Multi-rotor Aerial Vehicle with Variable Center of Gravity and Method Control thereof

IITM Technology Available for Licensing

Problem Statement

- The sensitivity of a **conventional quadrotor** to environmental disturbances can be reduced by using robust controllers or techniques. However, there are several areas in quadrotor design & control that **needs** to be further explored which states that to **control the quadrotor by varying its center of gravity** (CoG).
- There remains a need for a control configuration which is capable improved agility in large scale quadrotors, & also ground effect is an important criterion to be taken into consideration for improved stability during take-off and landing of the quadrotor.
- Hence there is a need to address the issues.

Technology Category/ Market

Technology: Multi-rotor aerial vehicle;
Industry: Aerospace, Other Technologies;
Applications: Robotics.
Market: The global multirotor drone market is projected to grow at a **CAGR** of **13.1%** during the forecast period of **2024-2031.**

Technology

- Present invention describes a multi-rotor aerial vehicle. (Refer Fig.1)
- Said Vehicle includes a frame having an axis & housing a control unit, a plurality of rotors affixed to the frame, each driven by a drive motor & a foldable landing gear.
- Said gear comprising a plurality of legs which are placed beneath the frame, each leg having a length & a control mass at the end thereof & pivotably attached to the frame via a control motor.
- Each control motor is configured to vary the angle of folding of the leg & move the control mass either inward toward the aerial vehicle axis or outward away from the axis under instruction from the control unit to adjust attitude of the aerial vehicle by varying the center of gravity (CoG) of the aerial vehicle.
- Each **control motor** is configured to vary the angle of folding of the leg & move the **control mass** either inward toward the aerial vehicle axis or outward away from the axis under instruction from the control unit to adjust attitude of the aerial vehicle by varying the CoG of the aerial vehicle.
- The drive motors are controlled using PID control logic.
- Further, a method for **controlling the attitude & position** of the **aerial vehicle** through variation of center of gravity (CoG) by moving the control masses is disclosed.

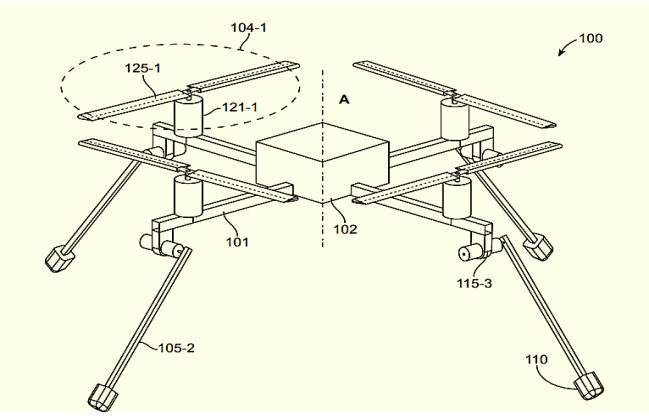

Fig.1

Intellectual Property

IITM IDF Ref. 1537;
IN Patent No. 493085 (Granted)

TRL (Technology Readiness Level)

TRL- 3/4, Proof of Concept ready, tested and validated in Laboratory

Research Lab

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Key Features / Value Proposition

❖ *Technical Perspective:*

❑ **Multi-Rotor Aerial Vehicle: Parts:**

❑ **Legs:**

- The vehicle consists of at least **4 legs** and the **lengths of the legs** of the landing gear are configured to **minimize thrust loss** due to ground effect to **3% or less**.
- The **angle of folding** of the **legs with respect to the frame** ranges between **0° to 145°.**

❑ **Control Masses:**

- **Attitude & position** of the vehicle are **controlled** by moving the control masses in coordination using an integral back-stepping controller.
- A ratio of a total of the control masses to mass of the vehicle is **0.1 or less**.

❑ **Rotors:**

- Vehicle comprises **4,6 or 8 rotors**.

❑ **Process of controlling the attitude & position of a multi-rotor aerial vehicle**

- The method describes a few steps which includes **setting & traversing way-points** in set sequence to achieve **desired position in space** while avoiding CoG saturation.
- The **Way-point navigation** of the aerial vehicle is adopted to **avoid CoG saturation**.

❖ *Industrial Perspective:*

❑ The claimed aerial vehicle is **cost-effective, reliable and efficiently**.

❑ It requires to provide way-points such a way that **neither the performance** of the vehicle degrades, **nor the actuators** saturate.

Images

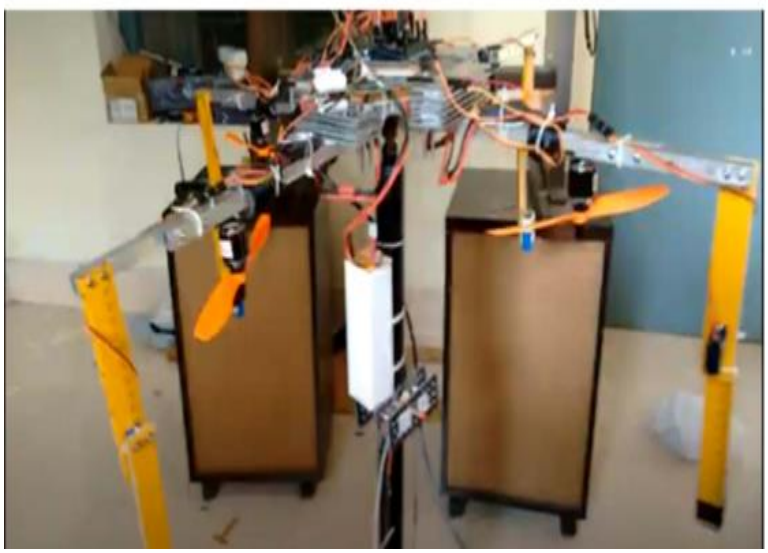

FIG.1A: Illustrates schematic demonstration of a prototype of the claim aerial vehicle;

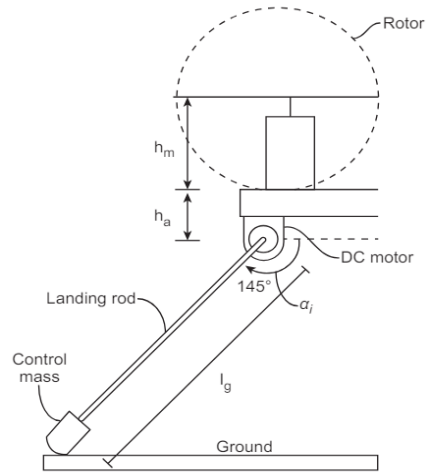

FIG. 2

FIG.2: Illustrates parameters considered for minimizing ground effect.

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