updates to at least one of a spiking  
5 neural network model, sensor calibration parameter, and control gain parameter based on the operational flight data; evaluating the bounded parameter updates against predefined safety metrics including stability margin, obstacle avoidance reliability, and flight-envelope compliance; rejecting parameter updates that degrade the predefined safety metrics and restoring a previously validated parameter state; detecting navigation  
10 inconsistencies by comparing global navigation data with locally estimated motion derived from event-based processing and inertial fusion; reducing reliance on inconsistent navigation sources and activating a fallback navigation mode upon detection of anomaly; wherein adaptation and navigation correction occur during active flight while maintaining compliance with enforced safety constraints.

15

#### **BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

This invention is described by way of example with reference to the following drawings. These drawings being referred herein are for the purpose of illustrating preferred embodiments of the invention only, and not for the purpose of limiting the same.

20 **Figure 1** illustrates a block diagram of an Autonomous neuromorphic drone System, according to an embodiment of the present invention.

**Figure 2** illustrates a flowchart of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to another embodiment of the present invention.

25 **Figure 3** illustrates an Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to yet another embodiment of the present invention.

**Figure 4** illustrates a Block Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to an embodiment of the present invention.

**Figure 5** illustrates a Logic Layer Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to an embodiment of the present invention.

5 **Figure 6** illustrates a system a Swarm Coordination Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to yet another embodiment of the present invention.

**Figure 7** illustrates a computer-implemented method for controlling an autonomous neuromorphic drone system, according to an embodiment of the present invention.

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## **DETAILED DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

The present invention is described hereinafter by various embodiments with reference to the accompanying drawings, wherein reference numerals used in the accompanying drawings correspond to the like elements throughout the description. This invention may, however, be embodied in many different forms and should not be construed as limited to 15 the embodiments set forth herein. Rather, the embodiments are provided so that this disclosure will be thorough and complete and will fully convey the scope of the invention to those skilled in the art.

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It will be understood by those skilled in the art that the foregoing general description and the following detailed description are exemplary and explanatory of the invention and are not intended to be restrictive thereof. The terms "comprises", "comprising", or any other variations thereof, are intended to cover a non-exclusive inclusion. Appearances of the phrase "in an embodiment", "in another embodiment" and similar language throughout this 25 specification may, but not necessarily do, all refer to the same embodiment.

Further, the words "a" or "an" mean "at least one" and the word "plurality" means "one or more" unless otherwise mentioned. Furthermore, the terminology and phraseology used 30 herein is solely used for descriptive purposes and should not be construed as limiting in

scope. The systems, methods, and examples provided herein are only illustrative and not intended to be limiting.

5 The present invention discloses a neuromorphic autonomous drone system based on Artificial Super-Intelligence (ASI) is disclosed for low-power, low-latency, safety-assured aerial operation. The drone integrates an event-based vision sensor with inertial and optional ranging/GNSS sensors to generate asynchronous perception events. A neuromorphic processing unit executes spiking neural network (SNN) inference to produce real-time ego-motion, obstacle proximity, and free-space cues. A dual-loop intelligence  
10 architecture is provided: (i) a high-frequency neuromorphic reflex loop that outputs immediate stabilization and collision-avoidance actions, and (ii) a cognitive mission loop that performs goal selection, route planning, task and energy management, and risk assessment. All commands are filtered through a safety governor that enforces flight-envelope constraints, detects faults/anomalies, and triggers emergency responses. A safety-  
15 constrained self-adaptation engine enables on-device learning while preventing unsafe parameter updates. Optional swarm coordination exchanges compact spiking embeddings, hazard maps, and trust flags for resilient multi-drone missions.

The first key novel aspect of the invention is the fully event-driven autonomy pipeline built  
20 around neuromorphic sensing and spiking computation. Instead of relying on conventional frame-based cameras that generate continuous, redundant images, the drone uses event-based vision (and optionally other event-driven sensors) that outputs information only when meaningful change occurs in the scene. This transforms the drone's perception from a "periodic sampling" model to a "continuous reflex" model, enabling extremely low-  
25 latency reaction to motion, edges, and obstacles. The novelty is not merely using an event camera, but architecting the complete perception–decision–control loop so that sensor output, inference, and control commands are all triggered by events, significantly reducing compute load and energy use while increasing responsiveness.

The second feature is the dual-intelligence architecture: Neuromorphic Reflex Loop + ASI-based Cognitive Mission Loop. Prior drones typically run a single autonomy stack where perception, planning, and control are tightly coupled and can suffer from computational bottlenecks. Here, the invention separates autonomy into two purpose-built loops. The  
5 high-frequency reflex loop uses spiking neural networks to convert raw neuromorphic sensor streams directly into stabilization and collision-avoidance actions. In parallel, a higher-level cognitive loop performs mission reasoning—goal selection, route planning, risk estimation, task allocation, and contingency handling. This separation is novel because it creates a biologically inspired structure similar to “reflexes + deliberation,” allowing  
10 each loop to be optimized for its role without compromising the other.

A third major feature is the Safety-Constrained Self-Adaptation Engine that enables on-device learning while guaranteeing flight safety. Many prior-art AI drones either do not adapt after deployment or perform adaptation in cloud/offline retraining. The invention  
15 provides a mechanism to adapt locally to new lighting conditions, wind patterns, sensor drift, payload changes, terrain textures, and unseen obstacle dynamics. However, unlike unsafe online learning approaches, all learning updates are filtered through a formal safety layer that enforces strict invariants such as flight envelope limits, minimum separation distances, geofencing, battery reserve thresholds, and safe recovery behaviors. This design  
20 makes “learning in the wild” practical for drones by preventing unstable model updates from affecting critical flight control.

A fourth feature is uncertainty-aware autonomy with graceful degradation. The invention continuously monitors sensor health (IMU noise, vibration levels, motor current,  
25 temperature), environment difficulty (event density, motion complexity), and model confidence (spiking activity patterns, consistency checks, residual errors). When uncertainty rises—such as during GPS anomalies, sensor failures, or extreme lighting—the system does not blindly continue. Instead, it automatically transitions among safe operating modes: slower flight, higher obstacle margin, increased sensor redundancy, conservative  
30 planning, cooperative assistance from other drones, and ultimately controlled landing or

safe return. This integrated “confidence-to-action” mechanism is more advanced than typical drones’ simple failsafes (low battery return-to-home) because it links autonomy decisions to real-time reliability indicators.

5 A fifth feature is the GPS-denied and spoof-resistant navigation stack integrated into neuromorphic perception. While earlier inventions may propose spoofing detection as a separate module, this invention treats navigation robustness as part of the core autonomy logic. It can use event-based visual odometry cues, inertial motion integration, and low-power ranging to maintain safe flight even when GPS becomes unavailable, inconsistent,  
10 or suspicious. The system applies anomaly detection and behavioral consistency scoring to identify navigation manipulation and then triggers safe fallback guidance strategies. This creates a tightly integrated approach where the drone can continue operating safely without relying on a single vulnerable navigation source.

15 A sixth feature is energy-efficient swarm intelligence using compact neuromorphic representations. Traditional swarms often exchange heavy telemetry or video streams, limiting scalability and draining power. The present invention enables drones to communicate lightweight event summaries or spiking embeddings that represent motion, obstacles, and intent. This reduces bandwidth and allows decentralized coordination in low-  
20 connectivity conditions. Additionally, the swarm includes trust and integrity scoring so that abnormal drones (compromised sensors, spoofed navigation, malfunctioning units) can be isolated, and tasks can be redistributed automatically. This makes multi-drone operations more reliable, scalable, and resilient.

25 Finally, the invention’s novelty lies in its low-cost practical implementation pathway. It is designed to be deployable on compact drone platforms by combining affordable sensors, modular compute, and optimized spiking inference—reducing dependency on heavy GPUs. The architecture is structured so that manufacturers or startups can implement it incrementally: starting with neuromorphic reflex control for avoidance and stabilization,  
30 then adding cognitive mission intelligence and safe adaptation. This staged, modular

neuromorphic autonomy approach—focused on real-world cost and usability—distinguishes it from earlier research prototypes that are powerful but difficult to productize.

5 **Figure 1** illustrates a block diagram of an Autonomous neuromorphic drone System (100), according to an embodiment of the present invention. The Autonomous neuromorphic drone System (100) comprises an aerial platform (102), a neuromorphic sensor suite (104), a neuromorphic processing unit (106), a neuromorphic reflex control module (108), a cognitive mission control module (110), a safety governor module (112), and a flight  
10 controller (114). The aerial platform (102) includes an airframe, a propulsion system and at least one electronic speed controller. The propulsion system comprises one or more motors. The neuromorphic sensor suite (104) comprises at **least** one event-based vision sensor (116) and at **least** one inertial measurement unit (IMU) (118).

15 In one embodiment, the event-based vision sensor (116) is configured to generate asynchronous event data representing pixel-level brightness changes with associated timestamps. The inertial measurement unit (IMU) (118) is configured to generate motion and orientation data.

20 In one embodiment, the neuromorphic processing unit (106) is operatively coupled to the neuromorphic sensor suite (104). The neuromorphic processing unit (106) is configured to receive the asynchronous event data and the motion and orientation data, perform event-driven processing using a spiking neural network (SNN), and generate real-time environment perception outputs including at least one of ego-motion estimation, obstacle  
25 proximity estimation, free-space direction identification, and collision risk indication.

In one embodiment, the neuromorphic reflex control module (108) is configured to receive the environment perception outputs, and generate immediate flight control commands for stabilization and collision avoidance based on the event-driven processing.

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In one embodiment, the cognitive mission control module (110) is configured to determine mission-level objectives including at least one of goal selection, path planning, task scheduling, energy management, and risk assessment, and generate higher-level flight intent commands.

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In one embodiment, the safety governor module (112) is operatively coupled to the neuromorphic reflex control module (108) and the cognitive mission control module (110). The safety governor module is configured to validate flight control commands and flight intent commands against predefined flight-envelope constraints, enforce safety limits including at least one of maximum attitude limits, velocity limits, altitude limits, geofence constraints, obstacle clearance thresholds, and battery reserve thresholds, and trigger a safe operating mode including at least one of hover, speed reduction, return-to-home, controlled descent, and landing upon detection of a fault or elevated risk condition.

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In one embodiment, the flight controller (114) is configured to receive validated and safety-bounded control commands from the safety governor and to generate motor control signals to the propulsion system. The system (100) operates using an event-driven perception-to-control pipeline in which computation is triggered by asynchronous sensory events rather than periodic frame-based image acquisition. The neuromorphic reflex control module (108) is configured to operate at a higher control frequency than the cognitive mission control module (110) to provide ultra-low-latency stabilization and collision avoidance independently of mission-level planning.

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The present invention relates to an Artificial Super-Intelligence (ASI) based, neuromorphic autonomous drone system designed to achieve ultra-low latency perception, energy-efficient onboard intelligence, safe adaptive learning, and robust navigation in complex and uncertain environments. The invention is implemented as a modular aerial platform comprising an airframe with propulsion units, a flight controller, neuromorphic sensing modules, an onboard neuromorphic inference engine, a high-level cognitive mission engine, a safety governor, communications interfaces, and optional swarm coordination

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support. The invention may be configured as a quadcopter, hexacopter, fixed-wing, VTOL, or micro-drone depending on mission requirements, but the core novelty remains the same: event-driven sensing and spiking intelligence form the primary closed-loop autonomy pathway.

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In one preferred embodiment, the drone includes a neuromorphic perception subsystem that uses at least one event-based vision sensor (dynamic vision sensor) that emits asynchronous events representing pixel-level brightness changes. Each event contains information such as pixel coordinates, polarity (increase/decrease), and time stamp. This event stream replaces conventional frame capture, thereby reducing redundant data generation and enabling high temporal resolution perception. In addition to the event camera, the drone integrates an IMU (accelerometer and gyroscope), optional magnetometer, barometer, ultrasonic sensor, lidar, lightweight radar, optical flow sensor, and GPS/RTK receiver where available. Sensor selection is configurable, but the system is designed to remain functional in GPS-degraded or GPS-denied environments by relying on event-driven odometry and inertial estimation.

The onboard computing unit consists of a neuromorphic inference engine and a conventional microcontroller/processor. The neuromorphic inference engine may be implemented using a spiking-capable processor, neuromorphic accelerator, or FPGA-based event processing fabric. The conventional processor is responsible for non-critical computation, telemetry, logging, and integration with the flight controller. The neuromorphic engine is responsible for high-frequency autonomy functions: detecting motion patterns, estimating ego-motion, recognizing obstacles, identifying free space direction, and producing control corrections. The architecture is designed so that the most time-critical operations remain on the neuromorphic engine, thereby minimizing latency and power consumption and improving real-time responsiveness.

The invention operates through a two-loop intelligence model. The first loop is the Neuromorphic Reflex Loop, which runs at high frequency and forms the primary

stabilization and collision-avoidance pipeline. In this loop, event data is converted into spiking representations and passed through a spiking neural network (SNN) that outputs motor-level corrective commands such as roll, pitch, yaw, and throttle adjustments, or higher-level velocity vectors that are translated into motor signals by the flight controller.

5 This reflex loop is trained to maintain stable flight, avoid imminent collisions, and respond to fast changes such as sudden obstacles, moving targets, and turbulent wind disturbances. The reflex loop is designed to be “always on,” functioning even when the high-level mission intelligence is operating with reduced confidence or is temporarily paused.

10 The second loop is the Cognitive Mission Loop, which is ASI-inspired in the sense that it prioritizes goal-directed reasoning, risk-aware decision making, and adaptive mission execution beyond basic navigation. This loop receives summarized state information from the reflex loop, including obstacle maps, motion estimates, localization confidence, energy budget, and environmental complexity. Using this information, the mission loop plans  
15 waypoints, selects task priorities, schedules sensing actions, and determines safe behaviors such as hovering, rerouting, returning to home, or executing controlled landing. The mission loop may use lightweight conventional AI models, neuro-symbolic rules, or hierarchical planners; however, its outputs are not executed directly. All mission actions are filtered through a safety governor so that deliberate decisions cannot violate flight  
20 envelope constraints or safety rules.

A critical element of the invention is the Safety Governor and Assurance Layer, which continuously enforces invariant constraints during all flight phases. The governor validates every control output and mission command against rules such as maximum roll/pitch/yaw  
25 rates, minimum obstacle clearance distance, maximum allowed speed in uncertain perception states, altitude ceilings, geofence boundaries, restricted zones, battery reserve thresholds, and motor temperature limits. If any computed action violates safety constraints, the governor modifies it to the nearest safe action, or triggers a safe mode transition such as reduced speed flight, hover stabilization, emergency braking, controlled  
30 descent, or immediate landing. This design ensures that the drone remains safe even if the

environment becomes unpredictable or if learning components produce unexpected outputs.

5 The present invention further includes a Safety-Constrained Self-Adaptation Engine that enables on-device learning while preventing unsafe model drift. In this mechanism, the drone collects operational traces such as event patterns, IMU dynamics, control actions, near-miss events, and stability margins. Adaptation occurs in a bounded manner using controlled learning rules (for example, constrained synaptic updates, limited parameter tuning, or periodic calibration) so the spiking networks can adjust to new conditions: sensor  
10 drift, camera mounting vibration, payload change, propeller wear, or local lighting and texture variations. Each adaptation update is tested against safety metrics before being committed. If the updated parameters reduce safety margin, increase oscillation risk, or degrade obstacle avoidance reliability, the update is rejected and the system reverts to a known safe model state.

15 To enable robust navigation under degraded GPS, the present invention includes an anomaly detection layer that monitors navigation consistency across sensors. The system compares GPS position/velocity with inertial estimates, event-based odometry, barometer altitude trends, and expected motion constraints. If inconsistencies exceed thresholds—  
20 indicative of spoofing, jamming, multipath errors, or sensor faults—the drone reduces reliance on GPS and shifts toward vision-inertial navigation and conservative motion policies. In extreme cases, the drone enters a safe recovery mode that attempts to move to a low-risk landing zone, climb to a safe altitude, or return along a recently verified trajectory, depending on mission context.

25 For multi-drone operations, the present invention supports an optional decentralized swarm intelligence module. Rather than exchanging heavy video streams, each drone generates compact neuromorphic summaries such as spiking embeddings, event density descriptors, local hazard maps, and intent signals. These messages allow drones to coordinate search  
30 patterns, share obstacle awareness, verify targets from multiple angles, and distribute tasks

efficiently under bandwidth limits. The swarm module also computes trust scores for each drone based on behavioral consistency, sensor credibility, and communication integrity. If a drone exhibits abnormal navigation signals, erratic behavior, or suspected compromise, the swarm controller isolates it and reassigns mission tasks to healthy drones, increasing  
5 collective resilience.

The flight controller integration can be implemented through standard autopilot firmware architectures. In one embodiment, the neuromorphic reflex loop outputs velocity vectors or attitude setpoints that are consumed by the flight controller's stabilization algorithms. In  
10 another embodiment, the reflex loop directly outputs motor mixing commands under strict safety bounding. The system maintains logs of event streams, model outputs, and safety decisions to support post-flight analysis, continuous improvement, and compliance documentation. The drone may also provide a user interface through a mobile application or ground station software, allowing operators to define mission objectives, geofence  
15 limits, risk profiles, and emergency behavior policies without needing deep technical knowledge of neuromorphic systems.

In overall operation, the drone starts with a safe initialization sequence where sensors calibrate and the safety governor validates baseline health (battery level, IMU stability,  
20 motor response). During takeoff, the reflex loop maintains stable lift while the mission loop confirms a safe ascent corridor. During navigation, the reflex loop continuously prevents collisions and corrects for disturbances, while the mission loop selects routes and manages tasks. During uncertainty or fault conditions, the safety governor triggers graceful degradation, prioritizing safe stabilization and recovery. On mission completion, the drone  
25 performs controlled landing and stores operational data for audit and future adaptation. Through this integrated neuromorphic, safety-bounded, ASI-inspired intelligence stack, the invention achieves practical autonomy with improved energy efficiency, reliability, and real-world usability compared to conventional AI drone systems.

**Figure 2** illustrates a flowchart of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System (100), according to another embodiment of the present invention.

- 5 The flowchart describes the complete operational method of the Artificial Super-Intelligence (ASI) based Neuromorphic Autonomous Drone System from start-up to shutdown, showing how sensing, neuromorphic intelligence, safety assurance, adaptation, and actuation interact as a closed-loop autonomous process.
  
- 10 The process begins at START/TAKEOFF, where the drone powers on, initializes its flight controller, calibrates onboard sensors, and performs pre-flight health checks such as battery level, motor status, and IMU stability. Once basic readiness is confirmed, the drone enters autonomous takeoff and transitions into the sensing phase.
  
- 15 Next, the system enters ENVIRONMENT SENSOR INPUTS, which represents continuous acquisition of real-world signals from multiple sensors. The first input is Capture Event Stream (Event Camera), where the neuromorphic camera outputs asynchronous events instead of full frames. These events represent brightness changes with time-stamps and polarity, enabling very fast motion perception and reduced data  
20 redundancy. In parallel, the system Reads IMU & Fusion Sensor Data, meaning gyroscope and accelerometer streams are collected at high frequency to estimate orientation, angular rate, and acceleration, which are critical for stable flight and for interpreting event streams correctly. The third line in this block, Optional: Radar/Lidar/GPS Inputs, indicates that additional sensors can be incorporated depending on application needs—radar/lidar for  
25 distance measurements and obstacle ranging, and GPS for global position if the operating environment permits reliable satellite navigation.

All these sensor streams are then passed into PERCEPTION PROCESSING, where the drone converts raw inputs into actionable intelligence signals. In Event Aggregation &  
30 Transformation, the event stream is cleaned and structured (noise suppression, time

windowing, feature extraction, motion clustering, time-surface formation, etc.) so it becomes suitable for spiking neural computation. Then, Spiking Neural Network (SNN) Inference executes neuromorphic inference to produce real-time outputs such as ego-motion cues, obstacle proximity estimations, dynamic object movement indicators, free-space direction, and other spatiotemporal scene interpretations needed for navigation and collision avoidance.

From perception, the system feeds the NEUROMORPHIC REFLEX LOOP, which is the high-speed control pathway intended to behave like a biological reflex. Here, Immediate Stabilization & Collision Avoidance Action is generated. This means the reflex module uses the spiking inference outputs (and IMU state) to compute rapid control corrections such as braking, sidestepping, yaw adjustment, corridor centering, hover stabilization, or descent assistance. This loop is designed to respond instantly to environmental changes and runs continuously during flight to maintain safe stability.

After reflex actions are computed, the flowchart enters the first decision block labeled SAFE. This decision represents whether the reflex-generated action maintains safe operating conditions—such as sufficient obstacle clearance, acceptable attitude rate, stable control margins, and no violation of flight envelope constraints. If the output is considered safe, the reflex loop continues and remains active as the primary low-latency safety mechanism. If the output is not safe or if uncertainty rises, the system routes control through additional safety enforcement.

In parallel with reflex processing, the system operates the COGNITIVE MISSION LOOP, which represents higher-level mission intelligence. In this block, Goal Selection, Path Planning, & Task Management means the drone decides what to do next based on mission objectives (for example: search pattern execution, target tracking, inspection route, area mapping, return-to-home). The block Risk Assessment & Mission Success Evaluation indicates that the cognitive layer evaluates hazards and feasibility—considering obstacle density, sensor confidence, GPS reliability, wind/turbulence signs, battery reserve, and

mission urgency—and predicts whether continuing the mission at current settings is safe and likely to succeed.

5 Outputs from the reflex loop and cognitive loop are then routed through the SAFETY GOVERNOR, which is the authoritative gatekeeping mechanism. In Validate/Stabilize Commands, the governor checks each command and can clamp or modify it to remain within safe bounds. In Monitor Flight Constraints, the governor enforces geofencing, altitude limits, speed ceilings, safe separation distances, and allowable attitude rates. In Fault & Anomaly Detection, it detects abnormal states such as IMU saturation, excessive  
10 vibration, motor current imbalance, overheating, GPS inconsistencies, or sensor dropouts. In Trigger Emergency Responses, it can override autonomy and force safe behaviors such as hover, slow mode, emergency braking, return-to-home, or controlled landing.

After safety governance, the system proceeds to SAFETY CONSTRAINED SELF-  
15 ADAPTATION, which is the invention's-controlled learning and calibration module. In Adapt to Drift, Noise, Environment, the drone updates parameters to handle sensor drift, lighting changes, turbulence, payload shift, or gradual mechanical wear. In Prevent Unsafe Parameter Updates, every adaptation attempt is validated against safety metrics; unsafe updates are rejected and the system reverts to a known stable configuration. This ensures  
20 learning improves performance without introducing instability or unsafe flight behavior.

The second decision diamond labeled RISK indicates a mission-level safety evaluation outcome. If the risk assessment indicates SAFE, the system proceeds with normal autonomy execution. If the risk assessment indicates RISK, the system shifts into more  
25 conservative or emergency logic controlled by the safety governor, such as reduced speed, increased obstacle margin, re-planning, or aborting mission objectives.

The ENGAGE MOTOR COMMANDS step represents the final actuation stage where validated and safe control outputs are sent to the flight controller/ESCs to drive the motors.  
30 This includes executing stabilization corrections from the reflex loop, navigation

maneuvers from mission planning, or emergency responses from the safety governor. The SAFE/RISK arrows around this stage indicate that actuation is continuously monitored—if the effect of motor commands results in unsafe behavior (for example, unstable oscillation, obstacle closing too fast), the safety governor and reflex loop immediately intervene to correct or override.

Finally, the process leads to MISSION COMPLETE/LANDING, where the drone either completes its assigned tasks and returns to land, or lands safely due to risk escalation, faults, or mission abort. Landing may be automatic and safety-enforced, ensuring controlled descent and motor shutdown only after stability is ensured. The final stage SHUTDOWN represents powering down propulsion and onboard intelligence modules, storing mission logs, saving adaptation states (if validated safe), and completing the operational cycle.

The flowchart demonstrates the operational method where (1) event-driven sensing and neuromorphic inference create fast perception, (2) a reflex loop provides ultra-low-latency stabilization and avoidance, (3) a cognitive mission loop provides goal-directed planning and risk evaluation, (4) a safety governor enforces constraints and manages faults, (5) safety-constrained self-adaptation enables learning without unsafe drift, and (6) motor actuation occurs only after continuous validation. This combination creates an autonomous drone system that is energy-efficient, fast-reacting, adaptive, and safety-assured—distinguishing it from prior art that relies on conventional frame-based compute, static models, and weaker real-time safety governance.

**Figure 3** illustrates an Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to yet another embodiment of the present invention.

The architecture works as a complete end-to-end autonomy loop in which the drone continuously senses the environment, interprets it through neuromorphic (event-driven) computation, decides safe actions through a layered intelligence structure, and then executes motor commands under strict safety supervision. The central “Neuromorphic

Drone Platform” represents the physical UAV (airframe, motors, battery, flight controller) carrying the sensing modules and onboard compute. During flight, all information originates from the drone’s sensors and is converted into time-stamped streams that feed both fast reflex control and higher-level mission reasoning.

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The Neuromorphic Perception block is responsible for turning raw sensor signals into meaningful, low-redundancy information. The event-based vision sensor (dynamic vision sensor) outputs events only when pixel brightness changes, which means it reacts strongly to motion and edges while eliminating repeated full-frame image capture. In parallel, the IMU and fusion sensors provide high-rate acceleration and angular velocity signals that describe the drone’s attitude and short-term movement. Optional radar/lidar and GPS contribute distance-to-obstacle measurements and global location when available. Together, these inputs form a synchronized perception stream that is extremely fast, power-efficient, and suitable for real-time autonomous flight even in difficult lighting and cluttered scenes.

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The Neuromorphic Processing Unit receives these perception streams and performs event-driven computation close to the sensor layer. It filters noise events, aggregates spatiotemporal patterns, and runs spiking neural network inference or neuromorphic feature extraction. From the event stream and IMU dynamics, it can estimate relative motion, detect approaching obstacles, infer free-space direction, and generate fast state cues such as collision risk level and motion vectors. Because the computation is triggered by events rather than continuous frame processing, the system reduces memory movement and processing overhead, making it practical to run high-frequency inference within the limited power budget of a small drone.

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The Neuromorphic Reflex Loop is the fastest intelligence loop in the architecture and is built to behave like a biological reflex system. Its spiking neural network takes outputs from the neuromorphic processing unit (and optionally direct sensor features) and produces immediate flight-control corrections. The reflex control module converts these into low-

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latency motor commands, such as stabilization adjustments (roll, pitch, yaw corrections), emergency braking, obstacle sidestep, corridor centering, or controlled descent behaviors. This loop runs continuously at high rate, so even if the environment suddenly changes—like a bird crossing, a wire appearing, or a gust hitting the drone—the reflex loop can respond quickly enough to prevent collisions and maintain stable flight.

The Safety-Constrained Self-Adaptation block provides the system with the ability to improve its performance over time without compromising safety. As the drone flies, it observes patterns such as sensor drift, vibration changes, payload effects, changing lighting, and local wind behavior. The on-device learning mechanism allows controlled updates to internal parameters (calibration values, thresholds, limited neural weights, or control gains) so the drone adapts to new conditions. However, the key functionality is that every adaptation is constrained by a safety envelope: the system checks whether proposed learning updates could reduce stability margin, increase oscillations, or worsen obstacle clearance. Unsafe updates are rejected and the drone reverts to a known safe model, ensuring that learning cannot make the drone dangerous.

The Cognitive Mission Loop is the higher-level “deliberative” intelligence layer that manages long-horizon autonomy. It performs mission planning (path selection, waypoint generation, area coverage patterns), risk assessment (how dangerous the environment is given sensor confidence, obstacle density, wind cues, GPS reliability), and task management (search, inspection, mapping, delivery, tracking, return-to-home scheduling). This loop does not act as a raw motor controller; instead, it produces mission intents such as “fly to this waypoint,” “reduce speed,” “increase obstacle margin,” or “switch to safe mode,” based on the overall objective and current risk.

The Safety Governor sits between the intelligence layers and actual action execution, acting as the primary assurance mechanism. Every command originating from the reflex loop or mission loop is validated against constraints such as maximum attitude angles, maximum angular rates, speed limits, minimum obstacle clearance, geofence boundaries, altitude

limits, and battery reserve requirements. The safety governor also performs continuous health and fault detection using battery telemetry, motor current symmetry, temperature readings, IMU vibration signatures, and sensor dropout patterns. When it detects high risk or failures, it triggers emergency response behaviors such as hover-and-evaluate, slow flight with increased margins, safe return-to-home, or controlled landing, depending on what is safest for the context.

The Robust Navigation & Swarm Coordination block ensures that navigation remains reliable when traditional signals degrade and enables cooperative intelligence among multiple drones. In GPS-denied or GPS-degraded scenarios, the drone can continue to navigate locally using event-vision odometry cues, inertial estimation, and ranging constraints, maintaining stable flight without reliance on global coordinates. Anomaly detection continuously checks consistency between GPS, IMU predictions, and vision-derived motion, identifying spoofing, jamming, or sensor failures through impossible jumps or mismatched motion patterns. If anomalies are detected, the system automatically reduces trust in the corrupted source and shifts to safer fallback navigation.

When operating in a swarm, drones share compact information rather than heavy video streams. Each drone can communicate lightweight event summaries, hazard maps, intent signals, and trust flags (for example, “GPS unreliable” or “high obstacle density here”). This allows decentralized coordination for tasks like distributed search, collaborative mapping, multi-angle target verification, and communication relaying. If one drone behaves abnormally due to malfunction or navigation manipulation, swarm logic can isolate it and redistribute tasks, increasing mission resilience.

The architecture functions as a layered, safety-governed, event-driven autonomy system. Neuromorphic perception and processing provide fast and energy-efficient understanding of the environment; the reflex loop delivers immediate stabilization and collision avoidance; the cognitive loop manages mission-level reasoning; the safety governor

enforces constraints and handles failures; and robust navigation plus swarm coordination keep the drone functional under GPS loss, uncertainty, or adversarial conditions.

**Figure 4** illustrates a Block Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to an embodiment of the present invention.

The hardware block diagram represents the complete physical implementation of the Artificial Super-Intelligence (ASI) based Neuromorphic Autonomous Drone System by showing how the major electronic subsystems are interconnected and how data, control, and power flow through the drone. At the top, the “Neuromorphic Autonomous Drone” icon represents the aerial platform (airframe, payload mounting points, propulsion arms) that houses all modules. The diagram is organized so that sensing is on the left, compute and control are in the center, communications are on the right, and power plus actuation are shown at the bottom, reflecting a practical engineering layout used in real drone designs.

On the left side, the Neuromorphic Sensor Suite is the primary input source for onboard intelligence. The Event Camera provides event-driven visual data, emitting pixel-level changes with time stamps, which helps the drone perceive motion and obstacles with very low latency. The IMU (Accelerometers, Gyroscope) provides high-rate inertial signals used for attitude estimation, stabilization, and motion understanding. The diagram also includes optional sensors such as Radar, Lidar, Ultrasonic, and Magnetometer to support obstacle ranging, altitude/near-field detection, and heading reference. Collectively, these sensors generate “Sensor Data” that is forwarded into the processing units for perception and control.

At the center, the Neuromorphic Processor is the specialized compute module that runs event-driven processing and spiking neural network inference. Its function is to convert raw neuromorphic sensor streams into actionable intelligence such as ego-motion cues, obstacle proximity, free-space direction, collision likelihood, and other fast perception

outputs. Because this processor is optimized for neuromorphic workloads, it can operate at higher reaction speed with lower energy compared to conventional GPU-heavy processing. The diagram shows a direct sensor-data connection into this processor, indicating that it is close to the sensing pipeline and supports real-time autonomy.

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Below the neuromorphic processor, the Microcontroller / Flight Controller represents the real-time embedded controller responsible for flight stabilization and motor control timing. It receives intelligence outputs and guidance from the neuromorphic processor (for example, collision avoidance vectors or attitude corrections) and translates them into flight-control actions using standard drone control loops. This block also manages the drone's state machine (takeoff, hover, mission flight, landing), executes actuator mixing, monitors system health, and generates "Controls/Status" outputs that can be shared with other subsystems such as communications and safety monitoring.

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On the right, the Communications Interfaces block provides external and internal connectivity for command, telemetry, and cooperative operations. The Wireless Transceiver supports communication with a ground station, remote operator, or other drones in a swarm. The GNSS Receiver (GPS, RTK) provides global navigation input when available and reliable, particularly useful for waypoint missions, mapping, and return-to-home. In addition, this block can enable transmission of telemetry, health data, and mission status, and it can also receive mission updates or emergency commands. The diagram indicates that both the neuromorphic processor and the flight controller can interact with communications, reflecting the fact that telemetry may include both AI-level perception outputs and low-level control/health data.

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At the bottom center, the Power Management block supplies regulated and distributed power to the entire system. The Battery Pack is the main energy source, and Power Distribution indicates voltage regulation and power routing to the sensors, processors, flight controller, and ESCs. This block is critical because neuromorphic autonomy is intended to reduce compute power draw; however, stable power rails are still required to

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avoid sensor noise, processor resets, or control instability. The diagram shows “PWR” flowing from power management to the sensor suite, emphasizing that sensors must be powered continuously and reliably.

5 On the bottom right, ESCs & Motors form the propulsion and actuation subsystem. The electronic speed controllers (ESCs) receive motor control signals from the flight controller and regulate the power delivered to each motor. The motors generate thrust and torque for lift, pitch, roll, and yaw control. The diagram links power management to ESCs and motors, showing that propulsion is the largest consumer of battery energy and must be supported  
10 by strong power distribution. The placement of ESCs & motors at the final stage highlights that all autonomy and safety processing ultimately exists to compute correct motor actions that result in safe flight and mission execution.

The hardware system functions as a closed loop: sensors generate data → neuromorphic  
15 processor interprets the environment → flight controller converts intelligence into stable control signals → ESCs/motors execute thrust commands → the drone moves and produces new sensor observations. In parallel, communications provide telemetry and mission control, while power management ensures all modules run reliably.

20 **Figure 5** illustrates a Logic Layer Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to an embodiment of the present invention.

The Software/Logic Layer Diagram represents how the invention’s autonomy is  
25 implemented as an interconnected set of software modules that transform sensor signals into safe motor outputs. The diagram is organized from left-to-right and top-to-bottom to show a logical flow: perception → reflex intelligence → safety enforcement → flight controller actuation, while a parallel cognitive mission layer and safety-constrained learning layer continuously refine and supervise behavior.

30

The process begins with Neuromorphic Perception, which is the software/logic layer that interfaces directly with the drone’s sensors. Event-based vision produces asynchronous perception events, while the IMU provides high-rate inertial signals that describe attitude and motion dynamics. Optional sensors such as radar, lidar, ultrasonic, and barometer supply range and altitude cues for improved reliability. This block performs foundational preprocessing such as timestamp synchronization, noise filtering, event aggregation, and sensor fusion preparation. Its output is not raw images; instead it is a time-accurate stream of perception events and IMU signals formatted for neuromorphic inference and rapid control.

10

From neuromorphic perception, the data feeds the Neuromorphic Reflex Loop, which is the high-speed, low-latency intelligence pathway. Inside this loop, a Spiking Neural Network (SNN) receives event-derived features and inertial cues to recognize critical motion patterns like obstacle approach, free-space direction, sudden disturbances, and imminent collision risk. The Reflex Control Module then converts SNN inference into immediate stabilization and avoidance intentions—examples include emergency braking, side-step maneuvers, corridor centering, hover stabilization, or fast attitude correction. The main purpose of this loop is to behave like a biological reflex: it operates continuously and reacts faster than high-level planning, ensuring the drone remains stable and avoids immediate hazards.

20

The outputs of the reflex loop enter the Safety Governor, which is the mandatory assurance layer in the invention. The diagram highlights three major functions: Validate Stabilization & Commands, Monitor Flight Envelope Constraints, and Fault Detection & Emergency Response. Validation ensures that any command produced by the reflex loop or other layers is physically feasible and within safe limits (roll/pitch/yaw boundaries, maximum speed, minimum obstacle clearance, altitude limits, etc.). Flight-envelope monitoring continuously checks real-time state against constraints and can clamp or reshape commands into safe bounded commands. Fault detection watches for abnormal conditions such as sensor dropouts, excessive vibration, overheating, unstable oscillations, or inconsistent

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navigation signals. If risk is detected, the safety governor triggers emergency behaviors like hover, slow mode, safe return, or controlled landing.

5 In parallel, the Cognitive Mission Loop represents the higher-level reasoning and mission autonomy layer. It performs goal selection and route planning, meaning it decides where the drone should go and how it should cover a region or follow waypoints. It also performs risk and environment assessment, evaluating whether the environment is safe enough to proceed based on sensor confidence, obstacle density, wind disturbances, and navigation reliability. Finally, it handles task and battery management, ensuring that mission  
10 objectives are scheduled within energy constraints, and it determines when the drone must return-to-home or abort a mission for safety. This cognitive loop produces higher-level validated control intents (such as route commands or speed policy changes), but these still must pass through safety enforcement before execution.

15 The diagram also includes a Safety-Constrained Learning block, which is responsible for controlled adaptation. This layer performs fine-tuned learning updates—for example, minor calibrations, threshold adjustments, or bounded parameter tuning of perception and reflex models—to handle drift, noise, and changing environments. The learning block includes a Safety Assurance Layer, meaning that learning is not applied blindly. Instead,  
20 updates are accepted only if they maintain or improve safety metrics such as stability margin, obstacle clearance reliability, and reduced oscillation risk. This is what makes the invention practically deployable: it allows improvement over time while preventing unsafe model drift. The arrows labeled bounded control commands and safety-constraint learning indicate that adaptation is tightly connected to safety governance and cannot override safety  
25 constraints.

At the bottom, the Motor Controller / Flight Controller block represents the final execution layer that converts safe bounded commands into actual motor output signals. It processes attitude setpoints (desired roll/pitch/yaw), velocity vectors, and motor mixing signals (how  
30 thrust is distributed across motors). The flight controller then generates real-time

PWM/DShot commands to the ESCs/motors. In the diagram, you see that only bounded control commands reach this layer—meaning commands already verified by the safety governor. This ensures deterministic, stable control output even when the AI layers produce aggressive actions, because the execution layer always receives commands constrained to safe flight limits.

The arrows in the diagram illustrate that the invention is a closed-loop system with continuous feedback and supervision. Neuromorphic perception continuously produces event and IMU signals; the reflex loop continuously proposes fast stabilization actions; the cognitive mission loop continuously updates goals and risk policies; the safety governor continuously filters, validates, and can override commands; and the learning layer continuously adapts within safe limits. The end result is that motor outputs are always produced through a safety-bounded pipeline, while both reflex and mission intelligence contribute to autonomy at different time scales.

The diagram shows that the innovation is defined by: (1) neuromorphic perception feeding a spiking reflex control loop, (2) a separate cognitive mission reasoning loop, (3) a safety governor that validates all commands and triggers emergency response, (4) a safety-constrained learning mechanism that adapts without risking unsafe behavior, and (5) a flight controller that executes only bounded safe commands into motor outputs. This structured separation of layers and enforced safety gating is a key differentiator from prior art where AI inference and control are often tightly coupled without strong safety assurance and without neuromorphic event-driven reflex architecture.

**Figure 6** illustrates a system a Swarm Coordination Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System, according to yet another embodiment of the present invention.

The Swarm Coordination Diagram explains how multiple ASI-based neuromorphic autonomous drones cooperate as a team while remaining resilient to faults, navigation

anomalies, and hazardous environments. The overall purpose is to show that autonomy is not limited to a single drone; instead, each drone contributes local intelligence and shares compact neuromorphic information so that the swarm can collectively complete missions such as search-and-rescue, large-area surveillance, mapping, inspection, or environmental monitoring. The diagram also highlights that the swarm is designed to remain stable even when one drone experiences GPS errors or when another encounters dense obstacles.

At the top center, the Ground Control Station (GCS) represents the human operator or mission computer. The GCS sends Command and Mission Updates to the swarm (shown with green dashed arrows) such as mission objectives, geofence limits, priority regions, and abort/return rules. The GCS also receives summarized feedback from the swarm so that a human can monitor mission progress without needing full video streaming from every drone. Importantly, the architecture supports both supervised operations (where GCS actively directs) and semi-autonomous operations (where GCS issues goals and the swarm self-organizes).

In the center, the box labeled Neuromorphic Reflex Loop acts as the swarm's shared coordination logic (conceptually a common protocol that runs on each drone or is distributed across drones). This block represents the common software capability inside every swarm member for generating and exchanging Spiking Embeddings/Events and Hazard Maps / Local Grid. "Spiking embeddings" are compact representations derived from event-based perception and spiking neural processing—these can encode motion cues, obstacle likelihood, free-space direction, or target signatures without transmitting raw video. The hazard maps/local grid represent short-range environmental risks such as obstacles, unsafe zones, or dynamic threats. By exchanging these compact representations, drones can coordinate effectively with low bandwidth and high speed.

The drones around the diagram represent individual swarm agents (for example Drone A, Drone D, and other members). Each drone runs its own neuromorphic perception and control, but shares selected information with the swarm. Blue dashed arrows indicate

Spiking Embeddings/Events being exchanged among drones and with the coordination block. This allows each drone to benefit from the perceptions of others—for example, if one drone detects a moving obstacle or target, it can share a compact signature so the swarm can reorient or verify from multiple angles.

5

Orange dashed arrows represent sharing of Hazard Maps / Local Grid. This is a critical safety feature: drones do not need to physically enter dangerous areas to learn about them—one drone can map local hazards and broadcast them so others reroute. For example, in the diagram the drone on the right side is associated with HIGH OBSTACLE DENSITY. That drone’s hazard grid can be shared so that other drones can avoid cluttered corridors, reduce speed near that region, or choose a safer altitude route. This enables swarm-level path planning and coverage optimization while minimizing collision risk.

Yellow dashed arrows represent Trust Flags (Anomaly, GPS, Obstacle Alert). These flags indicate that the swarm continuously evaluates the trustworthiness of information coming from each drone. If a drone’s navigation signals are inconsistent (for example, GPS is spoofed, jammed, or degraded), the drone generates a trust flag warning. The diagram explicitly shows GPS INCONSISTENT warnings around a drone, indicating that the swarm can detect that drone’s GPS-derived position does not match inertial or vision-based motion cues. When such a flag is raised, the swarm can reduce dependence on that drone’s global location reports and instead rely on other drones’ verified measurements or local relative coordination.

The shield/alert icons and the legend block “Anomaly Detection & Fault Tolerance / Coordination Module” indicate that the swarm includes dedicated logic for fault tolerance. This module checks consistency across shared data: whether hazard maps align, whether reported positions are physically plausible, whether spiking embeddings match expected target signatures, and whether a drone’s behavior deviates from swarm norms. If a drone is suspected to be unreliable (for example due to GPS inconsistency or sensor failure), the swarm can isolate it from critical decision-making, assign it a safer role (like hovering or

acting as a relay), or instruct it to return-to-home. This ensures that a single weak node does not compromise the entire mission.

5 The bottom banner labeled SWARM NETWORK represents the communication fabric connecting all drones. This could be implemented using Wi-Fi mesh, long-range radio, LTE/5G (when available), or a hybrid. The key point shown by the diagram is that swarm communication is based on lightweight intelligence exchanges—compact event embeddings, hazard grids, and trust flags—rather than heavy raw data. This dramatically improves scalability: as the number of drones increases, bandwidth remains manageable  
10 and coordination remains real-time.

In practical swarm operation, the flow works as follows: the GCS broadcasts mission goals; each drone explores or executes tasks locally using neuromorphic reflex autonomy; drones publish spiking embeddings and hazard grids; the swarm coordination logic aggregates  
15 these signals to build a cooperative understanding; anomaly detection monitors inconsistencies; trust flags mark unreliable drones or hazardous zones; and tasks are dynamically redistributed (for example, a drone experiencing GPS inconsistency can be reassigned to a safe role, while another drone takes over the high-precision mapping task). As a result, the swarm can maintain mission success even in complex environments with  
20 obstacles, noise, or adversarial navigation conditions.

**Figure 7** illustrates a computer-implemented method for controlling an autonomous neuromorphic drone system, according to an embodiment of the present invention.

25 According to an embodiment of the present invention, the computer-implemented method for controlling an autonomous neuromorphic drone system is disclosed. At step 702, the method comprises receiving, from at least one event-based vision sensor, asynchronous event data representing pixel-level brightness changes including associated timestamps.

At step 704, the method comprises receiving inertial motion data from at least one inertial measurement unit (IMU) (118).

5 At step 706, the method comprises processing the asynchronous event data and the inertial motion data using a neuromorphic processing unit (106) executing a spiking neural network (SNN) to generate real-time perception outputs including at least one of ego-motion estimation, obstacle proximity detection, free-space direction identification, and collision risk estimation.

10 At step 708, the method comprises generating, by a neuromorphic reflex control module (108), immediate flight stabilization and collision-avoidance commands based on the real-time perception outputs.

15 At step 710, the method comprises generating, by a cognitive mission control module (110), higher-level mission commands including at least one of waypoint planning, route adjustment, task scheduling, battery-aware mission modification, and risk evaluation.

20 At step 712, the method comprises validating, by a safety governor module (112), the flight stabilization commands and the higher-level mission commands against predefined flight-envelope constraints including at least one of attitude limits, velocity limits, altitude limits, geofence boundaries, obstacle clearance thresholds, and battery reserve thresholds;

25 At step 714, the method comprises modifying or overriding commands that violate the predefined flight-envelope constraints to produce safety-bounded control commands.

At step 716, the method comprises transmitting the safety-bounded control commands to a flight controller (114) configured to generate motor control signals for a propulsion system of the drone. The processing of sensory data is event-driven such that computation is triggered by asynchronous sensory events rather than periodic frame-based image acquisition. The neuromorphic reflex control module (108) operates at a higher control

30

frequency than the cognitive mission control module (110) to provide ultra-low-latency stabilization independently of mission-level planning.

5 According to one embodiment, the method further comprises a process for safety-constrained autonomous navigation of a neuromorphic drone, wherein the process, comprises collecting operational flight data including event-based perception data, inertial measurements, control outputs, and safety margin indicators, performing bounded parameter updates to at least one of a spiking neural network model, sensor calibration parameter, and control gain parameter based on the operational flight data, evaluating the  
10 bounded parameter updates against predefined safety metrics including stability margin, obstacle avoidance reliability, and flight-envelope compliance, rejecting parameter updates that degrade the predefined safety metrics and restoring a previously validated parameter state, detecting navigation inconsistencies by comparing global navigation data with locally estimated motion derived from event-based processing and inertial fusion, reducing  
15 reliance on inconsistent navigation sources and activating a fallback navigation mode upon detection of anomaly, wherein adaptation and navigation correction occur during active flight **while maintaining compliance with** enforced safety constraints..

20 According to one embodiment, the asynchronous event data comprises pixel coordinates, polarity information, and timestamp information generated by a dynamic vision sensor.

According to one embodiment, the method further comprises at least one of a: (a) aggregating the asynchronous event data into time-windowed event surfaces prior to executing the spiking neural network, (b) filtering noise events based on temporal  
25 consistency and spatial clustering thresholds, and (c) fusing the inertial motion data with event-based perception outputs to improve motion estimation accuracy.

According to one embodiment, the spiking neural network performs event-driven visual odometry to estimate relative motion of the drone.

30

According to one embodiment, the method of generating immediate flight stabilization commands comprises directly mapping spiking neural network outputs to roll, pitch, yaw, and throttle adjustments.

- 5 According to one embodiment, the neuromorphic reflex control module (108) operates independently of the cognitive mission control module (110) during detection of imminent collision events.

10 According to one embodiment, the reflex control commands are generated at a frequency greater than 100 Hz.

According to one embodiment, the method of validating the commands comprises continuously enforcing predefined maximum attitude angles and angular rate limits.

- 15 According to one embodiment, the method of modifying commands that violate flight-envelope constraints comprises clamping control outputs to nearest permissible safe values.

According to one embodiment, parameter updates that reduce stability margin are rejected and **previously** validated parameters are restored.

20

The system and method disclosed herein may be utilized in multiple real-world scenarios, including but not limited to:

A. Safety-critical and time-critical missions

- 25 1. Search & Rescue (SAR) and missing-person search in forests, hills, rubble, and flood zones—fast “reflex” obstacle avoidance + autonomous scanning reduces operator load and improves response speed.

2. Disaster response (earthquakes, floods, cyclones): rapid situational awareness, victim-zone sweep, and safe navigation through smoke/dust/low-visibility environments.
3. Fire and smoke operations (industrial fires, forest fires): event-driven perception supports navigation and hazard detection in smoke/glare and fast-changing scenes.
4. Emergency safety inspection after incidents (bridges, towers, chemical plants): the safety governor + fail-safe modes support conservative flight, safe landing/return-to-home under risk.

#### 10 B. Infrastructure and industrial inspection

1. Powerline and substation inspection (insulators, poles, transmission corridors) with safer close-proximity flight due to high-frequency reflex control and obstacle clearance.
2. Pipeline and oil & gas corridor inspection across remote terrain with limited connectivity (edge-first autonomy without cloud dependence).
3. Telecom tower and rooftop inspection in dense urban corridors where GPS multipath and clutter exist; the system supports GPS-degraded operation and conservative fallback behaviors.
4. Railway track, bridge, dam, and highway inspection with low-latency stabilization for stable imaging and safer navigation around structures.

#### C. Agriculture, forestry, and environment

1. Precision agriculture: crop monitoring, stress detection (via motion/edge cues + optional payload sensors), scouting with long flight time due to reduced compute energy.
2. Spray-assist guidance / smart route planning (where legally permitted): mission loop selects optimal coverage paths, while safety governor enforces safe altitude/speed constraints.

3. Forest and wildlife monitoring: low-disturbance, low-bandwidth operations using compact summaries instead of heavy video streaming; useful in low connectivity regions.
4. Environmental monitoring: air/waterbody perimeter mapping, erosion tracking, floodplain survey, landslide risk monitoring—especially where lighting changes rapidly.

#### D. Indoor and GPS-denied operations

1. Warehouse, factory, and indoor inspection (GPS-denied spaces): event-based odometry cues + IMU fusion support stable navigation and mapping without GPS.
2. Mining, tunnels, basements, and confined-space reconnaissance: reflex loop stabilizes in tight spaces; safety governor can trigger safe hover/landing on uncertainty.
3. Construction-site monitoring with obstacles, cranes, and moving equipment: fast detection of dynamic objects and collision avoidance improves operational safety.

#### E. Security, surveillance, and public safety

1. Perimeter security / facility surveillance for industrial plants, campuses, and critical infrastructure using autonomous patrol paths and risk-aware behavior.
2. Traffic and smart-city surveillance: road-incident detection support, congestion monitoring, accident-prone zone tracking, and event-driven motion cue extraction.
3. Remote-area surveillance with intermittent connectivity: decentralized, edge-first autonomy reduces dependence on network availability.

#### F. Swarm / cooperative missions (multi-drone)

1. Large-area distributed search patterns (SAR, wildlife, surveillance) using swarm sharing of compact spiking embeddings and hazard maps.

2. Cooperative mapping and multi-angle verification (e.g., inspection from multiple viewpoints) with low bandwidth because drones share compact event summaries rather than raw video.
3. Resilience in swarms: isolation of abnormal drones (e.g., GPS inconsistency / spoofing suspicion) using trust flags and behavior consistency checks.

#### G. Robustness and reliability uses (feature-driven uses)

1. Operation in low light, glare, flicker, smoke, dust and rapidly changing scenes where frame-based vision is unreliable, because perception is event-driven and spatiotemporal.
2. High-speed / cluttered flight stability due to a high-frequency neuromorphic reflex loop that reduces perception-to-control latency.
3. GPS-denied / GPS-degraded navigation and spoofing/jamming resilience via anomaly detection and fallback guidance modes integrated into the autonomy stack.
4. Longer endurance / better thermal profile on small drones because event-driven processing reduces redundant compute, improving flight time and thermal efficiency.

The foregoing description describes embodiments of the present invention. It should be appreciated that these embodiments are described for the purpose of illustration only, and that numerous alterations and modifications may be practiced by those skilled in the art without departing from the scope of the invention. It is intended that all such modifications and alterations be included in so far as they come within the scope of the invention as claimed or the equivalents thereof.

25

**We claim:**

1. An autonomous neuromorphic drone system (100), comprising:

an aerial platform (102) including an airframe, a propulsion system comprising one or more motors, and at least one electronic speed controller;

5 a neuromorphic sensor suite (104), comprising:

at least one event-based vision sensor (116) configured to generate asynchronous event data representing pixel-level brightness changes with associated timestamps, and

10 at least one inertial measurement unit (IMU) (118) configured to generate motion and orientation data;

a neuromorphic processing unit (106) operatively coupled to the neuromorphic sensor suite (104) and configured to:

15 receive the asynchronous event data and the motion and orientation data, perform event-driven processing using a spiking neural network (SNN), and generate real-time environment perception outputs including at least one of ego-motion estimation, obstacle proximity estimation, free-space direction identification, and collision risk indication;

a neuromorphic reflex control module (108) configured to:

20 receive the environment perception outputs, and generate immediate flight control commands for stabilization and collision avoidance based on the event-driven processing;

a cognitive mission control module (110) configured to:

25 determine mission-level objectives including at least one of goal selection, path planning, task scheduling, energy management, and risk assessment, and generate higher-level flight intent commands;

a safety governor module (112) operatively coupled to the neuromorphic reflex control module (108) and the cognitive mission control module (110), the safety governor module being configured to:

30 validate flight control commands and flight intent commands against predefined flight-envelope constraints,

enforce safety limits including at least one of maximum attitude limits, velocity limits, altitude limits, geofence constraints, obstacle clearance thresholds, and battery reserve thresholds, and

5 trigger a safe operating mode including at least one of hover, speed reduction, return-to-home, controlled descent, and landing upon detection of a fault or elevated risk condition; and

a flight controller (114) configured to receive validated and safety-bounded control commands from the safety governor and to generate motor control signals to the propulsion system,

10 wherein:

the system operates using an event-driven perception-to-control pipeline in which computation is triggered by asynchronous sensory events rather than periodic frame-based image acquisition; and

15 the neuromorphic reflex control module (108) configured to operate at a higher control frequency than the cognitive mission control module (110) to provide ultra-low-latency stabilization and collision avoidance independently of mission-level planning.

2. The system (100) as claimed in claim 1, wherein

20 the event-based vision sensor (116) comprises a dynamic vision sensor configured to output pixel-level events including spatial coordinates, polarity, and timestamp information;

the neuromorphic processing unit (106) performs event aggregation including time-window accumulation, noise filtering, and spatiotemporal feature extraction prior to spiking neural network inference; and

25 the spiking neural network is configured to estimate relative motion using event-driven visual odometry.

3. The system (100) as claimed in claim 1, further comprising at least one additional ranging sensor selected from the group consisting of radar, lidar, ultrasonic sensor, optical flow sensor, and barometric altimeter.

4. The system (100) as claimed in claim 1, wherein the neuromorphic reflex control module (108) directly maps spiking neural network outputs to roll, pitch, yaw, and throttle adjustments,  
wherein the neuromorphic reflex control module (108) configured to operate  
5 independently of the cognitive mission control module (110) during transient obstacle detection events,  
wherein the neuromorphic reflex control module (108) configured to execute at a control frequency greater than 100 Hz.
5. The system (100) as claimed in claim 1, wherein the cognitive mission control module  
10 (110) configured to perform dynamic waypoint re-planning based on obstacle density and sensor confidence levels,  
wherein the cognitive mission control module (110) configured to evaluate mission feasibility based on at least one of battery state, environmental complexity, and navigation reliability.
- 15 6. The system (100) as claimed in claim 1, wherein the safety governor continuously enforces a predefined flight envelope including maximum attitude angles, angular rate limits, and minimum obstacle clearance thresholds,  
wherein the safety governor performs anomaly detection by comparing GPS-derived position data with inertial and event-based odometry estimates,  
20 wherein the safety governor automatically transitions the drone into a conservative flight mode upon detection of elevated uncertainty,  
wherein the conservative flight mode includes reduced speed and increased obstacle avoidance margins.
7. The system (100) as claimed in claim 1, further comprising a safety-constrained self-  
25 adaptation engine configured to update model parameters based on operational data collected during flight,  
wherein parameter updates are validated against safety metrics prior to deployment,  
wherein unsafe parameter updates are rejected and a previously validated model state is restored,

wherein adaptation includes at least one of sensor calibration adjustment, control gain tuning, and bounded synaptic weight modification in the spiking neural network.

8. The system (100) as claimed in claim 1, wherein the neuromorphic processing unit (106) configured to supports navigation in GPS-denied environments using event-based odometry and inertial fusion.

9. The system (100) as claimed in claim 1, wherein the system detects GPS spoofing or jamming by identifying inconsistencies between global navigation data and locally estimated motion,

wherein the system reduces reliance on corrupted navigation sources and shifts to a fallback guidance mode.

10. The system (100) as claimed in claim 1, further comprising a swarm coordination module configured to exchange compact spiking embeddings with at least one additional drone,

wherein the exchanged information includes hazard maps or local obstacle grids,

wherein the swarm coordination module assigns trust scores to participating drones based on behavioral consistency,

wherein a drone with reduced trust score is isolated from mission-critical coordination decisions.

11. The system (100) as claimed in claim 1, wherein the neuromorphic processing unit (106) comprises a dedicated neuromorphic accelerator or FPGA-based event-processing fabric.

12. The system (100) as claimed in claim 1, wherein event-driven computation reduces redundant data processing relative to frame-based image acquisition.

13. The system (100) as claimed in claim 1, wherein the system is configured to operate independently of continuous cloud connectivity.

14. The system (100) as claimed in claim 1, wherein perception-to-control latency is reduced by processing asynchronous events in the absence of frame buffering.

15. A computer-implemented method for controlling an autonomous neuromorphic drone system, the method comprising:

receiving, from at least one event-based vision sensor, asynchronous event data representing pixel-level brightness changes including associated timestamps;

receiving inertial motion data from at least one inertial measurement unit (IMU) (118);

5 processing the asynchronous event data and the inertial motion data using a neuromorphic processing unit (106) executing a spiking neural network (SNN) to generate real-time perception outputs including at least one of ego-motion estimation, obstacle proximity detection, free-space direction identification, and collision risk estimation;

10 generating, by a neuromorphic reflex control module (108), immediate flight stabilization and collision-avoidance commands based on the real-time perception outputs;

generating, by a cognitive mission control module (110), higher-level mission commands including at least one of waypoint planning, route adjustment, task scheduling, battery-aware mission modification, and risk evaluation;

15 validating, by a safety governor module (112), the flight stabilization commands and the higher-level mission commands against predefined flight-envelope constraints including at least one of attitude limits, velocity limits, altitude limits, geofence boundaries, obstacle clearance thresholds, and battery reserve thresholds;

20 modifying or overriding commands that violate the predefined flight-envelope constraints to produce safety-bounded control commands;

transmitting the safety-bounded control commands to a flight controller (114) configured to generate motor control signals for a propulsion system of the drone,

25 wherein:

the processing of sensory data is event-driven such that computation is triggered by asynchronous sensory events rather than periodic frame-based image acquisition; and

the neuromorphic reflex control module (108) operates at a higher control frequency than the cognitive mission control module (110) to provide ultra-low-latency stabilization independently of mission-level planning.

16. The method as claimed in claim 15, comprising a process for safety-constrained autonomous navigation of a neuromorphic drone, comprising:

collecting operational flight data including event-based perception data, inertial measurements, control outputs, and safety margin indicators;

performing bounded parameter updates to at least one of a spiking neural network model, sensor calibration parameter, and control gain parameter based on the operational flight data;

evaluating the bounded parameter updates against predefined safety metrics including stability margin, obstacle avoidance reliability, and flight-envelope compliance;

rejecting parameter updates that degrade the predefined safety metrics and restoring a previously validated parameter state;

detecting navigation inconsistencies by comparing global navigation data with locally estimated motion derived from event-based processing and inertial fusion; and

reducing reliance on inconsistent navigation sources and activating a fallback navigation mode upon detection of anomaly,

wherein adaptation and navigation correction occur during active flight while maintaining compliance with enforced safety constraints.

Dated this 8<sup>th</sup> day of February 2026

Signature

-Digitally Signed-  
Anuradha Gupta  
Patent Agent (IN/PA-1514)  
Agent for the Applicant

## ABSTRACT

### **ARTIFICIAL SUPER-INTELLIGENCE (ASI) BASED NEUROMORPHIC AUTONOMOUS DRONE SYSTEM**

5

The present invention discloses an autonomous neuromorphic drone system (100) and its method. The system comprises an aerial platform (102), a neuromorphic sensor suite (104), a neuromorphic processing unit (106), a neuromorphic reflex control module (108), a cognitive mission control module (110), a safety governor module (112), and a flight controller (114). The aerial platform includes an airframe, a propulsion system and at least one electronic speed controller. The neuromorphic sensor suite (104) comprises one or more event-based vision sensor (116) configured to generate asynchronous event data representing pixel-level brightness changes with associated timestamps, and at least one inertial measurement unit (IMU) (118) configured to generate motion and orientation data.

10

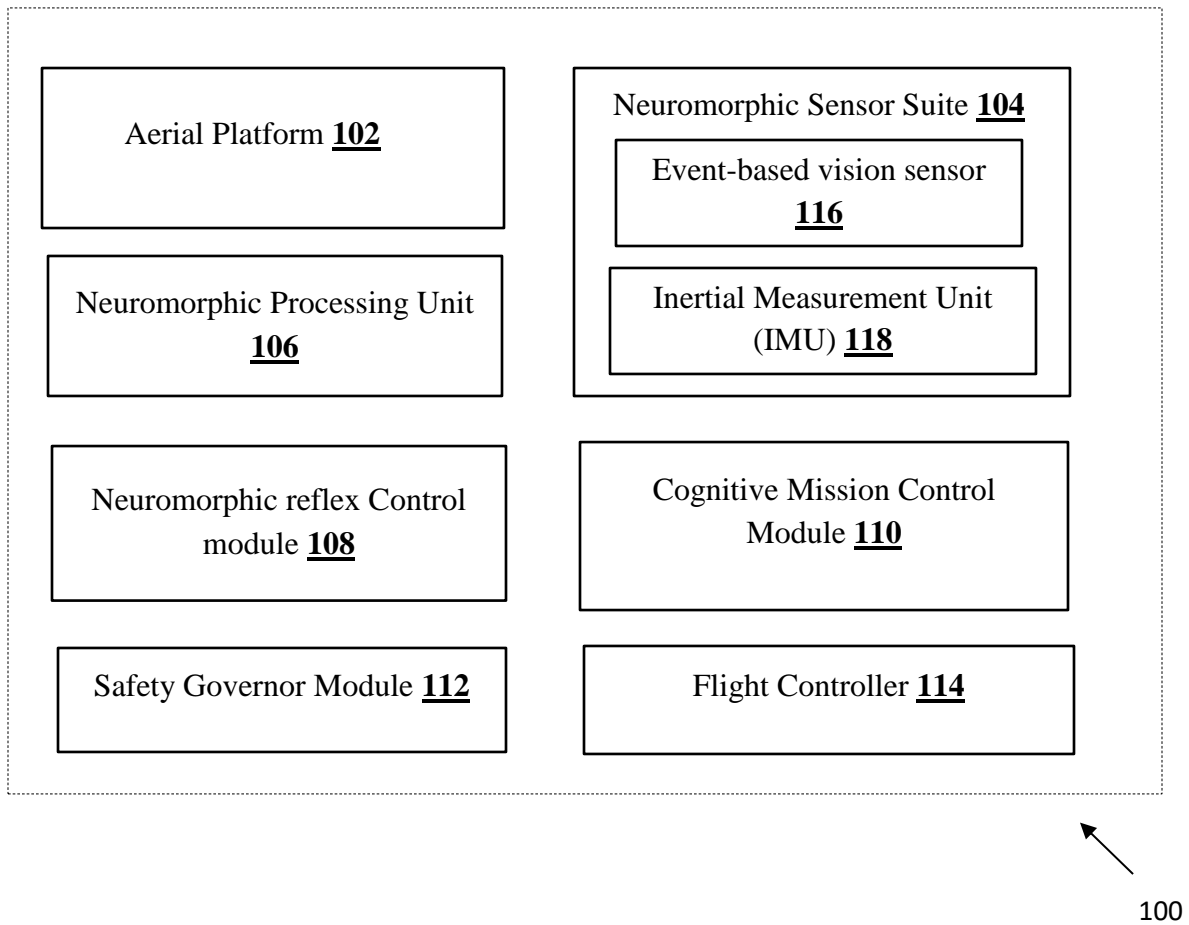
15

The neuromorphic processing unit (106) operatively coupled to the neuromorphic sensor suite (104). The flight controller (114) is configured to receive validated and safety-bounded control commands from the safety governor and to generate motor control signals to the propulsion system.

20

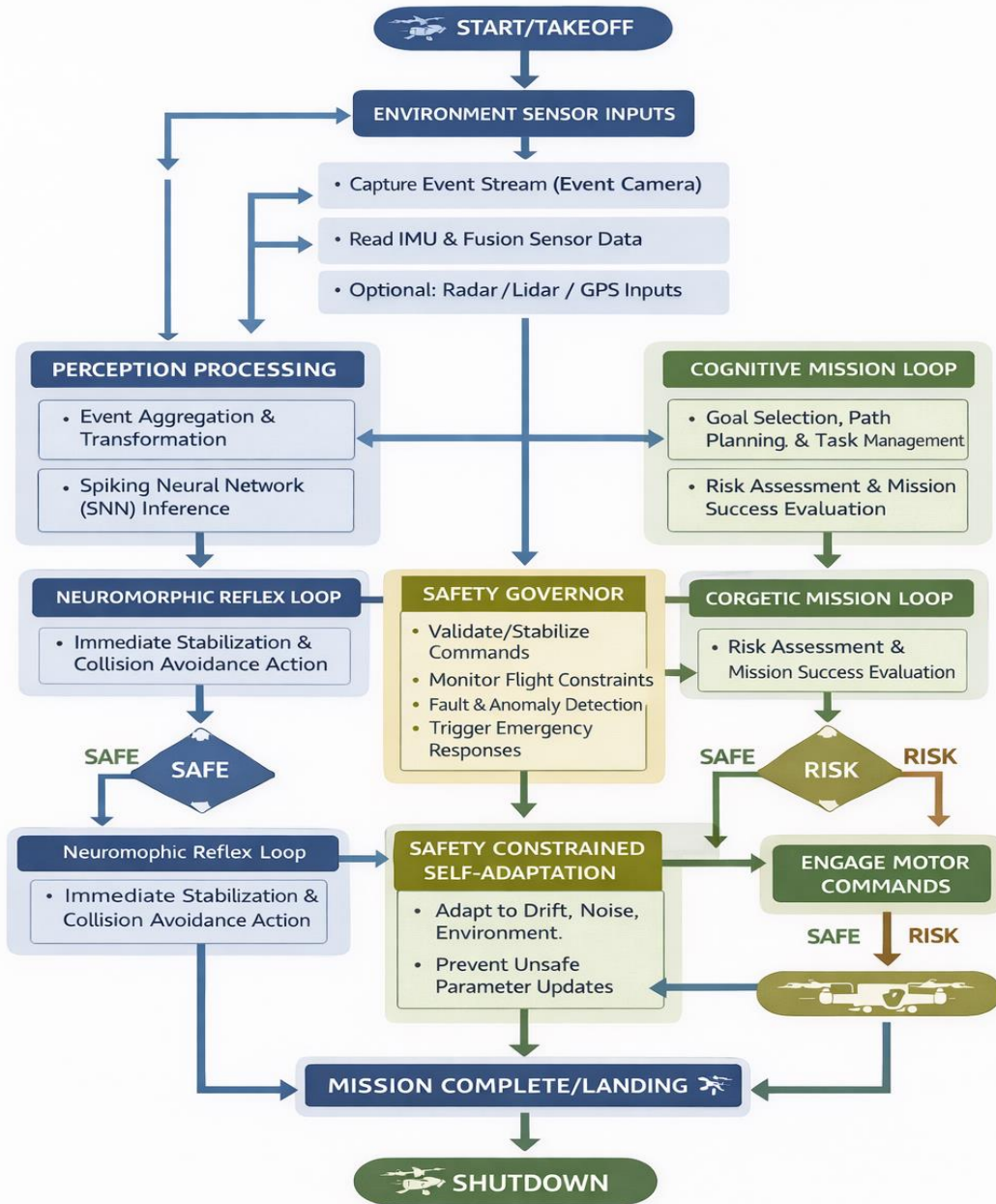
**Figure 1**

25



**Figure 1**

**Flowchart of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System**



**Figure 2**

### Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System

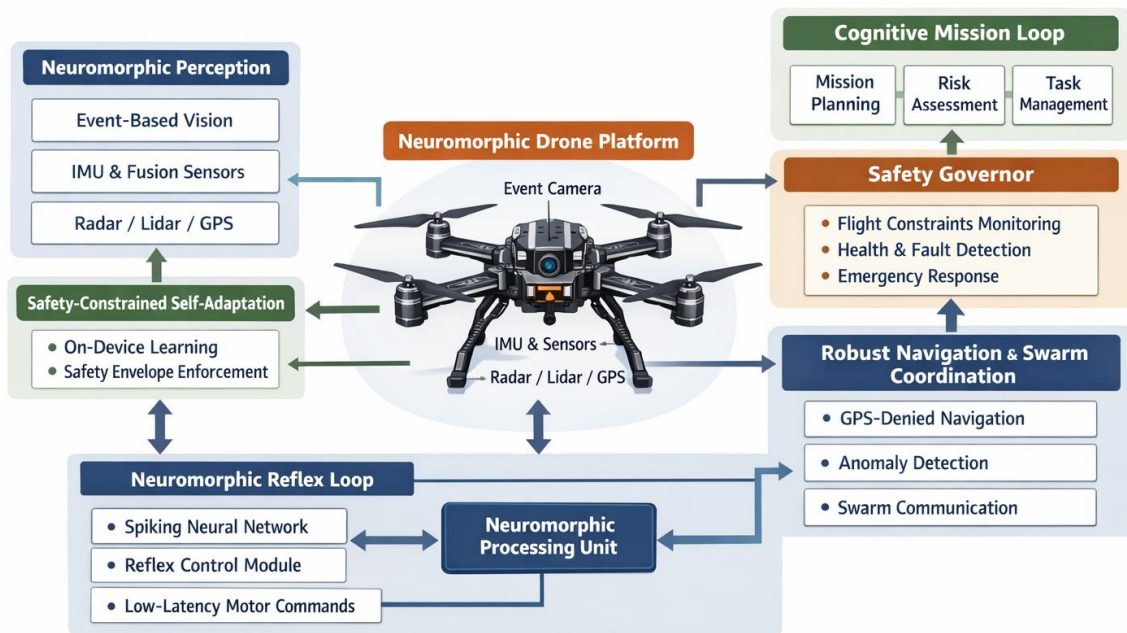


Figure 3

### Hardware Block Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System

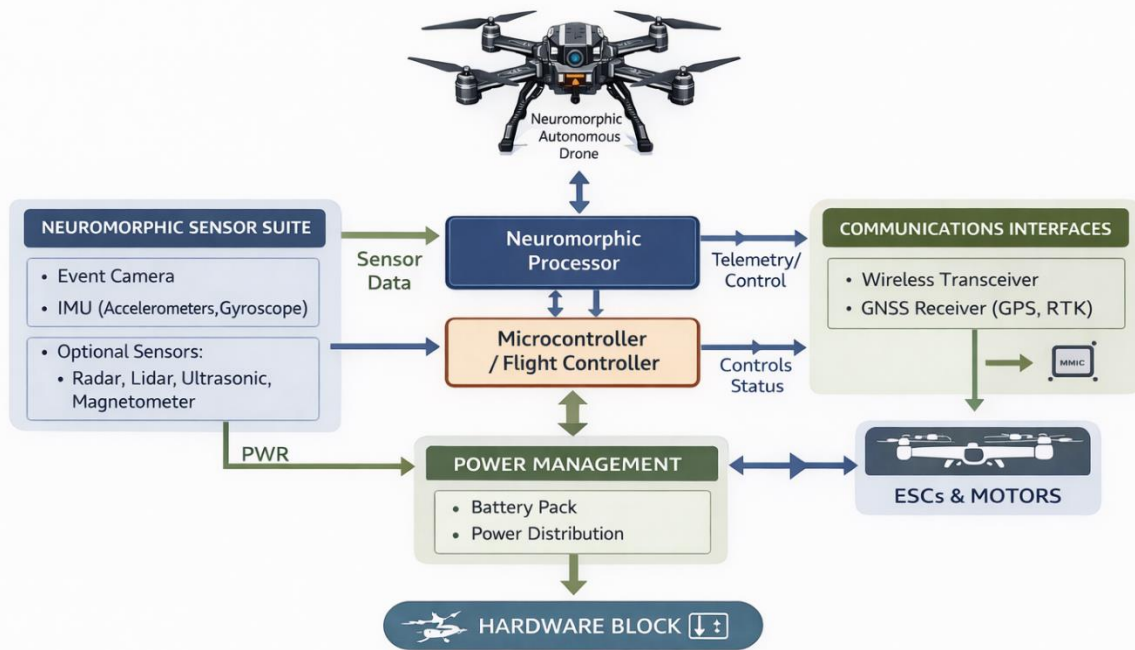


Figure 4

### Logic Layer Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System

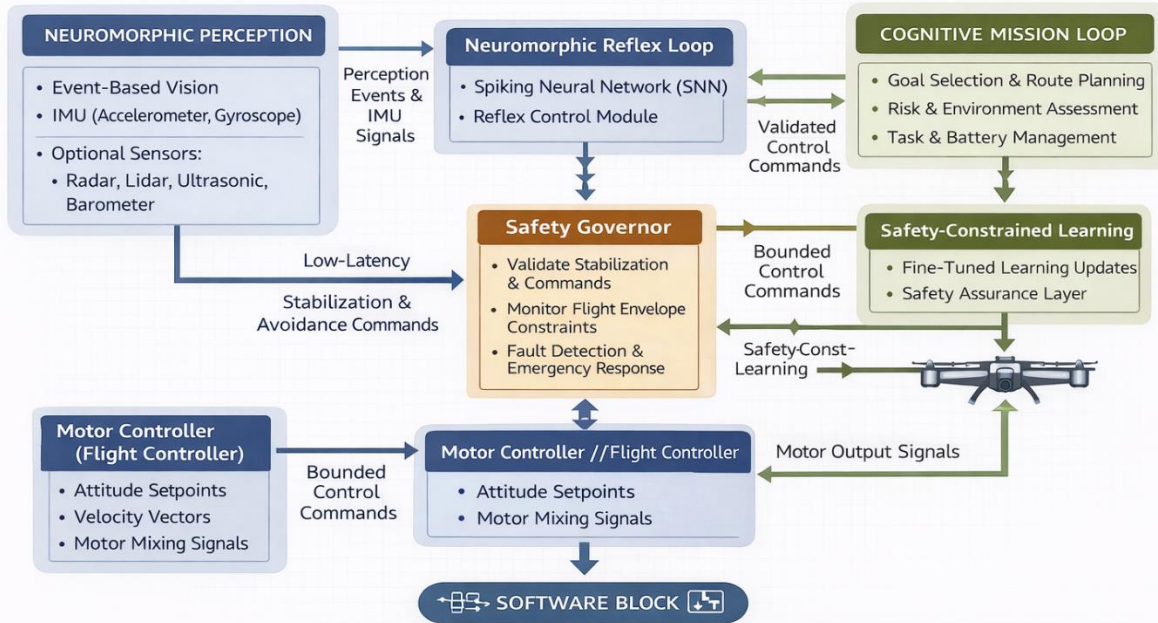


Figure 5

### Swarm Coordination Diagram of Artificial Super-Intelligence Based Neuromorphic Autonomous Drone System

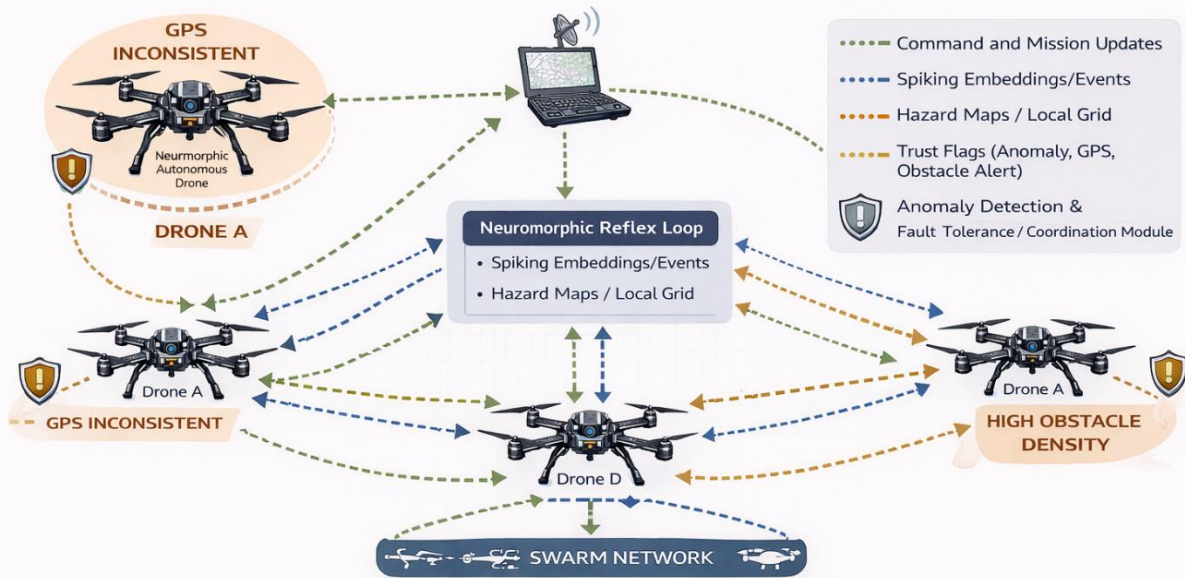
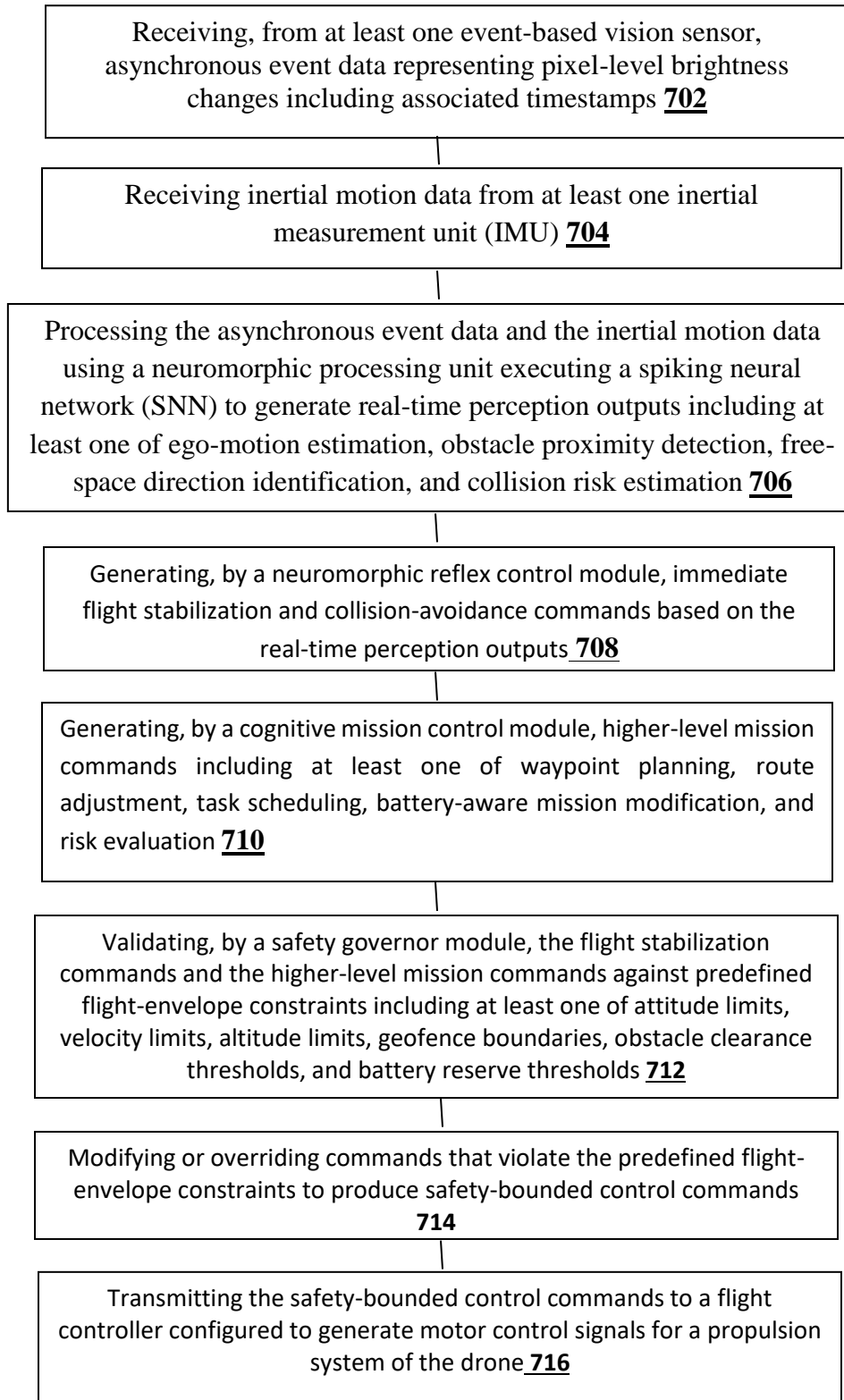


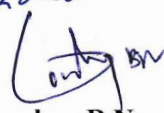
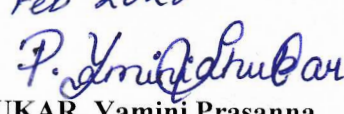
Figure 6



**Figure 7**

"FORM 1 THE PATENTS ACT 1970 (39 of 1970) and THE PATENTS RULES, 2003 APPLICATION FOR GRANT OF PATENT (See section 7, 54 and 135 and sub-rule (1) of rule 20)		(FOR OFFICE USE ONLY)			
		Application No.		202631013668	
		Filing date:			
		Amount of Fee paid:			
		CBR No:			
		Signature:			
1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)					
2. TYPE OF APPLICATION *Please tick (✓) at the appropriate category+					
Ordinary (✓)		Convention ( )		PCT-NP ( )	
Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )
3A. APPLICANT(S)					
Name in Full		Nationality	Country of Residence	Address of the Applicant	
SRJX RESEARCH AND INNOVATION LAB LLP		Indian Company	INDIA	House No.	PLOT NO.-3E/474 SECTOR-9, CDA
				Street	POST- MARKAT NAGAR,
				City	CUTTACK
				State	ODISHA
				Country	INDIA
				Pin code	753014
3B. CATEGORY OF APPLICANT *Please tick (✓) at the appropriate category+					
Natural Person ( )		Other than Natural Person (✓)			
		Small Entity ( )	Startup (✓)	Others ( )	
4. INVENTOR(S) *Please tick (✓) at the appropriate category+					

Are all the inventor(s) same as the applicant(s) Named above?	Yes ( )	No (✓)	
If "No", furnish the details of the inventor(s)			
Name in Full	Nationality	Country of Residence	Address of the Inventor
<b>JENA, Soumya Ranjan</b>	<b>INDIAN</b>	<b>INDIA</b>	House No. <b>PLOT NO.-3E/474 SECTOR-9, CDA</b>
			Street <b>POST- MARKAT NAGAR</b>
			City <b>CUTTACK</b>
			State <b>ODISHA</b>
			Country <b>INDIA</b>
			Pin code <b>753014</b>
<b>GOWDA, Shankar B N</b>	<b>INDIAN</b>	<b>INDIA</b>	House No. <b>No. 6, KANNAGUNI, N M PURA POST YEDIUR HOBLI KUNIGAL TALUK TUMKUR DISTRICT BANGALORE - 572130, KARNATAKA, INDIA</b>
<b>SAHUKAR, Yamini Prasanna</b>	<b>INDIAN</b>	<b>INDIA</b>	House No. <b>No. 314, 3<sup>rd</sup> STAGE, 4<sup>th</sup> BLOCK, BASAVESHWARA NAGARA, BENGALURU-560079, KARNATAKA, INDIA</b>
<b>5. TITLE OF THE INVENTION: ARTIFICIAL SUPER-INTELLIGENCE (ASI) BASED NEUROMORPHIC AUTONOMOUS DRONE SYSTEM</b>			
<b>6. AUTHORISED REGISTERED PATENT AGENT(S)</b>	Patent Agent No.	<b>1514</b>	
	Name	<b>ANURADHA GUPTA</b>	
	Mobile No.	<b>9213764385</b>	
<b>7. ADDRESS FOR SERVICE OF APPLICANT IN INDIA</b>	Name	<b>S G INTELLECTUAL</b>	
	Postal Address	<b>4-D ( UPPER FLOOR), DDA POCKET-2 SECTOR-6, DWARKA, NEW DELHI-110075, DELHI</b>	
	Telephone No.	<b>011 35586108</b>	

		Mobile No.	9213764385	
		E-mail ID	sav@sgintellectual.com	
8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION				
Country	Application Number	Filing date	Name of the applicant	Title of the Invention
-----	-----	-----	-----	-----
9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)				
International application number		International filing date		
-----		-----		
10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION-NA				
Original (first) application No		Date of filing of original (first) application		
-----		-----		
11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT-NA				
Main application/patent No.-----		Date of filing of main application -----		
12. DECLARATIONS				
(i) Declaration by the inventor(s)- (In case the applicant is an assignee: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).				
We, the above named inventors are the true & first inventors for this Invention and declare that the applicant herein is our assignee or legal representative.				
i) (a) Date: 9 <sup>th</sup> Feb 2026				
(b) Signature: Soumya Ranjan Jena				
(c) Name : JENA, Soumya Ranjan				
ii) (a) Date: 9 <sup>th</sup> Feb 2026				
(b) Signature: 				
(c) Name: GOWDA, Shankar B N				
iii) (a) Date: 9 <sup>th</sup> Feb 2026				
(b) Signature: 				
(c) Name: SAHUKAR, Yamini Prasanna				

ii) Declaration by the applicant(s) in the convention country ---N/A  
 (In case the applicant in India is different than the applicant in the convention country: the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)

I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.

- (a) Date
- (b) Signature(s)
- (c) Name(s)

(iii) Declaration by the applicant(s)

- I/We the applicant(s) hereby declare(s) that: -
- I am/We are in possession of the above-mentioned invention.
- The Complete Specification relating to the invention is filed with this Application.
- The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.
- There is no lawful ground of objection(s) to the grant of the Patent to me/us.
- I am/we are the true & first inventor(s).
- I am/we are the assignee or legal representative of true & first inventor(s).
- The application or each of the applications, particulars of which are given in Paragraph 8, was the first application in convention country/countries in respect of my/our invention(s).
- I/We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by me/us or by any person from which I/We derive the title.
- My/our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph 9.
- The application is divided out of my /our application particulars of which is given in Paragraph 10 and pray that this application may be treated as deemed to have been filed on DD/MM/YYYY under section 16 of the Act.

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) Form 1

Item	Details	Fee	Remarks
Complete specification	No. of Pages - 46	Rs. 8320/-	
Claim(s)	No. of Claims - 16 No. of Pages - 6	-----	-----
Abstract	No. of Pages - 1		
Drawing(s)-	No. of Drawings - 7 No. of Pages - 7		

- (b) Complete Specification
  - (d) Drawings
  - (c) Abstract
  - (d) Application Form-1
  - (e) DIPP Certificate.
  - (f) Form-28
- .....

We hereby declare that to the best of our knowledge, information and belief, the fact and matters stated herein are correct and We request that a patent may be granted to us for the said invention.

Dated this 9<sup>th</sup> day of February 2026

Signature: *Soumya Ranjan Jena*

(Dr. Soumya Ranjan Jena)

**DIRECTOR**

Name of Applicant: **SRJX RESEARCH AND INNOVATION  
LAB LLP**

To  
The Controller of Patents  
The Patent Office, KOLKATA

**SRJX Research and Innovation Lab LLP**  
**LLPIN: ACO-1435**



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INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

₹100

e-Stamp

Certificate No.	: IN-DL49794072924674Y
Certificate Issued Date	: 07-Feb-2026 06:44 PM
Account Reference	: SELFPRINT (PU)/ dl-self/ NEHRU/ DL-DLH
Unique Doc. Reference	: SUBIN-DL DL-SELF21149788829774Y
Purchased by	: SATYA NARAYAN SAV
Description of Document	: Article 48(c) Power of attorney - GPA
Property Description	: GPA FOR FILING PATENT APPLICATIONS
Consideration Price (Rs.)	: 0 (Zero)
First Party	: SRJX RESEARCH AND INNOVATION LAB LLP
Second Party	: SATYA NARAYAN SAV AND ANURADHA GUPTA
Stamp Duty Paid By	: SRJX RESEARCH AND INNOVATION LAB LLP
Stamp Duty Amount(Rs.)	: 100 (One Hundred only)

सत्यमेव जयते

₹100



SELF PRINTED CERTIFICATE TO BE VERIFIED BY THE RECIPIENT AT WWW.SHCILESTAMP.COM

IN-DL49794072924674Y

Please write or type below this line

Statutory Alert:

1. The authenticity of this Stamp certificate should be verified at 'www.shcilestamp.com' or using e-Stamp Mobile App of Stock Holding. Any discrepancy in the details on this Certificate and as available on the website / Mobile App renders it invalid.
2. The onus of checking the legitimacy is on the users of the certificate.
3. In case of any discrepancy please inform the Competent Authority.

**FORM 26**  
**THE PATENTS ACT, 1970**  
(39 of 1970)

**&**

**THE PATENTS RULES, 2003**

**Form of authorization of a patent agent/or any person in a matter  
or proceeding under the Act**

(See sections 127 and 132 and rule 135)

We,

**SRJX RESEARCH AND INNOVATION LAB LLP**, a company registered in India, having office at **PLOT NO.-3E/474, SECTOR-9, CDA, POST-MARKAT NAGAR, CUTTACK- 753014, ODISHA, INDIA**

do hereby authorize **S. N. Sav and Anuradha Gupta**, Patent Agent of **S G Intellectual**, 4-D (UPPER FLOOR) DDA Pocket-2, Sector-6, Dwarka, New Delhi--110075, **Delhi** , and also at A-108, Block -A, MBR Shangri La, Mysore Road, Kengeri, **Bangalore-560059**, India and/or all or any Associates/ Partners of the firm, to act on our behalf in connection with filing any and all Patent Application for any and all the inventions with the Controller of Patents, appearing on our behalf before the Controller, processing our application in respect of the same, filing provisional and/or complete specifications, and other necessary request and documents in connection with the grant of Patent for the patent application; obtaining certified copies/extracts from the Patent Office, Certificate/s of Registration, filing request for renewal of the Patent and generally to do all acts, deeds and things that may be necessary in connection with the above application, including appointment of any substitute or substitutes.

We request that all notices, requisitions and communication relating thereto may be sent to such person at the above address unless otherwise specified.

We hereby revoke all our previous authorization, if any made, in respect of same matter or proceeding.

We hereby assent to the action already taken by the above said person in the matter.

Dated this 7<sup>th</sup> day of February 2026


*Soumya Ranjan Jena*

(Dr. Soumya Ranjan Jena)  
Designation: Director  
SRJX RESEARCH AND INNOVATION LAB LLP

To,  
The Controller of Patents  
Patent Office, Kolkata

SRJX Research and Innovation Lab LLP  
LLPIN: ACO-1435

**FORM 3**  
**THE PATENT ACT, 1970**  
(39 of 1970)  
and  
**THE PATENTS RULES, 2003**  
**STATEMENT AND UNDERTAKING UNDER SECTION 3**  
(See Section 8; Rule 12)

1. Name of Applicant	I/We, <b>SRJX RESEARCH AND INNOVATION LAB LLP</b> established at PLOT No-3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR, CUTTACK- 753014, ODISHA, INDIA, Hereby Declare:				
(i) That I/We who have made the application for Patent number <b>202631013668</b> in India, dated 9 <sup>th</sup> February 2026 alone (ii) that I/We have not made any application for the same/substantially the same invention outside India Or <del>(ii) that I/We have made for the same/substantially same invention, application(s) for patent in the other countries, the particular of which are given below:</del>					
<b>Name of the Country</b>	<b>Date of application</b>	<b>Applicati on No.</b>	<b>Status of the application</b>	<b>Date of publication</b>	<b>Date of grant</b>
-----	-----	NIL	-----	-----	-----
2. Name and address of the assignee					
<del>(i) that the rights in the application(s) filed in India has/have been assigned to.....</del> (ii) that I/We undertake that upto the date of grant of the patent by the Controller, I/We would keep him informed in writing regarding the details of corresponding applications for patents filed outside India in accordance with the provisions contained in section 8 and rule 12.  Dated this 14 <sup>th</sup> day of February 2026.					
3. To be signed by the applicant or his authorized registered patent agent					
 Signature					
4. Name of the Natural person who has signed					
<b>(Anuradha Gupta)</b> Patent Agent (IN/PA-1514) Agent for the Applicant					
To The Controller of Patents, The Patent Office At Kolkata					

**FORM 5**  
**THE PATENTS ACT, 1970**  
**(39 of 1970)**  
**&**  
**The Patents Rules, 2003**  
**DECLARATION AS TO INVENTORSHIP**  
**[See section 10(6) and Rule 13 (6)]**

**1. NAME OF THE APPLICANTS: SRJX RESEARCH AND INNOVATION LAB LLP**  
established at PLOT No-3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR, CUTTACK-753014, ODISHA, INDIA,

hereby declare that the true and first inventor(s) of the invention disclosed in the Complete specification filed in pursuance of our application Numbered 202631013668 dated 9<sup>th</sup> February 2026 are:

**2. INVENTORS:**

(i) (a) **NAME** : JENA, Soumya Ranjan

(b) **NATIONALITY:** INDIAN

(c) **ADDRESS** : PLOT NO-3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR, CUTTACK- 753014, ODISHA, INDIA

(ii) (a) **NAME** : GOWDA, Shankar B N

(b) **NATIONALITY:** INDIAN

(c) **Address** : No. 6, KANNAGUNI, N M PURA POST, YEDIUR HOBLI, KUNIGAL TALUK, TUMKUR DISTRICT, BANGALORE-572130, KARNATAKA, INDIA

(iii) (a) **NAME** : SAHUKAR, Yamini Prasanna

(b) **NATIONALITY:** INDIAN

(c) **Address** : No. 314, 3<sup>rd</sup> STAGE, 4<sup>th</sup> BLOCK, BASAVESHWARA NAGARA, BENGALURU-560079, KARNATAKA, INDIA

**3. DECLARATION TO BE GIVEN WHEN THE APPLICATION IN INDIA IS FILED BY THE APPLICANT(S) IN THE CONVENTION COUNTRY :- N/A**

~~We the applicant in the convention country hereby declares that our right to apply for a Patent in India is by way of assignment from the true and first inventors.~~

Dated this 14<sup>th</sup> day of February 2026

Name of the signatory  **Anuradha Gupta**

**Patent agent - IN/PA-1514**

**4. STATEMENT** (to be signed by the additional inventor(s) not mentioned in the application Form : N/A

~~We assent to the invention referred to in the above declaration, being included in the Complete specification filed in pursuance of the stated application.~~

Dated this            day of 20.....

Signature of the additional inventor(s):

Name-----

To  
The Controller of Patent  
The Patent Office Branch  
At KOLKATA

<b>FORM 18 A</b> <b>THE PATENTS ACT,1970</b> <b>and THE PATENT RULES,2003</b> <b>REQUEST FOR EXPEDITED</b> <b>EXAMINATION OF APPLICATION FOR</b> <b>PATENT</b> [See section 11B and Rule 24C]	(FOR OFFICE USE ONLY)  RQ. No.: Filing Date: Amount of fee Paid: CBR no: Signature:
<p><b>1. APPLICANT:</b></p> <p><b>(A) NAME: SRJX RESEARCH AND INNOVATION LAB LLP</b></p> <p><b>(B) NATIONALITY: Indian Company</b></p> <p><b>(C) ADDRESS: PLOT No.-3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR, CUTTACK- 753014, ODISHA, INDIA</b></p>	
<p>2. We, <b>SRJX RESEARCH AND INNOVATION LAB LLP</b> established at PLOT No-3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR, CUTTACK- 753014, ODISHA, INDIA, hereby request that our Application Patent No. <b>202631013668</b> filed on 09-02-2026 for invention Titled “<b>ARTIFICIAL SUPER-INTELLIGENCE (ASI) BASED NEUROMORPHIC AUTONOMOUS DRONE SYSTEM</b>” shall be examined under sections 12 and 13 of the Act.</p> <p style="text-align: center;">or</p> <p>I/We _____ hereby request that my/our application for patent no. _____ filed on _____ for _____ the _____ invention titled _____ based on Patent Cooperation Treaty (PCT) application no. .... dated. .... made in country ..... shall be examined under sections 12 and 13 of the Act, immediately without waiting for the expiry of 31 months as specified in rule 20(4)(ii). or</p> <p>I/We hereby request that my/our request for examination bearing no. _____ for application for patent no. _____ filed on _____ for _____ the _____ invention titled _____ may be converted to a request for expedited examination of patent application under rule 24C and the application shall be examined under sections 12 and 13 of the Act.</p>	
<p>3. The applicant(s) to indicate (by ticking the appropriate box) any of the grounds applicable for request for expedited examination:</p> <p>( ) that India has been indicated as the competent International Searching Authority or elected as an International Preliminary Examining Authority in the corresponding international application; or</p> <p>(✓) that the applicant is a startup; or</p> <p>( ) that the applicant is a small entity; or</p>	

- ( ) that the applicant is a natural person or in the case of joint applicants, all the applicants are natural persons, then applicant or at least one of the applicants is a female; or
- ( ) that the applicant is a department of the Government; or
- ( ) that the applicant is an institution established by a Central, Provincial or state Act, which is owned or controlled by the Government; or
- ( ) that the applicant is a Government company as defined in clause (45) of section 2 of the Companies Act, 2013 (18 of 2013); or
- ( ) that the applicant is an institution wholly or substantially financed by the Government; or
- ( ) that the application pertains to a sector which has been notified by the Central Government, on the basis of a request from the head of department of the Central Government; or
- ( ) that the applicant is eligible under an arrangement for processing a patent applicant pursuant to an agreement between Indian Patent Office and a foreign Patent Office.

**ADDRESS FOR SERVICE IN INDIA:**

ANURADHA GUPTA

4-D (UPPER FLOOR), DDA Flat, Pocket-2, Sector-6, Dwarka, New Delhi-110075, India

Mobile No. +91 9213764385

Email: [sav@sgintellectual.com](mailto:sav@sgintellectual.com) ; [anuradha\\_sgi@yahoo.in](mailto:anuradha_sgi@yahoo.in)

Dated this 10<sup>th</sup> day of February, 2026

Name of the signatory:

Signature

-Digitally Signed-

**Anuradha Gupta**

**Agent for the Applicant**

**IN/PA-1514**

To

The Controller of Patent

The Patent Office, at Kolkata

**FORM 9**  
**THE PATENTS ACT, 1970**  
**(39 of 1970)**  
**&**  
**The Patents Rules, 2003**  
**REQUEST FOR PUBLICATION**  
**[See section 11A (2); Rule 24A]**

1. Name, address and nationality of Applicant(s)      We, **SRJX RESEARCH AND INNOVATION LAB LLP** a Company registered in India, having office at PLOT No.- 3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR, CUTTACK- 753014, ODISHA, India,
2. To be signed by the applicant or his authorized registered patent agent      **hereby** request for early publication of our Patent Application No. **202631013668** dated **9<sup>th</sup> February 2026** under section 11A (2) of the Patent Act.

Dated this 10<sup>th</sup> day of February 2026

3. Name of the natural person who has signed.      -Digitally Signed-  
(Anuradha Gupta)  
Patent Agent (IN/PA-1514)  
Agent for the Applicant

To  
The Controller of Patents,  
The Patent Office,  
At KOLKAT

Digitally Signed By:  
ANURADHA GUPTA  
Date: 10-02-2026 13:35:51

FORMS 28  
 THE PATENTS ACT, 1970  
 (39 of 1970)  
 AND  
 THE PATENTS RULES, 2003  
 TO BE SUBMITTED BY A SMALL ENTITY / STARTUP  
 [See rules 2 (fa), 2(fb) and 7]

1.	Insert name, address and nationality	We, <b>SRJX RESEARCH AND INNOVATION LAB LLP</b> , a company registered in India, having office at PLOT NO.- 3E/474, SECTOR-9, CDA, POST- MARKAT NAGAR, CUTTACK-753014, ODISHA, INDIA Applicant in respect of the patent application No. <b>202631013668</b> . Hereby declare that we are a startup in accordance with rule 2(fb) and submit the following documents(s) as proof:
2.	Documents to be submitted	
	ii. For claiming the status of a startup	
	A. For an Indian applicant: Any document as evidence of eligibility, as defined in rule 2(fb).	
	<b>Certificate of Recognition issued by DIPP: Certificate No. DIPP203406</b>	
3.	To be signed by the applicant(s) / patentee(s) / authorized registered patent agent.	The information provided herein is correct to the best of our knowledge and belief.  Dated this 10 <sup>th</sup> day of February 2026.
4.	Name of the natural person who has signed. Designation and official seal, if any, of the person who has signed.	Signature :  <p style="text-align: right;">-Digitally Signed-                  (Anuradha Gupta)                  Patent Agent (IN/PA-1514)                  Agent for the Applicant</p> To The Controller of Patents, The Patent Office, At Kolkata.

Digitally Signed By:  
 ANURADHA GUPTA  
 Date: 10-02-2026 13:54:57

CERTIFICATE NO:  
DIPP203406



सत्यमेव जयते

Government of India  
Ministry of Commerce & Industry  
Department for Promotion of Industry and Internal Trade

#startupindia

# CERTIFICATE OF RECOGNITION

*This is to certify that **SRJX RESEARCH AND INNOVATION LAB LLP** incorporated as a **Limited Liability Partnership** on **05-05-2025**, is recognized as a startup by the Department for Promotion of Industry and Internal Trade. The startup is working in 'Professional & Commercial Services' Industry and 'Professional Information Services' sector as self-certified by them.*

This certificate shall only be valid for the Entity up to **Ten** years from the date of its incorporation only if its turnover for any of the financial years has not extended **₹ 100 Cr.**

14-05-2025

DATE OF ISSUE



04-05-2035

VALID UPTO

Digitally Signed By:

ANURADHA GUPTA

Date: 10-02-2026 13:54:57