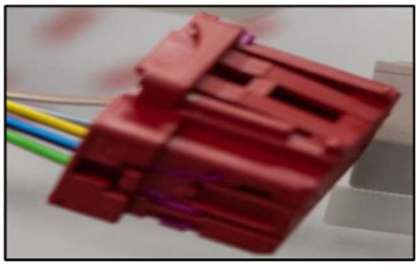
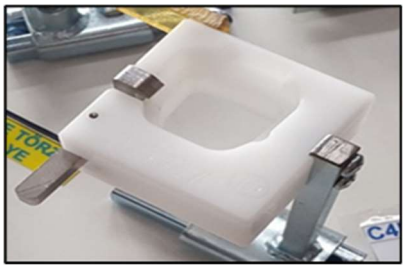
SECS Senior Design
Available Projects – Summer 2021

Development of a CAD-Based Connector Fixture - Lear Corporation

The “nervous system” of a modern automobile is the system of power and data wiring harnesses that link the various components of the vehicle. A wiring harness is a wrapped bundle of wires that contains two or more wiring connectors that interface with the various components of the vehicle. The design, layout and assembly of wire harnesses is complex, and suppliers are continuously looking for ways to streamline the process and improve the reliability of the wiring system.



Wire harness connector



Connector Fixture

Currently, wire harnesses are assembled on an 3D *assembly board* that provides receptacles to locate the component connectors in space, allows the assembler to insert wires into the connectors and route them along defined paths, and provides enough room to wrap the wire bundles to finish the wire harness. Designing and manufacturing a complement of 20 assembly boards, with roughly 120 connector fixtures per board, takes about 7 weeks. Much of this time is used designing and machining the connector fixtures.

Lear is seeking to reduce this time by leveraging existing CAD data for 20,000 standard automotive connectors to automatically generate and 3D print connector fixtures. These fixtures must allow for 3D positioning on the assembly board (via the stanchions seen on the right side of the figure above), for the connector to easily slide in/out and secure it during assembly and wrapping (for example, with the metal clip on the left side of the image above), and to give visual reference to the assembler where to begin and stop wrapping the wires. This will be a CAD-based project, using the parametric features of Catia.

Confidentiality and assignment agreements are required before students can begin work on this project.

Development of a Modern Electromechanical Lock

Locks have been securing possessions for thousands of years. Many complicated and complex mechanical locks have been developed to provide the often-contradictory requirements of robust security, ease of opening, ease of manufacturing, cost effectiveness and sometimes even portability. More recently electronics have been incorporated into lock mechanisms to make them easier to open and reduce costs, but very few electromechanical locks take full

advantage of the electronics and electrical actuators to fundamentally change the way a lock functions.

This project will involve the design, simulation and demonstration of an electromechanical lock:

- Research into various locking mechanisms, with a view to substituting electrical actuators for complex mechanical parts
- The design group may choose to design any existing type of lock: padlock, deadbolt, barrel lock, cylindrical lockset, cam lock, combination lock, etc.
- The electromechanical lock may not be larger, and preferably smaller, than existing models of that type of lock.
- The lock may be opened using a key or combination, wireless signal or some hybrid method.
- There must be a way for the user to change the specific way the lock is opened.
- Force applied to open the lock must not be transferred directly to any electric actuator, that is, the actuator will move other components to block the lock from opening.
- Success of the design will be demonstrated through CAD animations and electrical simulations, based on engineering simulations.

Hand Sanitizer Mixer/Dispenser

Hand sanitizers have been a much sought-after product lately. When a supply can be found, the pre-mixed lotion can be relatively expensive and be quickly exhausted when offered for public use. The objective of this project is to analyze and design a hand sanitizer machine for use by the general public/pedestrian traffic. It will hold sufficient quantities of the main ingredients, mix them into proper proportions, and dispense a given amount of the alcohol-based lotion when an open hand is detected. See the link below.

Specifications:

- It should hold enough raw ingredients to produce 10L of hand sanitizer.
- The ingredient bins and/or mixer needs to be locked or inaccessible to the general public.
- The mixer needs to be easily transportable to its dispensing location.
- There must be a feature to prevent excessive amounts of lotion being rapidly dispensed (i.e. someone filling their personal bottle).
- A way to quickly see that the dispenser is in working order or needs to be serviced.
- The raw ingredients must be fully utilized after loading into the machine (i.e. must not be stuck to the sides as it empties).
- Programmable for various proportions of alcohol in the mixed lotion.

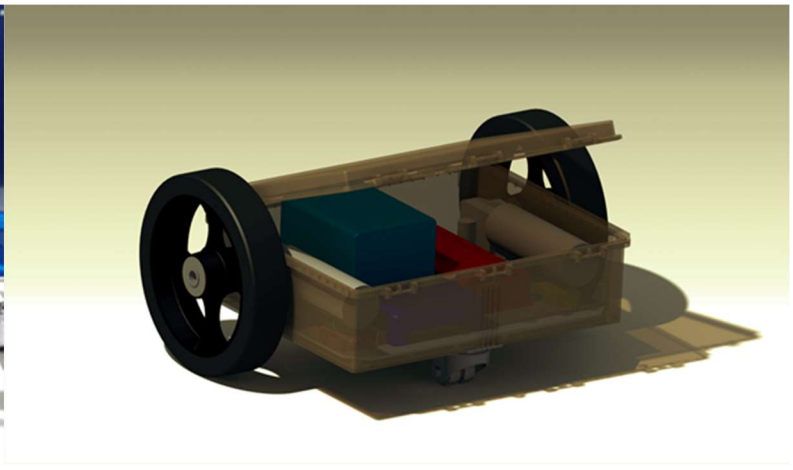
https://www.who.int/gpsc/5may/Guide_to_Local_Production.pdf

Afreecar E-Kit – Solar Cart and E-Kit Prototype

Project sponsors: Christopher Borroni-Bird (chris@afreecar.org), Richard Saad (rich@afreecar.org) https://afreecar.org/pages/inspiration

Afreecar seeks to achieve its mission to provide sustainable power and mobility for all the world's people by providing a universal E-Kit that can retrofit to an existing non-motorized

vehicle (e.g. wheelchair, tricycle, wheelbarrow, hospital bed, linen cart, etc.), providing power assist and enabling the vehicle to become a mobile power source. Afreecar has sponsored several recent projects with OU SECS that led to both improvements in a solar electric cart (left image below) and to a design for the universal E-Kit (right image below).



The Summer 2020 project can build off both these accomplishments in the following ways:

- During the Winter 2021 semester a senior design group developed and prototyped a universal E-Kit. Unfortunately, the prototype has issues with the communication between the motor controller and the motion control that could not be resolved before the end of the semester. These issues must be assessed and resolved in order to bring the E-Kit prototype to complete functionality.

- A solar-powered E-Cart has been prototyped for use in urban farm environments for range, performance, load carrying capability, user interface, etc., and to assess its utility for its intended rural Sub-Saharan Africa operation. In the Winter 2021 semester several mechanical and electrical issues were identified and resolved. Unfortunately, it continues to have recurring issues with its programmable motor controllers which prevents full functionality. The motor controllers need to be assessed, and replaced if necessary, in order to bring the solar-powered E-Cart to full functionality.

- The solar-powered E-Cart, once brought to full functionality, will be put through a set of rigorous tests to determine load capacity, hill-climbing ability, braking (especially when going downhill), user-friendliness, etc. These tests are vital to assessing the viability of the E-Kit concept under practical scenarios.

- If time permits, explore ways that the working E-Kit can replace the propulsion system of the working E-Cart without loss of functionality or performance.

- If sufficient numbers of students are interested – another Afreecar project would be to retrofit a commercial electric wheelbarrow (PAW Power Assist Wheelbarrow) into a solar

  E-Cart with the addition of the existing solar panels of the E-Cart and the E-Kit replacing the commercial electric propulsion system. The result would be lighter/smaller and have significant capacity while steering, braking and propelling properly.

- If sufficient numbers of students are interested – another Afreecar project would be to develop a scale model (quarter to third scale) of the E-Kit, various carts and attachment systems that could be 3D printed and allow verification of kinematics for proper steering and load balancing in multiple applications.

IMPORTANT: Non-disclosure and assignment agreements are required before students can begin work on this project. This project will require time on campus and/or off-site locations during the Summer 2021 semester. If you are uncomfortable coming to campus or have issue with any of the procedures or requirements of being on campus (https://oakland.edu/return-to-campus/), please do not select this project.