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Wolfgang Vogel

Fully 3d printable

wingspan 950 mm / 37.4 in retractable landing gear

3DLabGANG project by Wolfgang Vogel



Piranha

The Piranha is a fast yet easy to fly small sports plane with retractable landing gear. The original model was available in the late 70s as a kit with a glass fibre fuselage and foam core wings. It was designed around the Webra Speedy 15 2-stroke engine (1.8 ccm) including resonance silencer. It did not have retractable landing gear as this was not feasible at the time for a model this small.

The 3d printable replica is designed for a brushless motor and a 3 cell lipo battery and sculpted after the original plan. The size fuselage cross sections and used Airfoils are identical to the original. For the original look, you can print a dummy of the engine (STL included) and glue it to the bottom of the fuselage. The silencer fairing can also be mounted if you care for the original look, but it has no other purpose on this replica.

General specifications

Wingspan Length (incl. spinner) Wing area Wing loading Center of Gravity Airfoil Weight of printed parts Takeoff weight

max. prop diameter

950 mm / 37.4 in 730 mm / 28.7 in 17.4 dm2 / 1.87 sq ft 56.9 g/dm2 / 18.7 oz per sq ft 66 mm / 2.6 in from leading edge root NACA2412 / tip NACA0010 -2° washout min. 360 g - max. 410 g (all options) / 12.7 – 14.5 oz 990 g / 35 oz (incl. Retractable landing gear & printed wheels, without engine dummy and exhaust fairing) 7 in (due to ground clearance on landing gear)



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Requirements

Printer volume 200 x 200 x 160 mm Nozzle 0.4 mm heated bed is recommended but not necessary printed materials are PLA and TPU (for tyres)

Print strategies

	part	color	brand	layers [TBP]	layer height [mm]
wing	wing_A*	silver	Herz	002 / 001	0,15
	wing_B	silver	Herz	002/001	0,2
	wing_C	red	bq	002/001	0,25
	wing_D	silver	Herz	002 / 001	0,25
	wing_E*	red	bq	002/001	0,15
	ailerons (4 parts)	silver/red	Herz/bq	062/001	0,25
	servo hatch	silver	Herz	222	0,25
fuselage	spinner A+B	red	bq	222	0,15
	cowl	silver	Herz	022 / 001	0,25
	fuselage_A**	silver	Herz	002/001	0,25/0,15
	fuselage_B	silver	Herz	002 / 001	0,25
	fuselage_C	silver	Herz	002/001	0,25
	fuselage_D	silver	Herz	002/001	0,25
	fuselage_E*****	silver	Herz	002/001	0,25
	rudder	silver	Herz	002/001	0,25
	canopy_A	black	Prusament	002 / 001	0,25
	canopy_B	black	Prusament	002/001	0,25
	canopy latch	black	Prusament	222	0,15
	fairing_A	silver	Herz	002/001	0.25
	fairing_B	silver	Herz	002 / 001	0,25
horizontal stab	stabilizer_A	silver	Herz	012 / 001	0,25
	stabilizer_B***	red	bq	012 / 001 / 201	0,25
	elevator_A	silver	Herz	012 / 201	0,25
	elevator_B	red	bq	012 / 001	0,25
	elevator_connector	silver	Herz	222	0,15
	control horn (left+right)	silver	Herz	222	0,15
landing gear	tyre x2****	black	TPU Flexismart	555 (6%)	0,2
	rim inside x2	silver	Herz	222	0,15
	rim outside x2	silver	Herz	222	0,15
	gear leg fairing x2*****	silver	Herz	222	
optional	webra engine dummy	silver	Herz	222	0,15
	exhaust pipe fairing	silver	Herz	002 / 001	0,25

* needs low layer height to improve detail (undercarriage bay / wing tip)

** top surface is tilted 2° - to increase number of steps lower layer height from 88 mm above

*** needs some top layers on tip for closed part

**** tyres printed from TPU need at least 5 layers all around and 6% infill

***** parts need support



Part print weight

Weight figures given for material specified from table on page 4. Try to achieve weight +/-5%.



Bill of materials – HK wishlist

CA Glue – medium and thin (for hinges)

Activator / Kicker

soldering iron or any hot tool

<u>3 mm springsteel wire</u> for gear legs

1.5 mm wire for aileron linkages

1 mm wire for elevator linkage

2x carbon strip 1 x 3 x 130 mm

8x M2x6 DIN912 (hex socket) screw for retracts

2x <u>M5 nylon nuts</u>

2x M5x20 nylon screw

CA Hinges

Servos 2x <u>HXT900</u> micro Servo for ailerons

1x Corona CS238MG Servo for elevator

ESC <u>30A Hobbyking</u>

Motor <u>Turnigy Aerodrive SK3 2836-1500kV</u>

Battery <u>Turnigy Graphene Panther 2200mAh 3s</u>

- retracts servoless retracts with metal trunion for small models
- Propeller <u>Master Airscrew 7x5 or 7x6</u>



Assembly instructions

Please watch the assembly and maiden flight videos on Youtube - click for Playlist

Fuselage

Start by mounting the motor to Fuselage_A. It is possible to assemble (or replace) it later, but it is easier to do it before glueing all other parts. Extend the motor leads by 40 mm, which makes it easier to connect the ESC later. Always test fit the next part before applying glue. You may have to trim the tabs slightly, but if you got the print settings right, all parts should fit directly from the print bed.

All parts of the fuselage have a flat bottom up to the tail skid which makes it a lot easier to position the parts, especially the cowl to Fuselage_A, where you will not find any tabs.

Every printed section of the fuselage should have dual layers up to a height of 1.5 mm. The rest of the part is printed in single layer mode and therefore has a thickness of only 0.4 mm, which makes it difficult to apply glue. I use this thin side to apply a light layer of Activator <u>before</u> glueing the parts together, but <u>after</u> test fitting the parts.

Next, apply a small amount of CA glue to the <u>other</u> part which has dual layers at the mating surface. Do <u>not</u> mix up these parts as the CA glue would harden immediately when applied to the part with the layer of Activator and make this part useless.

Attach the two parts, but be careful to position them correctly.

- check for correct fitment
- spray Activator on single layered part
- apply CA glue to dual layered part
- put the two parts together
- press them as hard as you dare without breaking them, CA glue needs pressure



Do not forget to insert two M5 nylon nuts into the rear facing slots of Fuselage_C before glueing Fuselage_D. This should be a tight fit, but if not apply a drop of CA glue to prevent the nuts from falling back out.



Continue with all Fuselage parts up to Fuselage_E – do <u>not</u> glue the rudder yet! Be careful not to put any glue into the printed tube in parts Fuselage_D and E for the elevator linkage. Test fit a 1 mm steel wire from the servo bay to the end of Fuselage_E.

Use a soldering iron or hot knife to cut the marked area from the bottom of Fuselage_C.

Cut two 130 mm long strips from the 1 x 3 mm carbon fibre strip and glue them left and right on the inside of the fuselage over parts A and B. The strength of the fuselage is good enough for flying, but the carbon fibre strips help at rough landings.

Glue stabilizer A and B parts to the fuselage. Cut CA hinges to size and insert them into the slots <u>without</u> applying glue. Glue elevator parts A and B together and slide them onto the two hinges on each side. Make sure the gap between stabilizer and elevator is roughly 1 mm wide. Apply the thinnest CA glue available (best is the one with the watery like viscosity) on both sides of each CA hinge while bending each elevator flap away form the side you are applying the glue.

Do <u>NOT</u> use Activator for CA hinges. The only solution for good flexibility is patience!

When both elevator flaps are fixed to the stabilizer, glue the connecting piece to both flaps and make sure they are aligned. Glue left and right parts of the horn together and glue on the right elevator inside the rectangle, which should be at the bottom.

Glue rudder to Fuselage_E.

Glue Canopy_A and Canopy_B together and Canopy_latch on the inside of Canopy_B.





Wing

Start with the wing at the root and glue Wing_B to Wing_A for each wing in the same way as described for the fuselage. All internals of the wing will be installed later. You can continue to glue all wing parts together and, at the end, glue to two wing halfs together with thick CA glue to fill the gaps you might have at the front and/or rear between Wing_left_A and Wing_right_A.

Always apply CA glue to all inner ribs as well as the outer layer to improve stability.

Make sure the aileron and retract servo cables or long enough to run through their cable channels and extend at least 30 mm from their respective outlet hole on the root of the wing. The receiver will be placed right on top of these holes.

The two aileron servos are glued into their respective pockets and covered with the parts servo_hatch.

Make sure to center the servo with your RC transmitter set to neutral and attach a single armed horn to the servo incl. screw before glueing it to the wing. Use only a few tiny drops of glue to have at least a small chance to replace a servo in case the wing survived a crash but the servo did not.

Retracts

Remove the supplied 3 mm landing gear wire from the retracts as you will need to bend special gear legs for the Piranha. To make this job easier a bending template STL file is provided within the data package. Print the template with any solid print strategy you are familiar with and bend the 3 mm wire using a vice and a hammer. The template will help you to get the shape right in no time.

Cut off the legs at the marker found on the inclined surface of the template. Be as precice as possible with the cut. Make them too long and you will damage the retracts, make them too short and the wheel will not fit inside the wing.





This picture shows the legs of the prototype before being cut at the marker. Note that the 90° bend for the wheels is not perfect yet. This was corrected before the maiden flight. Take your time and make the legs fit as good as possible into the grooves of the template to ensure working retracts at all times.

The retracts are mounted to the

wings with 4 M2x6 counter sunk screws each. Do <u>not</u> overtighten these screws. Test and modify the gear legs as often as necessary to ensure perfect fitment. If you feel confident glue the lanfing gear flaps to the 3 mm legs with Epoxy, but do not forget to sand the steel wire before glueing and do not touch the metal between sanding and glueing.

The plane will fly perfectly fine even without the gear flaps because of the used airfoil NACA 2412, which is know for it's good handling characteristics no matter if the airfoil is intact or has holes, like the ones at the bottom for the wheels.

Fuselage / Wing

Test fit the wing on the fuselage and place the wing fairing A and B on top. Use a soldering iron to melt the missing holes on the fuselage for the M5x20 nylon bolts holding the wing and fairing.

Glue the wing fairing to the wing only (<u>not</u> the fuselage). The Piranha is a small plane, you can leave the wing on the fuselage from now on, or take them apart if you prefer to travel by bicycle. The battery will be replaced through the canopy.

Glue the four parts of the ailerons together in the correct order (see page 5) and make hinges as described on page 7 for elevator hinges.



RC Components

Make the aileron linkages using 1.5 mm steel wire and the elevator linkage using 1 mm steel wire. Connect all servo leads to the receiver and setup your RC transmitter for the following throws:

Aileron +/- 10 mm

Elevator +/- 12 mm

It is a good idea to use 30% Expo for both functions.

Place the Lipo Battery 3s 1800-2200 mAh as far forward as possible and the ESC underneath or above the battery. Secure the battery to prevent it from moving back.

You will find markings on the bottom of the wing for a safe position of the Center of Gravity. The prototype has been flown with a CoG as far back as 10 mm behind this marking. An experienced pilot will have no problem flying the Piranha with a CoG up to 76 mm behind the leading edge of the wing.





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