SMART BACKPACK

Team Sigma

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Background

How do people ensure they have all items needed for an event?

REMINDERS

CHECKLISTS

How is monitoring and identification done in our society today?

- RFID TECHNOLOGY
  - An RFID system consists of
    - Reader
    - Transponder or tag

Background

Goals

- Compensate for the failures of a reminder and checklist
  - Active Monitoring of items
- Avoid frustration of losing/forgetting important items

Who are our customers?

Problem Definition

What's Needed?

We need to monitor, track and crosscheck if user's essential items are within close proximity.

The Problem Statement

We want to design a system that monitors and keeps track of items needed based on a user's schedule and notifies the user whenever an item needed for any of the day's activities goes outside a certain range of the system.

Design Requirements

	Descriptions
Function	➢ Monitoring of users item when motion is first detected **(10 Sec)** ➢ Issue notification if user attempts to leave without an item needed at their projected destination. (**1M Proximity Range**)
User Interface	➢ Allow user to specify Events and items that are needed for each event **(Android Application)** ➢ Allow user to view and edit inventory, Associate Tagged Items with custom item name **(Android Application)** ➢ Notify the user of items needed if missing. (**Smartphone**)

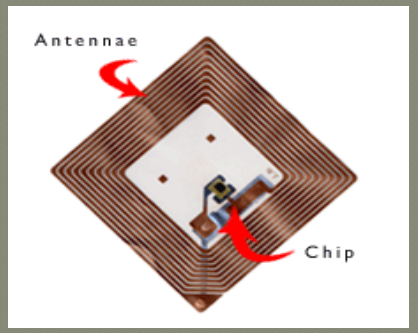
Design Requirements

	Descriptions
System capabilities	➢ Motion Triggered **(Motion Sensor)** ➢ Automatically update inventory received from the User interface ➢ Automatic Notification Alerts **(Less than 1min)** ➢ Wireless Communication between user interface and micro-computer **(Bluetooth 4.0) (10-12m range)**
Compliance	➢ Adhere to the relevant standard **(ISO 18185)**
Others	➢ Low Noise level (**20db**) ➢ Light weight system (**3lb**) ➢ Optimum battery life (**8hrs**) ➢ Ease of use (**10mins setup, 10mins learning**)

Current Status of Art

Fundamental Theory

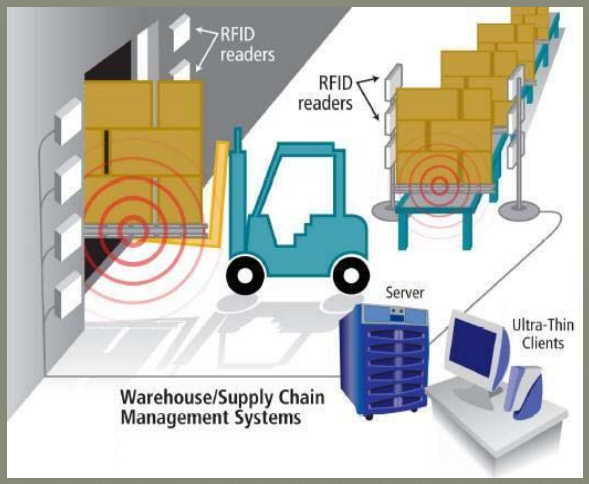
- RFID transceiver (reader) antenna emits radio waves
- RFID transponders (tags) within range absorb the energy discharged by the reader
- Absorbed signal is altered(amplitude shift keying) by the tag's data and backscattered to the reader
- The reader receives and compares this modified wave to the original to extract the data



Current Status of Art

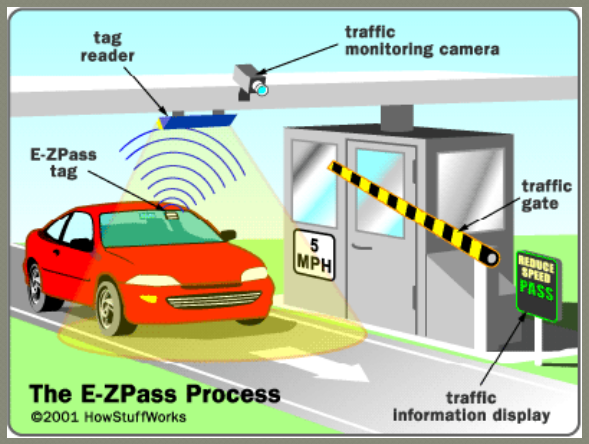
Features

- Tags can store 2KB of data
- No direct line of sight needed for system
- System can employ WIFI/Bluetooth technologies
- Tags can be located through triangulation



Weaknesses/Improvement Points

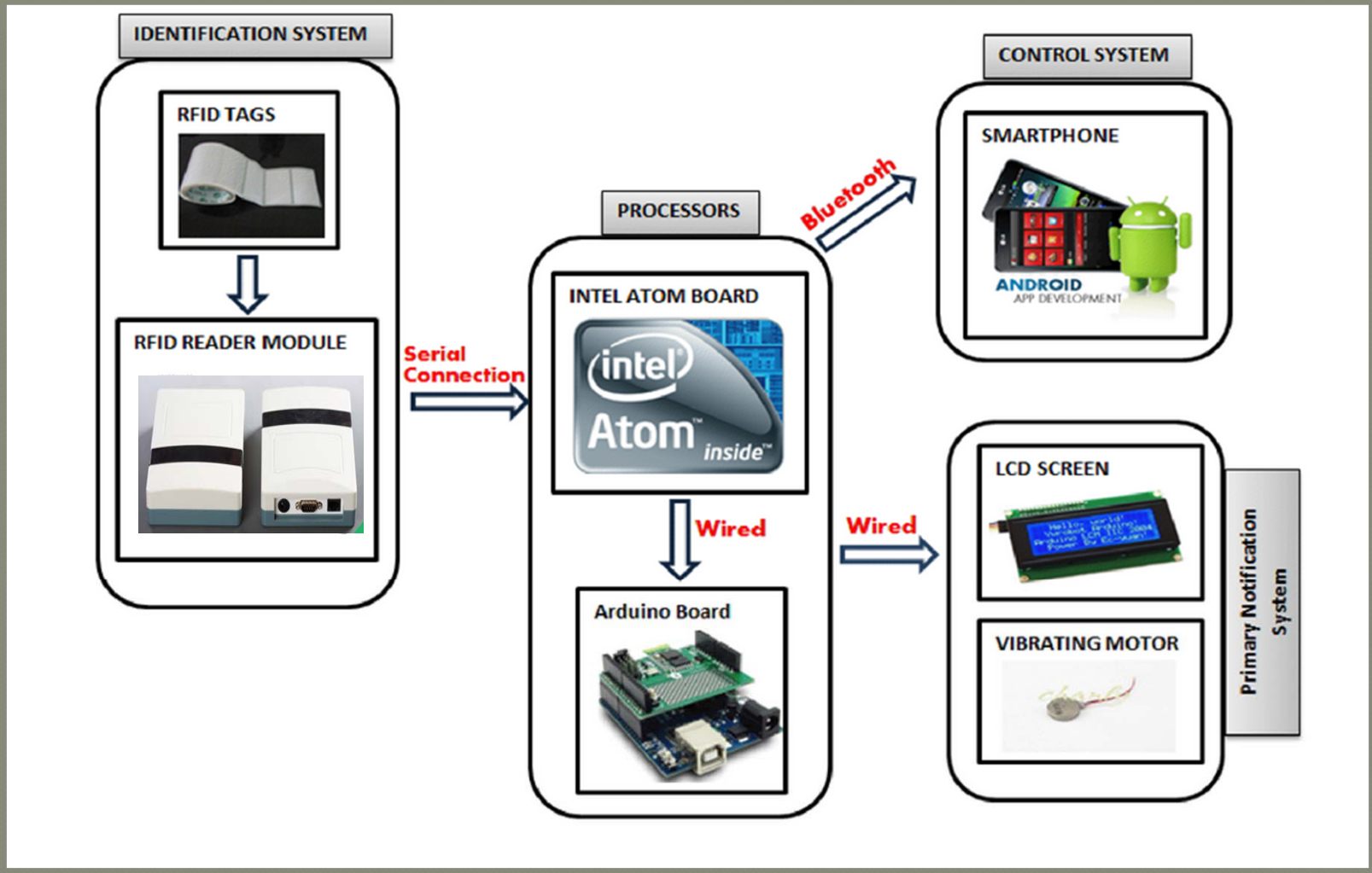
- Tradeoffs occur with change in RFID signal frequency
- Expensive
- Many metals and liquid(aluminum foil, water, etc.) can cause interference in the system



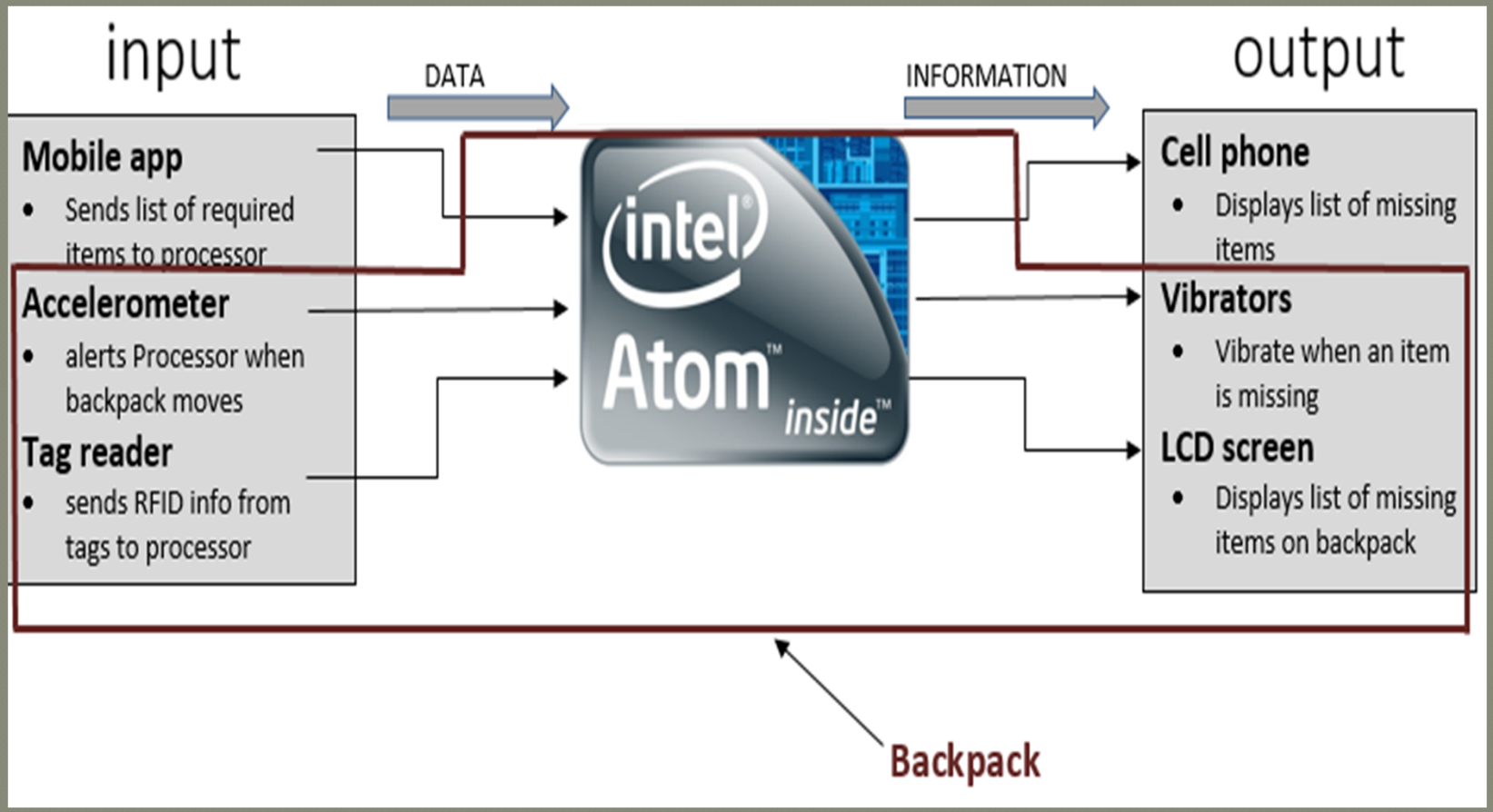
Solution Approach

1. Microprocessor obtains user's schedule from organizer
2. Required items are decoded from tasks listed on the schedule
3. RFID reading action is triggered whenever motion is detected by accelerometer
4. Notification (tracking) system is triggered as user leaves the home
5. Microprocessor notifies user whenever items go outside the RFID reader's range
   - Vibration motion, alert sent to phone & displayed on LCD screen

Solution Approach

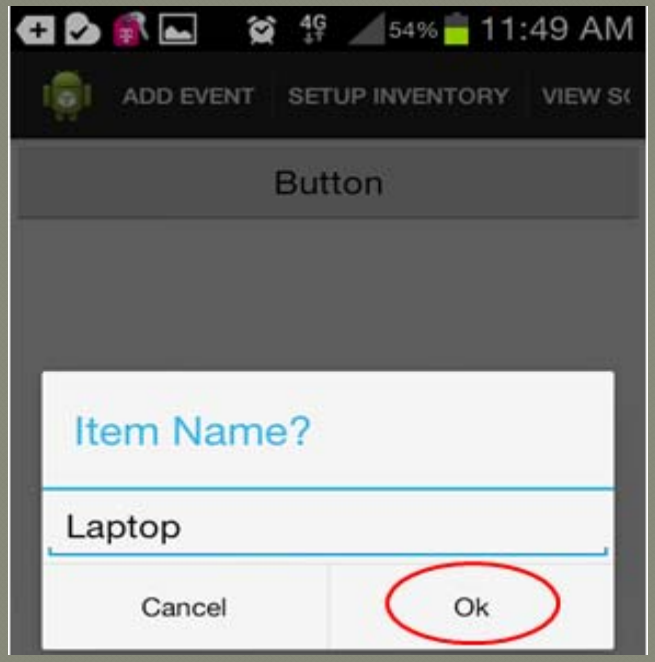


System Implementation

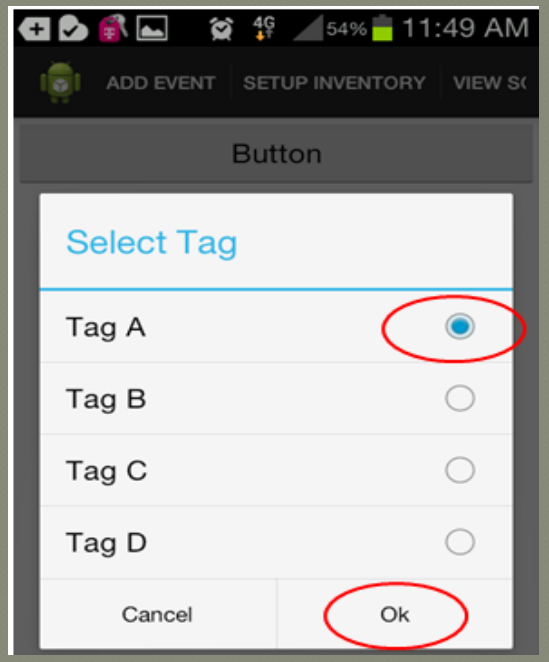


Solution Implementation

App Development :

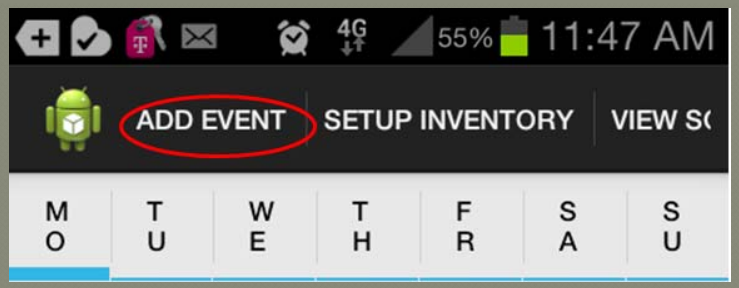


Adding Item to Inventory

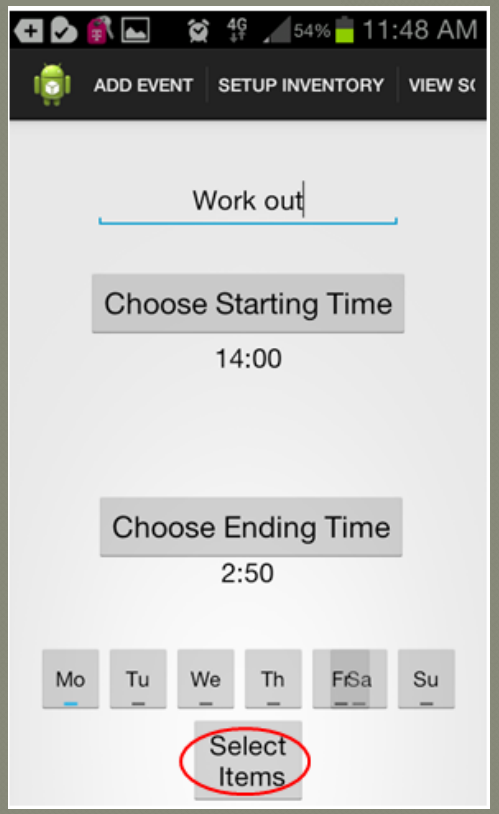


Associating Item with a Tag

Solution Implementation

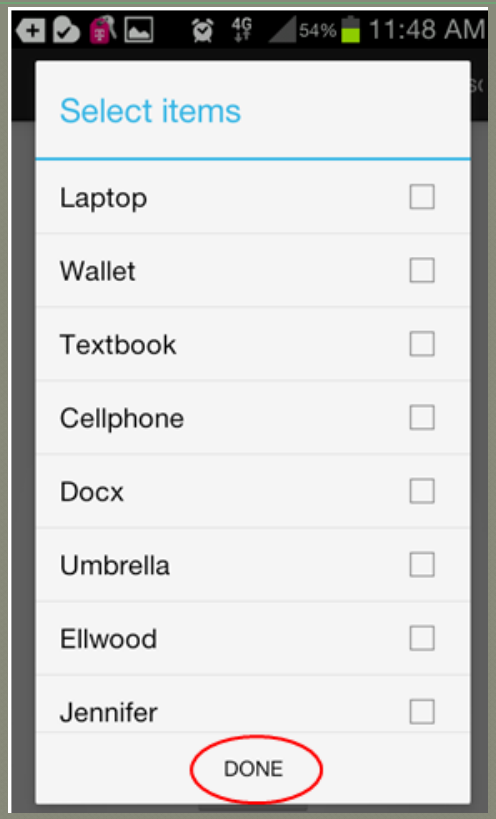


Adding an Event



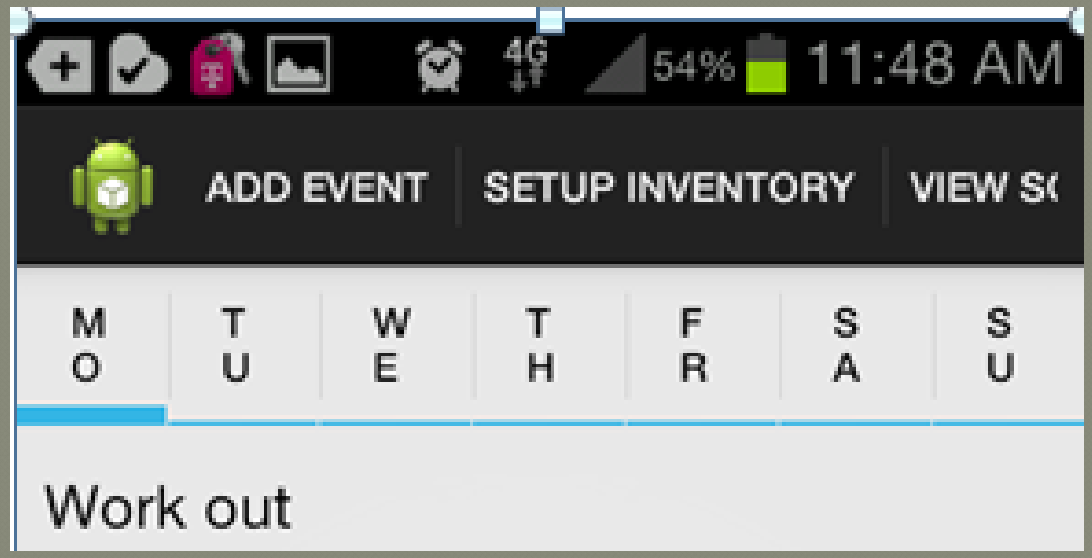
Associating an Event with its Items

Solution Implementation



Item Selection

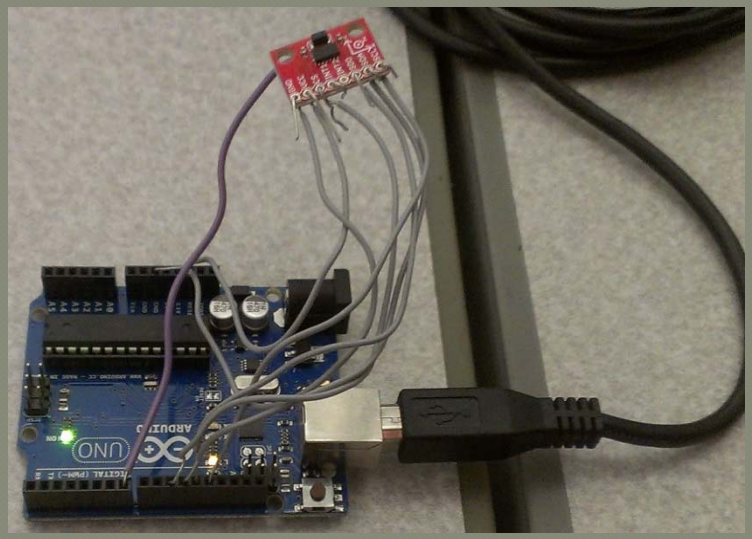
Solution Implementation



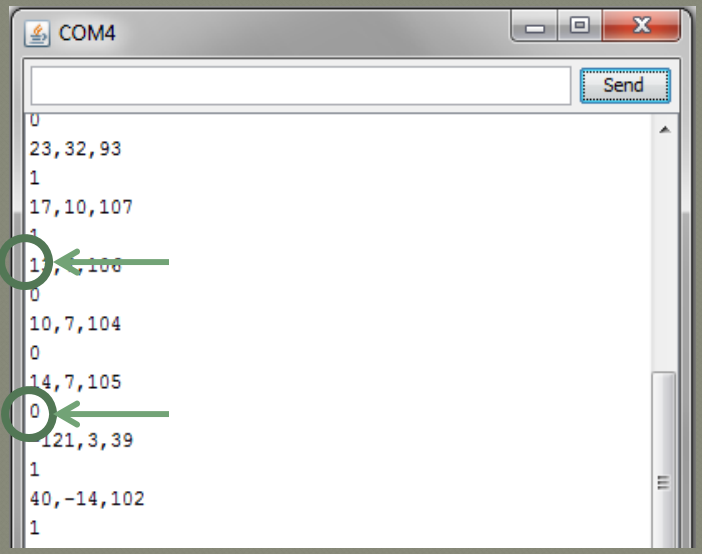
Finished Event for a Given Day

Solution Implementation

Accelerometer Functionality :



Arduino Uno + ADXL345 Accelerometer

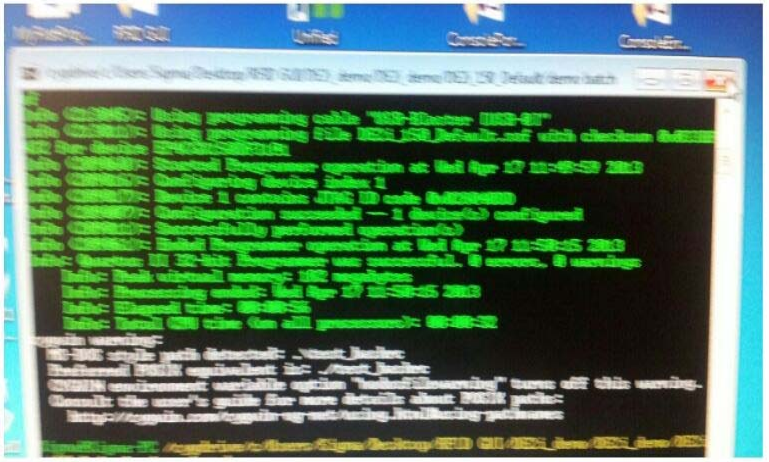


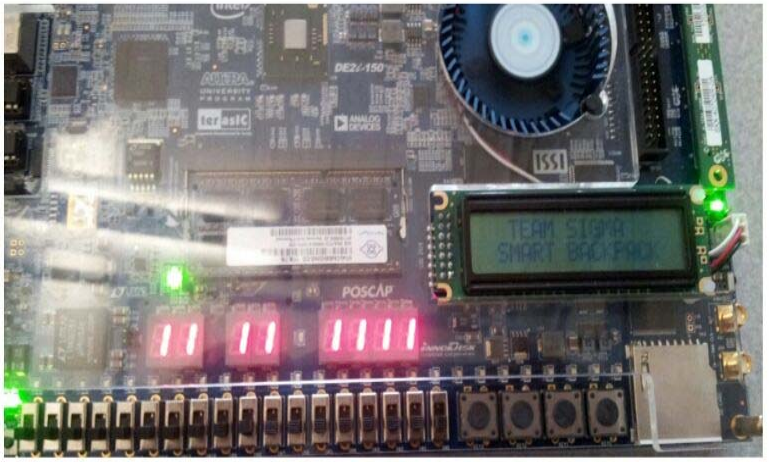
Serial Communication Port 4

Motion is detected when current accelerometer value is greater than past accelerometer value by more than a value of 15

Solution Implementation

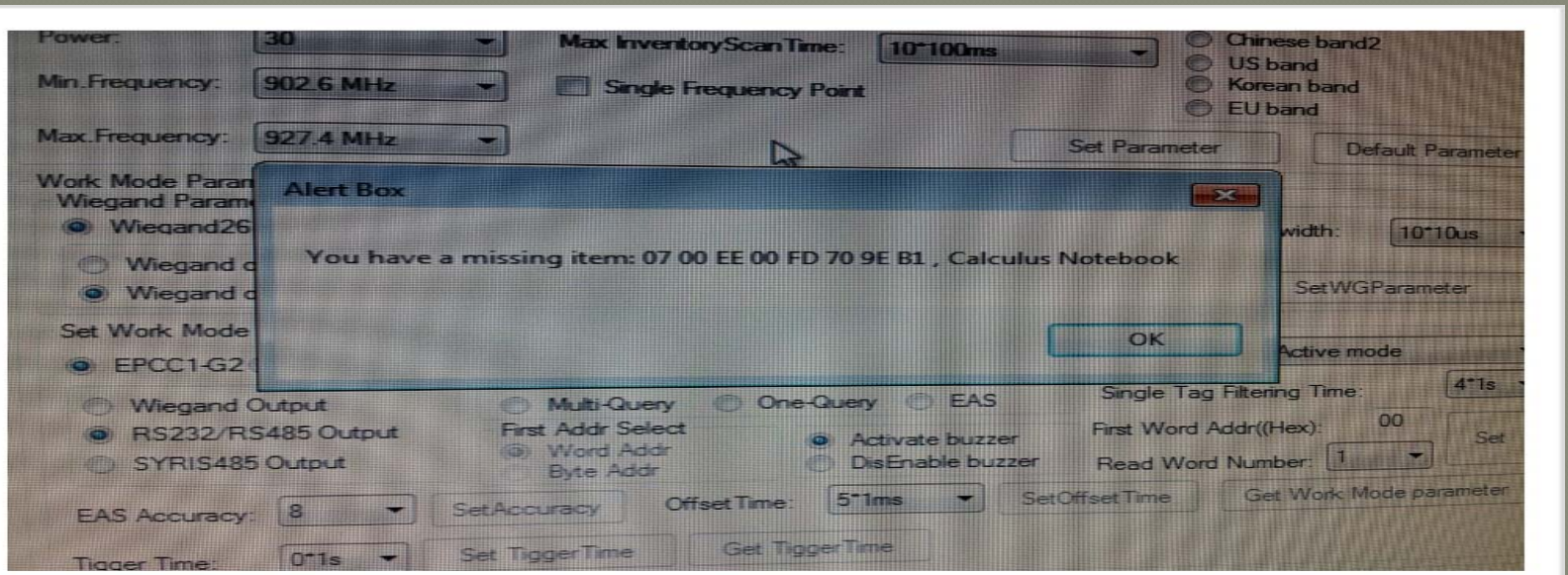
FPGA and LCD Functionality

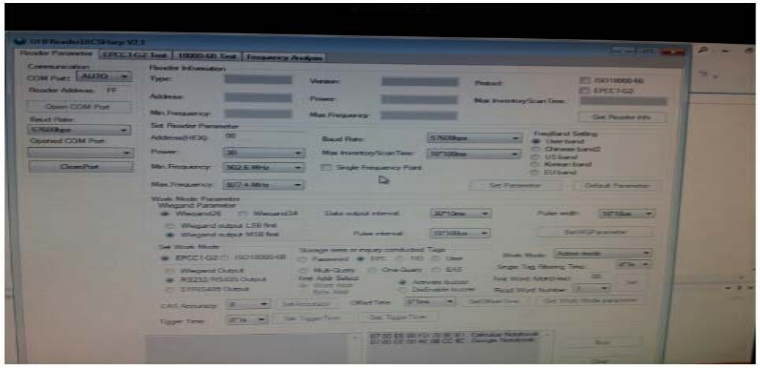




Solution Implementation

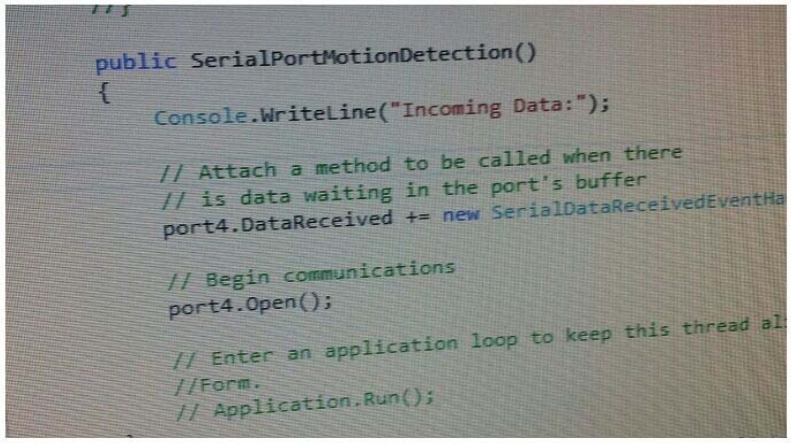
RFID Functionality

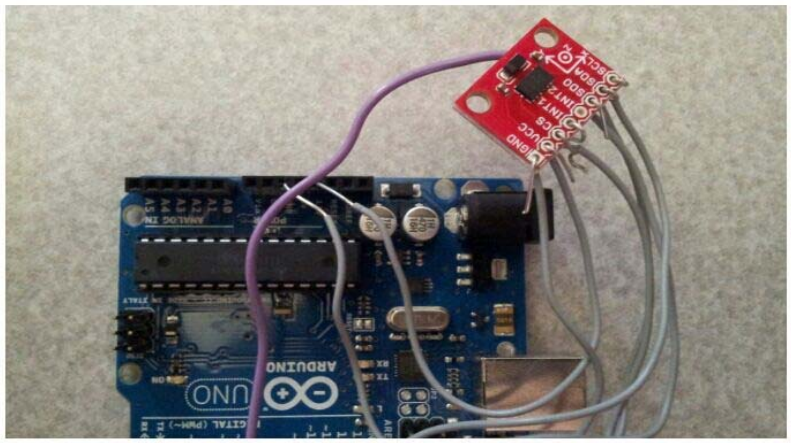


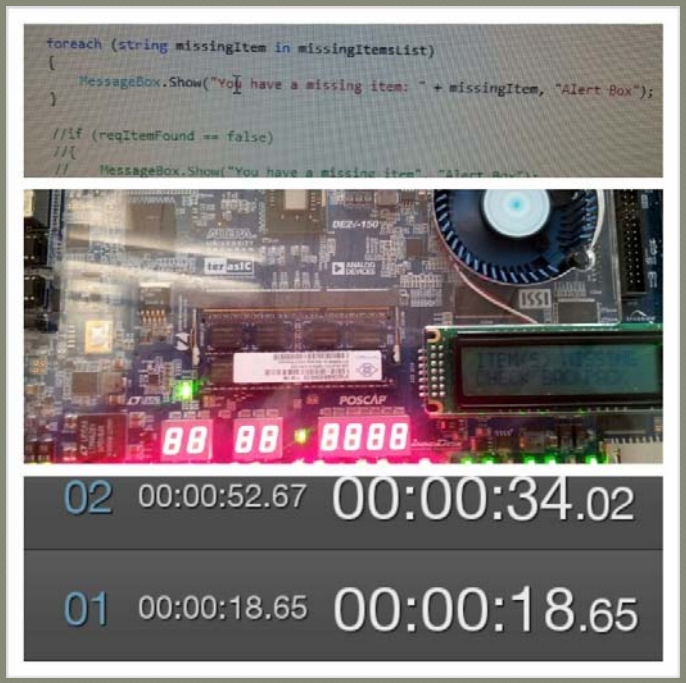


Solution Implementation

System Integration







Solution Implementation

Power Management

(Please Add Screenshots)

Solution Implementation

Team Sigma Smart Backpack Final Product

(Please Add Final Integration Picture)

Testing and Evaluation

Steps	Function	Test	Pass / Fail
Calendar information	Information is making it from app/phone to processor	Information is properly showing on processor	Pass
System state	Motion turns on RFID reader scanning	RFID reader begins to scan after motion is detected	Pass
Tag identification	Reader is recognizing tags within region	Tags are being read	Pass
Tag proximity	Error message is sent when tag moves outside of region	Processor correctly realizes that a certain tag is missing	Pass
User notification	Error message is received by user through each outlet	App/Vibrator/LCD screen correctly function	Pass

Testing and Evaluation

Test	Pass Value	Value	Pass / Fail
Weight	3 lbs		
Read Range(Direct LOS)	1m	1.5 m	Pass
Read Range(No Direct LOS)	1m	0.7 m	Fail
Noise Level	20 dB	52 dB	Fail

Testing and Evaluation

Test	Pass Value	Value	Pass / Fail
Motion Detection Time	<5s	4s	Pass
Error Notification Time – Vibrating Motor	<5s	3s	Pass
Error Notification Time – Phone	<5s	18s	Fail
Error Notification Time – LCD Screen	<5s	52s	Fail

Costs and Resources

Budget($2500)	
Items	Cost
RFID reader and tags	$200
Accelerometer	$30
Rechargeable Battery	$140
Vibrating Motors	$30
Bluetooth Adapter	$20
Travel to Orlando (CC Finals)	$970
Accommodation (CC Finals)	$1,060
Total	$2,450

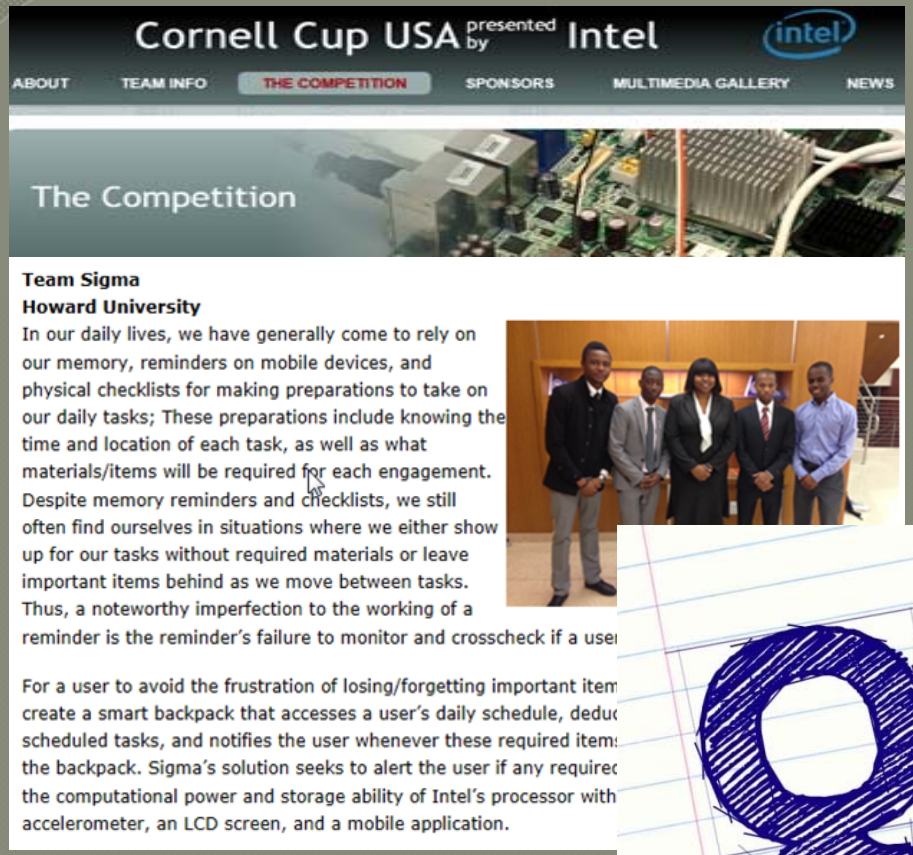
Costs and Resources

Physical Resources	Technical Resources
Quartus II – FPGA Access	Classwork background
Visual Studio – RFID control	Practical corporate experience
Eclipse – Application development	

Conclusion

- Our Smart Backpack solution partially meets our customers' need of ensuring that important items are never left behind
- With additional time, we will continue finishing our system integration
- Also, we will improve our designs performance to align with our design requirements
- We compete in the Cornell Cup 2013 Presented by Intel in May 2-4, 2013 at Disney's Contemporary Resort.

Q&A


Cornell Cup USA presented by Intel
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ABOUT
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Howard University
In our daily lives, we have generally come to rely on our memory, reminders on mobile devices, and physical checklists for making preparations to take on our daily tasks; These preparations include knowing the time and location of each task, as well as what materials/items will be required for each engagement. Despite memory reminders and checklists, we still often find ourselves in situations where we either show up for our tasks without required materials or leave important items behind as we move between tasks. Thus, a noteworthy imperfection to the working of a reminder is the reminder's failure to monitor and crosscheck if a user
For a user to avoid the frustration of losing/forgetting important item
create a smart backpack that accesses a user's daily schedule, deduc
scheduled tasks, and notifies the user whenever these required items
the backpack. Sigma's solution seeks to alert the user if any required
the computational power and storage ability of Intel's processor with
accelerometer, an LCD screen, and a mobile application.


Q&A
You have
Questions
We have
Answers