



Train&Go



TEAM MEMBERS



Garrett Bradshaw

Electrical Engineer

Team / Object Detection Lead

Raleigh, MS



Slade Hicks

Electrical Engineer

Wireless Comm Lead

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Brandon Waldrup

Electrical Engineer

Power Supply Lead

Laurel, MS



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Computer Engineer

Motion Tracking Lead

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INTERNAL ADVISOR

Dr. Lalitha Dabbiru

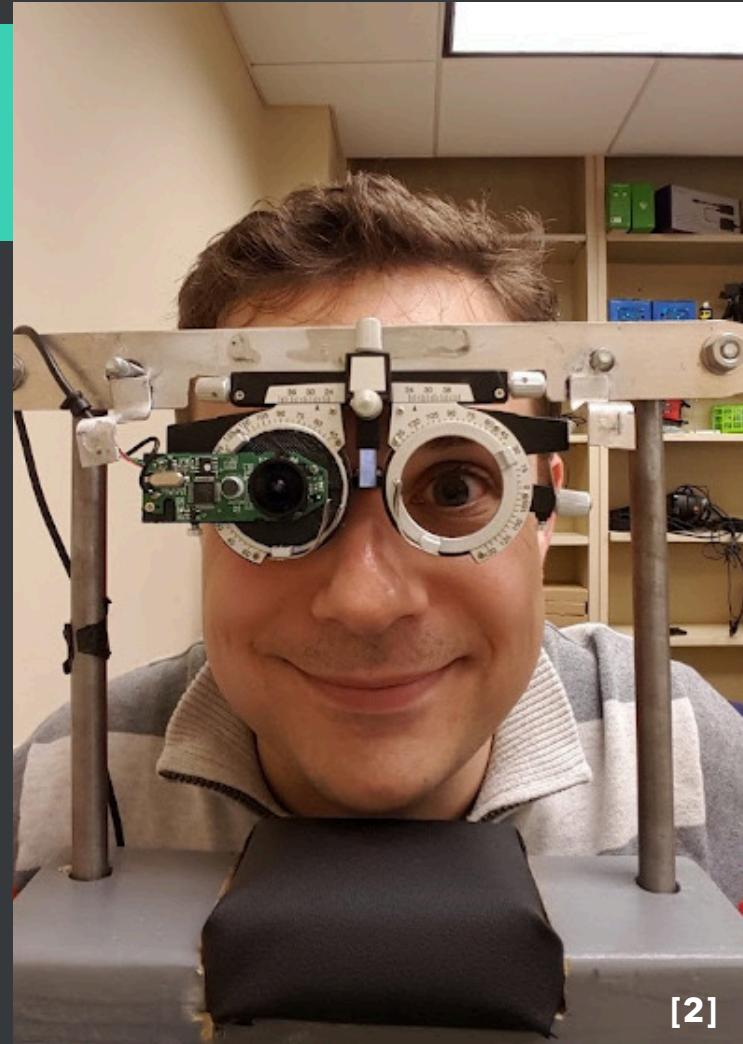
- Assistant Research Professor, Mississippi State University
- Expertise in remote sensing, radar and lidar image processing, and machine learning





EXTERNAL ADVISOR

Dr. Adam Jones



- Assistant Professor, Mississippi State University
- Expertise in neuroscience, psychophysics, and virtual reality



OUTLINE

Overview

Constraints

Approach

Evaluation

Progress



OVERVIEW



Problem

- Power wheelchair accidents
- Personal injury
- Property damage
- Emotional distress





Solution

- Virtual Reality training
- Spatial awareness
- Confidence





COMPETITION

- Braze Mobility
- LUCI





PRODUCT DESCRIPTION

- VR Software (Headset not included)
- Controller Mount
- Control box and six sensors
- Haptic Feedback Package



CONSTRAINTS





TECHNICAL CONSTRAINTS

Name	Description
Wheelchair Speed	The system is attached to a wheelchair moving no faster than five miles per hour [5].
Detection Distance	The system detects objects within a radius of no more than 2.2 meters.
Feedback Latency	The system's latency for sending feedback to the user in response to an object is no more than 250 milliseconds.
Sensor Accuracy	The system's false detection rate is less than 16 percent.
Wireless Range	The system can connect wirelessly to a Quest VR headset within 2.31 meters.
Wireless Latency	The wireless latency is less than 250 milliseconds.

PRACTICAL CONSTRAINTS



Type	Name	Description
Sustainability	Reliability	Train and Go is designed to operate for at least five years without component failure.
Sustainability	Sensor Maintenance	Sensor connections are placed strategically to allow simple maintenance or replacement.
Usability	Product Versatility	Train and Go offers a flexible packaging system to attach to a variety of wheelchair designs and does not inhibit existing chair functionality.
Safety	Collision Detection	Train and Go provides the user with feedback to minimize the risk of collisions with obstacles.
Functionality	VR Communication	Train and Go communicates with a Quest VR headset.

ENGINEERING STANDARDS



Specific Standard	Standard Document	Specification / Application
IP-44	International Electrotechnical Commission Standard 60529	The system is protected from solid particles that are over 1 millimeter in size and from splashes of water [6].
Bluetooth	Institute of Electrical and Electronics Engineers 802-15.1	The system adheres to IEEE Bluetooth standards [7].
Protection Against Electric Shock	International Electrotechnical Commission Standard 62368	The electrical components of the system are isolated from the user to prevent electric shock [8].
Wheelchair Accessory	FDA 21 Code of Federal Regulations § 890.3910	Train and Go satisfies the FDA standards for a wheelchair accessory [9].



Marketing

- Customers: PWDs using a wheelchair
- Purchases recommended through insurance
- Directly sold to Consumers in the US
- Marketing Strategies:
 - Word of mouth
 - Expert recommendation



APPROACH



SOFTWARE

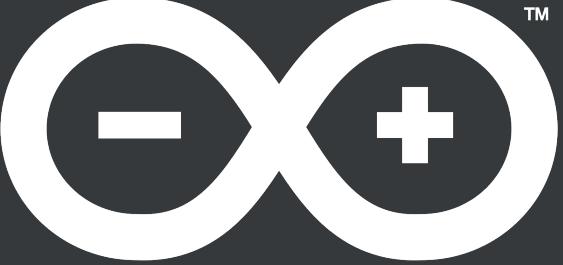
 Meta^[11]



[14]


**UNREAL
ENGINE**

[12]


ARDUINO

[13]



[15]

ASSEMBLY DIAGRAM



HARDWARE – COST ANALYSIS

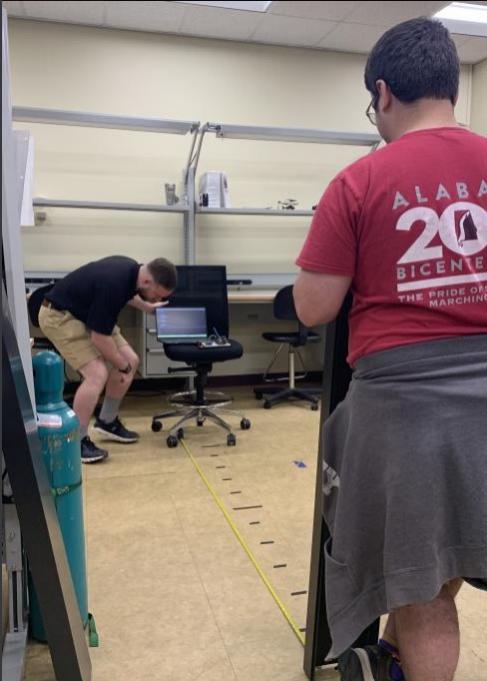


Part Type	Part	Quantity	Cost (USD)
Ultrasonic Sensor [17]	HCSR04	6	7.80
Rumble Motor [18]	Tatoko	1	2.00
DC-DC Converter [19]	Yipin Hexha	1	7.00
Detection Microcontroller [20]	Elegoo Mega	1	21.00
Battery [21]	Zeee 2S Lipo	1	19.50
Additional Materials		1	3.00
Custom PCB		1	0.40
Total			60.70



EVALUATION

ULTRASONIC SENSOR ACCURACY



Output Serial Monitor X

Message (Enter to send message to 'Arduino Mega or M')

```
Sensor1: 220
rumblePin: 0
Sensor1: 220
rumblePin: 0
Sensor1: 220
rumblePin: 0
Sensor1: 220
rumblePin: 0
Sensor1:
```



Actual Distance (m)	Sensor 1 (m)	Sensor 2 (m)	Sensor 3 (m)
0.40	0.44	0.45	0.44
0.60	0.65	0.63	0.65
0.80	0.86	0.82	0.84
1.00	1.04	1.03	1.03
1.20	1.20	1.21	1.20
1.40	1.41	1.41	1.40
1.60	1.61	1.61	1.60
1.80	1.83	1.82	1.80
2.00	2.03	2.03	2.00
2.20	2.25	2.23	2.21

SENSOR LATENCY



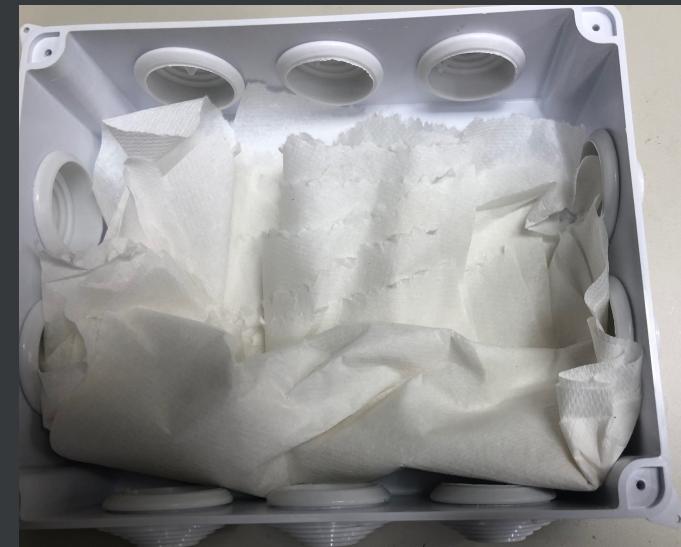
```
14:06:46.719 -> Sensor1:  
14:06:46.760 -> 29  
14:06:46.760 -> rumblePin:  
14:06:46.760 -> 1  
14:06:47.744 -> Sensor1:  
14:06:47.744 -> 19  
14:06:47.744 -> rumblePin:  
14:06:47.744 -> 1  
14:06:48.743 -> Sensor1:  
14:06:48.743 -> 19  
14:06:48.743 -> rumblePin:  
14:06:48.783 -> 1  
14:06:49.741 -> Sensor1:  
14:06:49.741 -> 19  
14:06:49.741 -> rumblePin:  
14:06:49.782 -> 1  
14:06:50.761 -> Sensor1:  
14:06:50.761 -> 19  
14:06:50.761 -> rumblePin:  
14:06:50.761 -> 1  
14:06:51.842 -> Sensor1:  
14:06:51.842 -> 1207  
14:06:51.842 -> rumblePin:  
14:06:51.882 -> 0  
14:06:52.860 -> Sensor1:  
14:06:52.860 -> 1207  
14:06:52.860 -> rumblePin:  
14:06:52.903 -> 0  
14:06:53.894 -> Sensor1:  
14:06:53.894 -> 1207  
14:06:53.894 -> rumblePin:  
14:06:53.942 -> 0  
14:06:54.886 -> Sensor1:  
14:06:54.918 -> 1207  
14:06:54.918 -> rumblePin:  
14:06:54.918 -> 0  
14:06:55.938 -> Sensor1:  
14:06:55.938 -> 1207  
14:06:55.938 -> rumblePin:
```



Test Number	Latency (ms)
1	72
2	73
3	72
4	72
5	72
6	73
7	72
8	73
9	72
10	72



IP44 WATER RESISTANCE TEST





PROGRESS





VR ENVIRONMENT BEFORE



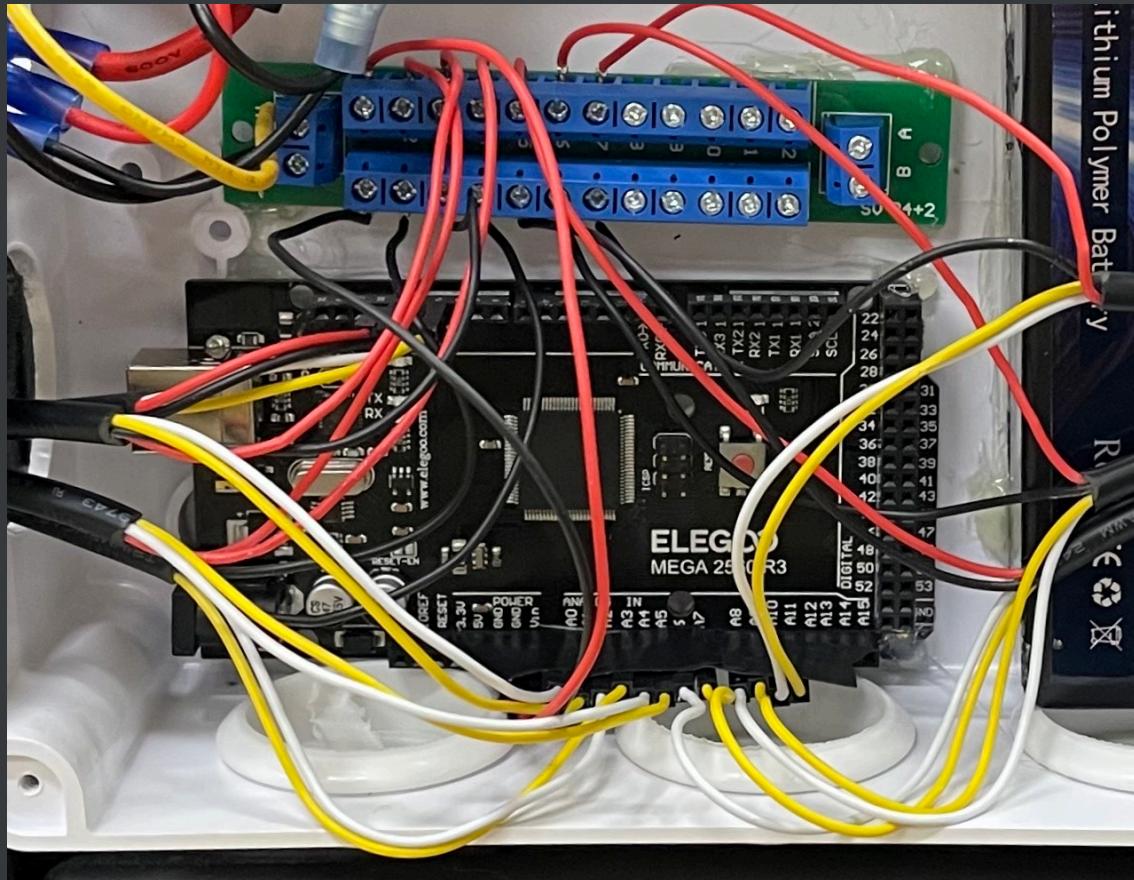


**VR ENVIRONMENT
AFTER**



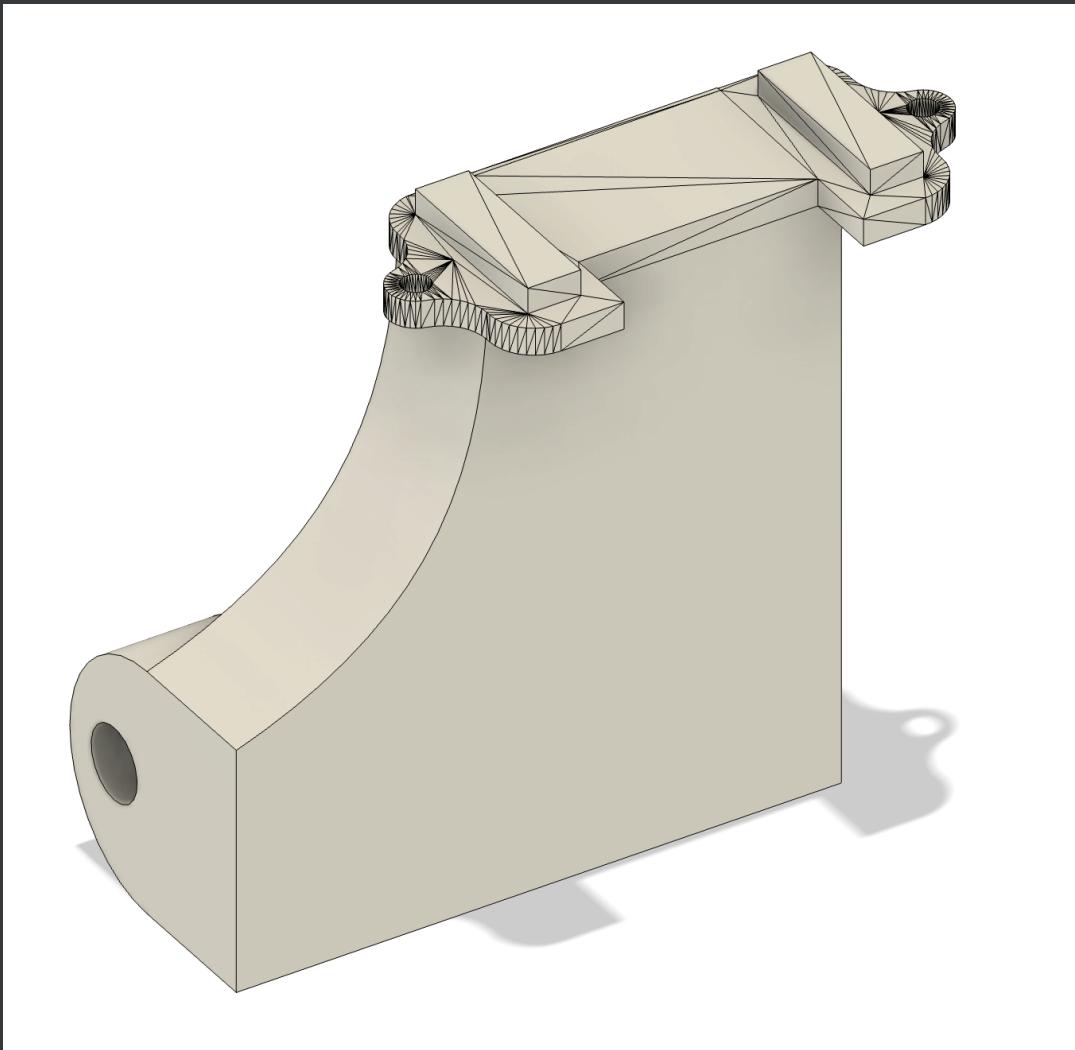


PACKAGING BEFORE



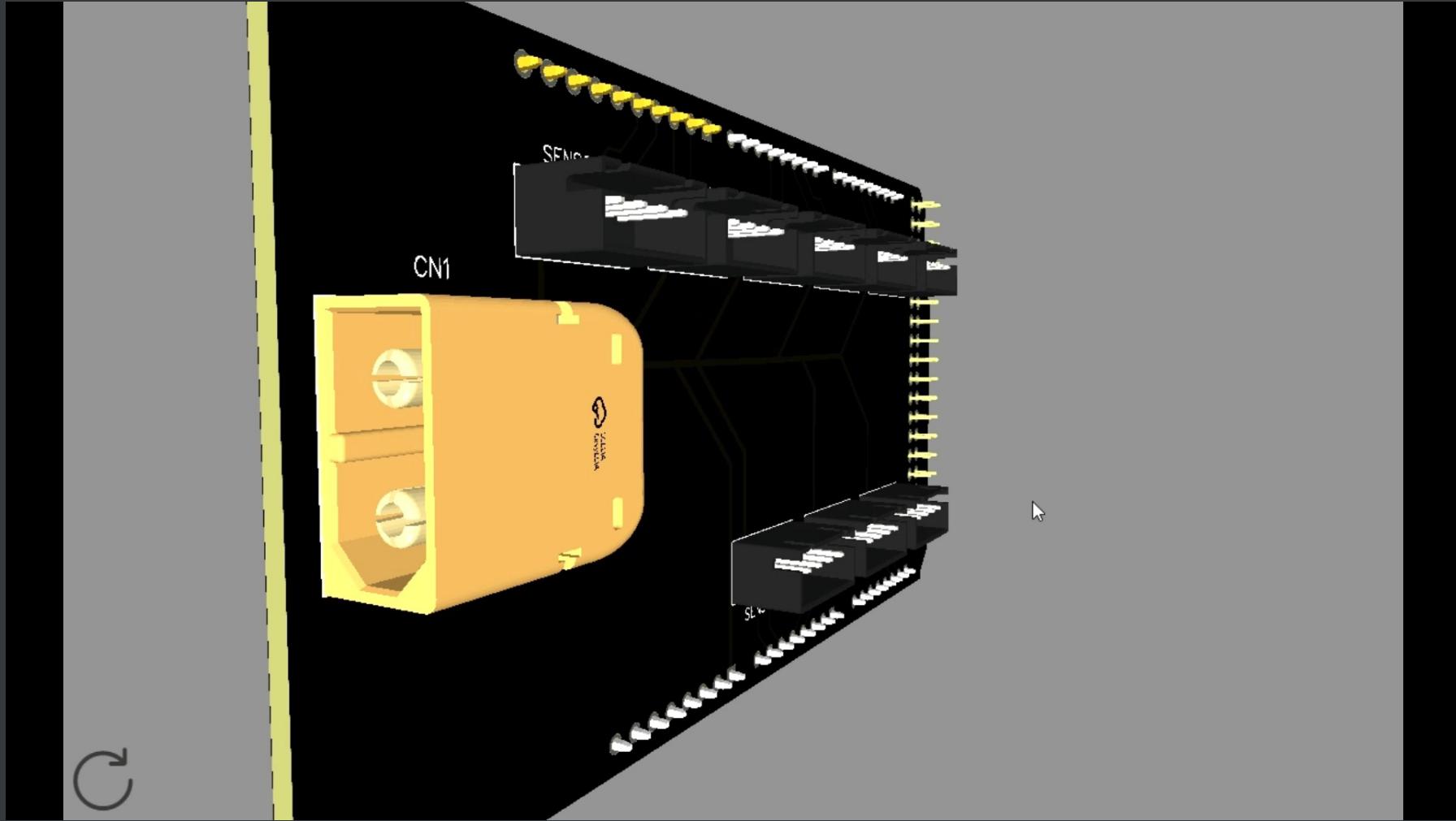


PACKAGING AFTER - SENSOR BRACKETS





PACKAGING AFTER - PCB





QUESTIONS?



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