

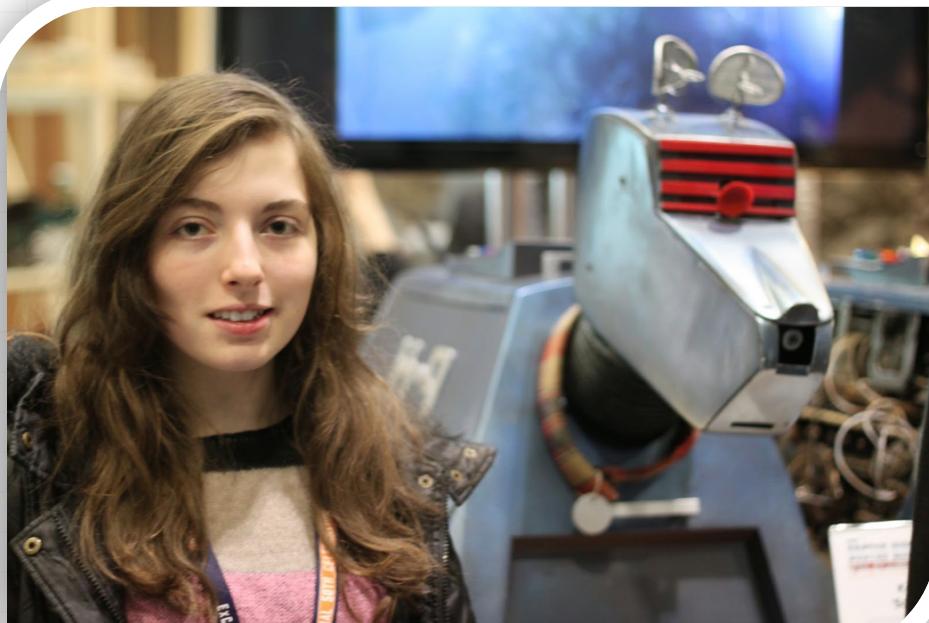
Hello Sensors
Meeting

22/04/2017

K9 Builders Handbook

Richard Hopkins FIET
IBM Distinguished Engineer
IBM Academy of Technology

Who is K9?



- K9 is Doctor Who's robot dog. He was introduced to the UK TV programme in 1977 to ride the Star Wars bow wave
- In fiction he is a mobile computer from the year 5,000 with an air of British superiority – he can beat the Doctor at chess...
- The character has appeared in Doctor Who and spin off series from 1977 to 2010 and the same hero prop has been for nearly 40 years.



Richard Hopkins, FIET
IBM Distinguished
Engineer
Member of IBM Academy
of Technology Core
Management Team

- I joined IBM from an arts degree over 25 years ago
- Systems engineer then architect; but hands off after Java 2 & XML
- Mostly delivered systems for public sector clients
- Currently GBS Public Sector CTO for Europe and 'digital provocateur' for the IBM AoT
- Married with three kids, three real dogs, six cats, three terrapins, 25 fish and a Morgan
- *Doctor Who* fan since 1977 and have built three previous K9s

Overall Goal

Public goal - Design and build a mobile robot recognisable as the BBC K9 prop that can be used both as an Internet telepresence and digital assistant.

Personal goal – learn hands on Agile, DevOps and modern programming techniques

Current appearance

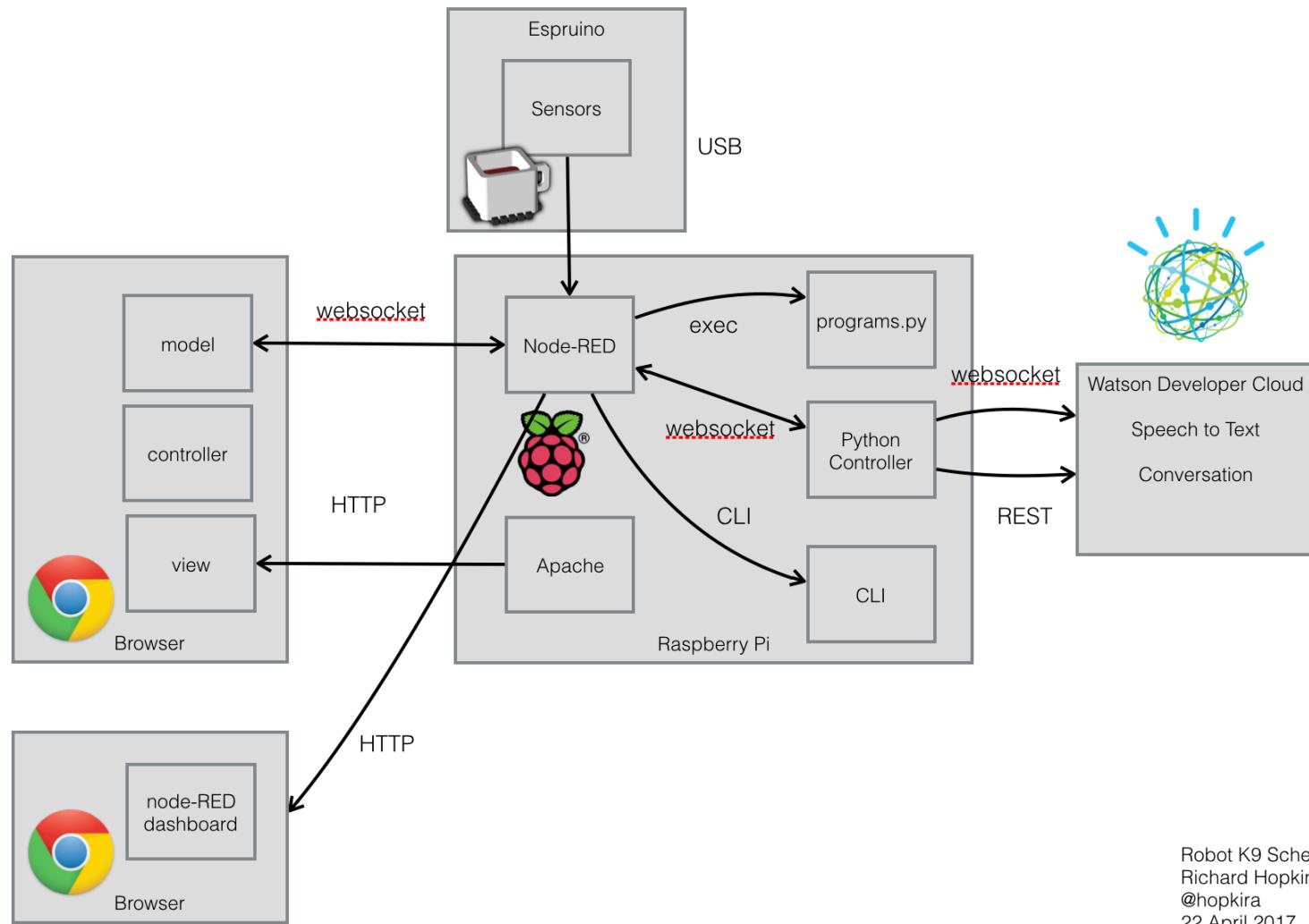


Progress to date

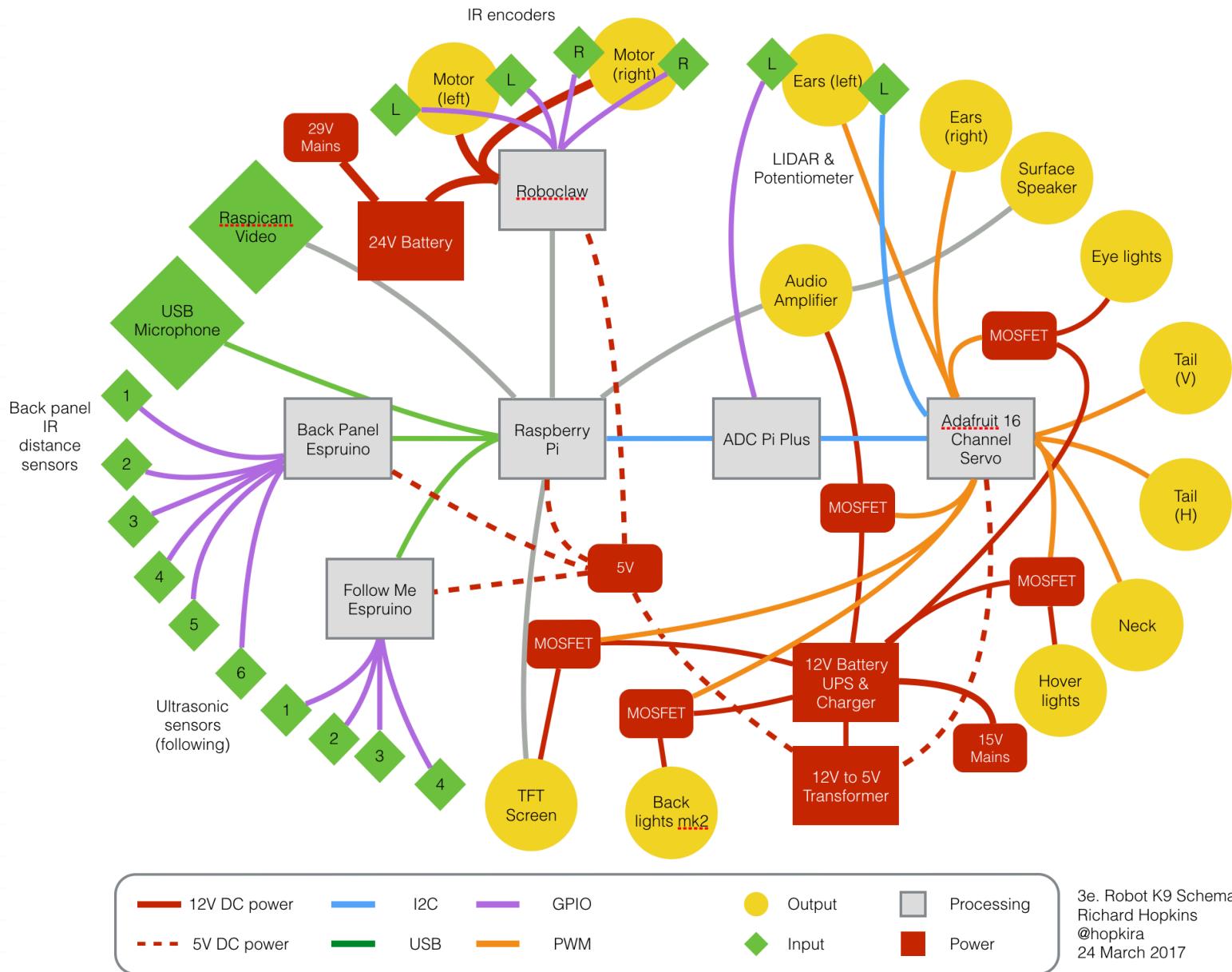
- Best viewed here: <https://youtu.be/EpR6BBRux3g>
- Blog and code here: <http://k9-build.blogspot.co.uk/>
- Can be driven remotely via HTML5 browser
- Tail, ears and neck can be controlled from browser
- Lights can be controlled from browser
- Side screen shows power consumption and voltage graphs
- Built in 'mood' animations, such as 'turn off' and 'wake up'
- Can also have a conversation using IBM Watson

Future plans

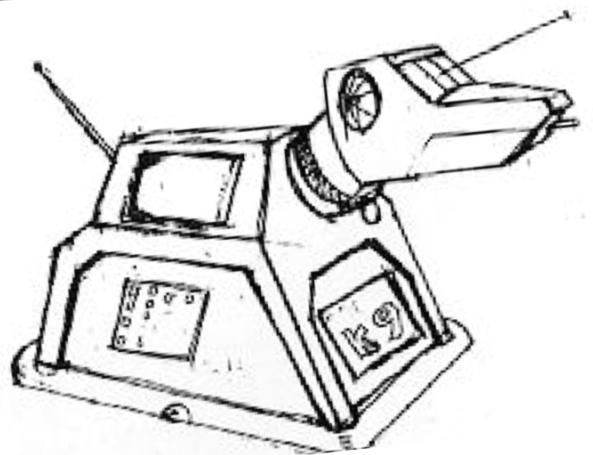
- 'Follow me' capability that will allow K9 to safely follow me through a crowd using an ultrasonic screwdriver
 - Forward facing rotating LIDAR sensor on left ear
 - Backwards facing IR Sensors on backpanel
 - Ultrasonic receivers at each corner
- Ability to play grand master level chess
 - Integration with Stockfish chess engine
 - 'Cognitive' use of historical games



Robot K9 Schematic
Richard Hopkins
@hopkira
22 April 2017



3e. Robot K9 Schematic
Richard Hopkins
@hopkira
24 March 2017



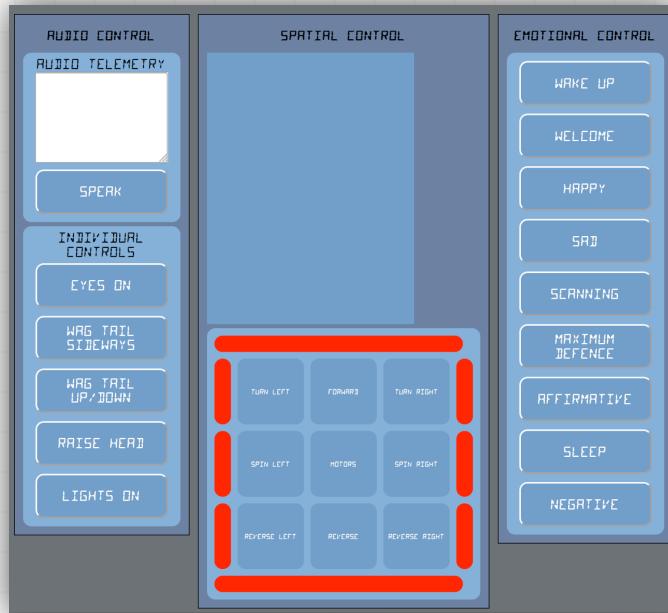
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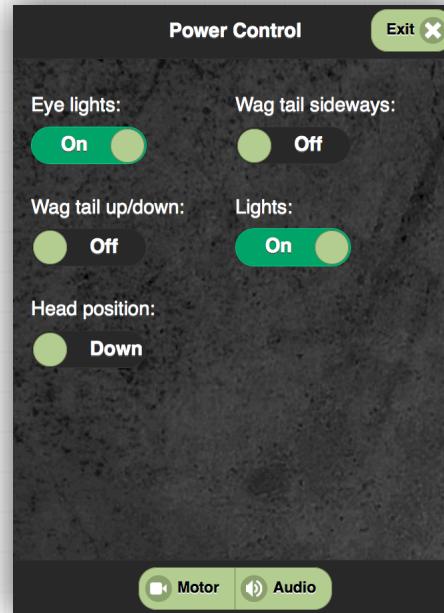
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Lessons Learned

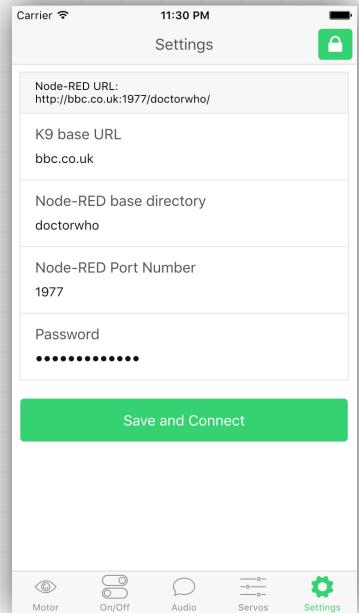
LL1: Migrating UI frameworks is painful



HTML5/JQuery/CSS3
2014

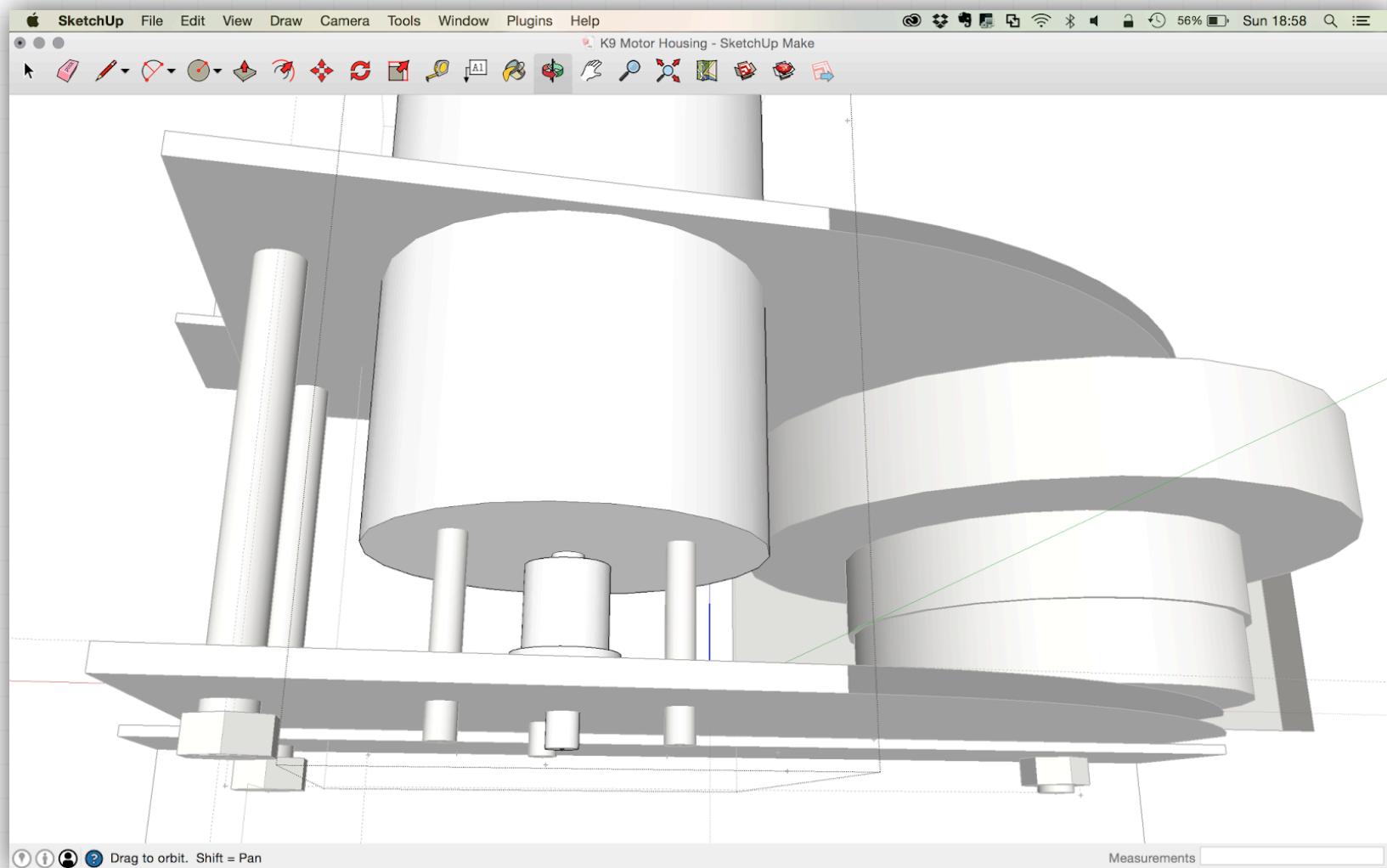


JQuery Mobile
2015

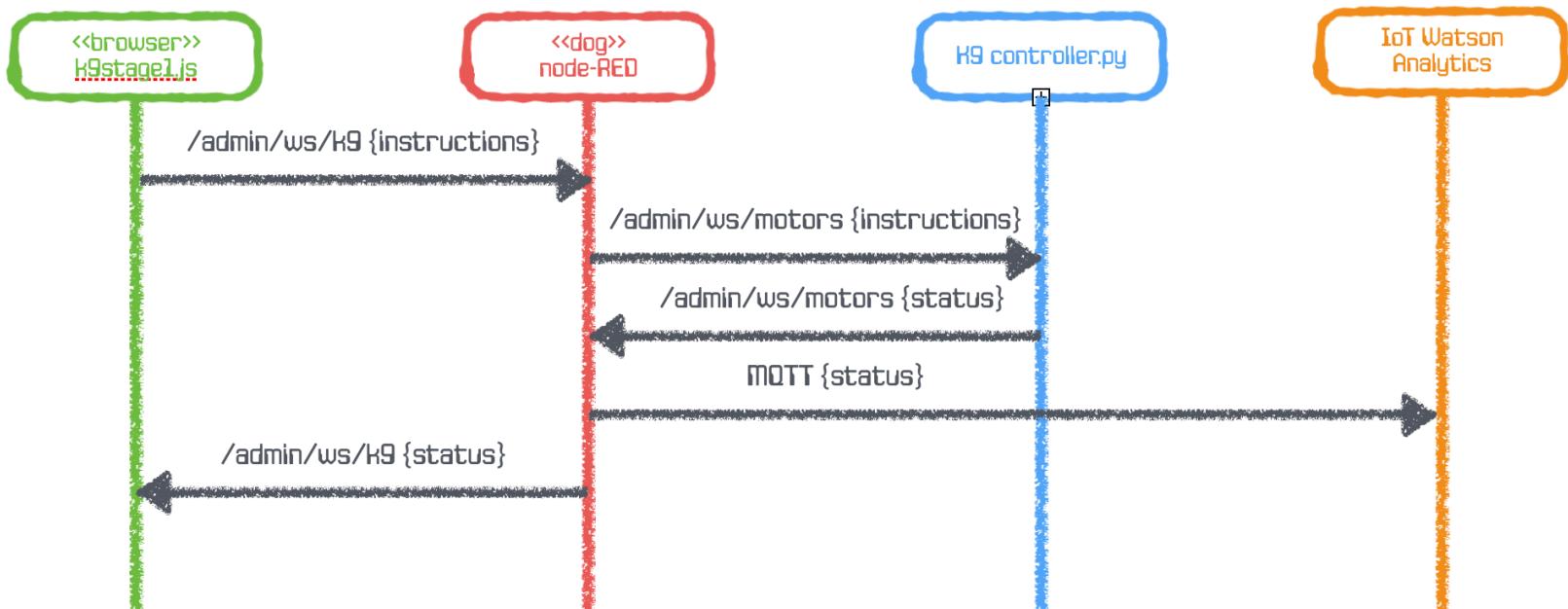


Ionic/AngularJS
2016

LL2: If in doubt, do it in CAD!

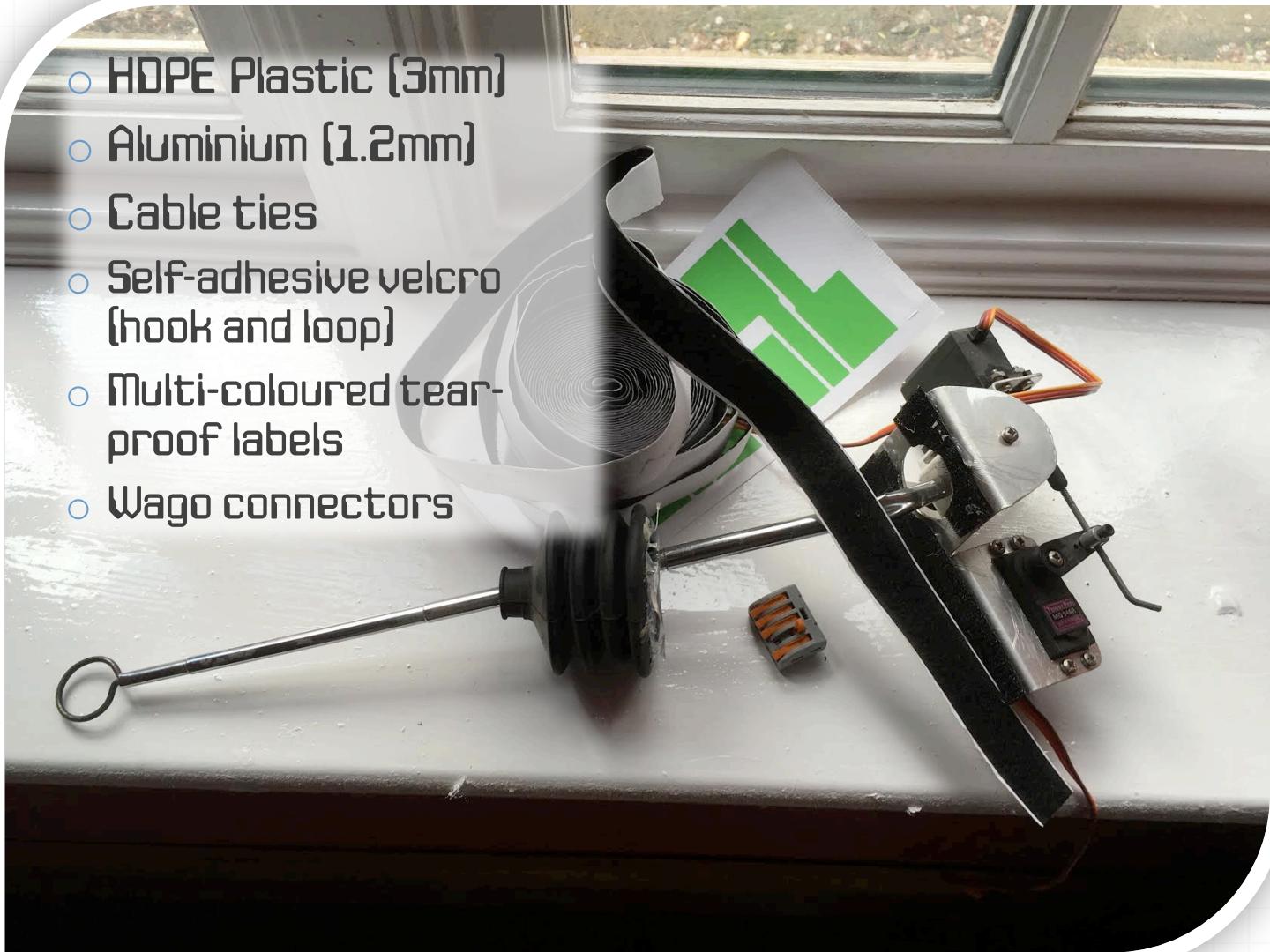


LL3: Big robots hurt - engineer for failure and children...



LL4: These materials will be your new friends

- HDPE Plastic (3mm)
- Aluminium (1.2mm)
- Cable ties
- Self-adhesive velcro (hook and loop)
- Multi-coloured tear-proof labels
- Wago connectors



Lessons Learned 5 to 10

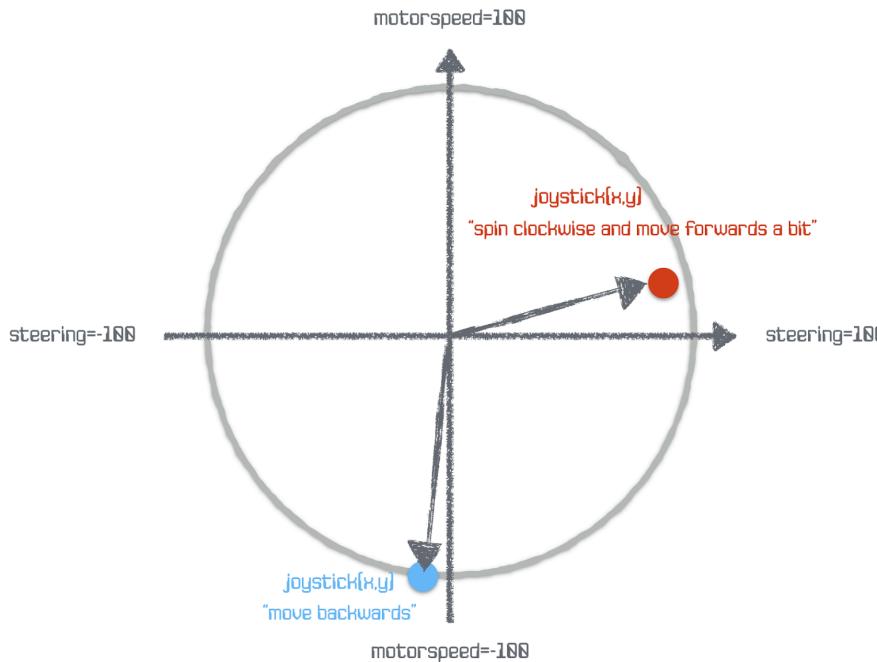
- 5 Treat it like any complex system integration project, just without the people and politics!
- 6 Develop on a big and mobile powerful platform
- 7 Engineer a smooth development to robot pipeline
- 8 Wrap the platform dependencies in your code
- 9 Buy good power supplies (5V and 12V)
- 10 Big motors and delicate electronics do not mix!

LL11: Build a motherboard!

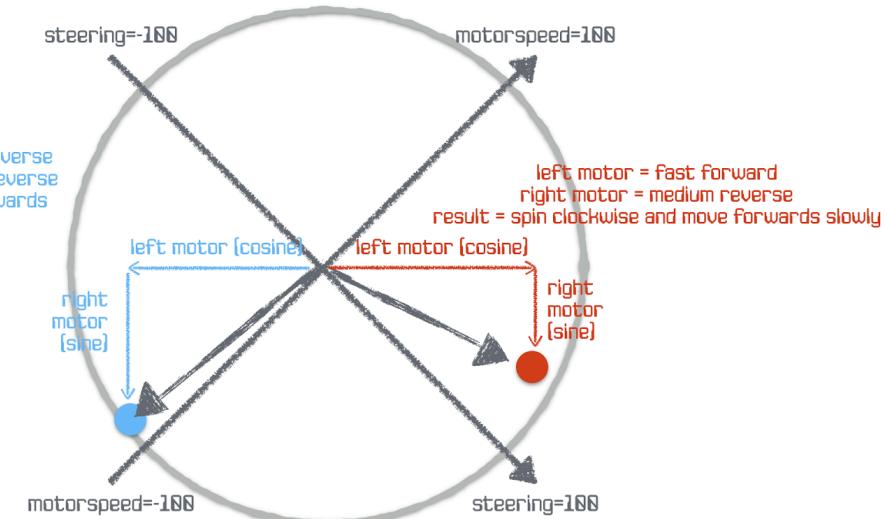
- Physical componentisation is important too
- Tightly integrated elements can be velcro'd together on a plastic 'motherboard'
- K9's current 'motherboard' integrates:
 - Raspberry Pi, USB hub and Wifi
 - Stereo Amplifier
 - Servo and Motor Controllers
 - Darlington Transistor light circuits
 - 12V to 5V transformer
 - Wago connectors for 12V in; 12v and 5v out
- The board itself is velcro'd to the inside of K9, but can be removed making the core of a 16kg (35 lbs) and 1.1m long robot rather more portable!
- The tear-proof coloured labels make connecting the c.20 leads manageable

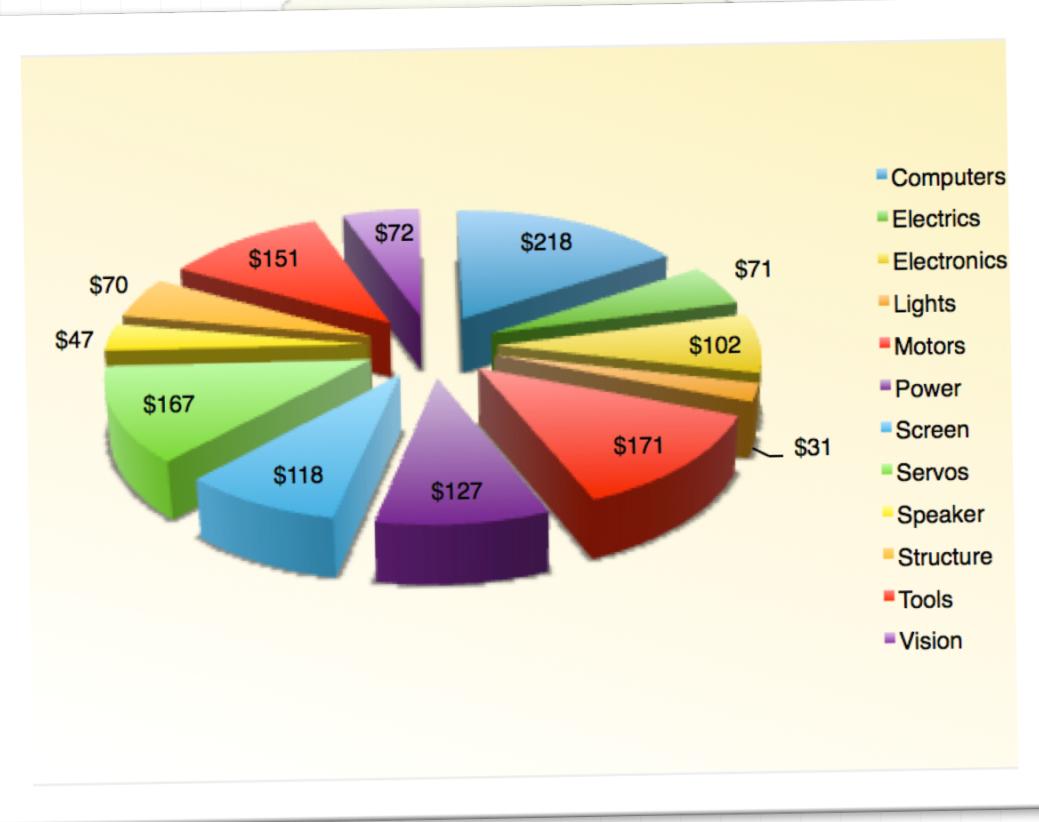
LL12: Simplicity is hard, but worth it

Single Joystick



Dual Motors





LL13: eBay will love you

Half the \$2,500 cost was the fibreglass shell, each of the remaining areas of the build cost between \$50 and \$200 including new tools; so far over 90 eBay purchases of c. \$15 each

LL14: Impress your kids with 12,815 likes on Facebook...

 Doctor Who ✓
20 October 2015 · 

How one #DoctorWho fan built a working model of K-9, completing a mission he started at 8 years old.

More via @Anglophenia: <http://bbc.in/1GQSDht>

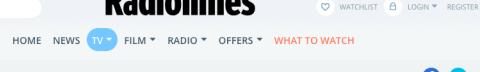


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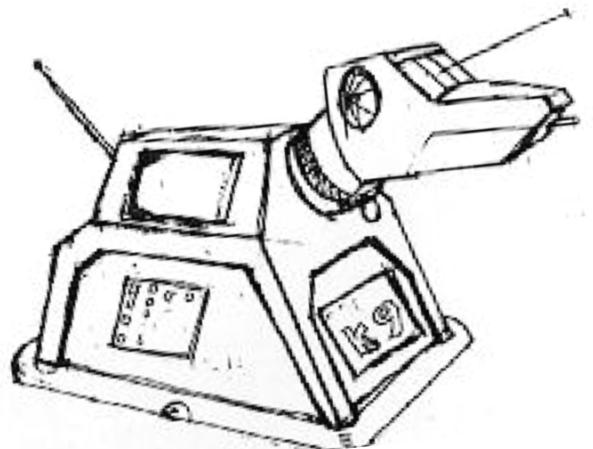
This brilliant tinkerer is building a Doctor Who K9 with a Raspberry Pi for a brain

A robot dog from the year 5000 built with a computer designed for kids. Genius...







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Please ask
questions via my
blog
<http://kg-build.blogspot.co.uk/>