Final year project: Viva

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Customized Front-end for Zebrafish Acquisition System

Queen Mary
University of London

Outline

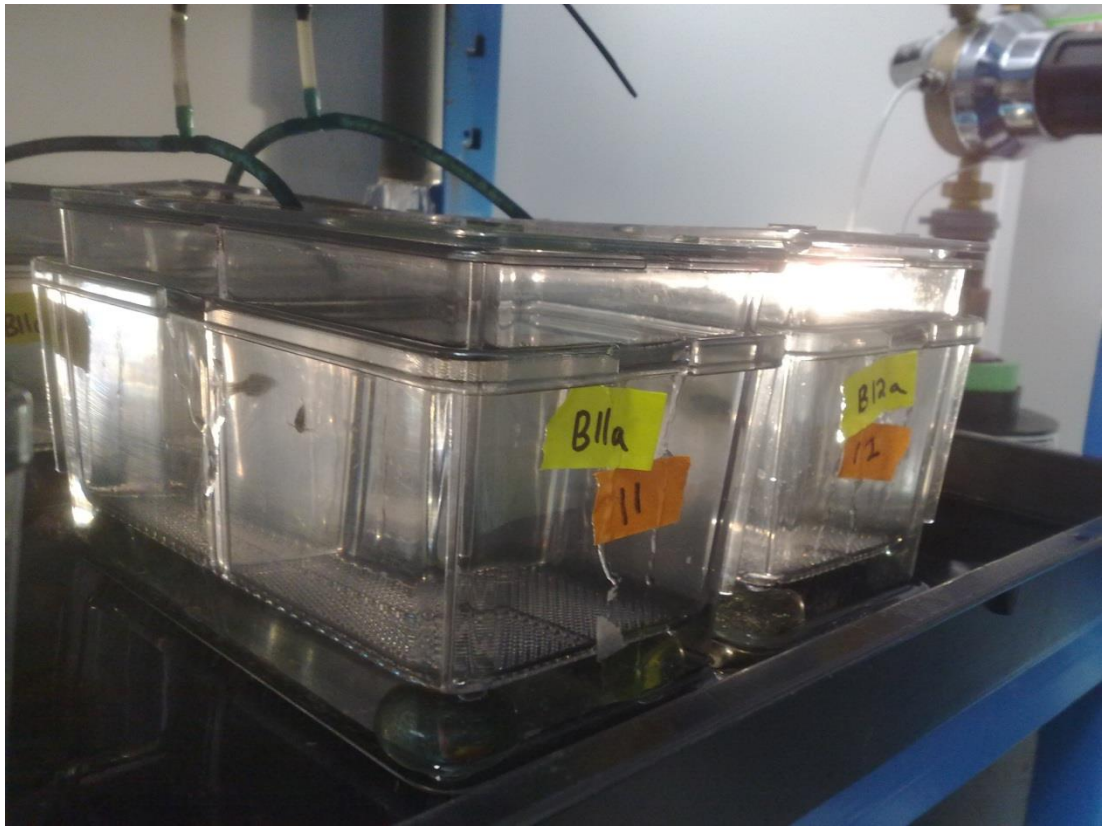
- Introduction
- Background
- Requirement Analysis
- Design
- Implementation
- User Evaluation

Introduction

- A software implementation project
  - Work on a real experiment
    - Zebrafish research
  - Cooperate with researchers
    - SBCS
- Data acquisition and processing
  - Solution
  - User-friendly interface
  - Matlab

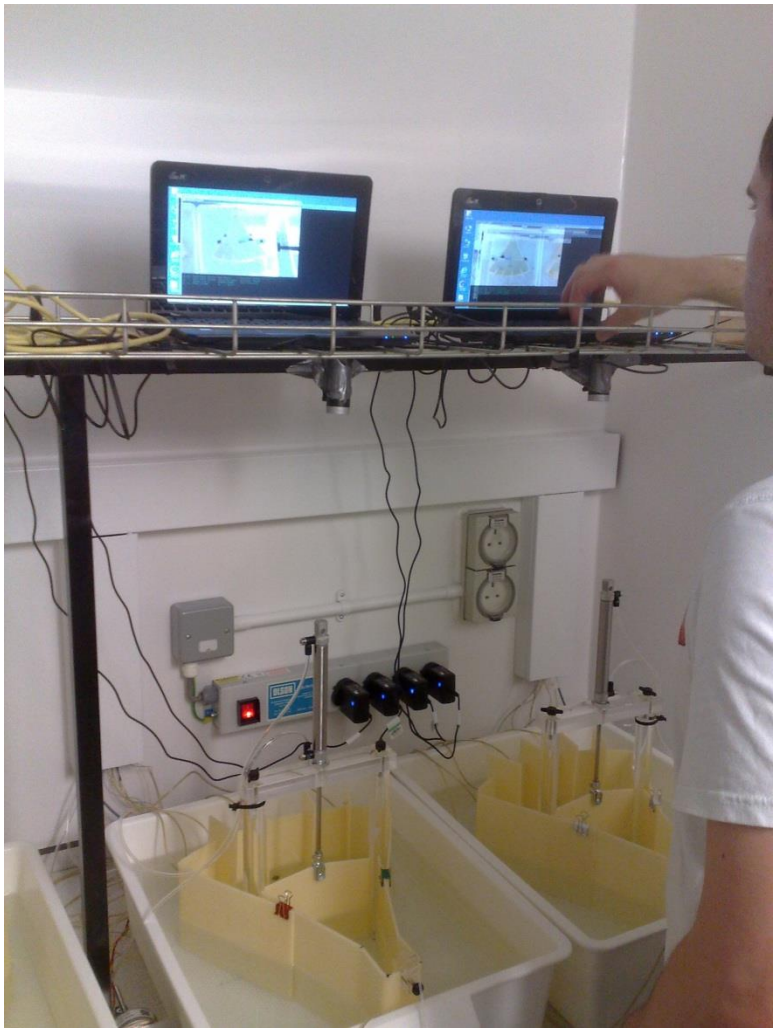
Background - Zebrafish

- Examine the effects of drugs
  - Behavioural test
- Evaluates on zebrafish
  - Performance
    - Attention
    - Impulse

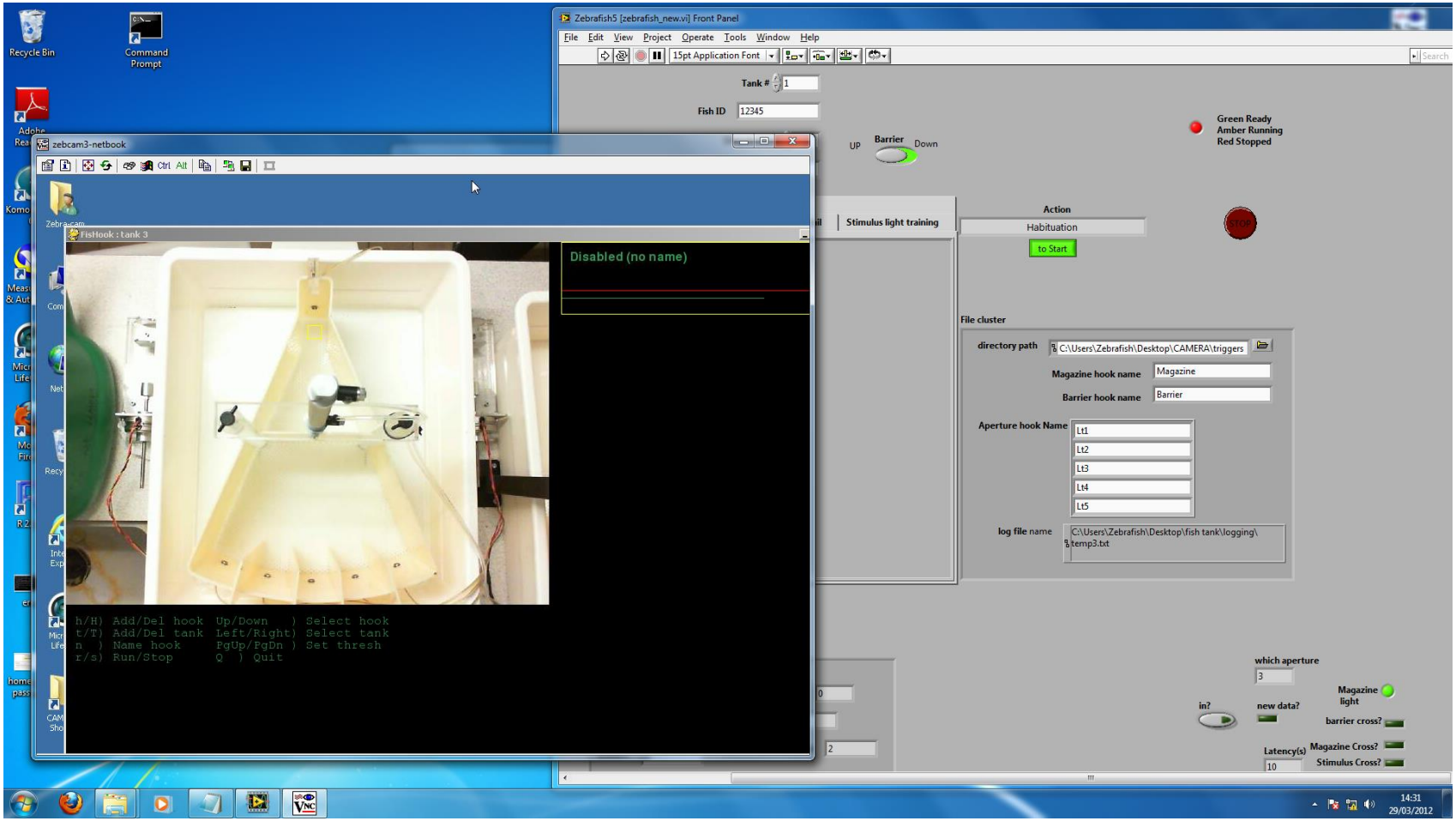


Background - Cooperation

- LabVIEW => Control
  - Automatic system
  - SEMS
- Python => Computer Vision
  - Capture
  - EECS
- My Project => Summary
  - Data
  - EECS



Background – LabVIEW + Python



Requirement Analysis - Scenario

- Scenario Document
  - Provided by the researchers
  - Targets

d130f15 - Notepad

File Edit Format View Help

```
Fish id:        d130f15
Action: 5-choice Serial Reaction Time task
Tank#:  1
Start logging   16:09:49
Time    21      Trial   0       Fish    Swim out        Delivery done   0
Time    51      Aperture#       4       Latency 15.00   Lights  8       food done       0
Time    63      Trial   1       Fish    Swim out        Delivery done   0
Time    65      Trial   1       Fish    Swim in Delivery done   1
Time    66      Trial   1       Fish    Swim out        Delivery done   1
Time    66      Trial   1       Fish    Swim in Delivery done   1
Time    69      Trial   1       Fish    Swim out        Delivery done   1
Time    101     Aperture#       5       Latency 11.40   Lights  16      food done       1
Time    113     Trial   2       Fish    Swim in Delivery done   1
Time    115     Trial   2       Fish    Swim out        Delivery done   2
Time    116     Trial   2       Fish    Swim in Delivery done   2
Time    120     Trial   2       Fish    Swim out        Delivery done   2
Time    152     Aperture#       1       Latency 13.37   Lights  8       food done       2
Time    231     Aperture#       3       Latency 31.59   Lights  8       food done       2
Time    374     Aperture#       3       Latency 24.59   Lights  2       food done       2
Time    427     Aperture#       5       Latency 13.38   Lights  4       food done       2
Time    465     Aperture#       1       Latency 0.80    Lights  16      food done       2
Time    502     Aperture#       5       Latency 8.50    Lights  8       food done       2
Time    537     Aperture#       5       Latency 2.80    Lights  2       food done       2
Time    580     Aperture#       1       Latency 15.60   Lights  16      food done       2
Time    617     Aperture#       1       Latency 8.30    Lights  2       food done       2
Time    669     Aperture#       3       Latency 24.90   Lights  8       food done       2
Time    761     Aperture#       2       Latency 32.49   Lights  4       food done       2
Time    822     Aperture#       4       Latency 23.09   Lights  8       food done       2
Time    857     Trial   15      Fish    Swim in Delivery done   2
Time    859     Trial   15      Fish    Swim out        Delivery done   3
Time    903     Aperture#       2       Latency 20.31   Lights  4       food done       3
Time    970     Aperture#       4       Latency 26.44   Lights  2       food done       3
Time    1033    Aperture#       1       Latency 4.39    Lights  2       food done       3
Time    1079    Aperture#       3       Latency 4.80    Lights  2       food done       3

        Food done
        3
```

Fish ID: D120

Date/ time:
10:25
20/11/2011

Trial parameters:	
ITI	5 sec
Stimulus duration	10 sec
LH	10 sec

Premature responses
Total: 1
%: 0.025

Accuracy
Total correct: 30
%: 75

Incorrect
Total incorrect: 7
%: 20.18

Omissions
Total omissions: 2
%: 0.05

Average time correct
5.4 sec

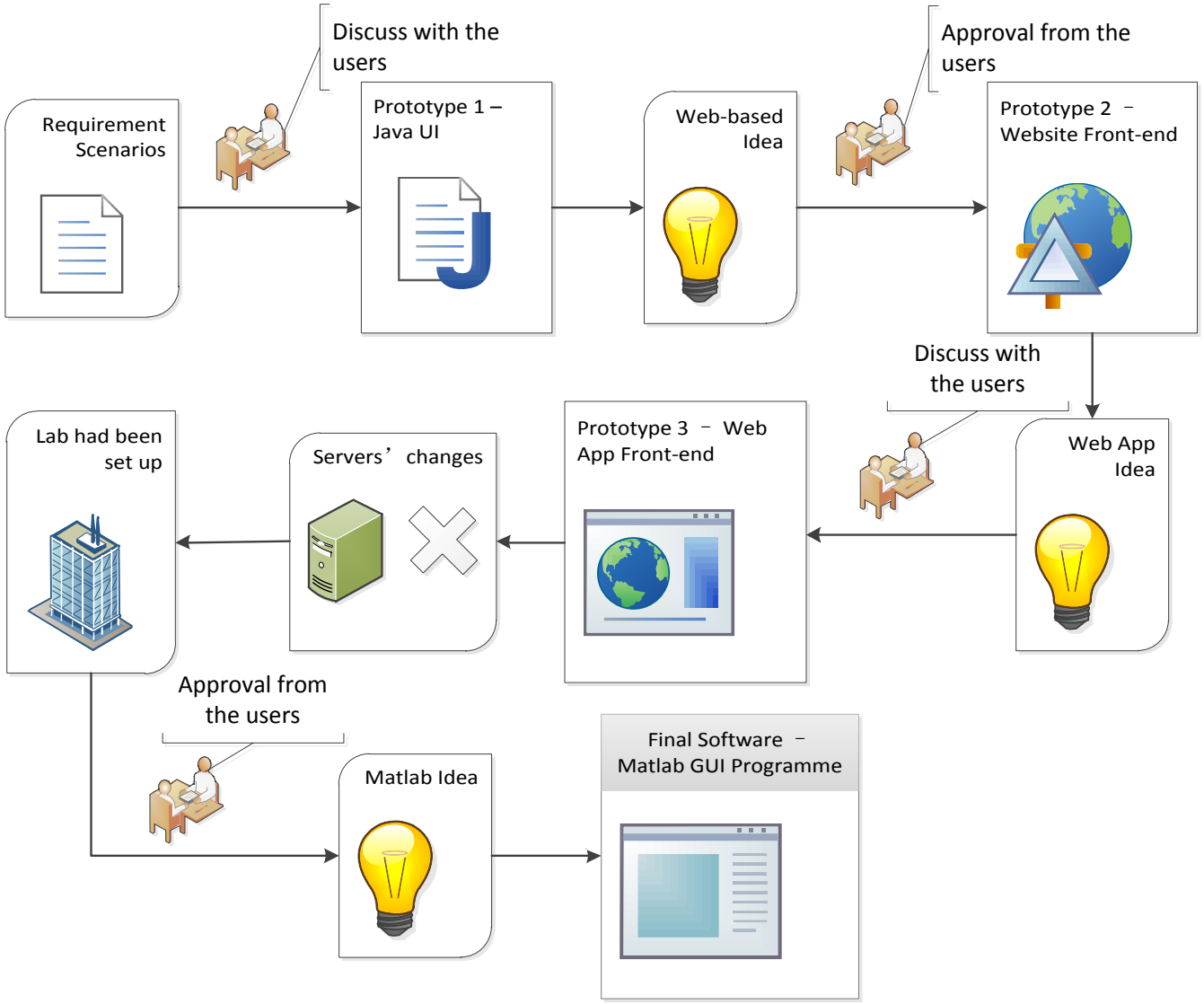
Average time incorrect
10.8 sec

Total completed trials
40

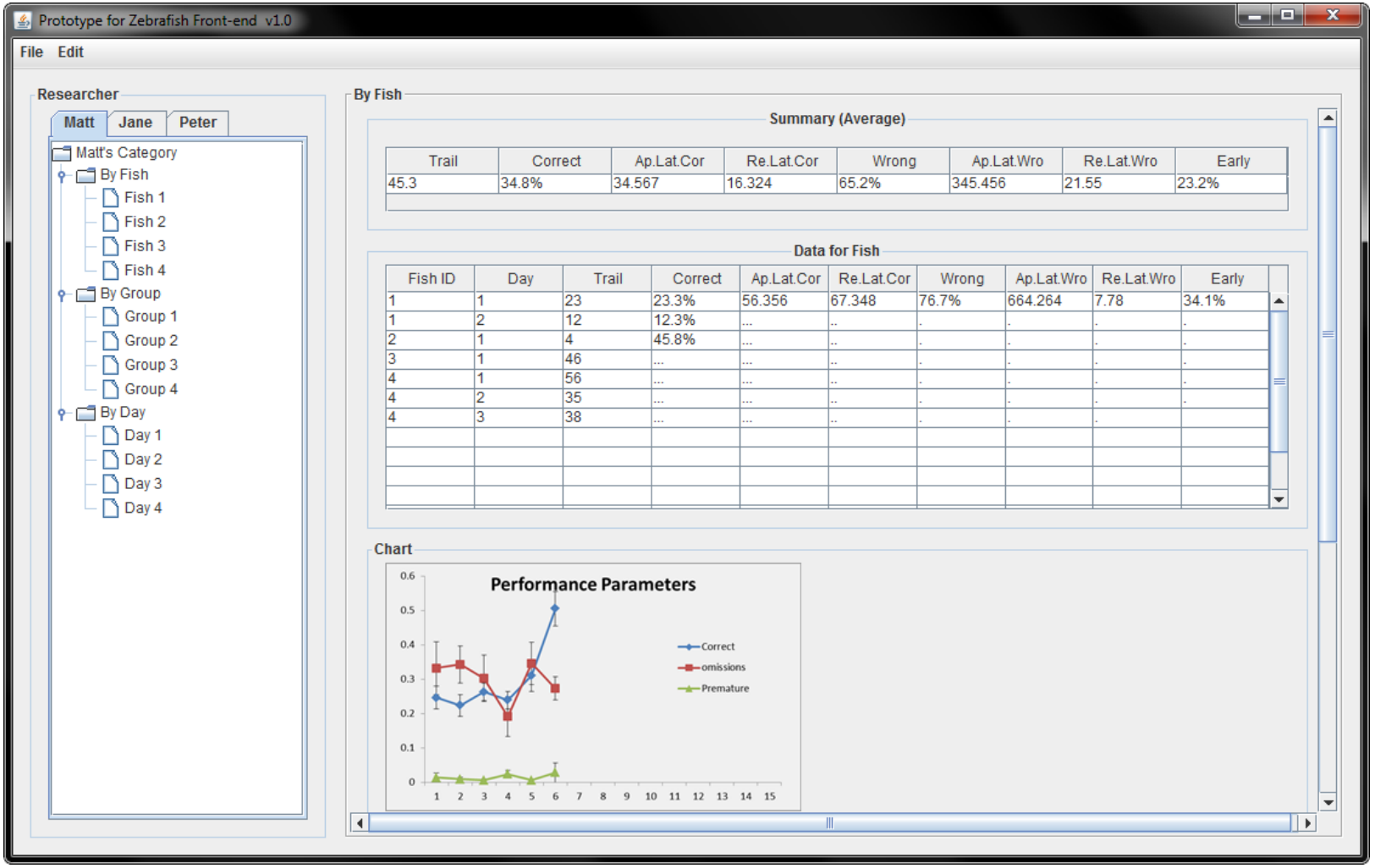
Requirement Analysis - Summary

- Data amount
  - $420000\ \text{records} = 70\ fishes\ \times 1\frac{file}{day \times fish}\ \times 60\ days\ \times 100\frac{records}{file}$
  - $12.6\text{MB} = 12600\text{KB} = 70\ fishes\ \times 1\frac{file}{day \times fish}\ \times 60\ days\ \times 10\frac{KB}{file} \times 0.3$
- Category classify
  - Group
  - Fish
  - Day
- Extract key parameters
- Fix data bugs
- Show comparison figures

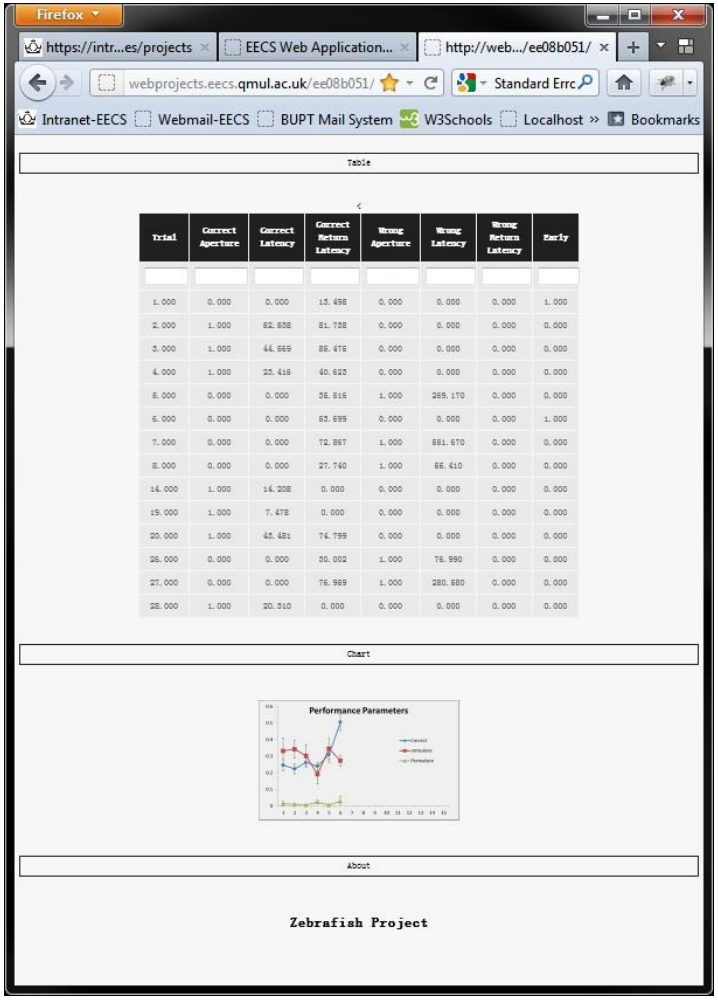
Design - Overview



Prototype 1 – Java UI

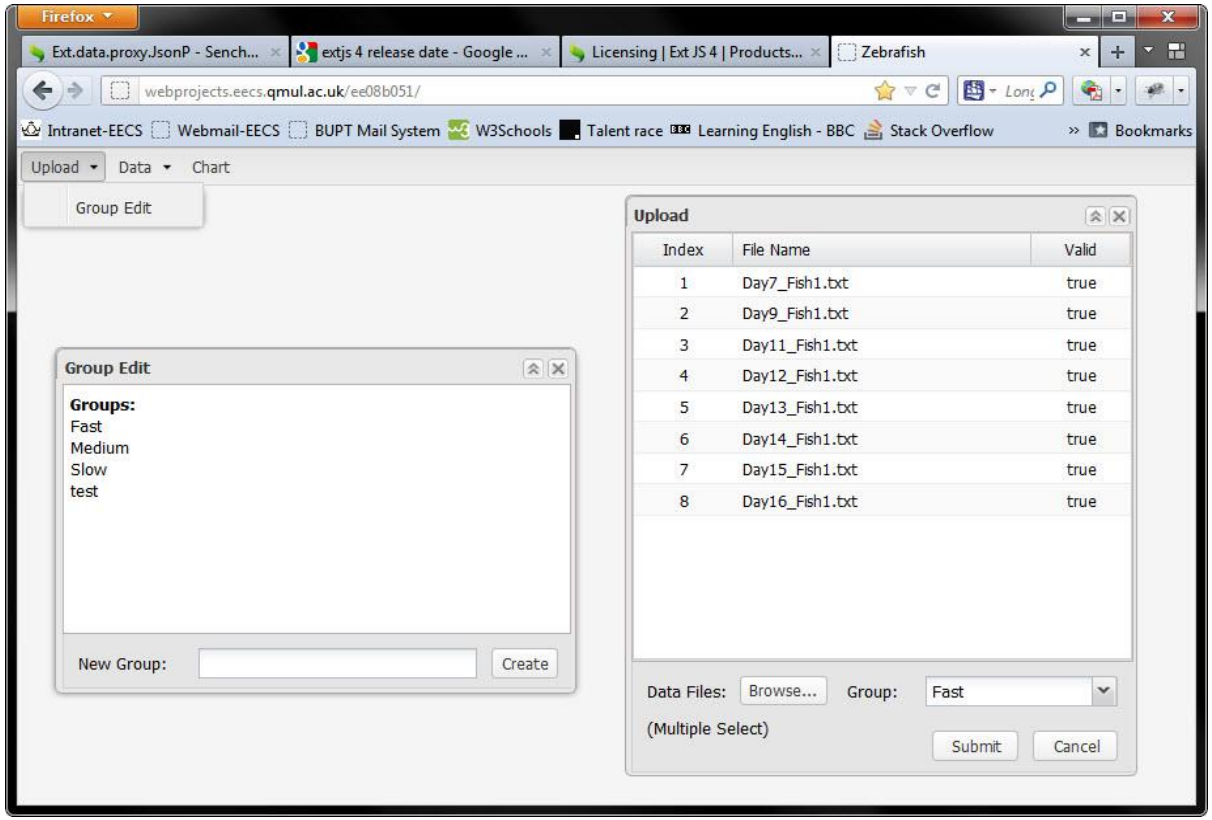


Prototype 2 – Website Front-end



- Link
  - http://webprojects.eecs.qmul.ac.uk/ee08b051/zebrafishJQuery

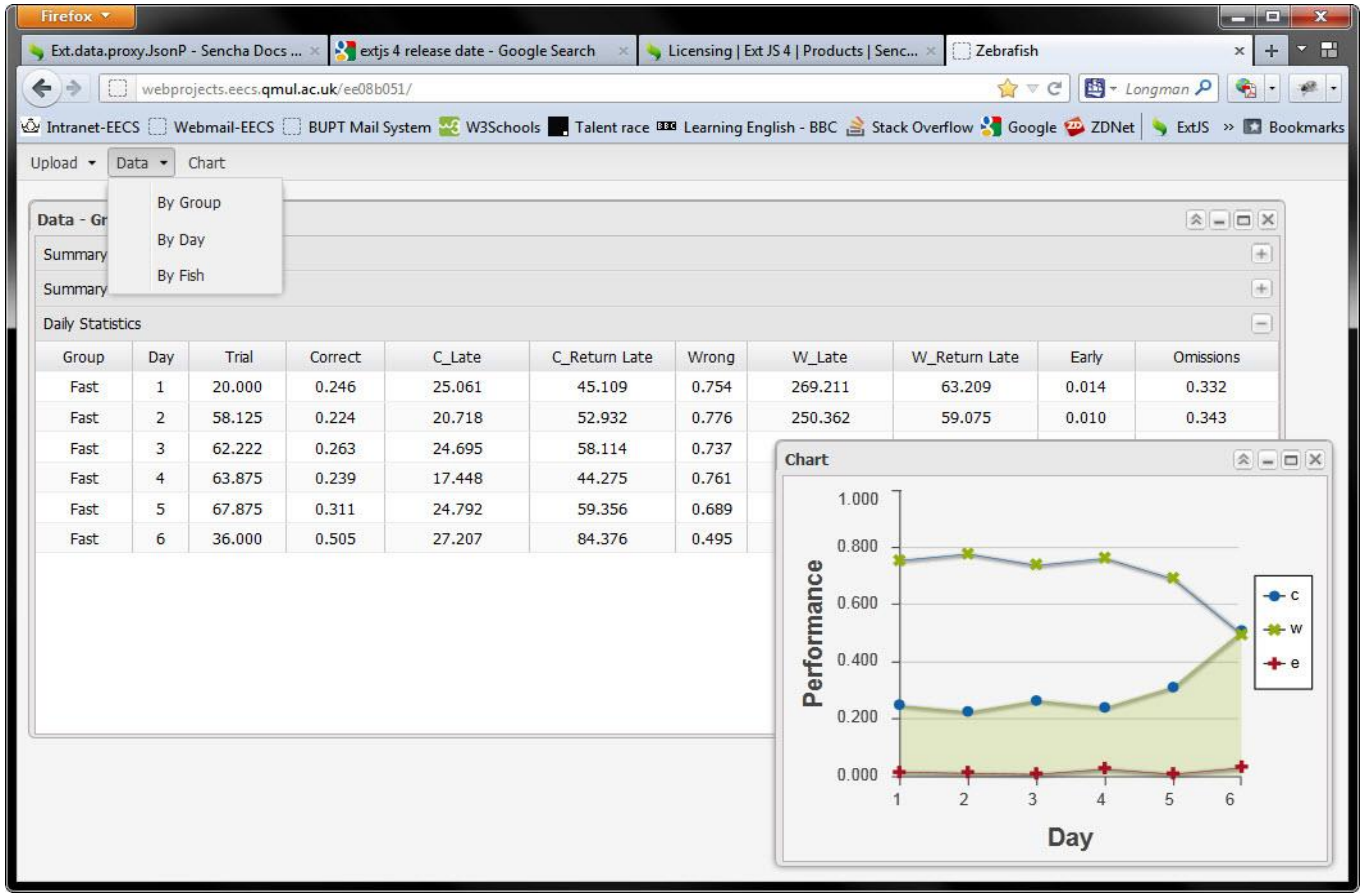
Prototype 3 – Web App Front-end



- Link
  - http://webprojects.eecs.qmul.ac.uk/ee08b051

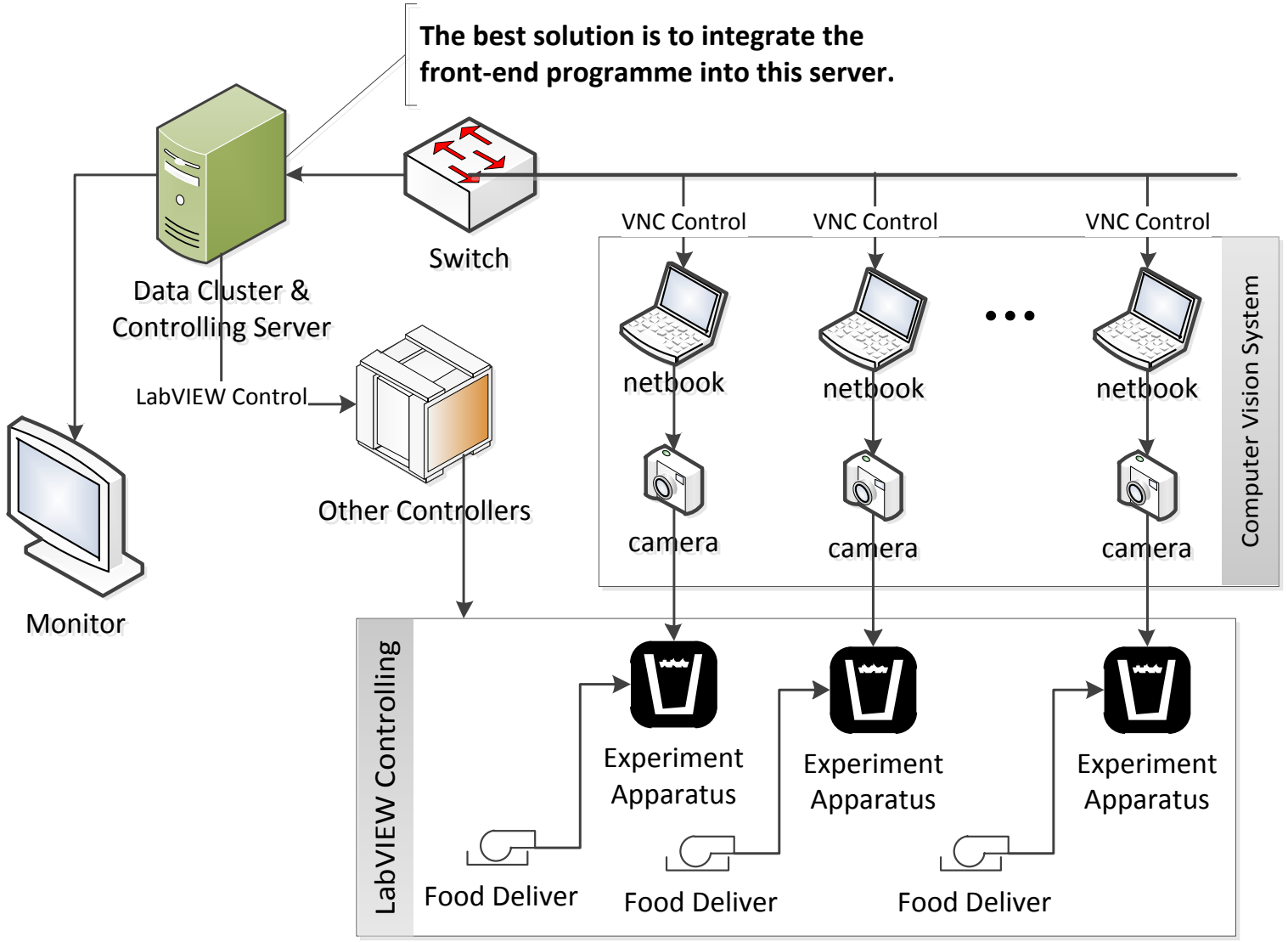
Prototype 3 – Web App Front-end

- Design to be the FINAL
  - Spent lots of effort
  - But…

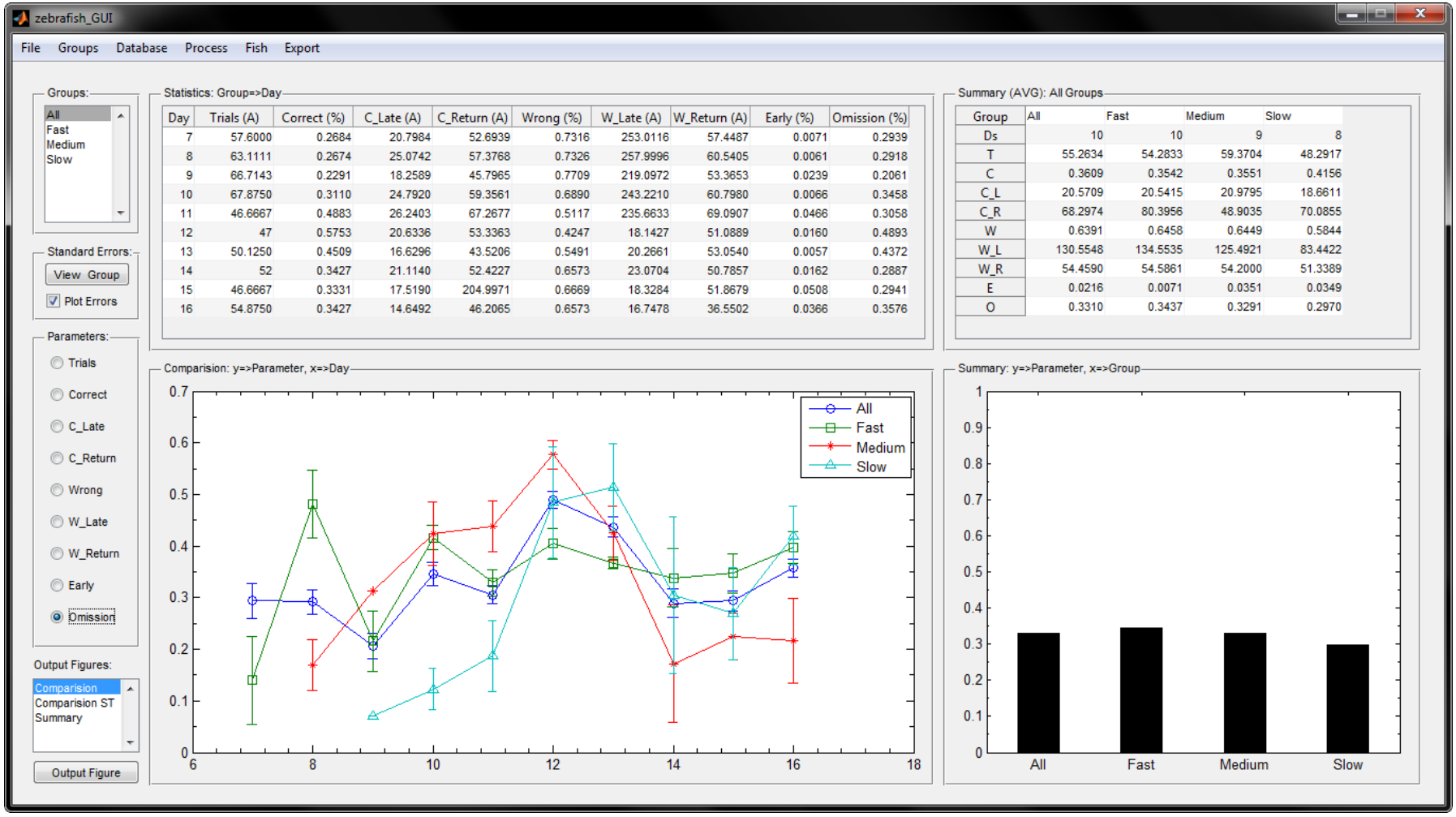


Design – Lab @29 March 2012

Design – Reconstruct the whole work



Design – Matlab for the FINAL



Design – Matlab for the FINAL

Groups:
All
Fast
Medium
Slow

Standard Errors:
View Group
Plot Errors

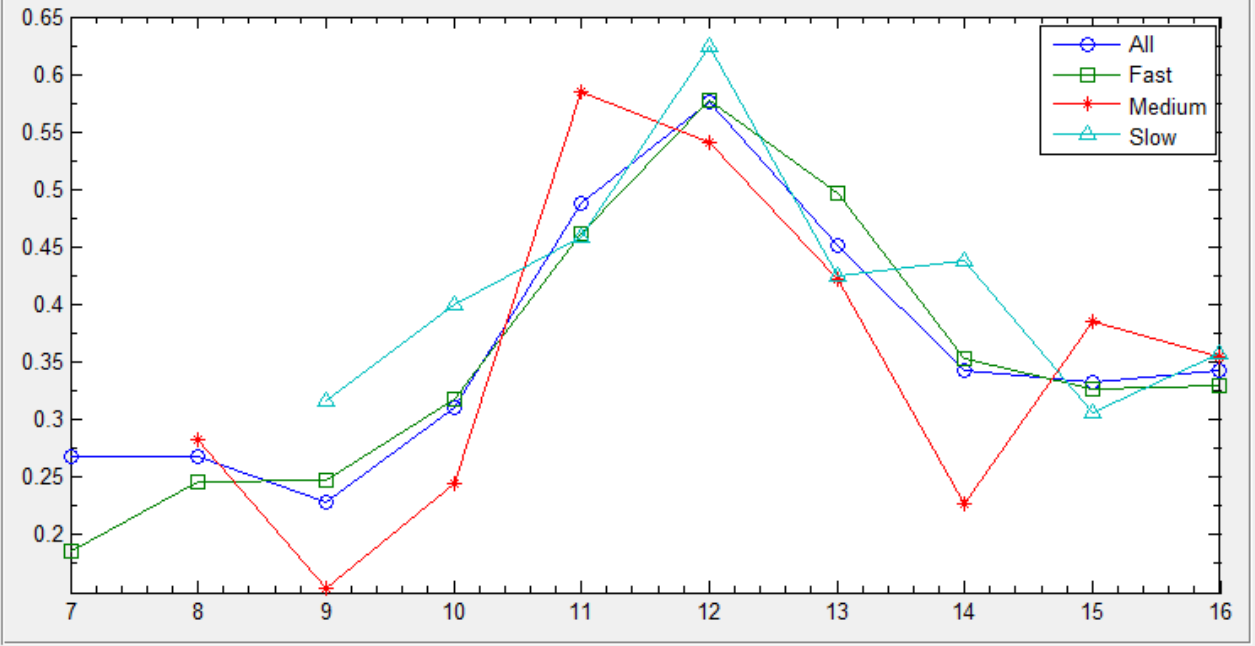
Parameters:
Trials
Correct
C_Late
C_Return
Wrong
W_Late
W_Return
Early
Omission

Output Figures:
Comparision
Comparision ST
Summary
Output Figure

Statistics: Group=>Day

Day	Trials (A)	Correct (%)	C_Late (A)	C_Return (A)	Wrong (%)	W_Late (A)	W_Return (A)	Early (%)	Omission (%)
7	57.6000	0.2684	20.7984	52.6939	0.7316	253.0116	57.4487	0.0071	0.2939
8	63.1111	0.2674	25.0742	57.3768	0.7326	257.9996	60.5405	0.0061	0.2918
9	66.7143	0.2291	18.2589	45.7965	0.7709	219.0972	53.3653	0.0239	0.2061
10	67.8750	0.3110	24.7920	59.3561	0.6890	243.2210	60.7980	0.0066	0.3458
11	46.6667	0.4883	26.2403	67.2677	0.5117	235.6633	69.0907	0.0466	0.3058
12	47	0.5753	20.6336	53.3363	0.4247	18.1427	51.0889	0.0160	0.4893
13	50.1250	0.4509	16.6296	43.5206	0.5491	20.2661	53.0540	0.0057	0.4372
14	52	0.3427	21.1140	52.4227	0.6573	23.0704	50.7857	0.0162	0.2887
15	46.6667	0.3331	17.5190	204.9971	0.6669	18.3284	51.8679	0.0508	0.2941
16	54.8750	0.3427	14.6492	46.2065	0.6573	16.7478	36.5502	0.0366	0.3576

Comparision: y=>Parameter, x=>Day



Design – Matlab for the FINAL

Group Standard Errors

Sandard Errors: Group=>Day

Day	Trials (A)	Correct (%)	C_Late (A)	C_Return (A)	Wrong (%)	W_Late (A)	W_Return (A)	Early (%)	Omission (%)
7	3.0351	0.0154	1.5349	2.1836	0.0154	12.4389	3.1427	0.0032	0.0340
8	2.4200	0.0086	0.6288	1.4431	0.0086	6.4258	1.0735	0.0014	0.0240
9	2.9758	0.0101	0.8610	1.9123	0.0101	10.0318	1.4257	0.0045	0.0244
10	2.4453	0.0165	0.7801	5.4895	0.0165	9.8492	1.5699	0.0017	0.0220
11	1.5466	0.0125	0.7846	2.0387	0.0125	6.1336	1.0600	0.0096	0.0178
12	2.3020	0.0185	0.4392	0.7450	0.0185	0.5488	1.6155	0.0038	0.0164
13	3.1092	0.0081	0.2021	0.8597	0.0081	0.4798	2.3973	0.0020	0.0196
14	2.4631	0.0113	0.6044	1.7620	0.0113	0.8			
15	1.3732	0.0065	0.2860	32.9851	0.0065	0.4			
16	2.7103	0.0117	0.4630	1.5972	0.0117	0.4			

View Statistics: Group=>Fish=>Day

File Export Figure

Excel (*.xls)
Text (*.txt)
CSV (*.csv)
Export with ST Errors ▸
Excel (*.xls)
Text (*.txt)
CSV (*.csv)

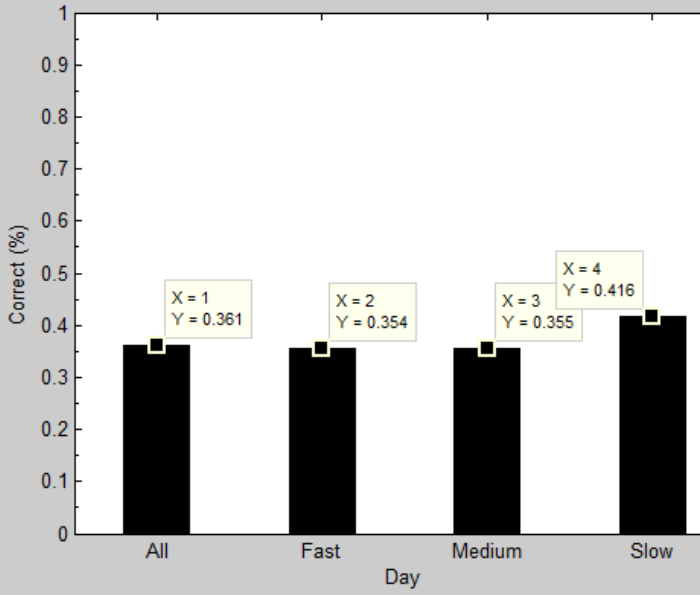
cs: Group=>Fish=>Day

	Trials (Max)	Correct (%)	C_Late (Avg)	C_R
		0.1765	20.5577	
		0.1923	26.9176	
		0.3243	25.3542	
		0.4615	24.8496	
11	46	0.4545	34.3596	
12	57	0.4643	22.2218	

Slow

Figure 1

File



Design – Review!!!

Fish ID: D120

Date/ time:
10:25
20/11/2011

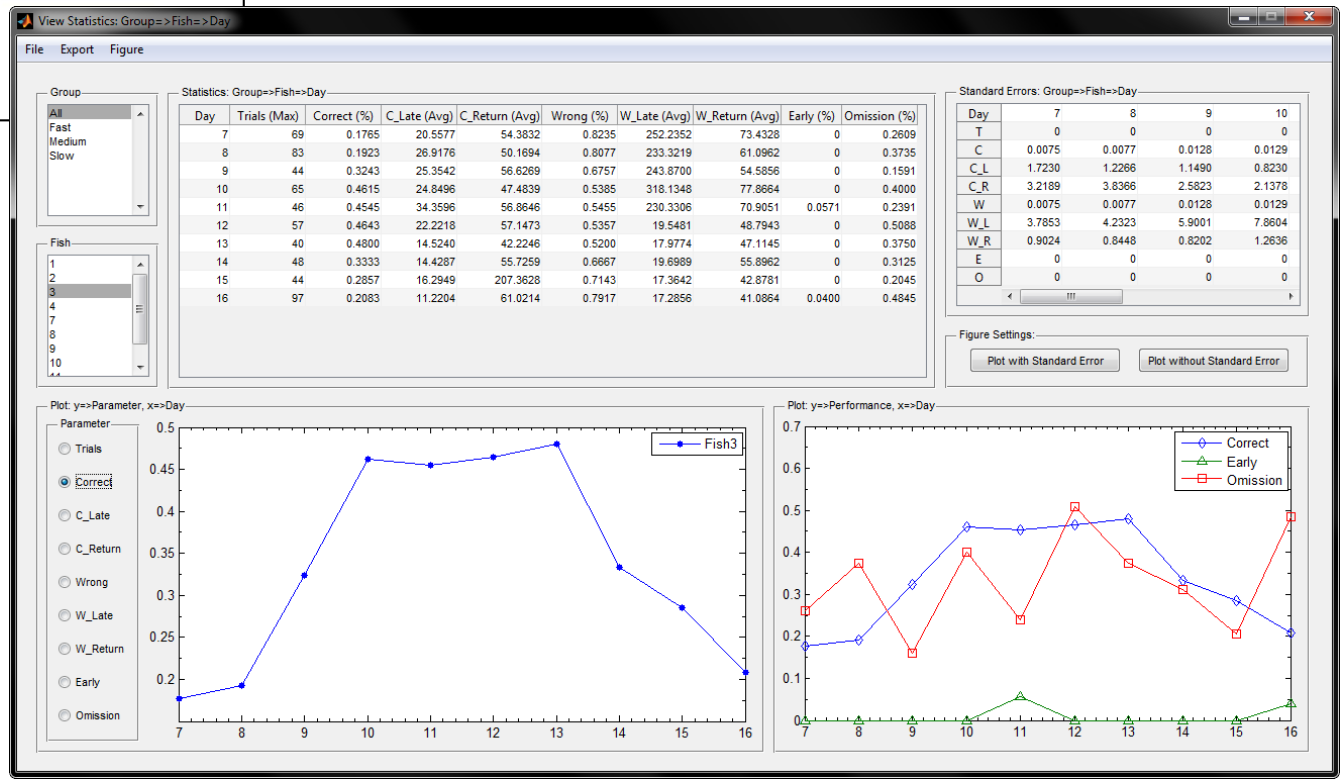
Trial parameters:	
ITI	5 sec
Stimulus duration	10 sec
LH	10 sec

Premature responses	Accuracy	Incorrect
Total: 1	Total correct: 30	Total incorrect: 7
%: 0.025	%: 75	%: 20.18

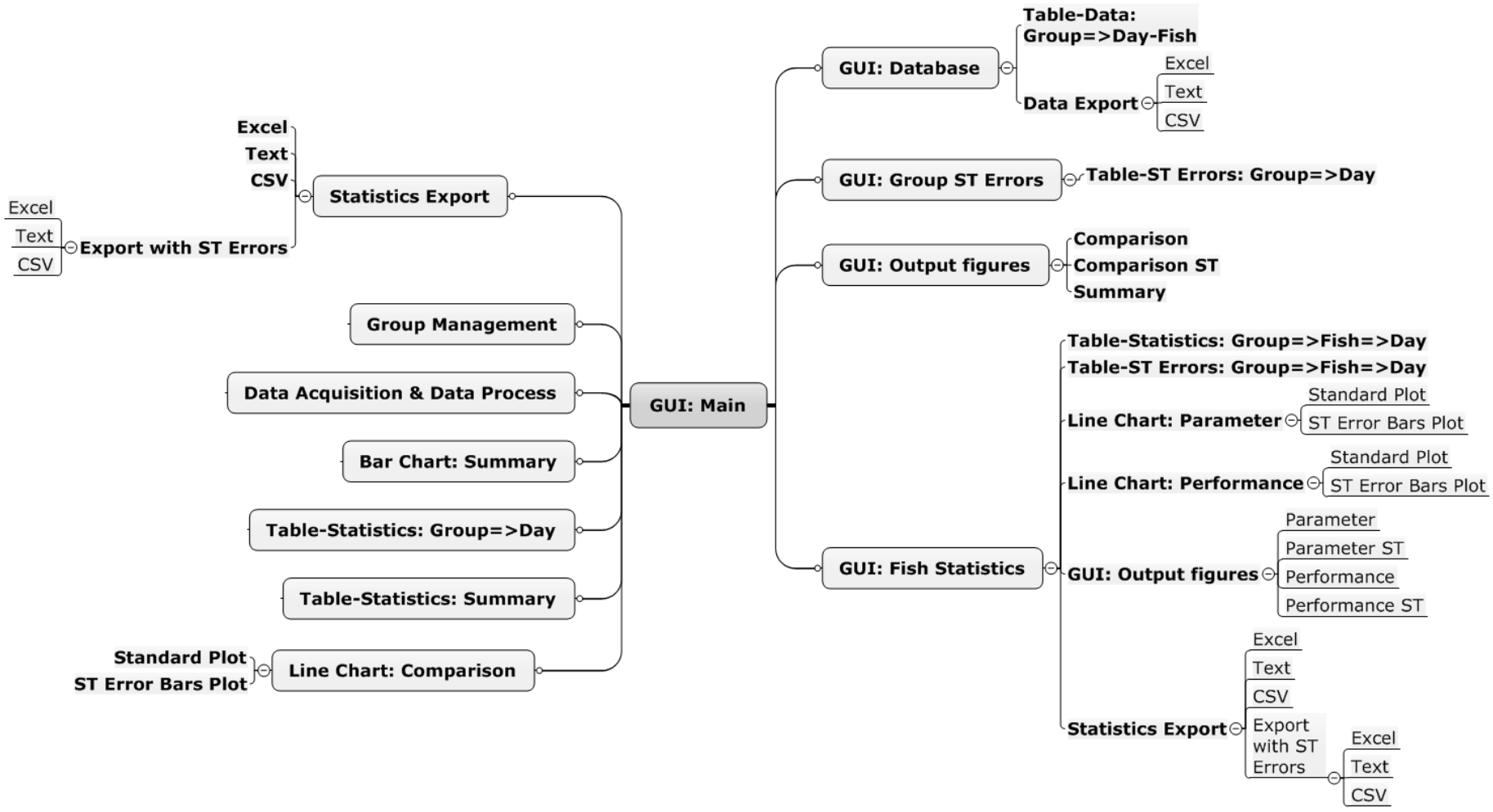
Omissions	Average time correct	Total completed trials
Total omissions: 2	5.4 sec	40
%: 0.05	Average time incorrect: 10.8 sec	

User's Expectation

Final Solution



Implementation - Overview



Implementation - Naming Rules

- Consistent
- Efficient
  - fn_SwapDataOrder.m
  - sc_LoadAllData.m
  - sSavePath
  - roGroupDayFishStatistics
  - maGroupDayFishDatas
  - stDataAll
  - OUT_coFishIDs
  - …

Implementation – Avoid Using for-loop

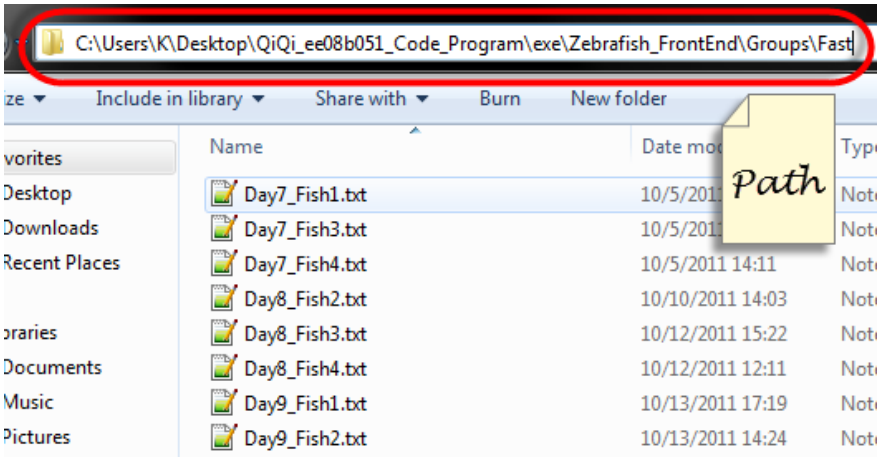
- Speed!
  - $a = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \overset{+}{\Rightarrow} a = \begin{bmatrix} 1+10 & 2+20 \\ 3+10 & 4+20 \\ 5+10 & 6+20 \end{bmatrix}$
  - Ex.

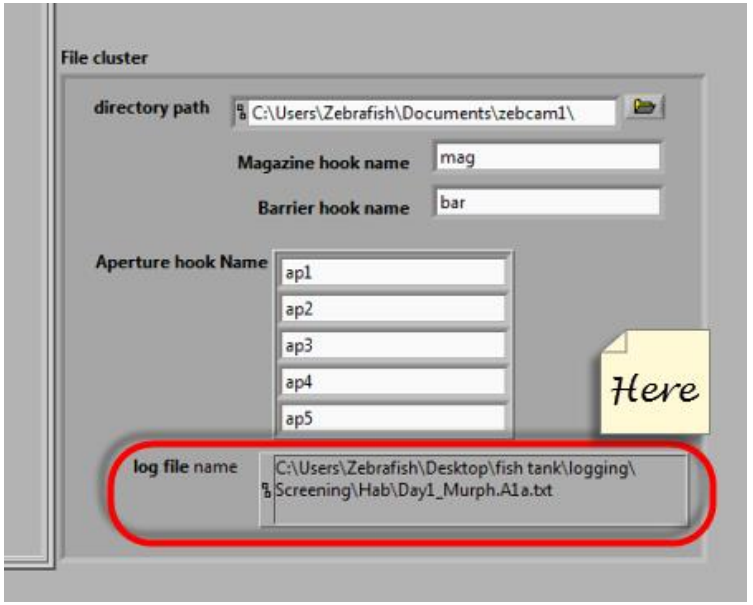
Using for-loop:	Using matrix operation:

[row col] = size(a);
for I = 1:row
  for j = 1:col
  if(j == 1)
  a(i,j) = a(i,j) + 10;
  else
  a(i,j) = a(i,j) + 20;
  end
  end
end
	a(:,1) = a(:,1) + 10;
	a(:,2) = a(:,2) + 20;

Implementation - Integration

- Data cluster
  - Front-end
  - LabVIEW
- Direct Access
  - Don’t need to import data





Implementation – Other issues

- Text data parsing
  - Regular expression
- Data manipulation
  - Matrix
- Data processing
  - ‘max()’, ‘mean()’, etc.
- Database construction
  - stDataAll.mat
- …

User Evaluation

- Dr Matthew Parker
  - …not only **very user friendly**, but has a number of features which will make our research process **much more effective**. The software uses the output files from LabView to organize our data into groups. This facilitates **simple comparison** of our different treatments during the course of our experiments. As we test up to 70 fish at any one time, this has **made our lives much easier**, **saving both time and effort**. In addition, the software produces publication-quality graphs, which will be **very useful** when attempting to publish our data in the future. Finally, as we intend to market the software and the testing system in the future, we feel that **Qi Qi's design will improve the marketability**…

Link for the Source Code

- https://bitbucket.org/qiqiuklife/zebrafish/src

Acknowledgments:

- Fabrizio Smeraldi
- Matthew Parker
- Jane Reid
- My Beloved Family

Questions?