eBaja Battery Team

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What is the eBaja

• Electric version of the SAE Mini Baja
• Designed for off-road entertainment use
Project Overview

• Increased usable energy by 128%

• Designed exchangeable battery system

• Implemented 52V or 104V operating voltage

• Solved some issues with the vehicle frame
Problems with Previous Design

- Limited range
- Difficult to troubleshoot
- Small frame issues
Primary Objective

1. Increase operational time
   a) Double usable capacity compared to previous lead acid batteries
   b) Create interchangeable battery packs
      ▪ Change batteries in under 60 seconds
      ▪ Single person needed to exchange battery pack
      ▪ User required to lift under 50 lbs
Secondary Objectives

1. Allow for “high performance” operating voltage
2. Create fuel gauge
3. Fix small frame issues
Double Usable Capacity

• Change battery chemistry
  – Increase energy density
Battery Cell

- New Energy LiFePO4
- 3.2 volt
- 60 amp hour
- 3.8 lbs
- 3700 charge cycles

electriccarparts.com
Double Usable Capacity

- Change battery chemistry
  - Decreased total mass by 130 lbm
  - Increase energy density
  - Increased usable energy

<table>
<thead>
<tr>
<th>Lead Acid</th>
<th>LiFePO4</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>2160 Wh</td>
<td>4915 Wh</td>
<td>128%</td>
</tr>
</tbody>
</table>
Cell Voltage Balancing

- Battery Management System (BMS) by CleanPowerAuto LLC
  - Monitor cell V individually
  - Limits throttle for low V
  - Stops charging for high V

cleanpowerauto.com
Charging

• Charge time is limited by charger
• Current charger runs at 1.3 kW
• Charge time of 2 hours
Interchangeable Packs

• Break each 52V pack into two 26V banks
Fuel Gauge

- EV Display by CleanPowerAuto LLC
## Expenses

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Company</th>
<th>Qty.</th>
<th>Unit Price</th>
<th>Shipping</th>
<th>Total Price</th>
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</thead>
<tbody>
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<td>1</td>
<td>Batteries</td>
<td>New Energy</td>
<td>32</td>
<td>91.25</td>
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<td>2920</td>
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<tr>
<td>2</td>
<td>Charger</td>
<td>Electric Car Pars</td>
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<td>525</td>
<td>0</td>
<td>525</td>
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<td>3</td>
<td>BMS head boards</td>
<td>MiniBMS</td>
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<td>252</td>
<td>0</td>
<td>504</td>
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<tr>
<td>4</td>
<td>Battery display</td>
<td>MiniBMS</td>
<td>2</td>
<td>115</td>
<td>0</td>
<td>230</td>
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</tbody>
</table>
Design Results

- 128% increase in usable energy
- Unlimited operating time with enough packs
- Decreased total vehicle mass by 200 lbm
- 52V or 104V operating voltage
Design Results

• Single user battery exchange system
• User required to lift 36lbs
• BMS prevents over/undercharge
• Implemented fuel gauge display
• Solved frame issues
Design Results

- Unable to exchange pack in 60 sec
- Non-permanent motor controller container
- Problems keeping battery voltages level
- Connections are all red to black
Failure Modes Analysis

- Improperly wired batteries
  - Consistent wiring
- Batteries overheating
  - Temperature monitor
- Battery box dropped or overturned
  - Metal box with heavy foam securing batteries
Questions?