RESEARCH DOCUMENT

Project Name : Drishya

(Product Web Link: **https://industriessparrow.wixsite.com/sparrow/drishya**)

Our aims for the project :

1. Cost efficient
2. Good Quality Drone
3. Type – Racing Drone (without camera)
4. Main focus is more flight time and it should be fast
5. Should be safe

Components Required –

1. Frame
2. Motors
3. ESC
4. Flight Board
5. Remote controller
6. Propeller
7. Battery
8. Charger
9. Power Distribution Board (PDB)
10. Transmitter (TBD)
11. Receiver (TBD)
12. Camera (TBD)

- **FRAME**

  (Note – The wheelbase size is the distance between the motors and it is not as important as the size of the propellers it can run)

  Propeller diameter – 5 inch as it is the most optimal size for racing drones and is widely used .

  It should have a horizontal division to put the components as it has much more space and easier to use .

The material should be optimally thick for protection in crashes .
Material – Carbon Fiber as it is strong and will prevent damage to the components .
The frame should preferably be a uni-build as it is much more compact and very less likely to break but a multi-build strong frame shall also suffice .
Wheelbase – 210-250 mm
Dimensions would be in accordance with the propeller size . Weight shall be kept optimal as too less weight makes it vulnerable to crashes and too much weight makes it slower .
Weight – 110g-150g
(Preferably a little towards the higher side for protection of the components eg. 140g .)

- **MOTORS**

(Mathematics)
Motor Kv has nothing to do with the applied voltage. Instead, Kv has to do with the back-emf .

KV=1/KE (where KE is the back emf constant .)
E=KE*w (where E is the back emf and w is the max speed)

(Note : Back emf is the voltage induced in the coils of the motor .)

W=V-R*Io/KE
W=(V-R*Io)KV

V=14.8V
Io=1.6A
R=0.068 ohms
(where V is applied voltage , R is resistance of the motor , Io is the the no load current)

W=33789.76
E=1/2300 * 33789.76 = 14.6912 (approx.) = 14.7 V*s/rad
max RPM =KV*E = 33789.76
(Note: This RPM is the maximum that can be achieved by the motor . In reality , it is much less than the Maximum RPM as there is always load and various forces acting on the motor .)

Torque = k*1/2300 where k is a constant .

Max G force = 1.12 * radius * (RPM/1000)^2 = 1783.86 N

Theoretical Top Speed – 102.6 kmph (approx.)

Theoretical Max Altitude – 41.44m (approx.)

Area = 19.63 cm^2

Estimated Required Thrust – 1100g

(Drone weight taken as 550g to calculate thrust required.)

Max Thrust = 4096g

(Note: This Real Thrust has been roughly estimated from experimental data available to us . It is thereby a close reliable estimation only .)

Max Thrust to Weight Ratio at 100% throttle – 7.5:1 (approx.)

(Note: This means that our drone will be capable of extreme aerobatic flying.)

Prop (inch)	Volts (V)	Amps (A)	Thrust (g)	Throttle (%)	Watts (W)	Efficiency (g/W)
5*4.5	16.8V	3.27	200	40%	55	3.6
		8.79	400	66%	148	2.7
		14.85	600	80%	249	2.4
		22.35	800	93%	375	2.1
		27.26	930	100%	458	2.0

(Fig 1 -Experimental Data taken from an authentic source .)

Motor type	The voltage (V)	Paddle size	current （A）	thrust (G)	power (W)	efficiency (G/W)	speed (RPM)
RS2205-2300KV	16	HQ5045 BN	1	76	16.00	4.75	7220
			3	183	48.00	3.81	10790
			5	283	80.00	3.54	13030
			7.1	352	113.60	3.10	14720
			9.1	426	145.60	2.93	16180
			11	497	176.00	2.82	17150
			13	560	208.00	2.69	18460
			15	628	240.00	2.62	19270
			17	692	272.00	2.54	20270
			19	754	304.00	2.48	21060
			21	812	336.00	2.42	21840
			23.3	878	372.80	2.36	22590
			25.4	936	406.40	2.30	23210
			27.3	997	436.80	2.28	23920
			29.9	1024	478.40	2.14	24560

(Fig 2 - Experimental Data taken from an authentic source .)

(Note – In reality , there will be small deviations from the values calculated and the values taken from sources .)

Motor – 2205 2300KV motor as it is the optimal motor for speed as well as more flight time .

Shaft Diameter (mm)	*5*
Compatible Propellers Size (inch)	*5*
Length (mm)	*27.9*
Width (mm)	*27.9*
Height (mm)	*31.7*
Weight (gm)	*30*

(Fig 3- Specifications of the motor)

- **ESC**

  Factors to choose the right ESC –

1. It should support the battery voltage .
2. It should support the Ampere draw of the motors .
   (Note: This does not mean that they should support the exact voltage or Amps but rather there should be a nominal gap between the max volt or amps it supports for safety .)

   ESC - 30A ESC's would be appropriate for a 2300KV motor .
   (Higher Amps ESC are more efficient and will work with 2300KV motor but it would be an overkill only .)

- **FLIGHT BOARD**
  There are specialized Flight Boards for racing drones and the most cost effective and efficient Flight Board suited to our needs is "SP F3 Flight Controller" .
  (Note: It's version depends on the funding . Preferably deluxe version but if the amount crosses the budget then ,ACRO version shall do . Furthermore , OSD is not required.)

- **REMOTE CONTROLLER -** Flysky FS-i6X 2.4GHz 6CH AFHDS 2A RC Transmitter With FS-iA10B 2.4GHz 10CH Receiver as it is the best remote controller at this price with many channels .

- **PROPELLER** – 5 inch propellers as it is the most optimal size for racing drones and is widely used .

- **BATTERY** – 2200 mAh 4s lipo battery(40C-80C) as it is optimal for good amount of flight time and speed .

  (Note – C represents the battery discharge rate .)

Model No.	*ORANGE 2200/3S-30C*
Capacity (mAh)	*2200*
Weight (gm)	*175*
Output Voltage (VDC)	*11.1*
Charge Rate (C)	*1 ~ 3*

(Fig – 4 specifications of battery)

- **CHARGER** - IMAX B6 80W 6A Charger/Discharger 1-6 Cells
- **FLIGHT TIME** – Capacity * Discharge / AAD where capacity is battery in amp hours , discharge is 80% as , if it is discharged less than that then it may harm the Lipo Battery , AAD is the Average Amp Draw . On calculating it we get Flight Time to be 16.7 minutes .

SPECIFICATIONS

COMPONENT	NAME	PRICE
Frame	MARTIAN-II REPTILE 220mm Quadcopter Frame Kit	1790
Motors	EMAX RS2205 2300KV RaceSpec Motor for FPV Racing CW & CCW	1189*4 =4756

ESC	Emax Bullet Series 35A ESC (BLHELI_S) with Oneshot (Original)	1459*4=5836
Flight Board	SP Racing F3 Flight Controller Deluxe	2590
Remote Controller	Flysky FS-i6X 2.4GHz 6CH AFHDS 2A RC Transmitter With FSiA10B 2.4GHz 10CH Receiver	5074
Propeller	Orange HD Propellers 5045(5X4.5) Tri Blade Bullnose Polycarbonate Black 2CW+2CCW-2pairs	288
Battery	Orange 2200mah 4S 40C/80C Lithium Polymer Battery Pack (LiPo)	2099
Charger	IMAX B6 80W 6A Charger/Discharger 1-6 Cells	1969
		TOTAL-24,402

PROJECT TEAM MEMBERS

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- *Srijan Kashyap*
- *Aryan Dahiya*

ROLE OF EACH TEAM MEMBER

- *Amogh - Researcher/Mathematics Department/Coordinator/HOD*
- *Aaryan - Researcher/Programming Department/HOD*
- *Srijan - Researcher/Programming Department*
- *Aryan - Researcher/Mathematics Department*

REFERENCES

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