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EV 2.0

Conversion of a Series Hybrid Vehicle to an Electric Vehicle

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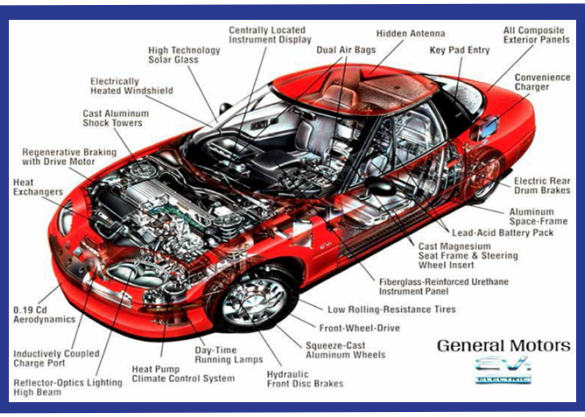

Department of Electrical Engineering and Computer Science (EECS)

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PROBLEM FORMULATION

Problem Definition

- The hybrid vehicle has an inefficient internal combustion engine (ICE) that emits greenhouse gases which pollute the air and contribute to global warming.

Long Term Goal

- Turn the series hybrid General Motors EV 1 into an autonomous electric car

Academic Year Goal

- Create a detailed implementation plan to replace the current propulsion system of the hybrid vehicle with a fully electric drivetrain.

BACKGROUND

- History
  - The EV1 was produced by General Motors from 1996-1999
  - Discontinued and recalled because of lack of profits
  - Donated to CEA for research purposes
  - Converted from an electric car to a hybrid car by Dr Ganley

- Interests
  - Research into real world electrical and mechanical systems
  - EVs are the future of road transportation
  - EVs are relevant to the advancement of the internet of things

CONSTRAINTS

- Intellectual
  - Large learning gap
  - Unable to access relevant documents
- Project-Specific
  - Vehicle not accessible
  - Poor working conditions
- Socio-Cultural
  - Lack of charging stations
  - Range per full charge is low
  - Relatively new technology
- Political
  - Renewable energy industry lacks full support from U.S. administration

DESIGN REQUIREMENTS

- Performance
  - Lifespan of battery pack - at least 2 years
  - Range per full charge - 75 miles
  - Battery module weight - 470 to 520 kg
  - 0 - 50 mph in 6.5 seconds
  - Motor power - 103kW
- Budget - $10,000
- Safety
  - National Highway Transport Safety Administration (NHTSA) Standards
  - Society of Automotive Engineers (SAE) Standards

CURRENT STATUS OF ART

	Before 2014	After 2014
Range	< 100 miles.	> 200 miles.
Battery	16 - 24 kWh	30 - 100 kWh

2018 Tesla Model S

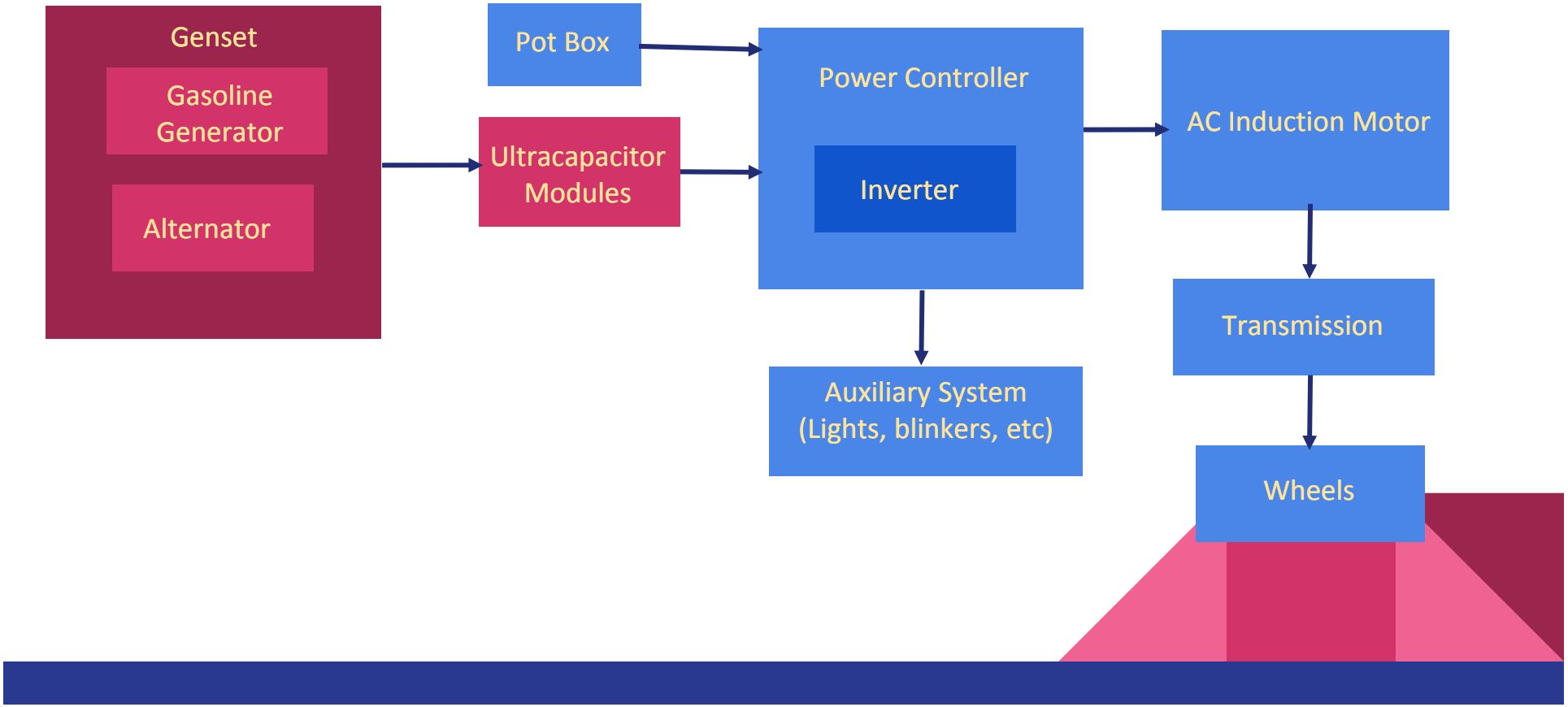
Quick Facts

- Companies like Tesla have made EVs trendy
- EVs with a range of 200+ miles cost at least $75k
- Electric car market is influenced by battery cost

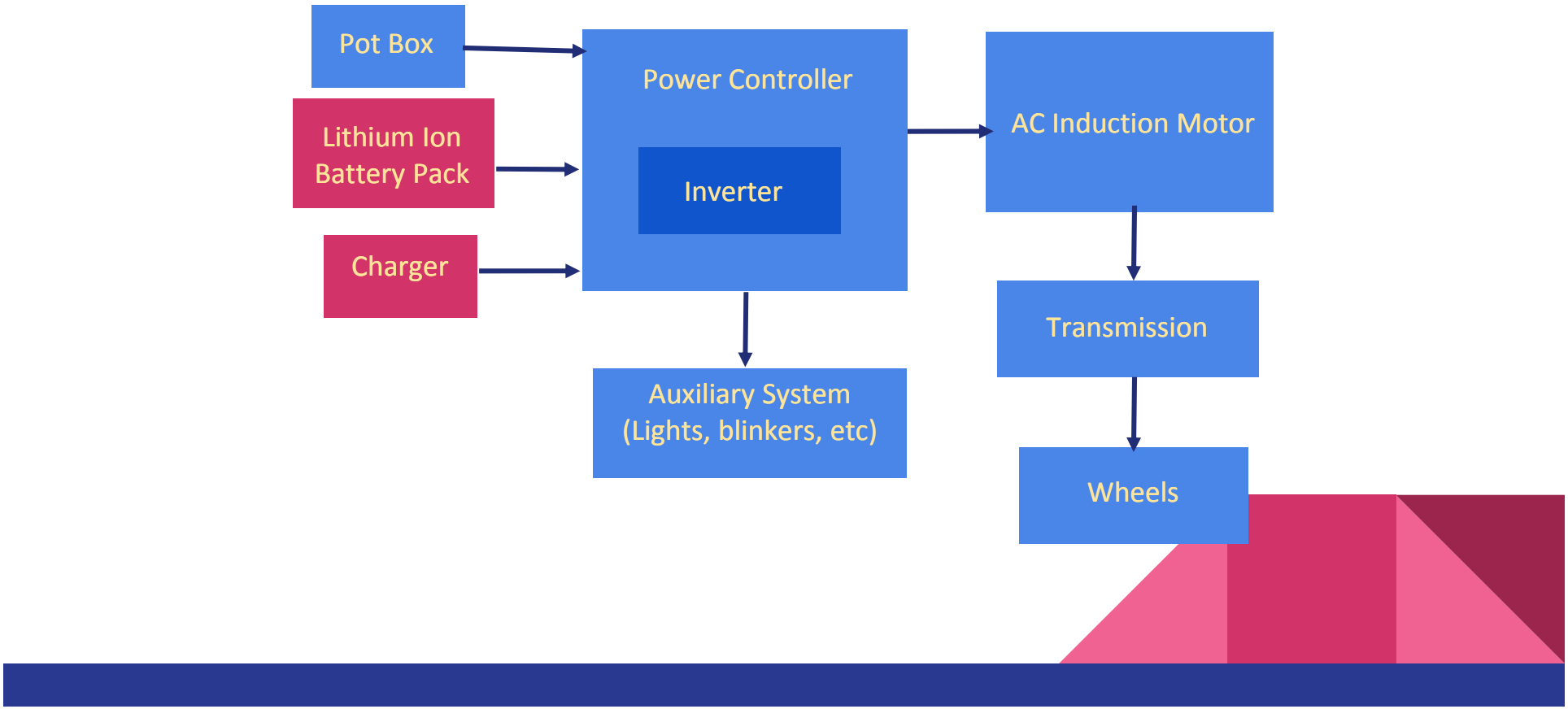
CURRENT STATUS OF ART

Electric Vehicle	2018 Tesla Model S	2018 Nissan Leaf	2018 BMW i3
Price	$74,500	$29,990	$44,450
Range	249 - 315 mi	151 mi	114 mi
Battery (Lithium Ion)	75 KWh	40 KWh	33 KWh
Charge Time at 220V	8.5 - 10.72h	8h	5h
Horsepower	259	107	170

CURRENT PROPULSION SYSTEM



PROPOSED PROPULSION SYSTEM



Battery Calculation

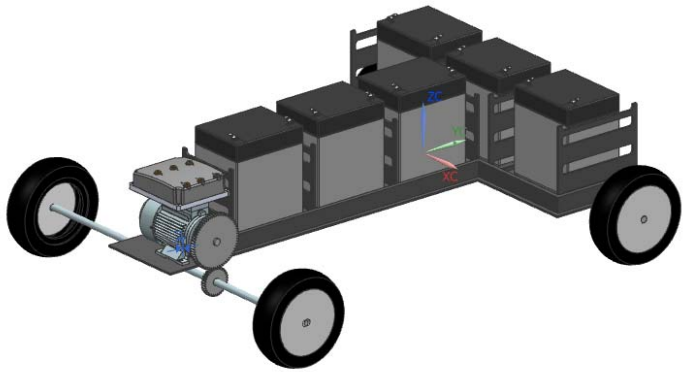
	EV 1	EV 2.0
# of Modules	26	32
Individual Module Rating	12V, 53Ah	12V, 50 Ah
Total Module Rating	312V, 53 Ah	380V, 50 Ah
Weight	~490 kg	~512 kg
Total Energy	16.5 KWh	19 KWh

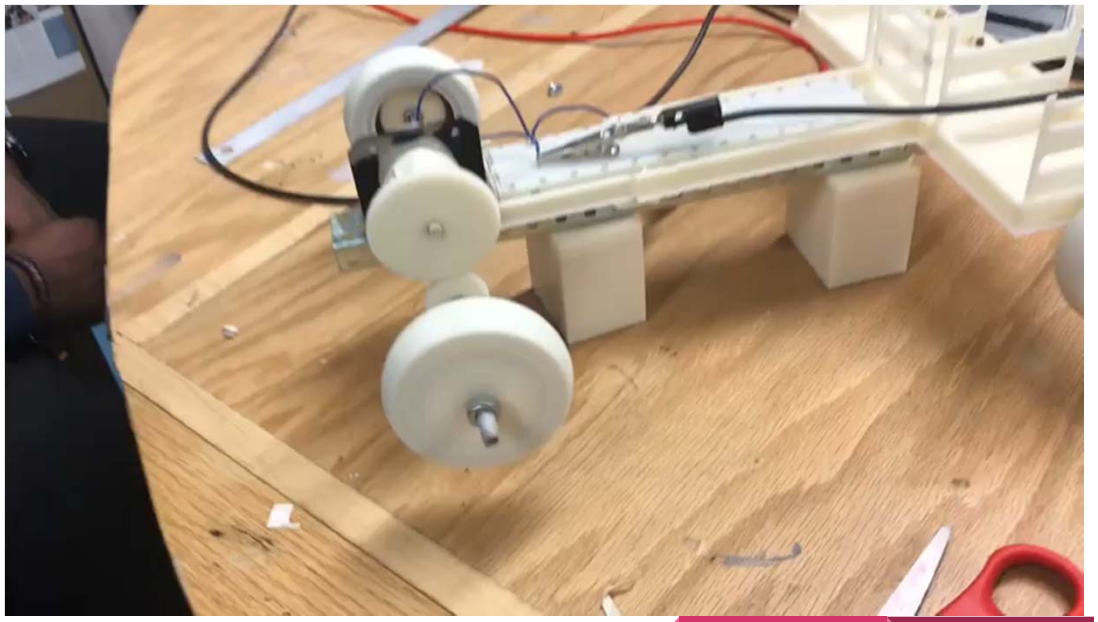
Total Energy =Voltage * Electric Charge in Amp-Hour

ASSIGNED TASKS

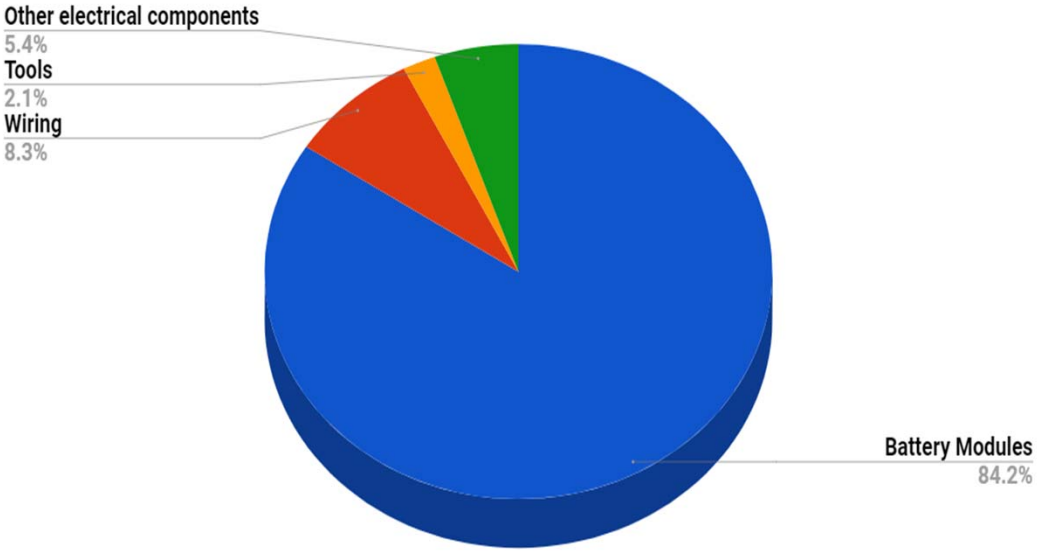
Task	Member Responsible
EV 1 Assessment	Ikenna Onyenze & Olaniyi Nafiu
Obtain relevant EV documents	Goodness Fowora & Arinze Udeh
Preparation of Implementation Plan	All
CAD Drawings	Ikenna Onyenze & Goodness Fowora
3D Printing	Goodness Fowora & David Quashie

CAD MODEL





COST ANALYSIS



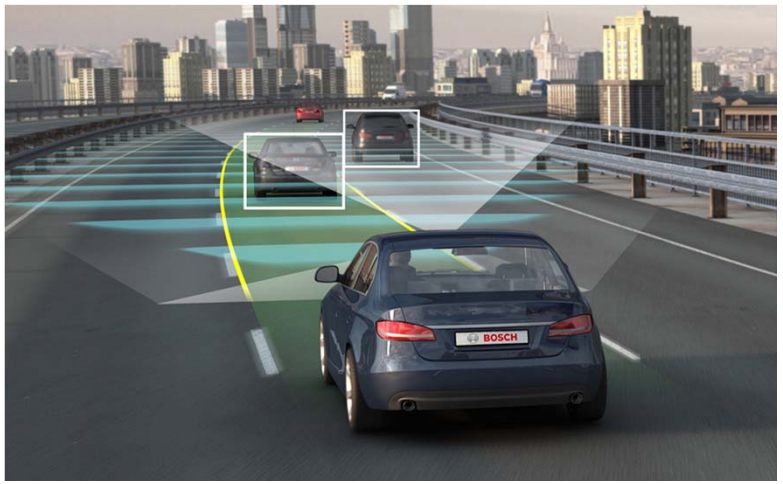
Item	Cost
Battery Modules (32 Lithium Ion Packs at $250 per pack)	$8,000
Wiring (150 ft at $5.25 / ft)	$787.50
Tools (Multimeters, wrenches, jacks, tachometer, etc.)	$200
Other electrical components (fuses, connectors, etc.)	$508.60
Total	**$9,496.10**

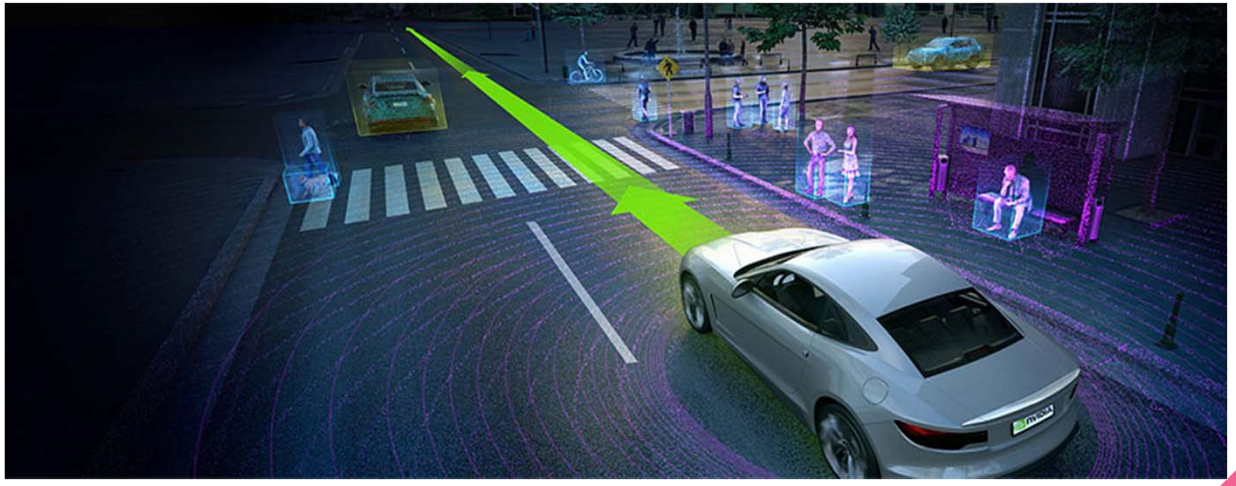
SUMMARY

- EV1 was donated to CEA by General Motors.
- Professor Ganley converted EV1 to a series hybrid vehicle.
- Advancement in battery technology will increase the demand of electric vehicles
- Goals
  - 4-year - Convert series hybrid vehicle into an autonomous electric vehicle.
  - 1st Year - Create an implementation plan for the electric drivetrain.
- Prepared a detailed implementation plan
- Create a Computer Aided Design (CAD) schematic of the electric drivetrain
- 3D Print EV 2.0 propulsion system

Project Next Steps

- Execute implementation plan
- Commence autonomous portion of EV 2.0





ACKNOWLEDGMENTS

- Team Members
- Dr Jason Ganley
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- Dr Emmanuel Glakpe
- Classmates
- EV 2.0 VIP Team