DigiSpark 4-channel propo encoder **Phil_G**

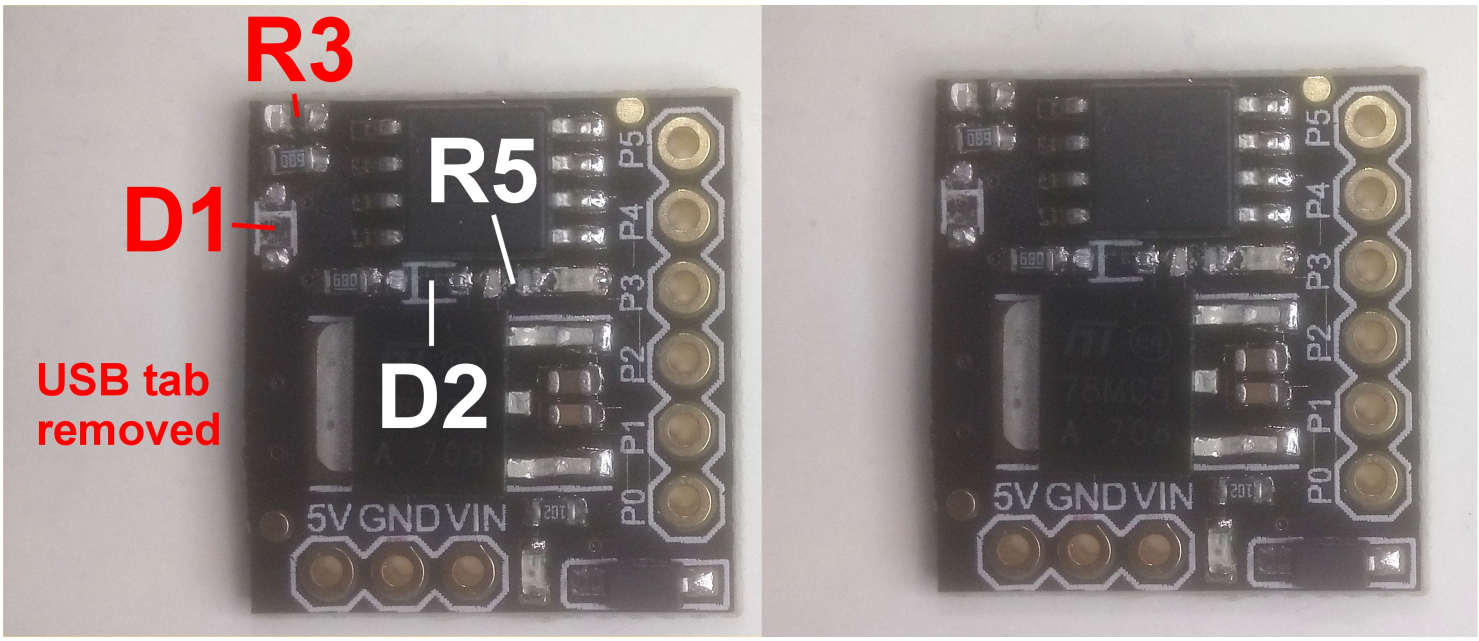
Here's a full 4-channel propo encoder for the DigiSpark, a tiny (3/4" square) cheap & cheerful Arduino board that works really well for our projects. This is a simple, minimal encoder so it doesnt have a colour telemetry display or anything fancy. What it does have is:

Four 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)

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.

As supplied, 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:



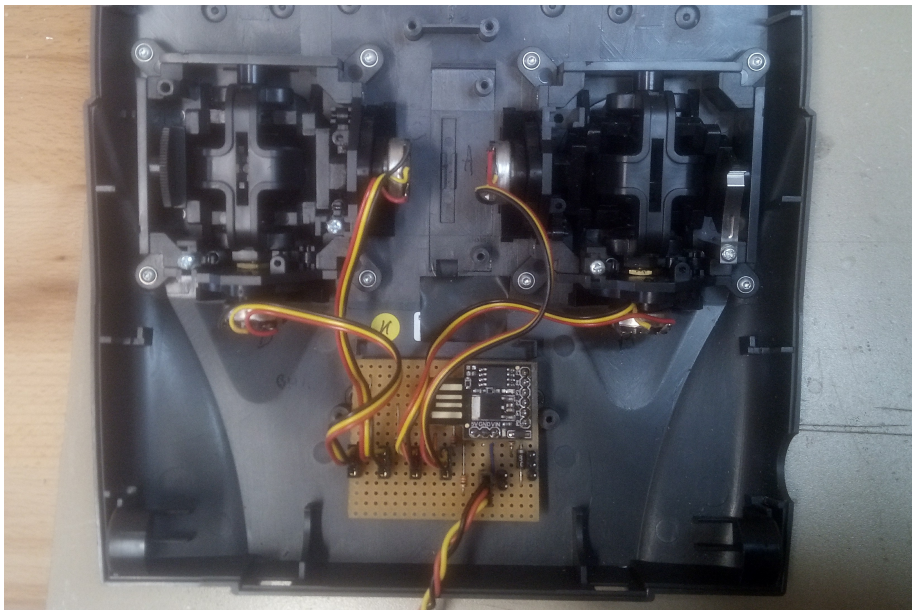
We need four joystick inputs, a calibrate link or button input, and a PPM output, so having freed up all 5 pins, we need one more. On the ATTiny85 chip, the reset pin P5 has a dual purpose, controlled by an internal 'fuse'. It can either be 'reset' as required for programming, or it can be another I/O pin which is what we need. The DigiSpark fuse programmer makes this change easy peasy: http://mode-zero.uk/viewtopic.php?f=41&t=643

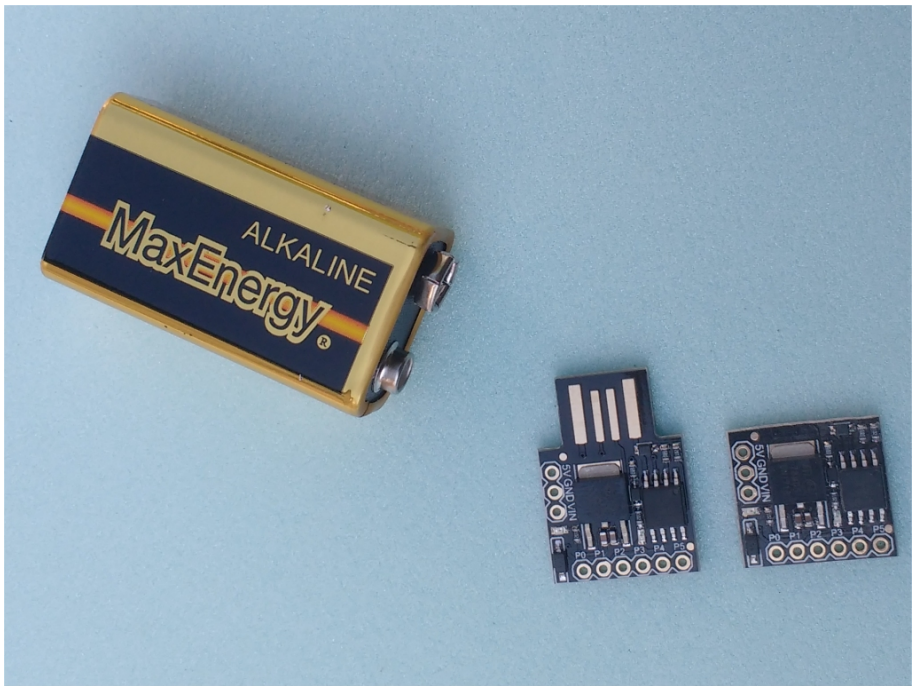
Now we have 6 pins, allocated as follows:
P5 (ADC0) Aileron
P4 (ADC2) Rudder
P3 (ADC3) Throttle
P2 (ADC1) Elevator
P1 Calibrate & S/C Button, also inactivity buzzer
P0 PPM output

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.

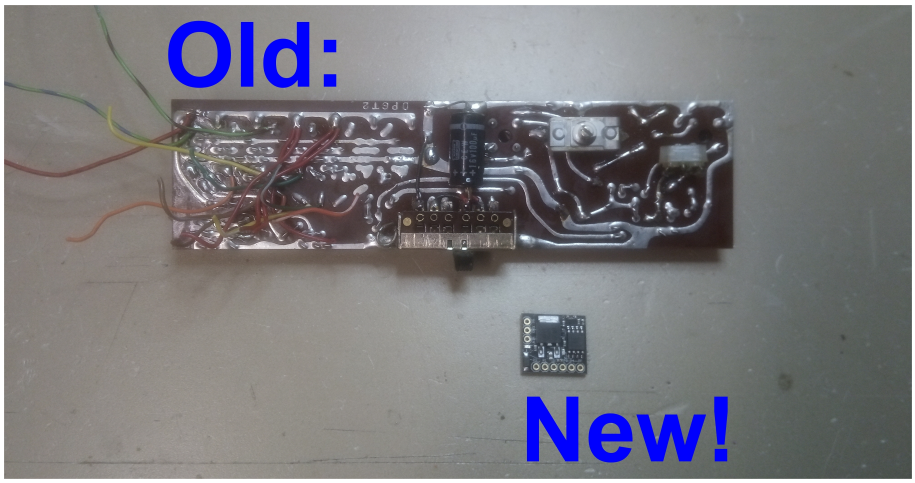
All the necessary information is here so it would be great if anyone else fancied having a go at this project. Just one pointer, if the throttle lock holds at the 'open' position (ie at the 2ms end of travel) then the throttle pot outer wires need swapping over, thats the +5 and neg. Its a safety thing 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 a couple of the DigiSpark 4ch encoders myself, this is one of testers which for convenience is mounted on a vero backplane, fitted into a Multiplex Pico. I've left the usb tab on this one, normally I saw it off. (It always amuses me to see the tiny 3/4" square board lost inside a transmitter!)



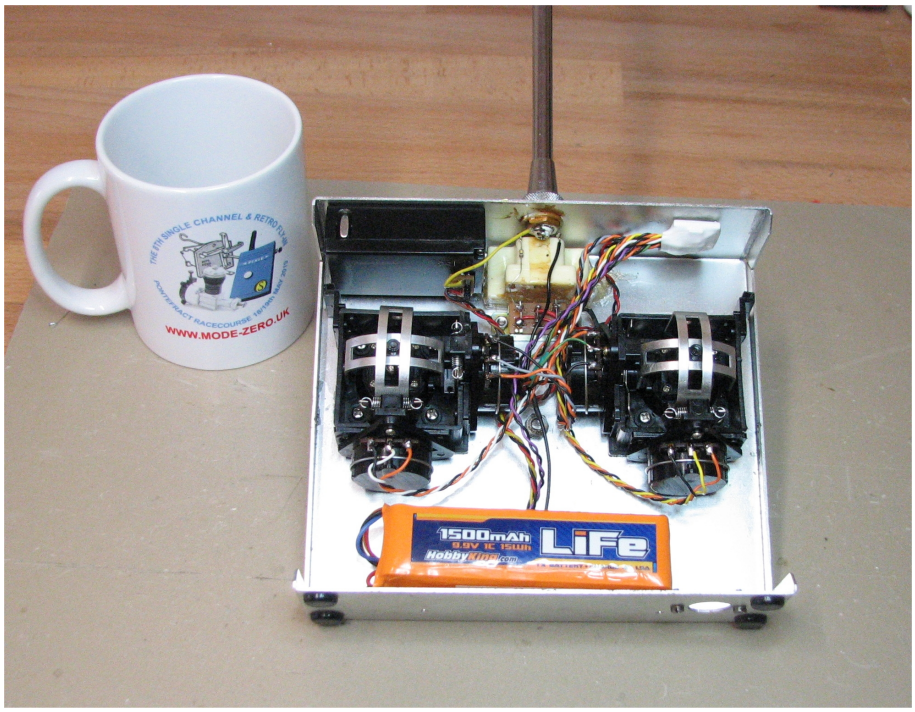


I find the comparison of old and new electronics really amusing - the old Digiace board had no facilities at all, not even servo reversing. It was the full planform of the transmitter, whereas its replacement is 3/4" square!



Here's an update to my old 27mhz KO Digiace. By way of a change from 2.4g this one uses a Hitec 35mhz module (from Profi) on my lucky channel of 76.

Looking into the back of the set, the RF module is top left and the DigiSpark encoder top right.
I've not fitted the S/C button as I feel it would spoil what was a very 'plain' set. Its actually wired, but tucked away behind the battery rather than having a non-standard button on the tx facia.



The meter reads just right with a fixed 100k in series, as long as it moves I'm not fussed about expanded scales or anything. From outside the set looks completely standard, with no extra buttons, switches or LEDs behind the meter, with just the lovely original satin steel finish.

The finished set works great, no different to how I remember it used to be, but with a few extra bells & whistles and hopefully a much better proposition these days than 27mhz.

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 four 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 seven-to-one medusa thing of 'negatives', similarly make up a two-to-one for battery positive and another four-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:

I've updated this sketch after I found that the Waltron pots were very slightly 'off' electrical centre at neutral stick. In all my previous encoder sketches, the calibration routine learns the full throw in either direction, then assumes that neutral is halfway between these values and until the Waltron this method has given spot-on neutrals.

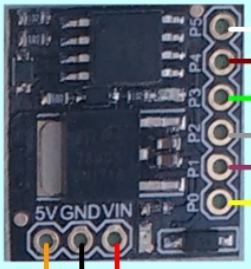
For this particular encoder the new calibration procedure is as follows:
Note that the 'calibrate' input is electrically inverted with respect to previous versions.
Centre all trims and dont touch them throughout the calibration process.
Hold the button in or disconnect the buzzer to open-circuit the '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 the 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.

The highest & lowest stick pot values are saved like before, but additionally the centres are now stored and the encoder now uses a separate map for either direction the stick is moved.

This ensures that stick-centre is channel centre whilst full travel is equal in both directions, even if the stick is mechanically slightly off-centre. It works great so I will be incorporating this into the 7ch+sc update too.

I cant update my DigiAce transmitter as the board is soldered up, just as well its sticks are spot on - but I've been using the update in the Multiplex Picoline (which has perfect sticks) and the Waltron (which didnt but does now!) :D

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



P5 White to Aileron pot wiper, twist with orange & black
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

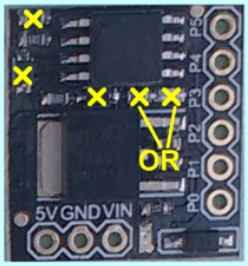
Twist with orange, black & white to Aileron pot
Twist with orange, black & brown to Rudder pot
Twist with orange, black & green to Throttle pot
Twist with orange, black & grey to Elevator pot
} Pot ccw end tags

Twist with purple to buzzer Neg (short leg)

Twist with red & yellow PPM to RF module

Battery neg

Twist with black & white to Aileron pot
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



"De-fluffing" a DigiSpark:

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 4-channel propo encoder for the DigiSpark with S/C escapement emulation. P5 is used as an analogue input, so after programming, the hfuse must be changed with a fuse programmer from DF to 5F	Date: May 2019	Drawn: Phil_G	Sketch: digispark_4ch_propo_sc.ino

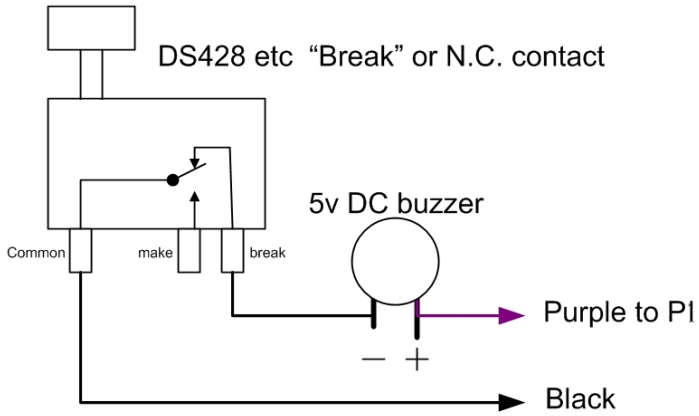
A couple of points to bear in mind before embarking on this project:

- For four propo channels we need all the available I/O on the DigiSpark, so after programming, the 'hfuse' needs to be changed using a fuse programmer from hex DF to 5F.

- The DigiSpark board also 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 4 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