Motorcycle Helmet Heads-Up Display

Product Name: OdinHUD
Prototype: $A^2J^3$

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Agenda

● Problem/Solution
● Project Diagram
● Responsibilities & Results per member
● Closing remarks
● Reference

Please come to our table for a live demo after this presentation
### Problem/Solution

A futuristic view:

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Before Image" /></td>
<td><img src="image2.png" alt="After Image" /></td>
</tr>
</tbody>
</table>
Prototype: A^2J^3
Responsibility #1

3D Print: Helmet Display Mount
## Power Management Control Unit

First Consideration: Motorcycle battery

<table>
<thead>
<tr>
<th>State of charge of battery</th>
<th>Per lead-acid battery cell (2.1v nominal)</th>
<th>6v nominal batteries (3x cell)</th>
<th>12v nominal batteries (6x cell)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Just charged*</td>
<td>2.13v</td>
<td>6.40v</td>
<td>12.80v</td>
</tr>
<tr>
<td>100%</td>
<td>2.10v</td>
<td>6.30v</td>
<td>12.60v</td>
</tr>
<tr>
<td>75%</td>
<td>2.06v</td>
<td>6.18v</td>
<td>12.35v</td>
</tr>
<tr>
<td>50%</td>
<td>2.01v</td>
<td>6.03v</td>
<td>12.06v</td>
</tr>
<tr>
<td>25%</td>
<td>1.95v</td>
<td>5.85v</td>
<td>11.7v</td>
</tr>
<tr>
<td>Fully discharged</td>
<td>1.75v</td>
<td>5.25v</td>
<td>10.5v</td>
</tr>
</tbody>
</table>
Responsibility #2

Power Management Control Unit
Buck converter nano module with embedded inductor

For more information visit: http://www.ti.com/lit/ug/snvu180/snvu180.pdf

VinMin = 10.0V
VinMax = 14.0V
Vout = 5.0V
Iout = 0.5A
LMZ21700SILR: Efficiency and Junction Temp Plots

Simulation to verify **efficiency** and **Temperature tolerance** of our system across different voltages
Rear View Camera

HD Camera Cape by Radiumboard.com

Image Sensor Board

1.6 MP Cam

Expansion board

Responsibility #3

Adrian

technical aspects of the display unit
Display Layout

➢ 4.3” TFT LCD display
  ○ Resolution: 16:9 display at 480 x 272 pixels

➢ Video driver
  ○ HDMI driver with HDCP stripper and RCA video output

➢ 3 way HDMI switch
  ○ Used to change video source of the display from the smartphone, Beaglebone, and rear view camera
App Development for ACDS
(Automatic Crash Detection System)

➢ Tasker
  ○ Automation of Android smartphone tasks that can be linked together to achieve features not enabled by the stock OS
  ○ Uses a GUI based programming interface to create XML script that is run based on parameters set by the user

➢ ACDS
  ○ The system uses an algorithm that incorporates the cell phone accelerometer to send out an automatic SMS to 5 contacts and inform them that the rider has fallen

➢ XML Code Excerpt

```xml
<Str sr="arg1" ve="3">I have fallen from my motorcycle. Please try calling me or emergency services.</Str>
<Int sr="arg2" val="0"/>
</Action><Action sr="act1" ve="7">
<code>548</code><Str sr="arg0" ve="3">Emergency text sent!</Str><Int sr="arg1" val="0"/>
</Action>
```
How ACDS Works

➢ Tasker

○ **Profile** - Links the context or conditions to the desired task to be implemented

○ **Tasks** - Actions that can be performed in series once certain enabling criteria are met

Start

Phone polls for accelerometer value and GPS

Send SMS Task in queue to run

If heavy jostling detected and rapid stop from GPS

Send Emergency message

End
Sensor Data Interfacing

Beaglebone Black

- Linux (Debian)
- AM335x 1GHz ARM Processor
- micro HDMI output
- SDA and SCL for I2C interfacing
- Powered with 5V 1A for normal operation
- Includes over 43000 precompiled packages
Sensor Data Interfacing

Why Go with the Beaglebone Black?
Sensor Data Interfacing

- **I2C**
  - 3-Axis Accelerometer
  - Barometric Pressure and Temperature Sensor

- **Analog**
  - Ultrasonic Range Finder
  - Analog solution for LED blind spot indication
Blind spot Detection

- Blindspot Detection
  - Ultra Sonic sensors for distance calculation
- Comparator Circuit
  - Setting and calculation of vehicle distances from bike
- LED and Photo resistor
  - Alerts drivers of vehicles in blindspot through LED strategically mounted in helmet
Blind spot Detection Modules

➢ Ultrasonic Sensors
  ○ Low power sensor
  ○ Cheap, reliable, easy to use
  ○ 6 in to 254 in resolution
  ○ 9.8mv/in power consumption
Blind spot Detection Modules

➢ Comparator Circuit
  ○ Simple, efficient design
  ○ Solution to complex Software and Hardware issues
  ○ Amplification of low voltage Ultrasonic signals
  ○ Quick setting of blind spot threshold
Sensor Data Interfacing

[Diagram showing circuitry with components labeled: Sensor_Out, OP07, 5V, 330, and other resistors and diodes.]
## Budget and Part list

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3 inch TFT LCD Module Display with HDMI+VGA+Video AV Driver Controller Board</td>
<td>1</td>
<td>$38.34</td>
</tr>
<tr>
<td>3X1 Pigtail HDMI® Switch</td>
<td>1</td>
<td>$13.26</td>
</tr>
<tr>
<td>BeagleBone Black</td>
<td>2</td>
<td>$55.00</td>
</tr>
<tr>
<td>HD Camera Cape For BeagleBone Black With Fixed Sensor Module</td>
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<tr>
<td>Ultrasonic Range Sensors</td>
<td>2</td>
<td>$8.99</td>
</tr>
<tr>
<td>LEDs W/ Photoresistors</td>
<td>2</td>
<td>&lt; $3.99</td>
</tr>
<tr>
<td>Micro USB to HDMI</td>
<td>1</td>
<td>$7.99</td>
</tr>
<tr>
<td>Helmet</td>
<td>1</td>
<td>Free/Donation</td>
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<tr>
<td>Misc. Mounts</td>
<td>1</td>
<td>&lt; $15</td>
</tr>
<tr>
<td>2 X 2 Solder Board</td>
<td>1</td>
<td>$3.99</td>
</tr>
<tr>
<td>Resistors</td>
<td>1</td>
<td>Free/Donation</td>
</tr>
<tr>
<td>LM324 op amp</td>
<td>1</td>
<td>Free/Donation</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td></td>
<td>$323.00</td>
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</tbody>
</table>
Challenges Faced

- Calibration
- Weights and Dimensions
- Compatibility
- Debugging/ Auto Scripts
- Funding/ Budget
- Placement
Future Improvements

- Wireless Integration
- Voice Command Functionality
- Lane Splitting Detection
- Lighter Components
- Overall a More in Helmet Design
- Reduction of Cost
Resources

- **Funding**
  - Self Funded
  - A.S. Students
  - TI Innovation Challenge

- **Knowledge**
  - Dr. Sotoudeh Hamedi-Hagh
  - IEEE
  - Texas Instruments / Adafruit Technologies
Closing Thoughts

● 8.5 Million Motorcycles on the road in the U.S.
  ○ 4,957 (2012 N.H.T.S.A)
  ○ 26 times more likely to get into an accident

● Advances in Motorcycle Safety
  ○ Blind Spot detection
  ○ A.C.D.S.
  ○ On demand GPS
  ○ Rear Camera

● Potential to Save Lives
References


Questions?