DigiSpark 3-channel propo encoder **Phil_G**

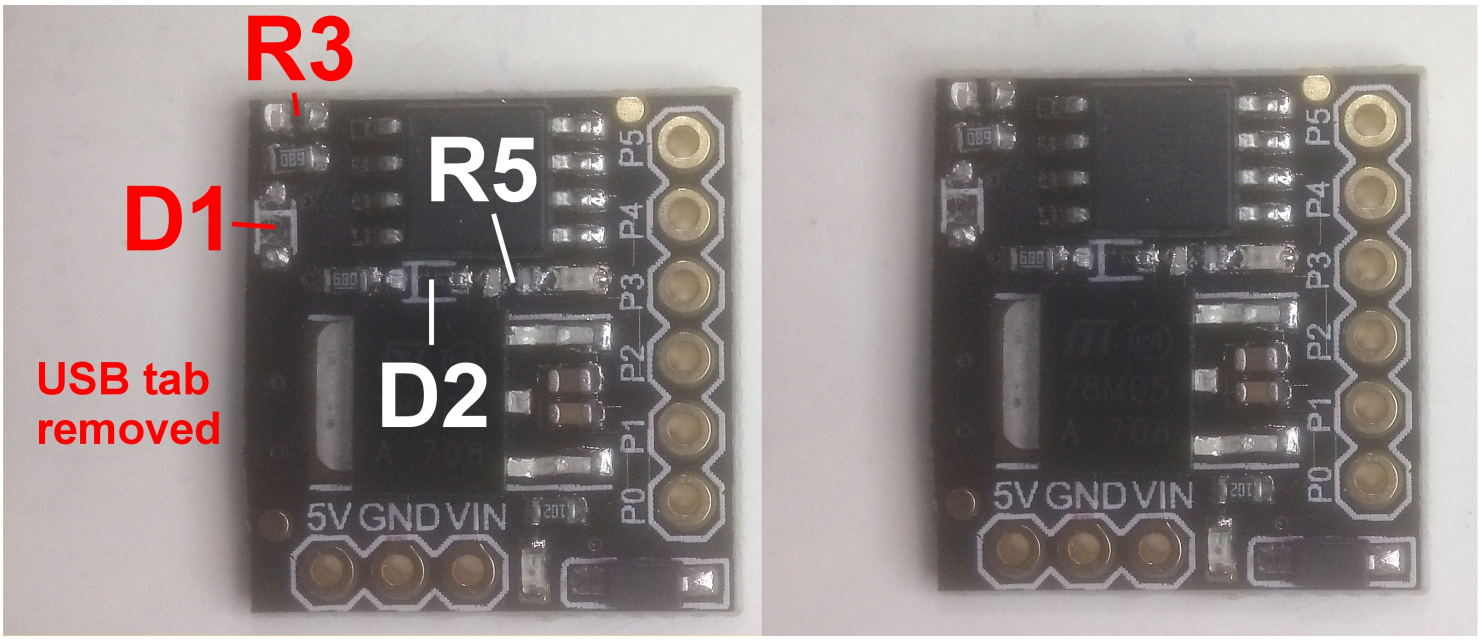
Here's a 3-channel propo encoder for the DigiSpark, a tiny (3/4" square) cheap & cheerful Arduino board that works really well for our projects. Its a simple, minimal encoder so it doesnt have a colour telemetry display or anything fancy.
What it does have is:

Three proportional channels, inbuilt stick calibration,
'Soft' throttle lock (has to be closed before it will open)
Reversing by powering on with the stick held over, saved to flash (throttle is not reversible for safety)
V-tail or Elevon mixer (60:40 ratio)
Single Channel compound escapement emulation mix with kick-up elevator
Inactivity timer (should you forget & leave it switched on) which also waggles the servos in case the receiver has been left on too.

We've no pins to dedicate to a buzzer, so for the inactivity warning, we multiplex the SC/Calibrate pin so it performs all three tasks - see the diagram.

Some of the 5 DigiSpark pins have USB circuitry which we need to remove as it affects the linearity when those pins are used for joystick inputs - its just four components - two zener diodes, a pull-up resistor, and an LED ballast resistor (or the led, removing either will do). Since the board is all SMT this is easily done by 'flicking' off the unwanted components with a jewellers screwdriver.

This is all covered in some detail in the DigiSpark thread:
http://mode-zero.uk/viewtopic.php?f=41&t=60.
It sounds much more fiddly than it actually is - in fact it takes a couple of seconds to remove the four components.



We need three joystick inputs, a calibrate link or button input, and a PPM output.
For this encoder we dont need P5 which is the dual purpose reset-cum-I/O pin, so we dont need to change any fuses and the DigiSpark fuse programmer isnt required.

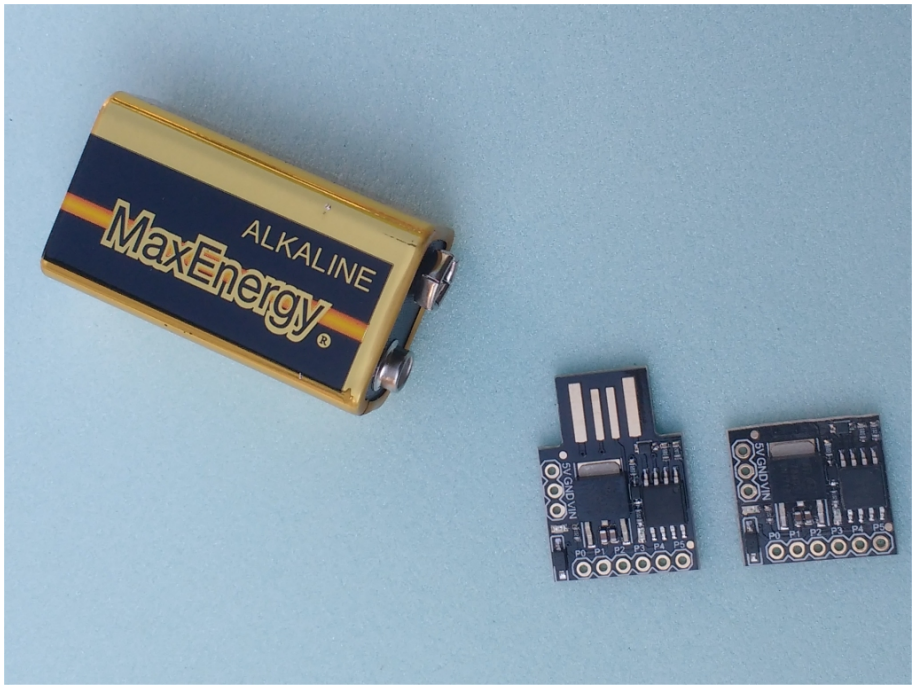
Now we have 6 pins, allocated as follows:
P5 (Reset) not wired
P4 (ADC2) Rudder
P3 (ADC3) Throttle
P2 (ADC1) Elevator
P1 Calibrate & S/C Button, also inactivity buzzer
P0 PPM output

Of course the encoder needs mechanical stick trims as theres no provision for subtrim.
Theres no expo and no rates. The V-tail/elevon mixer is permanently enabled and appears on receiver channels 5 & 6.

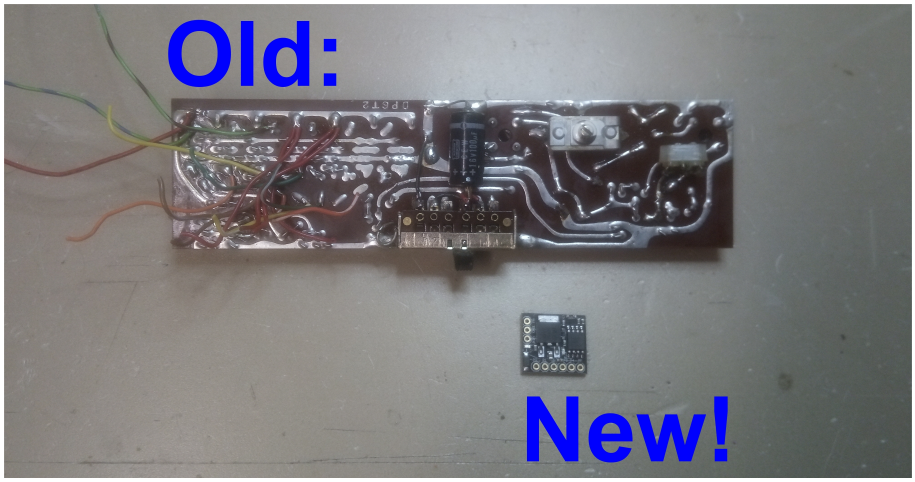
All the necessary information is here so it would be great if anyone else fancied having a go at this project. Just one pointer, if the throttle lock holds at the 'open' position (ie at the 2ms end of travel) then you have the hrottle pot outer wires reversed so swap the +5 and neg on the outer tags. Its a safety thing for electric flyers. Similarly if your S/C emulation works the wrong way, the rudder or elevator pot outers need swapping. After any pot-swapping it will need recalibrating.

I've done several of the DigiSpark 3 & 4ch encoder conversions including this 3 channel Logictrol:





I find the comparison of old and new electronics really amusing - the old encoder boards often had no facilities at all, not even servo reversing, whereas its replacement has many features and is 3/4" square!



Other than the aerial, from outside the Logictrol 3 looks completely standard, with no extra buttons, switches or LEDs, with just the lovely original red vinyl finish.

Wiring:

There are two options for wiring up, the diagram below shows the method I use.

Much of the wiring is common to several components – for example, battery negative goes to the encoder, to all three stick pots, to one side of the button, and to the RF module.

The first method is as per the diagram, that is to make up a six-to-one medusa thing of 'negatives', similarly make up a two-to-one for battery positive and another three-to-one for 'stick positives (5V)' Then for each pot we take one of the many negatives, one of the stick positives, and one of the DigiSpark inputs, twist these 3 wires together into a 'pot cable'. This is repeated for each pot.
A three-wire cable for the RF module is made by twisting one of the negatives, one of the battery positives and the PPM output – then one of the negatives and the button input are twisted together for the calibrate/SC button/buzzer.

The second way is to just have one wire to each DigiSpark connection. Negative is externally daisy-chained from one pot to the next, similarly all the stick positives are daisy-chained from the 5v stick supply. The encoder and the RF module both get their positive battery supply from the on/of switch.

Electrically both methods are identical, the second method is quicker to do and probably takes up less space, where the first method is probably neater. Take your pick, horses for courses.

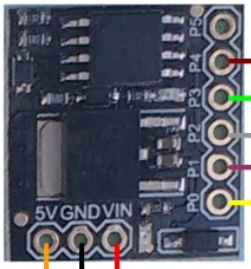
Stick Calibration:

For this particular encoder the new calibration procedure is as follows:
Note that the 'calibrate' input is electrically inverted with respect to previous versions.
Centre all trims and dont touch them throughout the calibration process.
Hold the button in or disconnect the buzzer to open-circuit the 'calibrate' input. Switch on.
Keep the button pressed or maintain the disconnect and waggle the sticks to their extremes but then (and this wasnt necessary before) centre all sticks including throttle before you release the button or reconnect the buzzer. Do not switch off during this process! If you're not using a button, wire the buzzer through a plug/socket, so it can be unplugged for calibration.

Optionally, and at risk of complicating a simple process - the throttle response can be made non-linear during calibration by 'centering' the throttle stick to say 2/3 rather than to neutral stick.

Calibration remembers extreme up and extreme down stick and also wherever the stick is when you let go of the button, so if your throttle is at say 2/3 when you come out of calibration, then the overall range of low throttle to high throttle will be normal, but 1.5ms will be at 2/3 stick. This means that half the throttle servo travel, mid-to-low is expanded into the bottom 2/3 of the stick movement and the other half servo travel, mid to high is compressed into the top 1/3 of the stick movement - where normally it would be half and half equally. This gives finer control at low throttle and courser at high. Of course throttle stick at centre no longer gives throttle servo at centre, though overall travel remains the same. Most IC engines are non-linear. Its one of those things thats much easier to demo than to explain!

"De-fluffed" DigiSpark – remove two schottky diodes, 1k5 pull-up and LED or LED ballast resistor



P5 unused
P4 Brown to Rudder pot wiper, twist with orange & black
P3 Green to Throttle pot wiper, twist with orange & black
P2 Grey to Elevator pot wiper, twist with orange & black
} Pot centre tags
P1 Purple to Calibrate/SC Button 'break' contact to buzzer Pos (long leg)
P0 Yellow to RF module PPM, twist with red & black

Switched battery pos

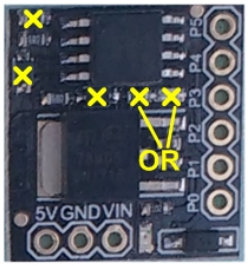
RF module pos, twist with yellow & black

5v DC buzzer

'Break' or NC microswitch

Twist with orange, black & brown to Rudder pot
Twist with orange, black & green to Throttle pot
Twist with orange, black & grey to Elevator pot
} Pot ccw end tags
Twist with purple to buzzer Neg (short leg)
Twist with red & yellow PPM to RF module
Battery neg

Twist with black & brown to Rudder pot
Twist with black & green to Throttle pot
Twist with black & grey to Elevator pot
} Pot cw end tags



<u>"De-fluffing" a DigiSpark:</u>

Some of the 5 DigiSpark pins have USB circuitry which we need to remove as it affects the linearity when those pins are used for joystick inputs. Also P1 has an LED which similarly distorts readings when used as an analogue input.

Remove the marked components using a jewellers screwdriver, they should easily flick away, but a stubborn component can be gently 'chiselled' to break it up. Remove either one of the two components nearest P3, the LED or its ballast resistor – I always go for whichever has the least solder.

Simple 3-channel propo encoder for the DigiSpark with S/C escapement emulation.	Date: May 2019	Drawn: Phil_G	Sketch: digispark_3ch_propo_sc.ino

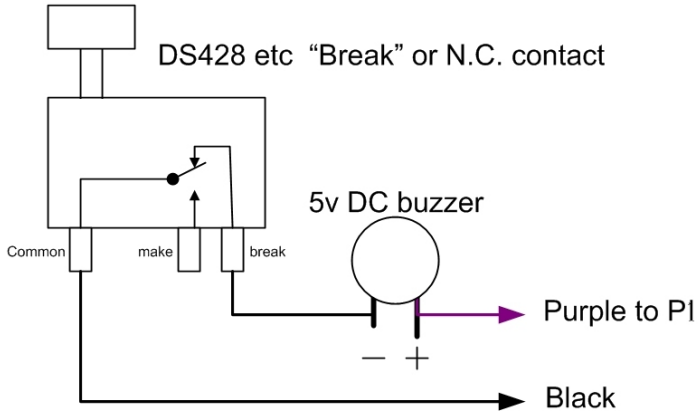
A couple of points to bear in mind before embarking on this project:

- For three propo channels we dont need P5 on the DigiSpark, so theres no need to change the 'hfuse' with a fuse programmer.

- The DigiSpark board needs all the USB and LED circuitry disabling as the linearity of the analogue inputs is affected otherwise, This is easily achieved by removing four components from the board, as detailed above. Dont worry, this is very easy to do!

- As with the 7ch encoder, for less than 3 channels, dont leave unused inputs floating - connect them to a used input.

- The single-channel/calibrate button must be a Normally Closed, 'break' contact, on the DS428 and DS438 microswitches its the outermost tags:



If you dont want the S/C facility, omit the button and connect the buzzer via a plug/socket, negative to ground (black) and positive to purple. The plug & socket allows you to disconnect it for calibration.

Cheers
Phil