MIDWAY DESIGN REVIEW

Team Leaf

November 2013

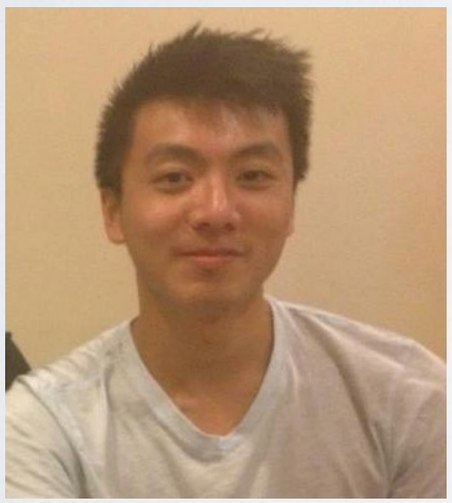
Leaf

WEARABLE TECHNOLOGY

The Team

Marco Chiang
CSE (Team Lead)

Chris Garry
CSE (Web Master)



Steven Tso
CSE (Hardware Lead)

Aaron Tye
EE (Algorithm Lead)

MOTIVATION

- Over $10 billion are spent a year on business cards
- Business cards are eventually forgotten and thrown out
- Revolutionize human interactions with wearable tech
- Simplify the information exchange process
- Create a new experience for conference and event attendees

CONCEPT

- Unobtrusive and lightweight wrist band
- Simple mobile application
- Build your network

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INPUTS & OUTPUTS

Bluetooth 4.0

GUI

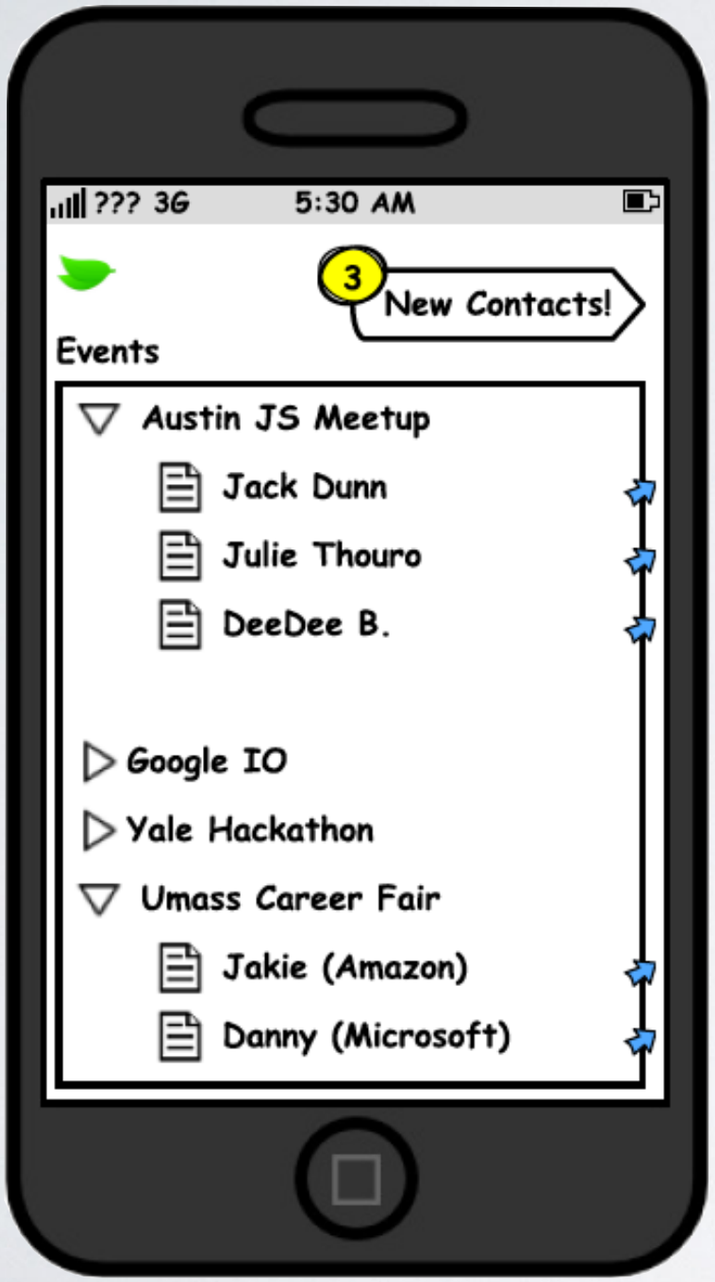
Input

- Accelerometer (X, Y, Z) data
- Timestamp

Output

- Contact information

USER INTERFACE



Mobile Application

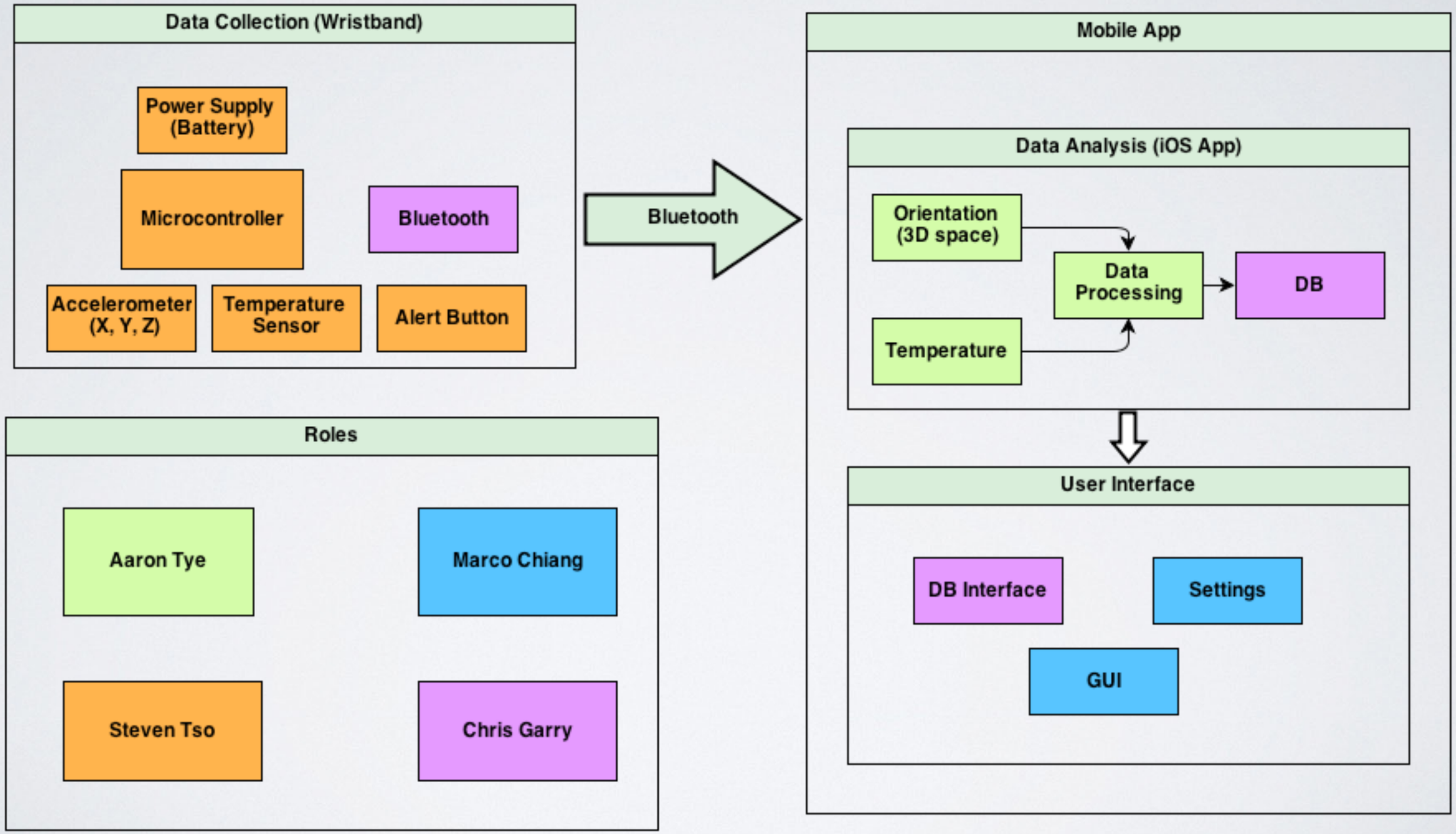
- Events
  - Organize contacts by where you met them
- New Contacts
- Confirm and request information

PRESS

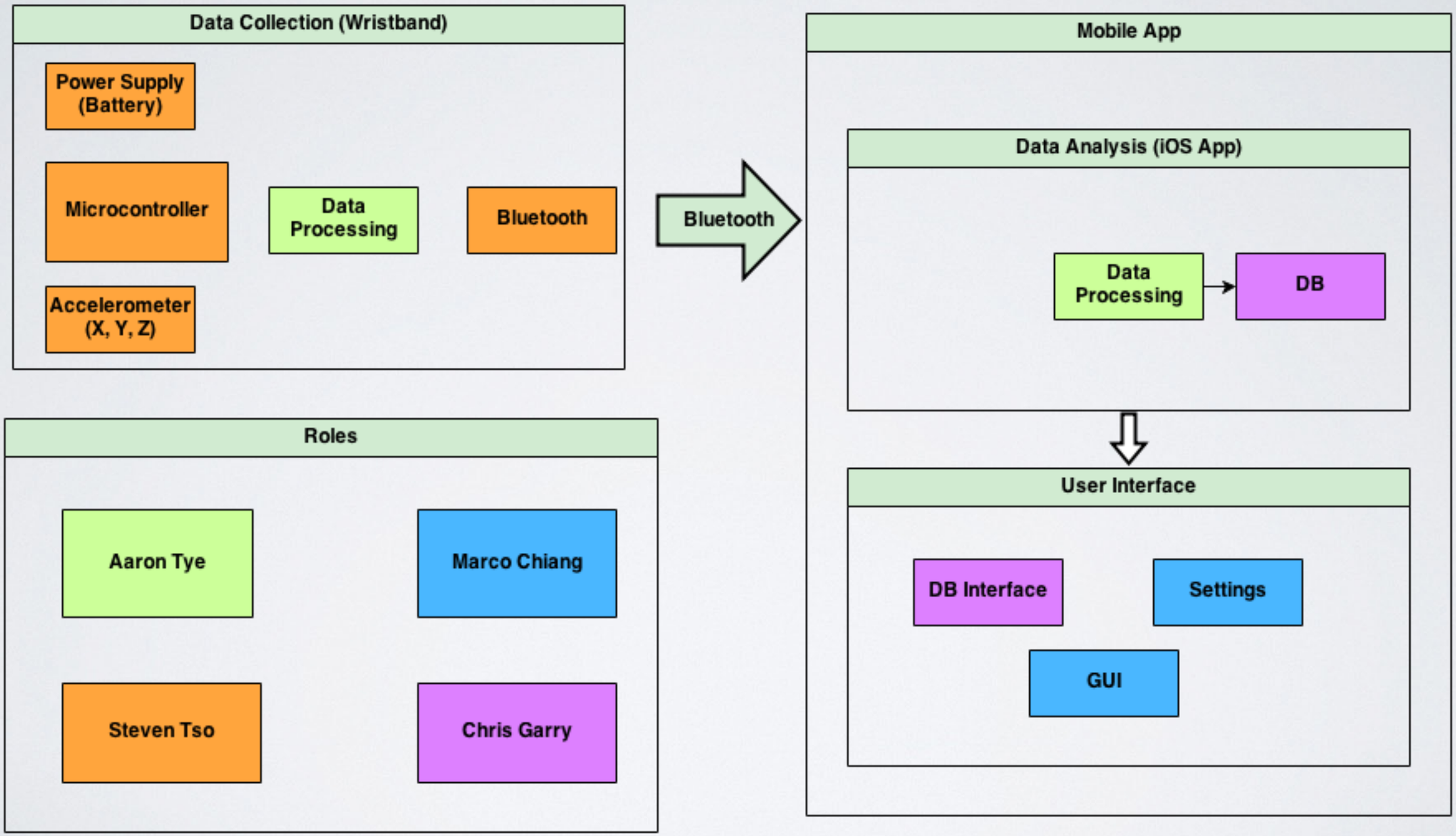
UMass Team Finishes in Top Six of Yale Hackathon

On November 8 and 9, Marco Chiang, a senior BSCSE major, and his team from the Computer Science Department finished in the top six out of more than 500 "amazing hackers" and 200 teams that competed in the Yale Hackathon in New Haven, Connecticut. According to Chiang, the Hackathon is an event in which students compete to create the most innovative and complex computer software and hardware hacks to win a variety of cash and prizes. As Chiang explained, "Leaf, the name of our product and vision, is working hard to bring a piece of technology into our lives to revolutionize social and professional interactions."

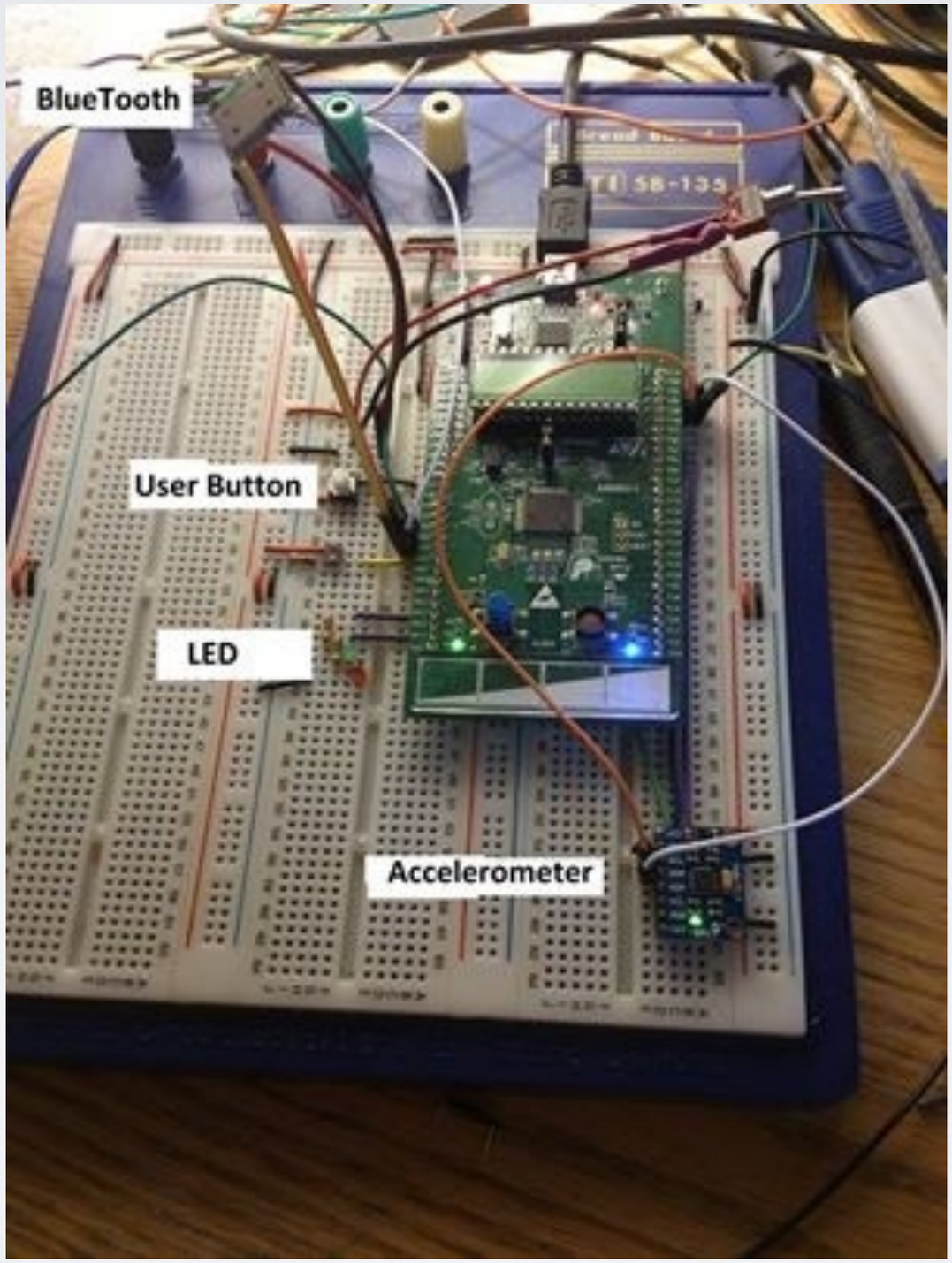
PREVIOUS SOLUTION: BLOCK DIAGRAM



REVISED SOLUTION: BLOCK DIAGRAM



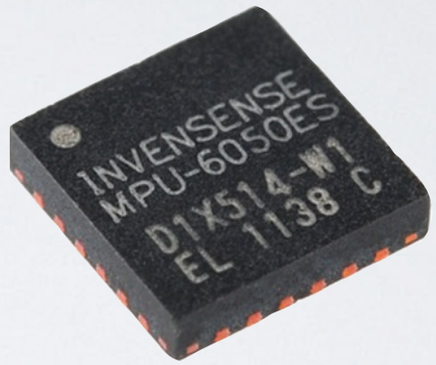
HARDWARE PROTOTYPE



SENSORS

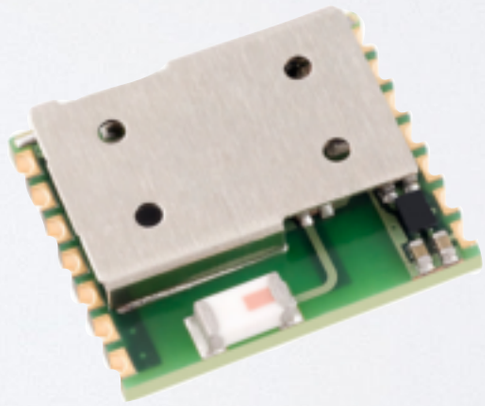
Accelerometer

- Invensense MPU - 6050
- I2C communication



Bluetooth

- ST SPBT2632C2A (Class 2)
- Amp'ed Up Bluetooth Stack
- UART communication

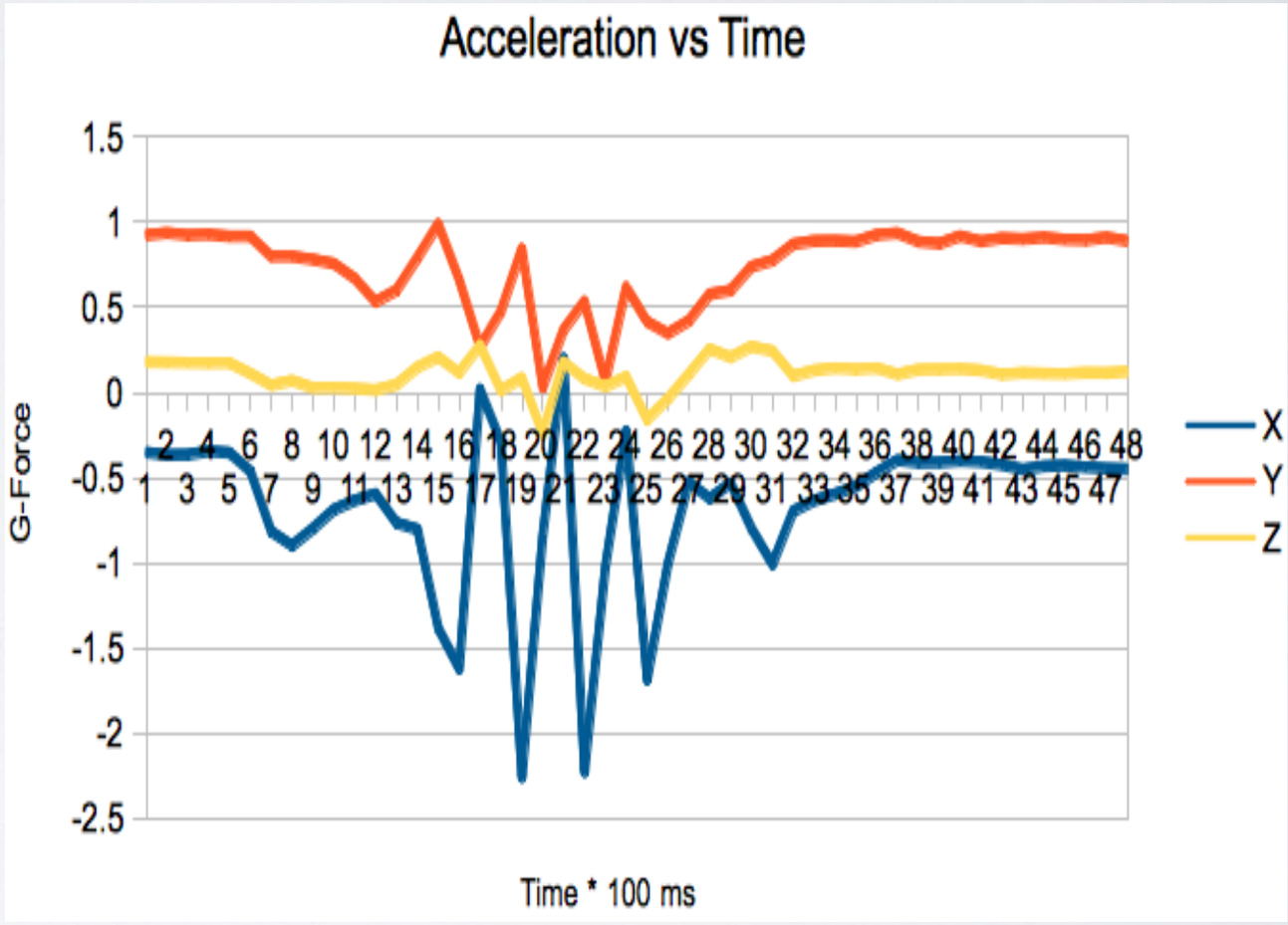


HANDSHAKE DETECTION ALGORITHM

WHAT DOES A HANDSHAKE LOOK LIKE?

Oscillatory motion in X

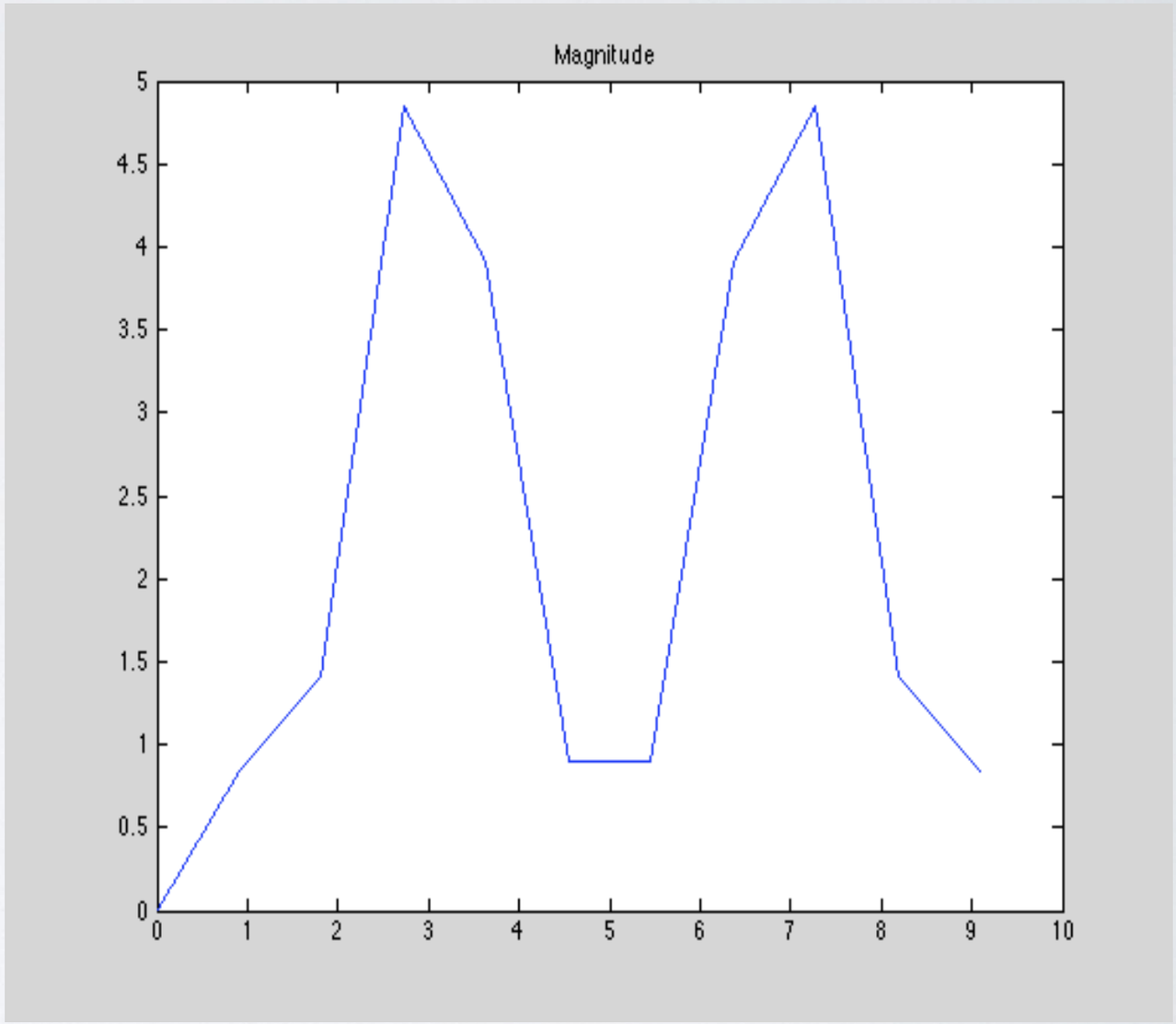
- Frequency of oscillation
- Crest factor



DISCRETE TIME FOURIER TRANSFORM

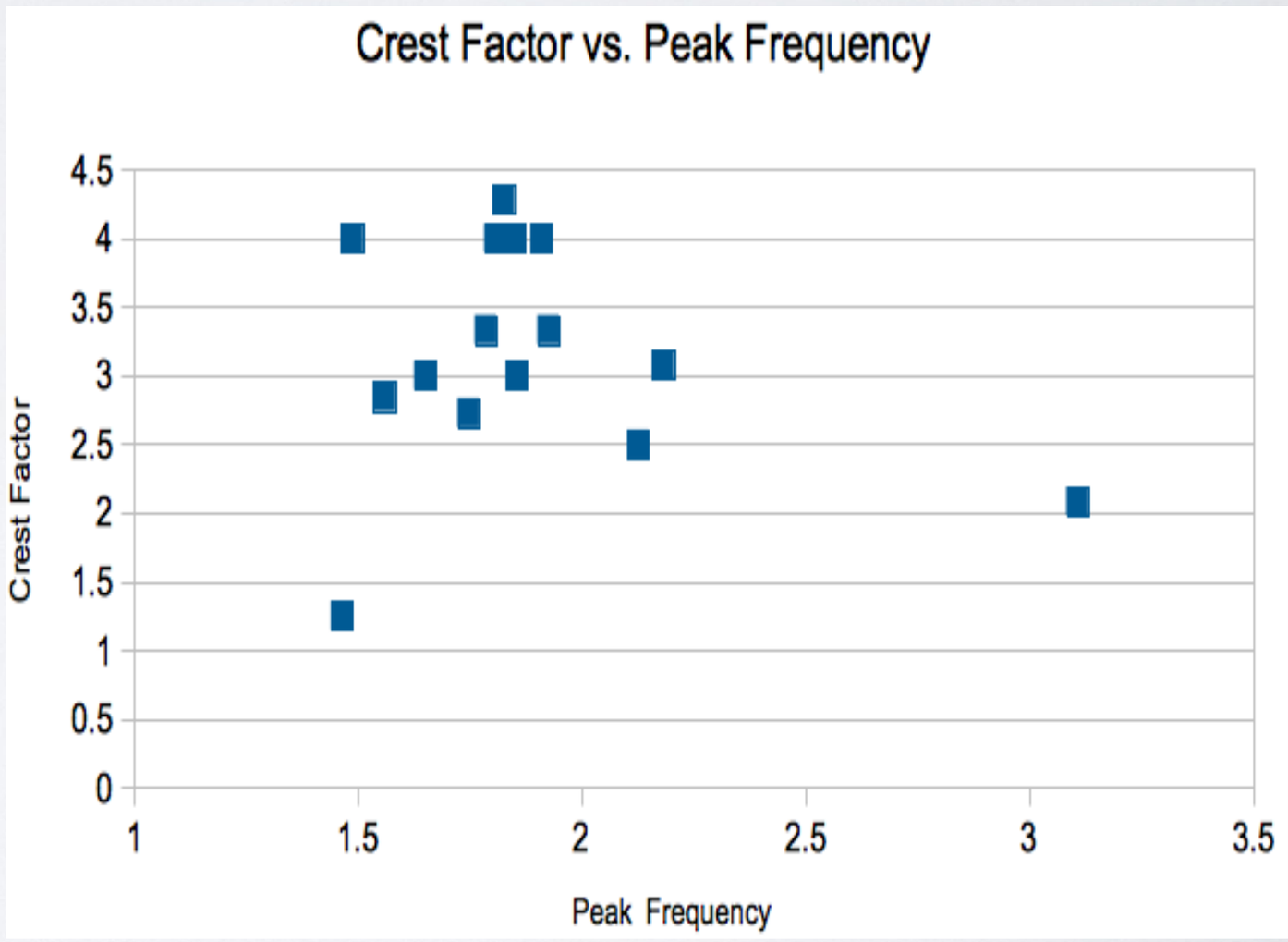
[maxX,i] = max(mX)
Frequency resolution = fs/N
PeakF = (10/12)*(i-1)

CF = mXpeak/mXrms



CREST FACTOR VS. PEAK FREQUENCY

if (2<peakF<4.5 && 1.4<CF<2.5)
possible handshake



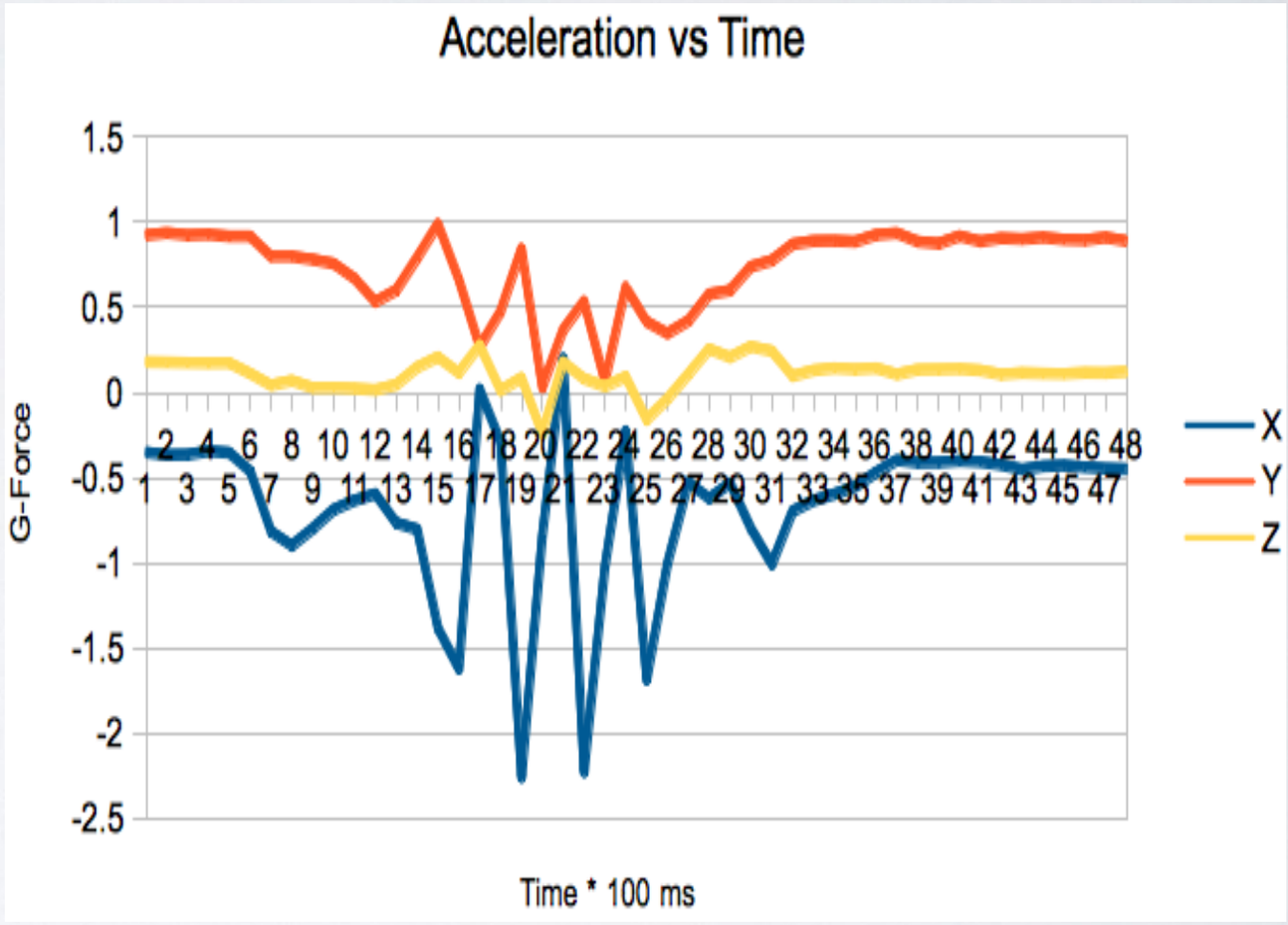
Y & Z VALUES

Y values
- Not as consistent as X
- But still oscillatory

Check number of 0.4 crossings

Z values
- Somewhat oscillatory
- Low amplitude

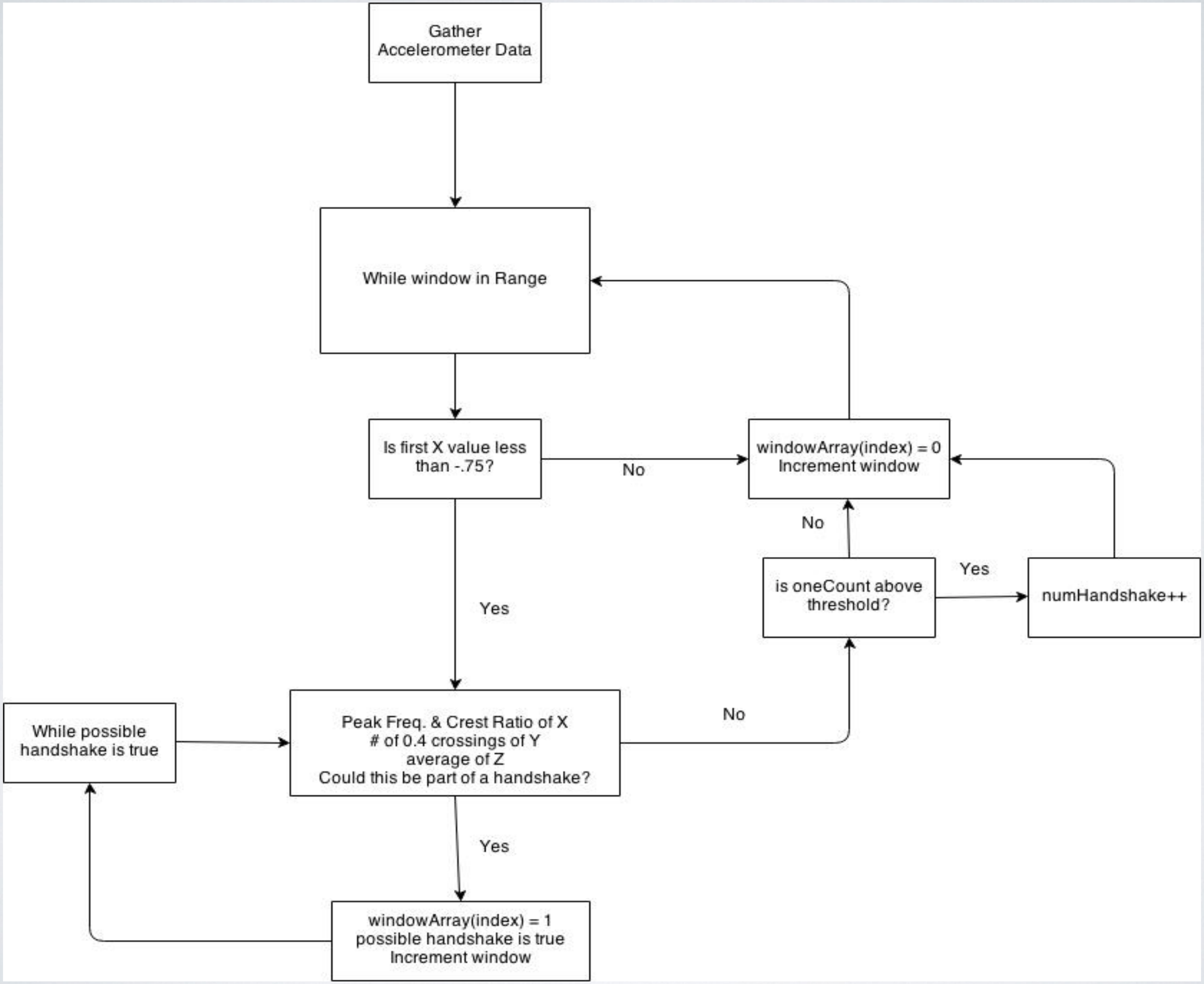
Check for small average value



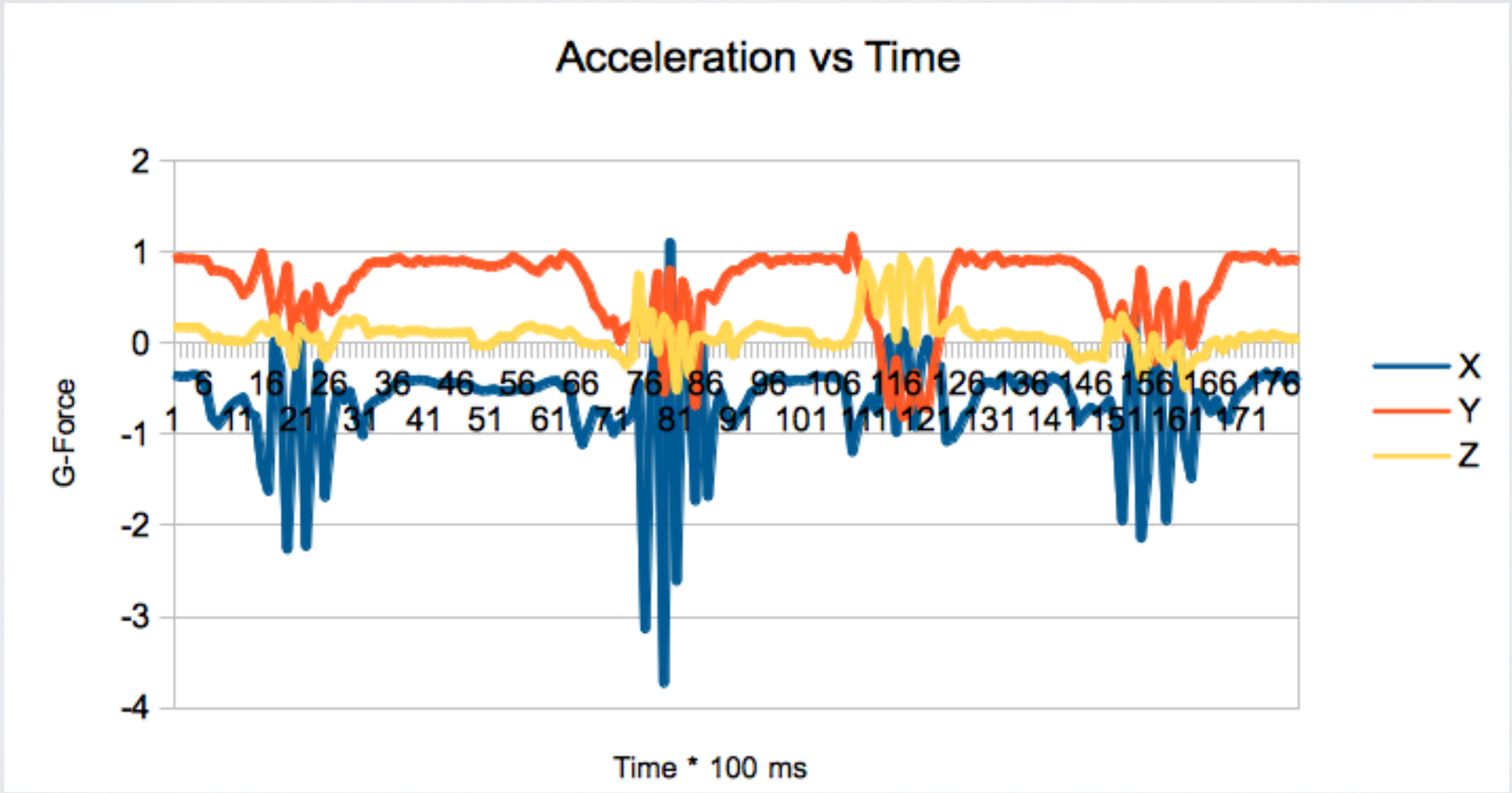
TAKING SNAPSHOTS OF DATA

Window size of 12 samples
if (X <= -.75)
if (window has handshake features)
windowArray(index) = 1
else
windowArray(index) = 0

Check number of consecutive 1's


Gather Accelerometer Data
While window in Range
Is first X value less than -.75?
No
windowArray(index) = 0
Increment window
No
is oneCount above threshold?
Yes
numHandshake++
Yes
While possible handshake is true
Peak Freq. & Crest Ratio of X
# of 0.4 crossings of Y
average of Z
Could this be part of a handshake?
No
Yes
windowArray(index) = 1
possible handshake is true
Increment window

DEMO


Acceleration vs Time
G-Force
2
1
0
-1
-2
-3
-4
1
6
11
16
21
26
31
36
41
46
51
56
61
66
71
76
81
86
91
96
101
106
111
116
121
126
131
136
141
146
151
156
161
166
171
176
X
Y
Z
Time * 100 ms

PROPOSED MDR DELIVERABLES

Prototype of hardware working on breadboard

- Accelerometer
- Bluetooth

Demonstration of bluetooth connectivity with mobile phone

- GUI interface and send data to mobile device via bluetooth

PROPOSED CDR DELIVERABLES

- Robust integration of hardware device with mobile phone
- Implement handshake algorithm into hardware device
- Mobile application receive data from hardware and sent to back end server
- Demonstration of mobile app use with GUI

GANTT CHART

Team Leaf																														
		Oct				**Nov**				**Dec**					**Jan**					**Feb**				**Mar**				**Apr**		
Tasks	Leader	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	3	4	1	2		
Handshake algorithm	Aaron																													
Micontroller w/ accelerometer	Steven																													
Microntroller w/ bluetooth	Chris																													
GUI on phone	Marco																													
Moblie phone app development	Marco																													
	Chris																													
Form factor development	Aaron																													
Energy Saving R&D	Steven																													
Phone integration w/ wrist device	Marco																													
	Chris																													
Manufacturing and polishing	Aaron																													
	Aaron																													
	Chris																													
	Marco																													
	Steven																													

Q&A

ADDENDUM

PROJECT BUDGET

- Board $12 (back up for chips)
- Fabrication costs (tbd)

Estimated final budget:

Cost	
MCU	6
IMU	7
BlueTooth	31
Battery	8
Misc.	8
	60

POWER BUDGET

Estimated final budget:

Power Consumption		
	Average Case (mA)	Worst Case (mA)
MCU	3	6
IMU	2	4
BlueTooth	10	18
	15	28
Battery Capacity (mAH)	Life Expectancy (Hours)	
110	7.33	3.93
400	26.67	14.29

SECURITY

Design for

- Bluetooth 128-bit AES
- Transport Layer Security/Secure Socket Layer for mobile application
- Secure databases