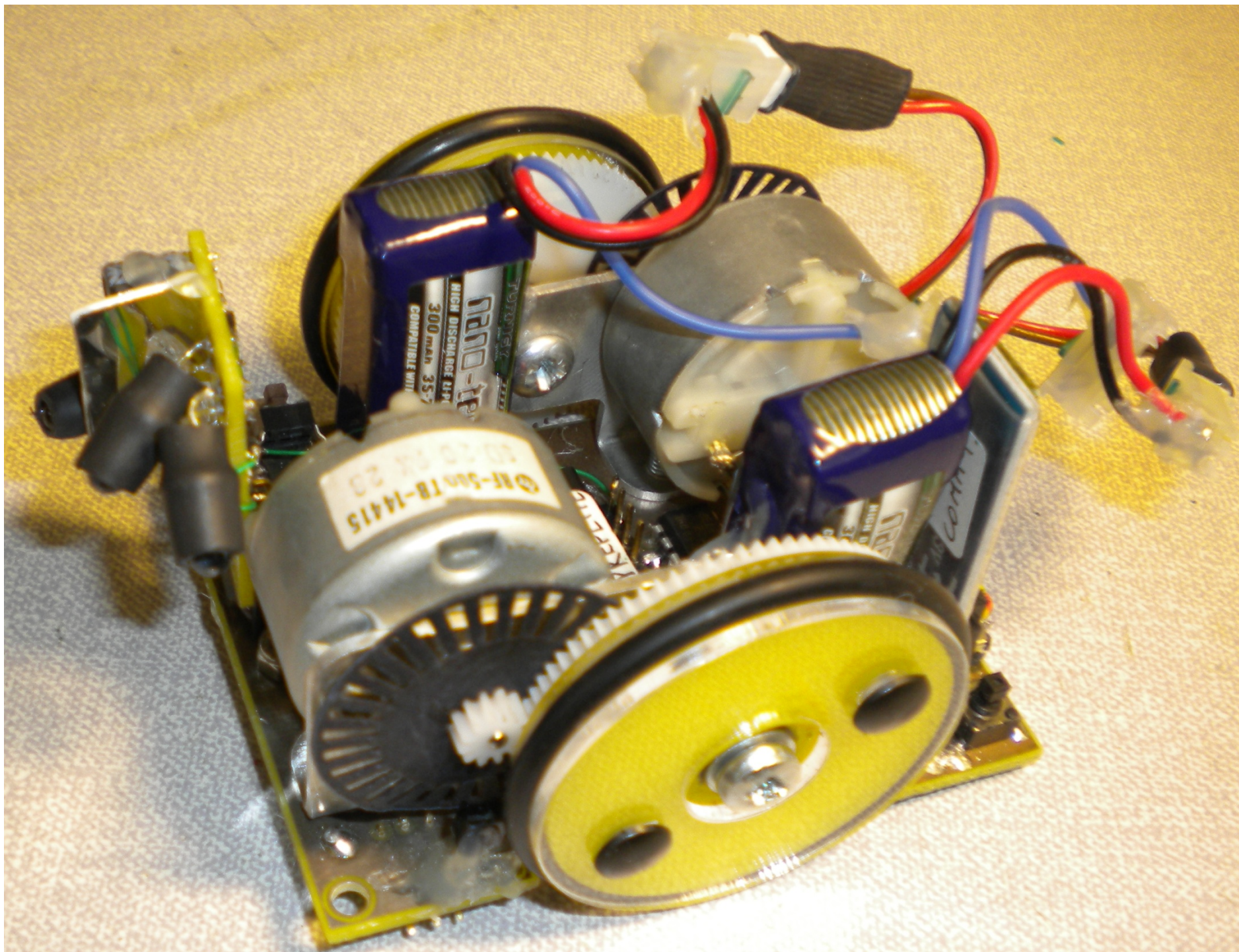# Some details of PREFLITE

Duncan Louttit

MINOS 2014
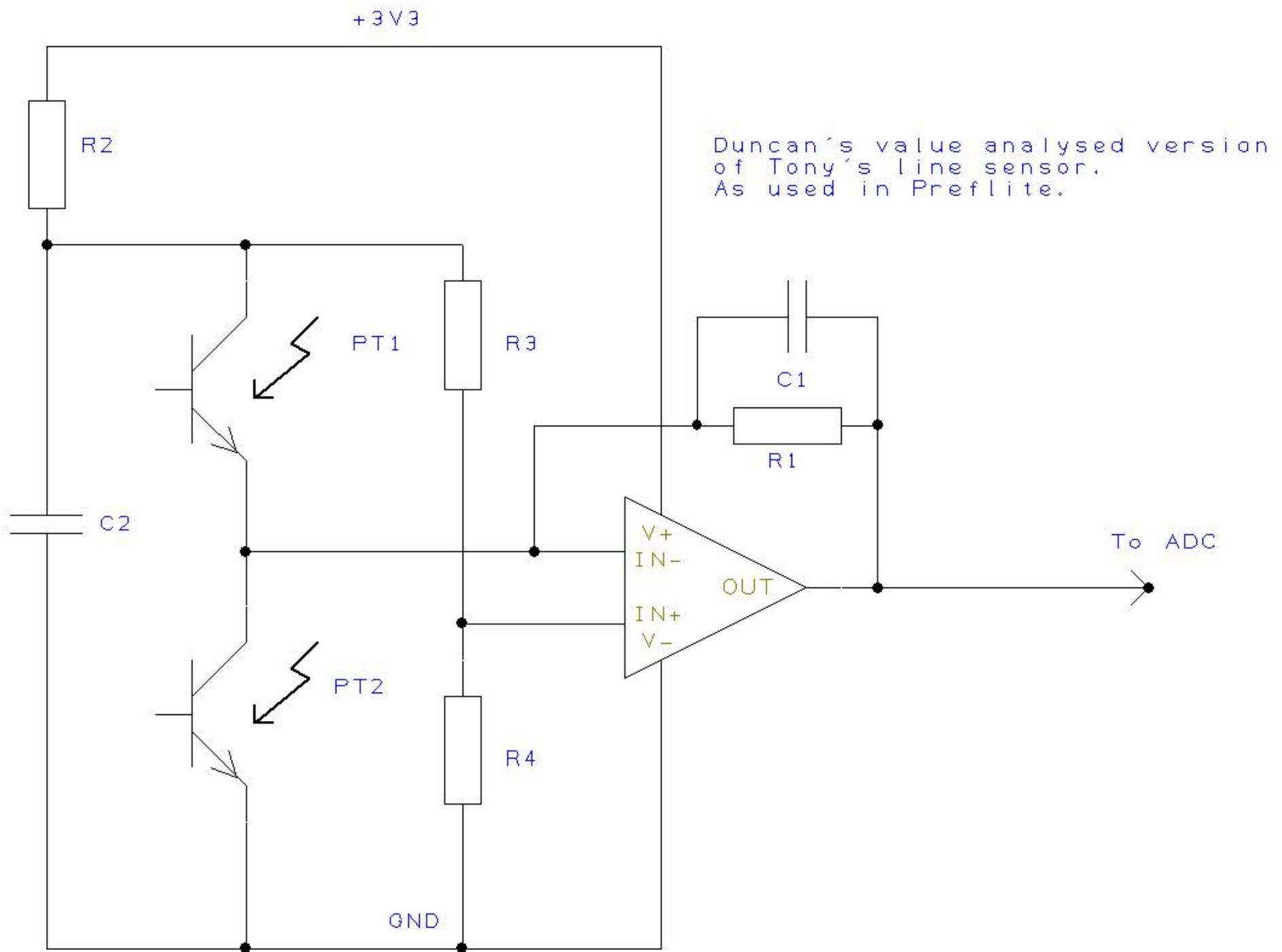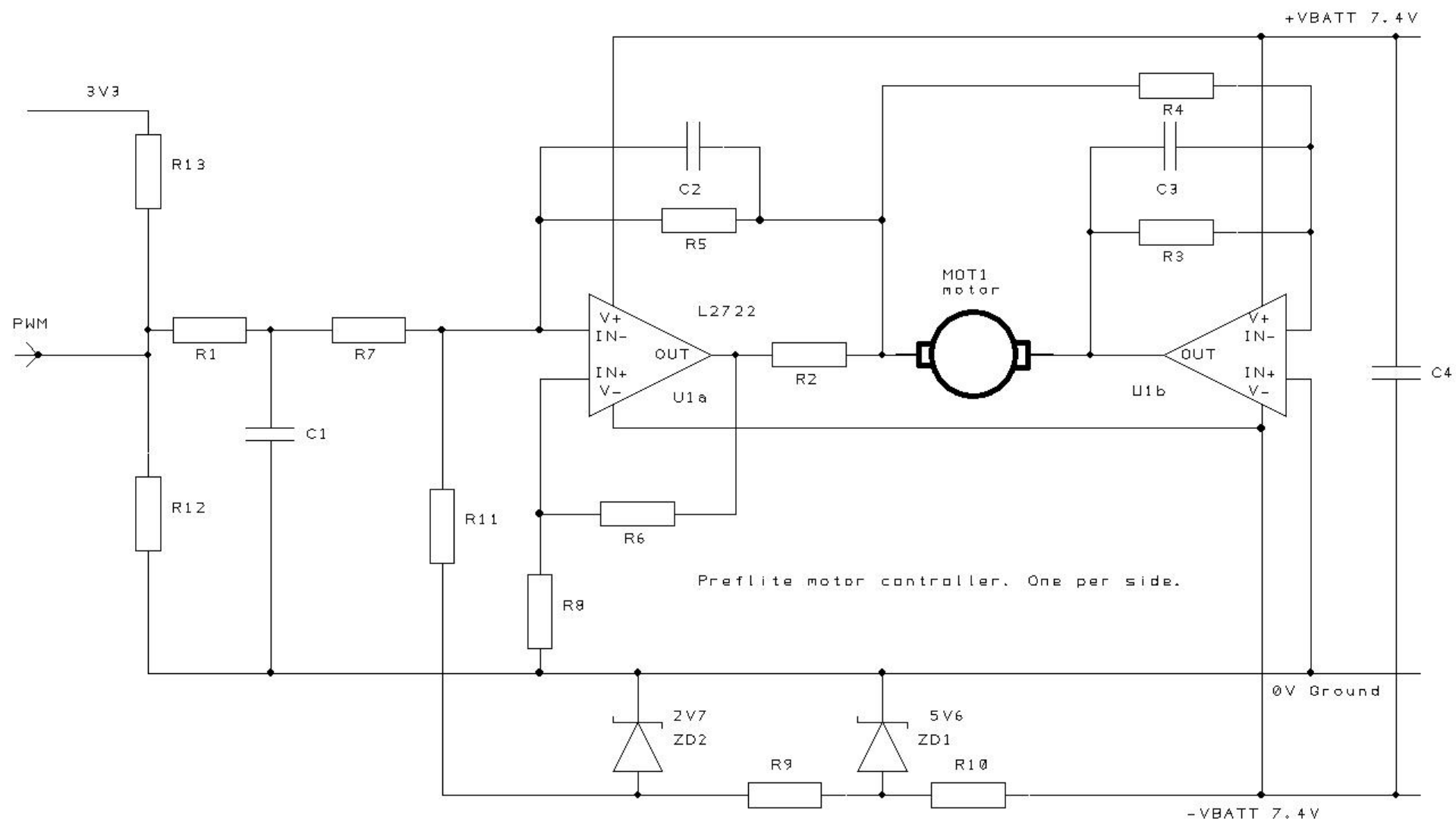
Novel? Bits:

- The line sensor is a "value analysed" version of Tony's line sensor.

- The motor controllers are an upgrade on my "positive feedback" system using two batteries for balanced supplies.

- It uses MPE's MSP430 Lite FORTH compiler.

Layout of LEDs and phototransistors

+3V3

R2

PT1   R3

C2   C1   R1

PT2   V+   To ADC
       IN-
       OUT
       IN+
R4   V-

GND

Duncan's value analysed version
of Tony's line sensor.
As used in Preflite.

+VBATT 7.4V

3V3

R13

R4

C2

C3

R5

R3

PWM

MOT1
motor

L2722

V+
IN-

V+
IN-

OUT

OUT

IN+
V-

IN+
V-

R1

R7

R2

U1a

U1b

C1

C4

R11

R6

0V Ground

R8

Preflite motor controller. One per side.

R12

2V7
ZD2

5V6
ZD1

R9

R10

-VBATT 7.4V

Marker Sensors

- There are two Kingbright KTIR 0811S reflective sensors mounted on removable booms for the markers.

Wall follower

- Wall follower sensors are 3 red LEDS multiplexed from one Hamamatsu sensor.
- The LEDs are aimed at the junction of the wall and floor at the relevant place.
- These is a piece of mirrored plastic to help the Hamamatsu see the closest wall.
- Only two LEDs are actually used at any time.

Software

- Uses MSP430G2553 16 bit controller in 20 pin DIP package.

- Uses MPE's beta version of FORTH LITE for this processor.

- Uses Bluetooth for comms at 9600 baud.

- Only 16K flash and 512 bytes of RAM. FORTH itself used 12K flash and a lot of RAM so it was a bit cramped.
- Source is compiled into flash. Different downloads for drag/line follower and time trial. (Could have been made to fit with a bit more time!)
- No space for the multi-tasker (shame)

FORTH (again)

- INTERACTIVE. This allows real-time interaction with the code. It runs at full speed. All the definitions are accessible to the user.

- Easy to send debug information from the mouse over Bluetooth during a run. The drag race PD controller was tuned by printing the errors during a run.

- Once downloaded, typing DRAG ran the drag racer, LINEFOLLOWER ran the line follower and TRIAL ran the time trial.

- Before starting, DRAG and LINEFOLLOWER typed the line sensor values so that the mouse could be correctly positioned on the line.

- TRIAL exercised the sensing LEDs so that the mouse could be accurately positioned here.

Costs

- TI Launchpad programmer (to put the FORTH in) £7.61 plus VAT (Farnell).

- MSP430G2553 in PDIP £1.51 plus VAT (Farnell).

- The only support for the controller is a reset pull-up resistor and capacitor.

Future developments

- MPE have put out a FORTH for the STM32F072B-DISCO board. This has over 70KB of free space, 13K of free RAM, floating point, multi-tasking, 32 bit processor running at 48MHz and a three-axis gyro for the princely sum of £6.75 plus VAT.

Cock-ups

- There is a single-axis gyro fitted. It is not currently used.
- The time-trial software never reached full speed for the full length of each side.
- There are two extra line-sensors under the mouse. These are not used.
- The batteries have to be charged separately and they are not removable.

Possible improvements

- Acceleration/braking profiles are not flexible enough. The drag racer should accelerate and brake much harder. It spends over 1.5 seconds in this phase.

- Improved software using the gyro will vastly improve the time trial performance.

- Learning the line follower course will speed it up a lot.

FORTH compilers

Both the MSP430 and Discovery STM32F072B-DISCO board compilers have now been released as free downloads from MPE. (Thanks Stephen!)

The URL is:

http://www.mpeforth.com/xc7lite.htm