Spherical Flying Object

Introduction: A Spherical flying object, as its name suggests, is a spherical machine capable of full-fledged flight, and can comfortably manoeuver in air. Also, the spherical exterior also renders it capable of terrestrial locomotion, to some extent. The means of flight, in our case, was a single powerful motor with a customized propeller.

Motivation For The Project: We had participated in the RC plane competition conducted by the Aeromodelling Club(One of our teammates finished 4th, in fact!). Lots of times, due to a plethora of reasons, we saw planes crashing on the ground. The most common outcome of this would be the obliteration of the high-spin rotor blades, but sometimes things escalated and we saw entire planes devastated. (Sometimes even like this)

We thought it could also happen with traditional drones, and thus devised the concept.

Technical Aspects: We used a single rotor system. We used a 2800 KV Outrunner BLDC motor to fulfil our thrust requirements. In combination to that, we used an APC 7x5 propeller. The estimated peak thrust for this assembly was around twice our weight(360 grams). For steering and overall locomotion, flaps were employed. Flaps were controlled by servos(9g servos). All of them were mounted rigidly on the frame. For power, we utilized a 2S LiPo battery. Also, a 30 A ESC was used in the project.

THE FRAME was the crucial part. Our frame consisted of a wooden skeleton and Styrofoam supports to facilitate the terrestrial motion.

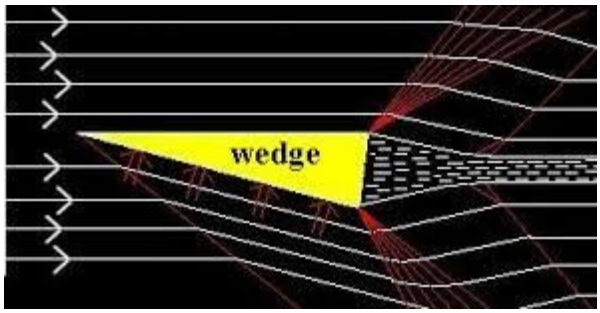
The mounts were also made of wood.

The frame was about 22 cm in diameter(outer) and was around 2 cm thick.

To mount the electronic components, we had two orthogonal bars emanating inwards from the interior of the frame

Our frame looked like this(without the supports):

Theory and Working: The BLDC was connected to the ESC and then to the battery. Using an RC, we controlled the thrust of the motor. We used the concept of thrust vectoring to manoeuver the drone. This was done by using servo controlled flaps to deflect the air stream. Also we used flow separators (in form of wedges)to separate the airflow to avoid creation of wake regions, and the resulting vortices.(Note that the wake region in case of plate is considerably bigger)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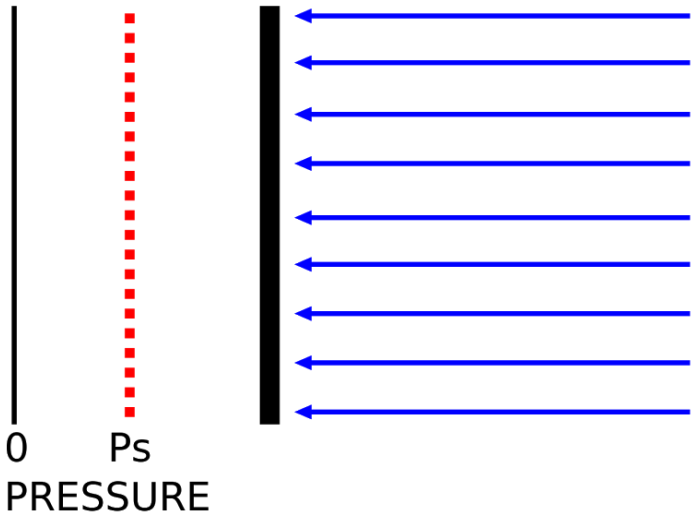
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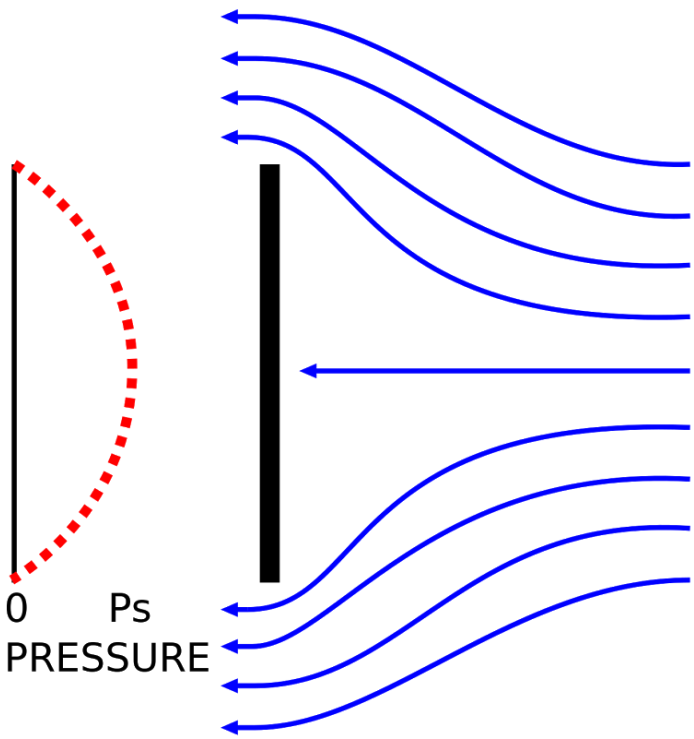
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Timeline of action: Can be found in the presentation(Link below).

Challenges Faced: The project seemed easy at first, but it packed some nasty challenges. Manufacturing a sturdy spherical frame was difficult. After rejecting several ideas, we hunted for the frame in various shops, for half a day. After hours of scouting, we finally found what we were looking for.

Also, a single rotor system relied heavily on estimated values. This was a tricky thing. We tried plenty of simulators, and then agreed upon an Avionic 2250 KV motor. However, it was insufficient in spite of the simulations. We then upgraded to the current motor.

The current motor had some small parts and was also faster. So fastening it was a problem. Its own speed created vibrations, which loosened the motor-frame mount. To solve this problem, we had to wait for 2 mm lock nuts.

The crux of all these issues wasn't the complexity, but rather the local unavailability of components and the resulting gaps of days, due to online shopping.

Presentation Link:
https://drive.google.com/open?id=0B6A8QWJySantN2JzTWl0dXlOMk0

References:

http://personal.osi.hu/fuzesisz/strc_eng/

http://www.gobrushless.com/testing/thrust_calculator.php?prop=41&rb1=1&Value=20720&Altitude=0&submit=Calculate+Now

http://adamone.rchomepage.com/calc_thrust.htm (Thrust calculators)

http://rcadvisor.com/simplified-motor-propeller-selection-method (On selection of motor and propeller)

And of course,

www.google.com

Components and costing:

1. 2S LiPo Battery and Charger-2068(from robokits.com)
2. Avionic 2250 KV Brushless Motor-820(From RC bazaar)
3. Avionic 2800 KV Brushless Motor-730(From RC bazaar)
4. APC 7x5 propeller-299(Ebay)
5. Servos-440(From Mangaldeep)
6. Plywood for the mount- 160(From a local shop)
7. Epoxy Adhesive-95(Mangaldeep)
8. Styrofoam-317(From Masjid)
9. Frame rings-90

   Total-5019

   (All in INR)

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Cheers!