DRONE LAB FOR APS IN EASTERN COMMAND

APPROACH PAPER

Introduction

1. Drones are increasingly being used in diverse fields from pesticide spray to monitoring terrain, finding objects, guiding rescuers and a host of civilian and military applications. Its early embedding in learning systems in APS of Eastern Command would provide a definite platform to students to enhance and expand their knowledge horizons.

2. Inclusion of Drones in K12 curriculum has been happening in a big way since 2018 in Europe and USA. Drones are also a great vehicle to teach aspects of Science, Design, Problem-Solving, Math and Skills similar to those needed in Robotics, although at a higher level.

3. With the establishment of Drones Lab in APS, the main goal is to inspire and educate the students in the field of UAVs, STEM and Developing Problem Solving Skills. It is expected that an engagement with Drone Lab will help generate interest in the design, application and piloting of Drones and create engineers in the field of UAVs.

Objectives

4. To provide students with hands on operation of Drones including a practical understanding of physics of Drone flight.

5. To develop scientific thinking skills, logical and critical thinking skills and Problem solving skills.

6. To introduce and expose students to technical skills required for UAV operation.

7. To get equipped with information about potential career paths in UAV technology.

8. To understand basics of Drones operation and modification including software changes, autonomous and controlled line of sight flight

Outline Structure

9. The Drone Lab shall consist of 3 levels :-

   (a) **Starter Level**. To use Drones on a virtual platform. Learning and practicing how to pilot the Drone.

   (b) **Phase - 1**. Basic Drone assembly, flight and control.

   (c) **Phase - 2**. Applying Drones by picking loads, recording and mapping through FPV cameras, etc.

Recommended Composition of the Drone Lab

10. **Drone Simulation Software**.

11. **Features**.

(a) Step-by-step drone simulation learning.

(b) Independent motor control.

(c) Free flight mode for general experience.

(d) Multiple pilot profile creation.

12. **Activities**.

(a) Drone simulator training and operation.

(b) Meeting and completing challenges on the software.

13. **Outcomes**.

(a) Develops the student's structural thinking by making them learn about drone construction using the Drone Garage.

(b) Develops technical skills required for UAV operation in students by making them work on the Simulator.

(c) Develops the student's problem-solving skills by challenging the students on the different levels of the Drone Simulator.

Recommended for Grades

14. Grade - 8 onwards to be assisted by a teacher (licenses can be installed on the systems in the computer lab.

15. **Basic Drone (e.g Pluto 1.2)**.

16. **Activities**.

(a) Assembly of drone kits.

(b) Flying the drone using the provided basic controls. The controls work from software across a WIFI interface.

(c) These are light drones <100 gm and with a max flight time of 8 minutes.

(d) There are 12 experimental activities to be conducted.

(e) The drone controller is programmable.

(f) Conduct a drone Event with races for Drones.

17. **Outcomes**.

(a) Understanding practical aspects of drone flight.

(b) Drone assembly safety, regulations and flight methods.

(c) Controlling the flight of the drone an aspect involving problem solving reasoning and logic.

(d) Programming the drone to make changes in the behavior; Learning to implement C++ code.

Recommended for Grades

18. The tasks are graded for 8 to 10 grades to enable each school to build a comprehensive drone curriculum as suited to local geography/talent/skills

19. **Mega Quad Copter**.

20. **Features**.

(a) Big Quad Frame.

(b) 8.5mm Brushed Coreless Motors with Gears.

(c) 1 set of 135mm Propellers.

(d) Extra Battery.

(e) Screw Driver.

21. **Specifications**.

(a) Dimensions - 22cm X22cm.

(b) Weight - 110 grams.

(c) Flight time -14 mins with zero payload.

(d) Payload capacity - 40 grams (10 mins).

22. **Activities**.

(a) Assembly of drone kits.

(b) Flying the drone using the provided basic controls. The controls work from software across a Wi-Fi interface.

(c) There are 12 experimental activities to be conducted.

(d) The drone controller is programmable.

(e) Conduct a drone event with races for Drones.

23. **Outcomes**.

(a) Understanding practical aspects of drone flight.

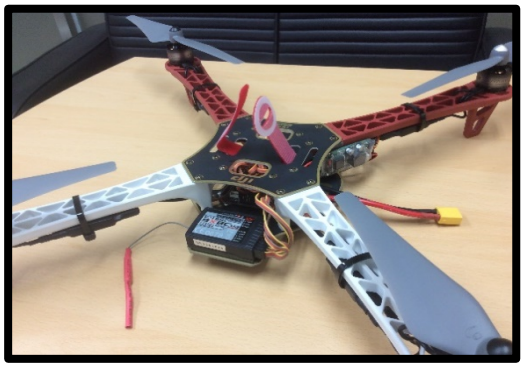
(b) Drone assembly safety, regulations and flight methods.

(c) Controlling the flight of a bigger drone an aspect involving problem solving reasoning and logic.

(d) Programming the drone to make changes in the behavior.

(e) Learning to implement C++ code.

24. **Professional Drone with FPV, Autonomous Mode with 300 gm Payload**.



25. **Features**.

(a) Manual Controlled Flight through mobile app specially interfaced for the chosen controller.

(b) Can be in two versions: With camera which records and with streaming RF camera FPV without Gimbal.

(c) The default version is with WIFI based mobile app control. For direct RF control can be configured with Sky Fi Rf controller (additional cost).

(d) Payload is 350 gm which can be lifted using a software-controlled gripper. This is calculated at an altitude of 1000 ft above MSL.

(e) Flight time is estimated at 16 minutes.

(f) Has GPS and Return to Home Feature.

26. **Activities**.

(a) Assembling, testing and programming the drone.

(b) Planning and executing missions.

(c) Programming drone for autonomous planned flight.

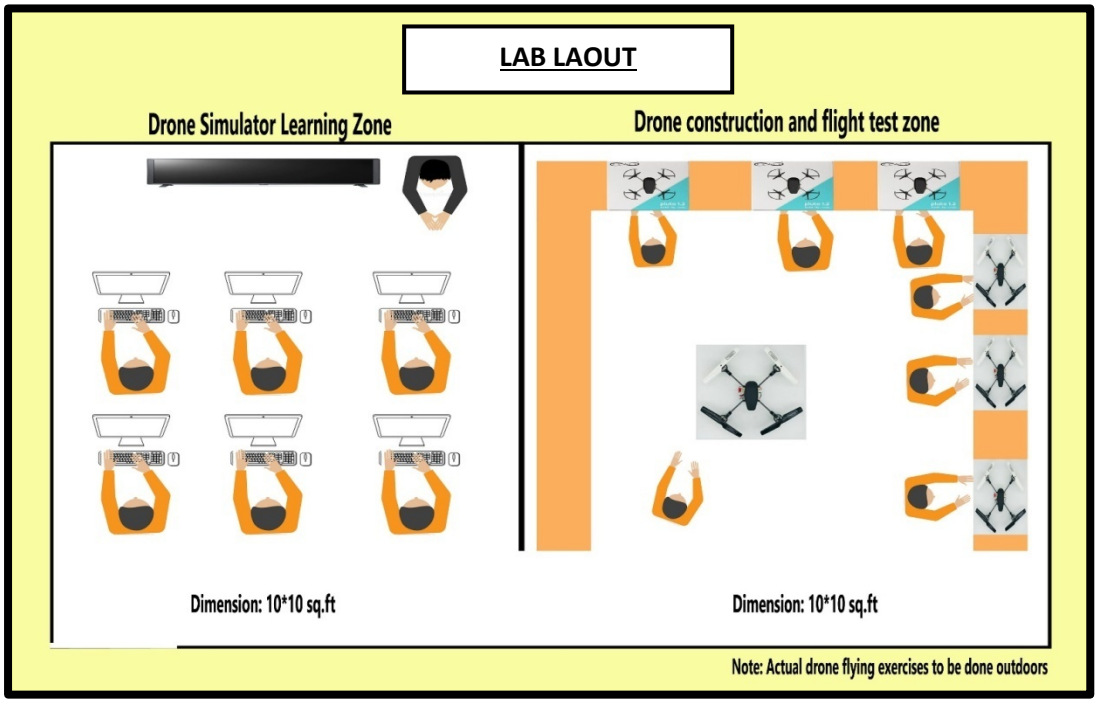
(d) Experiments with different propeller sizes.

(e) Experiments with different volumes of payload.

(f) Zeroing in version for beacon-based targeting.

27. **Recommended for Grades**. Grade 8 and above

28. **Representative Lab Layout**.



29. **Grade Wise Activity Mapping for Various Lab Components**.

Lab Material to Grade mapping	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12
Drone Simulator	✔	✔	✔	✔	✔
Basic Drone	✔	✔	✔	✔	✔
Advanced Drone	✔	✔	✔	✔	✔

30. **Equipping Drone Labs**. All APS will be equipped with the following eqpt (Detailed Bill of Mtrls (BOM) is encl) :-

(a) **Large Schools (13)**.

(i) Basic Quad Copter Drone - 06.

(ii) Mega Quad Copter Drone - 06.

(iii) Drone Simulator License – 06.

(b) **Small Schools (10)**.

(i) Basic Quad Copter Drone - 04.

(ii) Mega Quad Copter Drone - 04.

(iii) Drone Simulator License – 04.

DETAILED SPECIFICATIONS, QUANTITY AND BUDGETED COSTING OF LAB ITEMS (BOM)

Item	Detailed Specification	Quantity	Cost	Total
Mega Drone Kit - Drone Simulator License	**Drone Simulator:-** 1. Desktop application for simulation of drone flight. 2. Drone training and operation on drone movements. 3. Meeting and completing challenges on the software. 4. Windows 10 or Browser based version (Needs 2 GB RAM).	04	14,950 (For 01 Drone Simulator license + 01 Basic Quadcopter Drone + 01 Mega Quadcopter drone)	59,800
Basic Quad Copter Drone	**Basic Quad Copter Drone:-** 1. Primus V4 STM32F303: 72Mhz Controller. 2. Total 4 MOSFET drives. 3. 10-DOF sensor suite. 4. WIFI interface. 5. 10 Minutes flight time: 600mAH Battery. 6. Range: 60m. 7. Programmable with Cygnus IDE in C++. 8. Payload max 15 gm. 9. Total weight 85 gm. 10. Size 16cm X 16cm. 11. Lipo Battery 600 mAh.	04		
Mega Quad Copter Drone	**Mega Quad Copter Drone:-** 1. Total 4 MOSFET drives. 2. 10-DOF sensor suite. 3. WIFI interface. 4. 10 Minutes flight time: 600mAH Battery. 5. Range: 60m. 6. Programmable with Cygnus IDE in C++. 7. Payload max 15 gm. 8. Total weight 85 gm. 9. Size 16cmX 16cm. 10. Lipo Battery 600 mAh.	04		
			Total	**59,800**
			18% GST	**10,764**
			Final Lab Cost	**70,564**