Remote Controlled Mini Air Vehicle

Design, Build and Fly
What is a MAV???

1. MAV is basically a much smaller prototype of an actual aircraft and hence its dynamics are much different and tougher to understand.
2. There are 3 degrees of freedom for a MAV: roll, pitch and yaw.
3. To achieve these motions, there are three control surfaces: ailerons, elevators and rudder.
CONTROL SURFACES

- propeller
- aileron
- rudder
- elevator
Forces on a MAV

- **Lift**
- **Drag**
- **Weight**
Realize the problem statement

Decide the dimensions of the MAV

Select the components according to the problem statement and the weight of the MAV

Integrate all the parts with best possible precision and test the motors.

Get it flown by someone who knows flying.
Steps to make a MAV

Choose Material for body:
1. Balsa-Soft and light
   Easy to work on
   Available in strips
   Most widely used in aero modeling
2. Thermocole / Foam-
   Choose High Density Thermocole (HDT), Foam
   Very light
   Needs Reinforcement

Source:
1. Balsa in India Hobby Centre, Lamington Road
2. Foam in Abdul Latif Habib Bhai Shop, Crawford Market, CST.
Get a Brushless Motor to power your MAV and a speed Controller

Motor Controllers upto 140A

4gms to 1kg motor weight
PROPELLER

Fixed Pitch
2.5 cm to 65 cm
50 gm to 15 kg aircraft

Variable Pitch
For small motors
For reverse flying
Actuators

SERVOS

Servos - 4gm to 100 gms
Power Source

NiMH or Lithium Polymer battery pack
100 mAh to 6000 mAh
Remote Controller
R/C Receiver
Calculation worth consideration:

- \( W = L = \frac{1}{2} \rho v^2 S C_L \)

- Where
  - \( L \) = lift, \( v \) = flight velocity, \( C_L \) = lift coefficient, \( \rho \) = density of air

- \( W/S \) = wing loading
  - wing loading gives idea about flight velocity.

- For gliders wing loading is less than 15 N/m²
- Air density is about 1.2 kg/m³
- The minimum flight velocity should be 5 m/s
- \( C_L \) max is 1.0
- Aspect ratio $= AR = \frac{b}{c}$

This is how $C_l$ and angle of attack affect each other at different aspect ratios.
Some numbers to remember

- Wing aspect ratio for gliders > 6
- Fuselage length –2.5 to 4 times wing chord
- Horizontal tail area –18-22 % of wing area
- Horizontal tail aspect ratio –3 to 5
- Vertical tail area –8 to 12 % of wing area
- Vertical tail aspect ratio –1.5 to 3
COST!!!!

Cost of the components involved:
1. Receiver: 1800 Rs.
2. Servos: 425Rs. each
4. Motor Combo (includes a motor, speed controller and 1 propeller): 1300 Rs.
5. LiPo battery: 600 Rs.
6. Propellers: 95Rs. Each

Total cost involved (without the RC system and the propellers): Rs.3175

Foam costs around 120Rs. Per sheet.

Source:
1. Online but the costs will become 1.5 times due to shipping charges.
2. Mr. Sai from Chennai. (His son had won the last year’s Techfest’s powered glider event.)
Some IMPORTANT Tips!!!!

1. Always start off with designing the MAV on paper and show it to a professor/senior before starting off with building.
2. Check the LiPo battery for its voltage before using it. You may need to charge it once. (We had almost a blast due to this. And worse we lost the 2000Rs. Worth battery.)
3. MAV is a highly unstable plane in flight. Hence any slight asymmetry in the design will get highly demonstrated in the flight.
4. The design of MAV is more about precision than its actual design. Also try to keep its surface smooth to reduce drag. Try to give an aerofoil shape to the wing.
5. The building of the MAV should easily be done within 3 days after having all the components and the design ready.
1. The actual challenge is flying the RC plane which needs LOTS of directed practice.
2. Last year, we had our plane ready 10 days before the competition and tried our level best to fly it but couldn’t even fly till 10 mts.
3. This year, you have many facilities which can help you in learning flying.

Facilities in the department:
1. We have imported a RC Flight Simulator which simulates the flight of a MAV and has the remote controller as the joystick. It will give the nearest-to-actual flying experience.
2. We have a RC gyroscope which autopilots one degree of freedom. I practiced it by auto piloting the roll motion and was very helpful in learning. (We didn’t have the RC Flight Sim at that time.)