FEDS
(Fall Emergency Detection System)

Presentation & Demo

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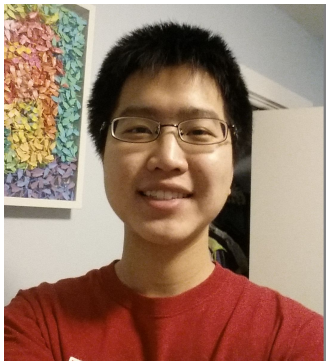

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The Team

Outline

- **Problem and Solution**
- System overview
- Physical components and software design
- Assembly and mounting
- Design challenges
- Experienced gained
- Budget (Estimated vs Actual)
- Timeline
- Future Considerations
- Conclusion

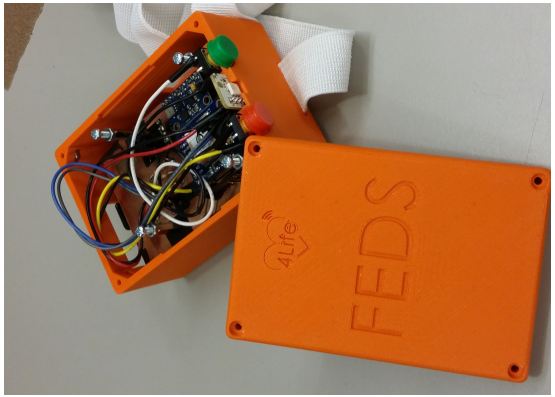
Social Problem

- Falling big issue for elderly
- People prone to seizures, heart attacks, etc.

Possible Solutions

- Living with family
- Hire a caretaker
- Exercising

Our Solution



- Fall Emergency Distress System (FEDS)
- Device senses for a fall and will notify operator
- Device automated -> user won’t feel like a liability
- Cheaper than caretaker

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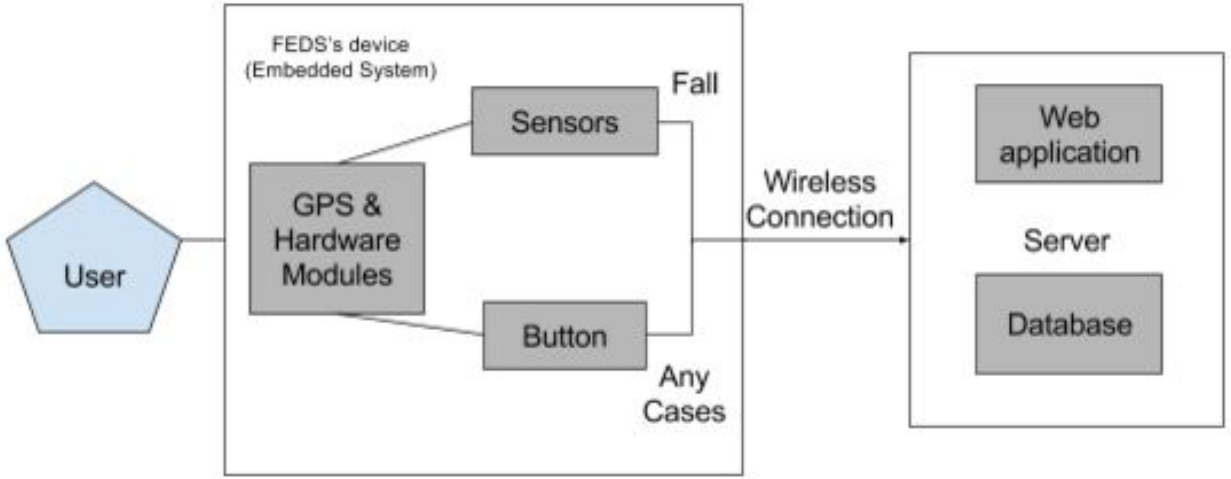
System Overview



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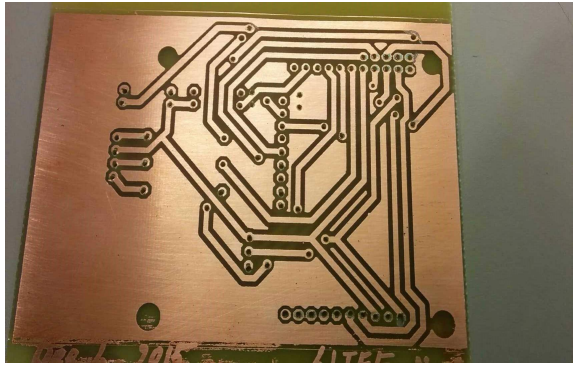
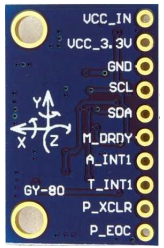
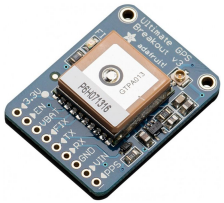
Components

- Raspberry Pi 2
- Accelerometer (ADXL-345)
- GPS (Adafruit Ultimate GPS)
- Buttons
- Buzzer
- LED
- PCB
- Case



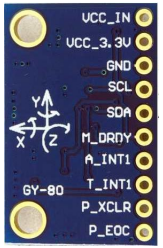


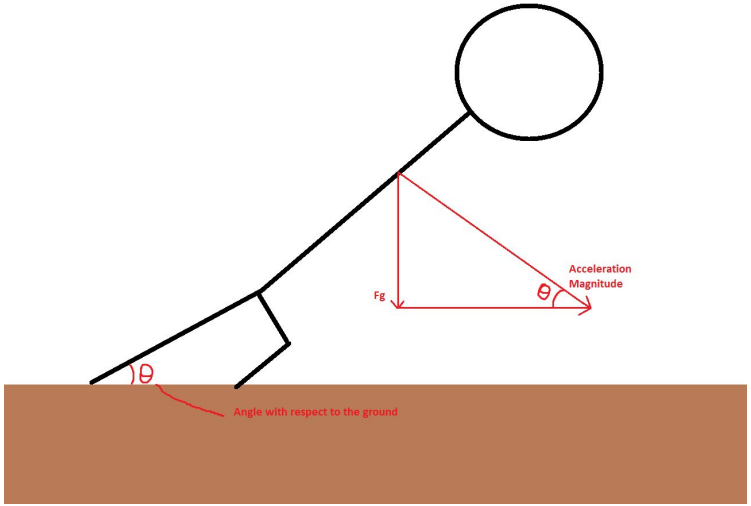


Fall detection (Accelerometer)

- Acceleration magnitude threshold
- Angle detection

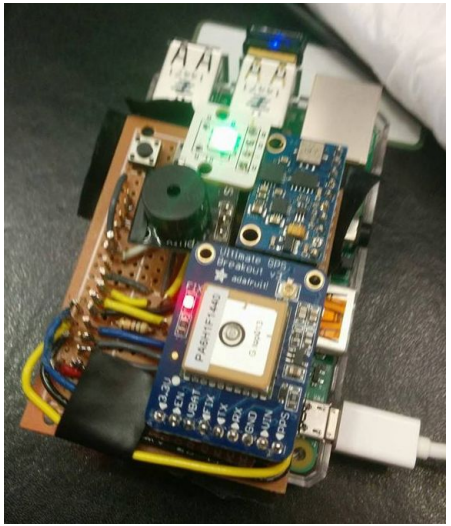
$$Acceleration = \sqrt{{a_x}^2 + {a_y}^2 + {a_z}^2} < threshold$$

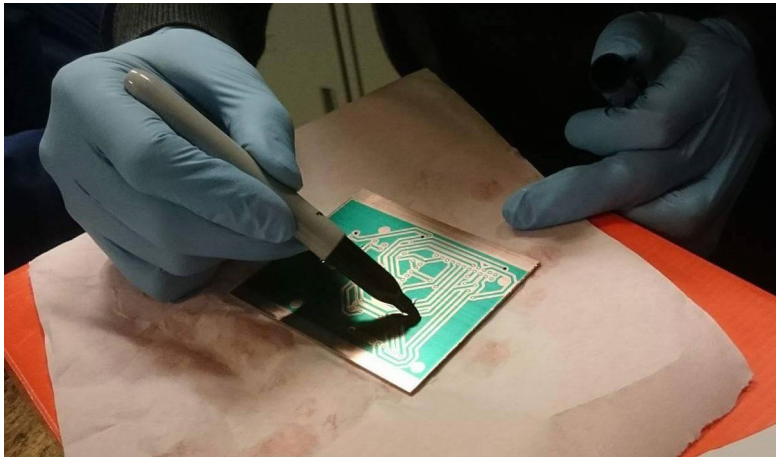


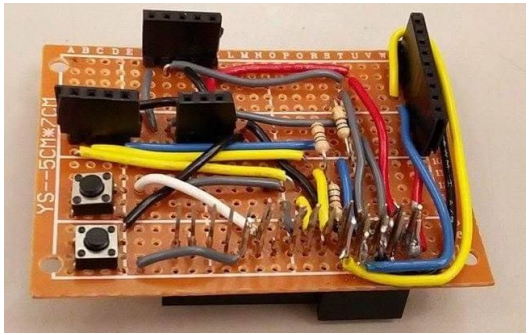


Protoboard and PCB

- Integration of hardware
- Soldered circuit board as a two layer board







Operator Application Quick demo (Link)

FEDS Operator Application (Link)

http://feds4life.com/public/index.html

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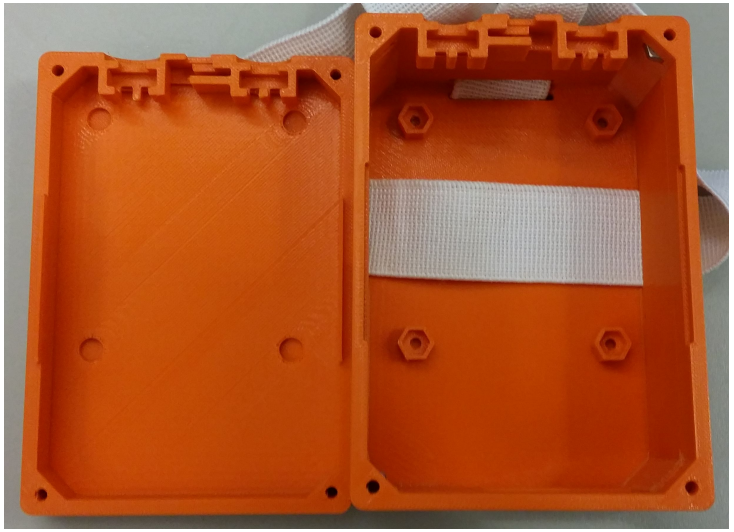
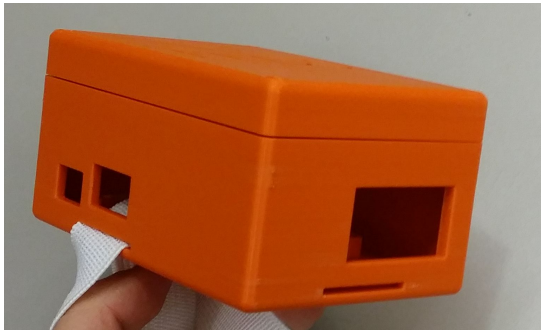
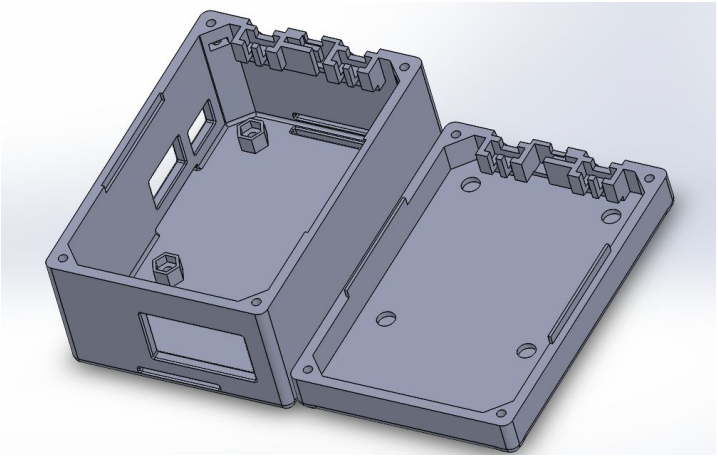
Assembly (Casing)

- 3D Printed using ABS
- Hole placement for straps
- LED and button placement
- Groves for Raspberry/PCB support

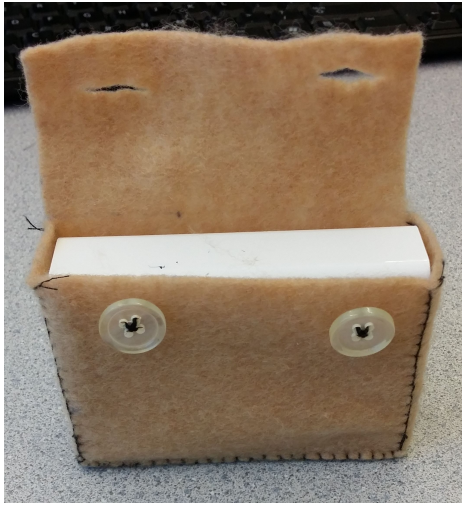


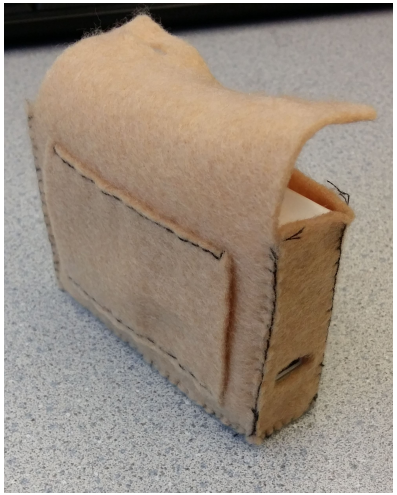




Battery & Battery Holder

- 9000mAh external battery
  - FEDS runs at roughly 650mA/h
  - Runs for around 9000/650 ≈ 14 hours
- Built modularly from the case
  - Can use other batteries if required
- Straps on beside FEDS





Wearing the device

- 2 Straps
  - Around the neck
  - Around the chest
- Held together with velcro for various sizes
- Battery goes along the one of the straps

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Design Challenges

- Accelerometer X,Y,Z individual thresholds
- Magnitude of acceleration calculation wasn’t enough
- Outdated tutorial for the UART to be used with the GPS
- GPS cannot get location inside a building
- Getting location from wifi tend to be unreliable
- Soldering and desoldering components
- Buzzer does not work properly

Experience Gained/Learned

- Project Management
- Linux based environment
- Good modular design for embedded applications
- Coding with different modules (ie. accelerometer, buttons, LEDS, etc.)
- Eagle PCB design
- Scheduling
- Simple tasks generally take a lot longer than expected (debugging)
- Importance of planning ahead for meetings

Budget

Components	Estimated	Actual	Notes
Raspberry Pi 2 Model B kit	$90	$89.95	
3-Axis Accelerometer	$30	$17.66	GY-80 (accelerometer, gyroscope, barometer)
Wires	$40	$41.25	
Printed Circuit Board	$60	$86.81	Solution and drill bits can be used again
Safety Equipment	$40	N/A	
Li-po Battery	$40	N/A	
Shock Sensor	$15	N/A	
Heart Pulse Sensor	$30	$6.69	
GPS	$90	$55.75	
Speaker	$20	$1.32	Buzzer
Button	$45	$6.17	
Website domain name and Hosting Server	$100	$1.97	
Misc.	$100	$85.37	Includes velcro, elastic, switch, etc.
Shipping	$50	N/A	
3-D Printed Case	N/A	$47.35	
	$750	$392.94	

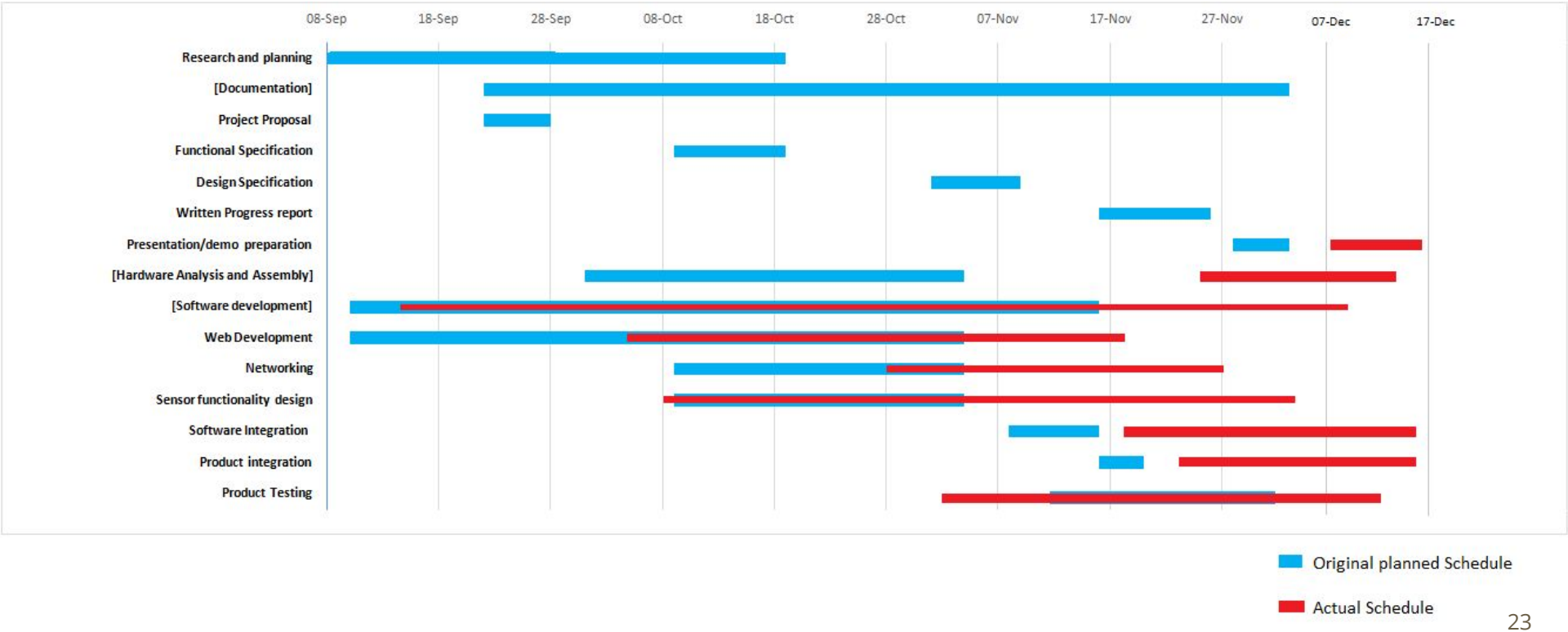
Market considerations

- Selling price: $100
- Profit: $100 - $40 = $60
- Expected production time per unit: 5 hours
- Main market: elderly, people prone to fainting, hospitalized patients
- Region : Canada

Competition	**FEDS**	**Philips Lifeline**	**LifeFone**
Device	1 device	home base + device	2 device (indoor and outdoor)
Monthly Service Fee	$45	$85	$50

Components (for 100+ units)	USD
ADXL345	$1.34
GPS	$15
Active Buzzer	$0.09
SMD LED	$0.025
Push Button	$0.085
PCB	$3
Raspberry Pi Zero	$5
Casing	$3
Battery	$5
around	$30 +$10 markup

Timeline


08-Sep
18-Sep
28-Sep
08-Oct
18-Oct
28-Oct
07-Nov
17-Nov
27-Nov
07-Dec
17-Dec
Research and planning
[Documentation]
Project Proposal
Functional Specification
Design Specification
Written Progress report
Presentation/demo preparation
[Hardware Analysis and Assembly]
[Software development]
Web Development
Networking
Sensor functionality design
Software Integration
Product integration
Product Testing
Original planned Schedule
Actual Schedule

Future Considerations

- Improvements
  - Smaller microcontroller (Arduino mini Pro, Raspberry Pi Zero)
  - Custom Lithium polymer battery (to fit in case)
  - Better fall detection algorithm (with accelerometer only)
  - Login page for each operator
  - Safer and smaller casing to fall on
  - Display of connectivity to the server (for the user)
- Additional Features
  - Heart rate detector
  - Gyroscope (combine with accelerometer: Kalman filter)
  - GSM module (Arduino GSM Shield)

Conclusion

- FEDS is a fall detection system
- What we learned:
  - Writing technical documentations
  - Various sensor coding
  - Server design
  - Hardware design
- We experienced anxiety, frustration, anger, rejection, sadness, despair, depression, BUT...

- WE HAD FUN! (Up to the point Welson had a seizure)

Acknowledgements

- Dr. Andrew Rawicz (Helped us come up with the idea)
- Mr. Steve Whitmore
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- Mr. Omar Aziz
- Mr. Mike Henrey
- Mr. Gary Shum
- Engineering Student Society (For the ESSEF)

References

[1] Finding Balance, “Campaign Toolkit”, 2015. [Online]. Available: http://findingbalancebc.ca/home/campaign-toolkit/. [Accessed: 8-Dec2015].

[2] phac-aspc.gc.ca, “If you fall or witness a fall, do you know what to do?”, 2015. [Online]. Available: http://www.phac-aspc.gc.ca/seniors-aines/alt-formats/pdf/publications/public/injury-blessure/falls-chutes/falls-chutes-e.pdf/. [Accessed: 8-Dec2015].

[3] NCHPAD blog, “Thinking[1]”, 2015. [Online]. Availabe: http://blog.ncpad.org/2013/01/31/raising-a-new-generation-of-ability-thinkers/thinking1/. [Accessed: 9-Dec2015].

[4] raspberrypi.org, “Raspberry pi 2 on sale now”, 2015. [Online]. Available: https://www.raspberrypi.org/blog/raspberry-pi-2-on-sale/. [Accessed: 10-Dec2015].

[5] selfbuilt, “GY-80 - Multi Sensor Board…”, 2015. [Online]. Available: http://selfbuilt.net/shop/gy-80-inertial-management-unit/. [Accessed: 10-Dec2015].

[6] RobotShop, “Adafruit Ultimate GPS Breakout - 66 Channel MTK3339”, 2015. [Online]. Available: http://www.robotshop.com/en/adafruit-ultimate-gps-breakout-66-channel-mtk3339.html/. [Accessed: 10-Dec2015].

References Continued.

[7] Riechtron embedded solutions, “Tactile Button Assortment”, 2015. [Online]. Available: https://www.riecktron.co.za/en/product/149/. [Accessed: 10-Dec2015].

[8] Futurlec, “PCB Mount Buzzer” ,2015. [Online]. Available: http://www.futurlec.com/Buzzers.shtml/. [Accessed: 10-Dec2015].

[9] aeenw.wordpress.com, “Early bird registration deadline extended to May 2nd!”, 2015. [Online]. Available: https://aeenw.wordpress.com/2014/04/23/early-bird-registration-deadline-extended-to-may-2nd/. [Accessed: 14-Dec2015].

[10] english channel Teacher Cristina, “What Are Tag Questions?”, 2015. [Online]. Available: http://tx.english-ch.com/teacher/cristina/kids-b/what-are-tag-questions/. [Accessed: 14-Dec2015].

Questions