2026 Senior Design Conference Project Abstracts

(Projects listed alphabetically by discipline)

Architectural Engineering

AE1 - Kingsville: The New Era

Team Members: Cecilia Aguirre, Guillermo Torres, Melania Gonzales, Larizza Guerra

This senior design project proposes the renovation and repurposing of two buildings and a recreational area in downtown Kingsville to create a vibrant mixed-use destination. The development is intended to support live music events, parades, wine walks, and other community activities that can strengthen local engagement, attract tourism, and stimulate commercial growth. The design integrates architectural, structural, mechanical, and electrical/lighting systems through coordinated use of Revit, Microsoft Teams, Excel, and shared documentation to support interdisciplinary collaboration, scheduling, cost estimation, and code compliance. By combining efficient building systems, safe and functional environments, and respect for the site's historical and cultural character, the project seeks to make downtown Kingsville more attractive, active, and economically resilient while upholding strong professional and ethical standards.

AE2 - Design of Historic Theater in Kingsville

Team Members: Christopher Galvan, Humberto Brianda Vasquez, Destinay Harris

This senior design project focuses on the revitalization and expansion of an existing historic theater in downtown Kingsville, Texas. The proposal preserves the original theater structure and character while expanding into the adjacent building to provide additional movie screening rooms. By locating the expansion to the side of the theater, the design protects the building's historical significance while improving capacity, functionality, and access to modern technologies. The project also seeks to preserve the theater's classic character by closely referencing its scale, spatial organization, and material palette. Structural, mechanical, and electrical systems are being redesigned to satisfy current building codes and accessibility standards, while sustainability strategies such as energy-efficient systems and selective material reuse are incorporated to extend the building's service life. Overall, the project demonstrates how adaptive reuse and strategic expansion can revitalize a deteriorating landmark, support community engagement, and preserve a historic venue while meeting contemporary cinematic demands

AE3 - Rolls and Reels - Entertainment Facility

Team Members: Carla Ortiz, Shelbie Peal, Tiffany Fuchs, Sarena Pena, Caitlyn Henderson

Rolls & Reels is a proposed multipurpose entertainment facility in Kingsville, Texas, developed to address the community's limited local entertainment options. The project combines a bowling alley, movie theater, arcade, and full-service restaurant within a single community-centered complex. The design process involves collaboration across architectural, structural, mechanical, and electrical engineering disciplines, supported by guidance from professional mentors, to create a safe, efficient, and engaging environment. Conceptual development and preliminary design efforts have established the building layout, occupancy classifications, code compliance strategy, and overall architectural character using AutoCAD and Revit. Preliminary structural design includes a steel framing system developed in Visual Analysis, while mechanical design has progressed through cooling-load and airflow studies that estimate a peak total airflow requirement of 13,580 CFM. Electrical planning emphasizes energy-efficient lighting, power distribution, and code-compliant safety features. The project demonstrates the application of engineering principles to a real-world design intended to enhance community engagement, economic activity, and quality of life in Kingsville.

AE4 - Design of Barbell Rodeo Gym

Team Members: Angel Mendoza, Noah Chavez, Eduardo Canchola, Jesus Vargas Jr, Octavian Keith Modeste Jr.

Barbell Rodeo Gym is a proposed 49,282-square-foot fitness facility located on South 14th Street in Kingsville, Texas, designed to promote health, wellness, and community engagement through a safe, efficient, and modern environment. Developed by a team of senior architectural engineering students at Texas A&M University–Kingsville, the project integrates architectural, structural, mechanical, and electrical disciplines to create a fully functional and sustainable gym facility. The design includes dedicated spaces for free weights, cardio training, locker rooms, daycare, posing rooms, saunas, and indoor turf activities, while incorporating energy-efficient HVAC and lighting systems to reduce environmental impact. The team applies industry standards, building codes, and software such as Revit to ensure design accuracy and interdisciplinary coordination. Operating 24/7, the proposed gym is intended to address local demand for a larger and more accessible fitness center while fostering inclusivity, convenience, and long-term community wellness.

AE5 - Design of Kleberg Agricultural Complex

Team Members: Elias Sierra, Dayton Noriega, Daniel Gone, Jose Lozano - Cantu, Lucio Nava

This project proposes a centralized academic facility to support the College of Agriculture, Natural Resources, and Human Sciences by consolidating departments, classrooms, laboratories, and faculty spaces into one coordinated location. At present, the college relies on primary facilities such as the Kleberg Agriculture Building and Howe Agriculture Lab, as well as several secondary buildings, including the Human Sciences Building, Howe Hall, Rhode Hall, Eckhardt Hall, and the Support Services Building. Because laboratory and classroom space in the primary facilities is limited, students and faculty must depend on dispersed secondary spaces that can restrict access, reduce efficiency, and complicate scheduling. The need for improved facilities has become more urgent as enrollment in agriculture-related majors has increased during the past five years. By creating a centralized facility with adequate classrooms, study areas, and laboratories, the project aims to improve the learning environment, reduce scheduling conflicts, and support timelier student progress toward graduation.

AE6 - Design of a Kingsville Emergency and Evacuation Shelter

Team Members: Sydney Whitmire, Alonso Jimenez, Makayla Richards, Pandora Hernandez, Odette Fernandez

Our senior design project focuses on the development of a permanent emergency and evacuation shelter in Kingsville, Texas, intended to serve individuals displaced by natural disasters and other emergency events. The project addresses the limitations of the city's existing temporary shelter, including overcrowding and inadequate infrastructure, by proposing a safer, more resilient, and more accessible facility. The design incorporates modular planning, sustainable building strategies, renewable energy systems, and water conservation measures to improve functionality and long-term performance. Special consideration is given to inclusive design so the facility can accommodate children, elderly individuals, and people with disabilities. In addition to its primary role during emergencies, the shelter is also intended to function as a multipurpose community space for services such as public meetings, health-related support, employment programs, and voting activities. Overall, this project demonstrates a practical and community-centered design approach that enhances preparedness, supports recovery, and provides a valuable civic resource for the City of Kingsville.

Chemical Engineering

CH1 - Production of Dimethyl Ether from Methanol

Team Members: Flor Beltran, Isabella Duncan, Celeste Torres, Gustavo Riojas

Dimethyl ether (DME) is a clean-burning alternative fuel and versatile chemical intermediate used in aerosol propellants, LPG blending, and transportation fuels. This senior design project focuses on developing a continuous process for DME production via catalytic dehydration of methanol. The process utilizes a fixed-bed plug flow reactor (PFR) with γ-alumina (γ-Al_2O_3) as the catalyst, operating at elevated temperatures to achieve high conversion. Due to the exothermic nature of the reaction, precise thermal management is required to prevent catalyst deactivation and thermal runaway. The process was modeled in Aspen Plus V14 using the NRTL property method to represent non-ideal vapor–liquid behavior in the methanol–water system. Methanol feed is preheated and vaporized before entering the reactor, where it is converted into DME and water. Product recovery is achieved through distillation, producing high-purity DME while recycling unreacted methanol to improve efficiency. Key design considerations include reactor sizing, catalyst performance, and separation efficiency. A target production capacity and continuous operation were established based on industrial benchmarks. Safety systems and an economic evaluation were incorporated to assess feasibility, integrating reaction engineering, separation design, simulation, and process safety.

CH2 - Off-Shore LNG

Team Members: Jesus Cisneros III, Jonathan Majek, Austin Venable, Andres Hinojosa

This work presents the conceptual design of a Floating Liquefied Natural Gas (FLNG) facility for offshore gas processing at a capacity of approximately 1.5 MTPA (~200 MMSCFD). A Dual Mixed Refrigerant (DMR) liquefaction system was selected after evaluating alternative processes due to improved thermodynamic efficiency through better temperature matching between refrigerant and natural gas streams while maintaining a relatively compact configuration for offshore service. The final configuration reflects a balance between thermodynamic performance and offshore constraints, including equipment footprint, safety, and operability. The process includes inlet separation, amine sweetening using MDEA/piperazine, acid gas compression, triethylene glycol dehydration, molecular sieve drying, mercury removal, and cryogenic liquefaction. A steady-state ProMax simulation was developed to establish operating conditions and generate design data for equipment sizing. Major units were sized using standard design correlations, and preliminary capital costs were estimated using cost-estimation software, with upstream systems totaling approximately $96.6 million. Process safety was addressed through HAZOP analysis, while sustainability focused on heat integration, solvent regeneration, and waste management. Design decisions were guided by simulation results, literature data, and engineering judgment, resulting in a practical and technically consistent basis for offshore LNG production while accounting for the operational and environmental constraints inherent to FLNG systems.

CH3 - Hydrogen from Methane
Team Members: Katherine Claudio, Audrey Rodriguez, Justin Calderon, Brett Prause

This senior design project focuses on the production of hydrogen from methane using Steam Methane Reforming (SMR) followed by the Water-Gas Shift (WGS) reaction. The objective of the project was to design a cost-effective and efficient hydrogen production plant capable of producing 100,000 metric tons of hydrogen per year with an operating factor of approximately 330 days per year. The plant is located on the Texas Gulf Coast to take advantage of existing infrastructure, methane availability, and industrial hydrogen demand. The process begins with methane and steam reacting in a steam methane reformer to produce synthesis gas consisting primarily of hydrogen, carbon monoxide, carbon dioxide, and water. The syngas then enters a water-gas shift reactor where carbon monoxide reacts with steam to produce additional hydrogen and carbon dioxide. The process stream is cooled and sent through flash separation units to remove water and carbon dioxide, increasing hydrogen purity to approximately 94%. The process was modeled and simulated using Aspen Plus to evaluate reactor performance, separation efficiency, and overall process conditions. An economic analysis was performed using equipment cost estimation and the Lang factor method, resulting in an estimated total capital investment of approximately $206 million. Safety, sustainability, and heat integration were also evaluated to improve overall process efficiency and reduce environmental impact.

CH4 - Syngas from Natural Gas
Team Members: Gilberto Gonzalez, Donovon Perez, Parker Shearer

Synthetic gas, or syngas, is an intermediate product consisting of hydrogen and carbon monoxide. There are several methods for the synthesis of syngas in industry where it is commonly used as a cleaner fuel alternative in automobiles, as a building block for chemicals like methanol or ammonia, and even simply for provision of hydrogen. One such method and this team’s method of choice is Tri-Reformation (TRM) of syngas from natural gas. Wherein, feedstock of both methane and flue gas is fed into the same reactor at a specification temperature of 800°C and a pressure of 3 bar with a nickel-based magnesium oxide catalyst bed. Methane undergoes three reactions: Partial Oxidation (POX), Steam Reformation (SRM), and Dry Reformation (DRM), where TRM gets its namesake. This system maximizes conversion and reduces carbon coking, resulting in a cleaner and more efficient method of syngas production. The target ratio for this model, ran in Aspen plus, is 2:1 in hydrogen and carbon monoxide. Annual output is estimated at about 100 million lbs of syngas product per year, at a rate of 1360 kilomole per hour and an operating factor of about 70.5% with a total planned 6174 hours per year.

CH5 - Ethylene from Ethane
Team Members: Millissa Boussoualim Sergio Farias, Zoe Slusher, Joshua Guajardo

Ethylene is the most widely produced petrochemical and is essential for the manufacture of plastics and other chemical products. The objective of this project is to design an industrial process for producing ethylene from ethane using steam cracking. The plant is designed to operate in Port Arthur, Texas, with a target production capacity of approximately 2.92 billion pounds per year. The process involves converting ethane into ethylene in a cracking furnace operating at 800°C, followed by separation and purification to obtain a high-purity product. Aspen Plus was used to simulate the process and perform material and energy balances. Equipment sizing was conducted using standard chemical engineering design methods, and equipment costs were estimated using CapCost. The final design aims to achieve high ethylene production while maintaining efficiency, safety, and economic feasibility. This project demonstrates the application of process design principles to develop a realistic and scalable industrial ethylene production process.

CH6 - Phenylalanine from Glycerol
Team Members: Alejandro Barrera, Nathanael Beck, Daniel Jones, Dylan Maldonado

Our design project describes a process for converting glycerol to phenylalanine using a genetically modified *Escherichia coli* biocatalyst. Glycerol was selected as a carbon source due to its low cost and status as a byproduct of biodiesel manufacturing, thus furthering the goals of sustainable and circular economics. L-Phenylalanine was selected as a product due to its high value and growing demand, secondary to its use as an aspartame precursor and potential R&D/pharmaceutical applications, as well as dietary and supplementary uses. We propose the use of the genetically engineered BL21 (DE3) strand of *E. Coli* as it is well suited to produce specialty chemicals. Additionally, we achieve glycerol conversion with five equally sized, parallel chemostats, and we produce high-purity L-phenylalanine with a multi-stage separatory process including a centrifuge, crystallizer, and vacuum dryer. By using the novel substrate, glycerol, our process converts biodiesel's waste into a high-value fermentation product at a lower cost than traditional substrates such as glucose.

CH7 - T-butanol from Isobutane
Team Members: Ivan Gomez, Adrian Rios, Francisco Salazar, Daniel Trevino

This project presents the design and simulation of a process for producing tert-butanol (TBA) from isobutane through a hydro peroxidation pathway. The primary objective is to develop a safe, efficient, and economically viable process that converts a low-cost feedstock into a high-value product. The process consists of four main units: an oxidation reactor to form tert-butyl hydroperoxide (TBHP), a decomposition reactor to produce TBA, a flash drum for phase separation, and a distillation column for final purification. Aspen Plus was utilized to model the system, perform mass and energy balances, and optimize operating conditions. A recycle stream was incorporated to enhance overall conversion while maintaining safe operating limits due to the presence of reactive peroxide intermediates. The expected outcomes include achieving high purity of TBA, improved process efficiency through recycle integration, and identification of key safety and environmental considerations. The final design demonstrates technical feasibility and underscores the potential for industrial-scale implementation of TBA production.

Civil Engineering

CE1 - Project ReGrowth
Team Members: Emede Canales, Adrian Sepulveda, Brandon Ochoa

This project presents a comprehensive, multidisciplinary design proposal addressing critical infrastructure and research limitations at Texas A&M University–Kingsville, specifically within the Dick and Mary Lewis Kleberg College of Agriculture, Natural Resources and Human Sciences. Prompted by stakeholder input, the team identified key deficiencies in water control, storage capacity, and the structural integrity of existing greenhouse facilities. In response, the project delivers a fully developed engineering solution, including site surveying, structural analysis, foundation design, and hydrological system modeling.

The proposed design features a two-story, 50’ × 100’ research and teaching facility that replaces outdated structures with a modern, resilient alternative. Structural systems were designed وفق ASCE 7-16, incorporating detailed wind load calculations, member capacity checks, and optimized steel framing. Subsurface conditions were evaluated to inform foundation redesign, while a rainwater harvesting system—engineered for a 50-year storm event—demonstrates applied hydrologic analysis and sustainable water management.

Beyond its engineering scope, the design aims to restore research efficiency, expand academic opportunities, and reinvest in the university’s agricultural future through durable, sustainable infrastructure. This project is expected to come at a cost of $5.6 million, and to be completed within a 19-month period.

CE2 - Title: Athletic Offices Renovation
Team Members: Farris Ashour, Andres Cantu, Rudy Solis, Ryan Solis, Angelo Rangel

Concept: This project is a redesign of the TAMUK athletic office, it encompasses the complete demolition of the existing athletic office to be redesigned and rebuilt into a two-story building that will be bigger than the previous. It also includes additional staff and student parking behind the building to give easier access to the building while also helping us to have buses and ambulances closer to the stadium.

CE3 - Brackish Groundwater Desalination Plant
Team Members: Denise Palma, Renata Canales, Amy Co, Christopher Wheeler, Abdallah Alazemi

This senior design project presents the civil engineering design of a brackish groundwater desalination plant in Driscoll, Texas. The region currently relies on surface water from Lake Corpus Christi and Choke Canyon, which are currently in a stage three drought. The purpose of this project is to design a sustainable water resource for Bishop, Driscoll, and Kingsville.

The proposed plant is designed as an integrated civil system consisting of a groundwater extraction well, a central reverse osmosis treatment facility, hydraulically connected tank system, and a separate deep well injection system. Additional civil components include a site layout and grading, structural and foundation designs of the facility and tanks, a bunded storage system for the raw, brine, and potable water tanks to avoid spillage. Additional components include site access, ADA compliant parking, and stormwater management. The facility is designed for a treatment capacity of 1.79 million gallons per day, providing a long-term water supply solution for South Texas.

CE4 - Renovating Javelina Stadium

Team Members: Cameron Roulston, Donald Cruz, David Villarreal, Caleb Muschalek, Jayden Shilling

Renovating Javelina Stadium is a redesign of the existing west side bleachers by adding new concrete stands with luxury suites, and adding new home side locker-rooms, concession stands, and restrooms underneath the concrete stands, as well as redesigning the east side parking lot. Our project includes structural design and analysis, foundation design, pavement design, parking lot design, and hydrology analysis.

CE5 - Sequin Transit Center

Team Members: Yasmin Garcia, Jazmin Gutierrez, Emmanuel Jimenez Claudia Cervantes, Michael De La Rosa

The Seguin Transit Center is a modern transportation facility proposed for Seguin, Texas. This project addresses the infrastructure demands of a growing regional hub by delivering a safe, functional, and sustainable addition to the Central Texas transportation network. Situated on a 13-acre site, the 15,000-square-foot, single-story steel-framed station will serve as a central link connecting Austin, Houston, and San Antonio. By offering passengers dining and retail options, comfortable waiting areas, and a range of additional amenities, the facility is designed to enhance the overall travel experience while supporting efficient and reliable transit operations. The design employed a multidisciplinary framework, focusing on structural and transportation elements, with limited consideration of hydrological aspects, to mitigate impacts from a 100-year storm event and flooding.

The project is estimated to require an initial investment of $3.6 million, with annual maintenance costs of approximately $1 million. Based on projected ticket sales and additional revenue sources, the project is expected to generate about $5 million per year, resulting in a payback period of roughly two years. Overall, the final design aims to deliver a functional and maintainable transit station that meets the demands of a growing community while ensuring strong long-term operational performance.

CE6 - Parking Garage

Team Members: Leonel Santos, Ehklo Say, Abelardo Pena, Abdulrahman Almegrin, Saud Alghanem

The project aims to provide better parking options whether it comes to student use or closer parking to events that are held on campus such as football and basketball games. The parking garage is planned to be constructed in front of the Javelina stadium on the corner of W Ave C and N Armstrong St. Constructed from concrete, It is three floors in total with each floor holding 100 parking spaces (300 parking spaces total) and 7 ADA parking spaces included in each floor. Elevators will be installed to assist handicapped pedestrians with an easy way to move to the first floor and back. Four stairwells will be available – two on the east and west sides of the parking garage – to ensure a safe and easy exit. A contactless and ticket-less system will be implemented for non-student users; drivers will pay and register their vehicle with a QR code. This project plans to eliminate the major issue with limited parking within the university with the added benefit of it being another source of income during major events.

CE7 - Ricardo Overpass Project

Team Members: Angel Elissetche, Daniel Garza, Eduardo Perez, Edward Dancause, Jason Gaddy

The Ricardo Overpass Project is located at the intersection of US Highway 77 and FM 1118 in Ricardo, Texas. The primary purpose of this project is to improve traffic flow and public safety based on increasing demand, crash history, and the site's proximity to Ricardo Middle School while also supporting TxDOT's I-69 corridor actualization plans. The scope of the design includes transportation, structural, hydrological/hydraulic, and geotechnical elements within the 21.33 acre project area.

The transportation design includes the overpass's geometry in accordance with TxDOT's Design Manuals. The structural design includes all superstructure and substructure elements for a three-span bridge with a total length of 375 feet; this includes slabs, girders, abutment and interior bent caps, and columns. The structural analysis was completed using HL-93 loading criteria per TxDOT's Bridge Design Manual. The geotechnical design includes the design of drilled shafts as supporting elements for the columns of the bridge. The hydraulic design includes a stormwater drainage system with inlets, roadside ditches, and 24-inch outfall pipes. The estimated project cost is $12.31 million, with a proposed construction duration of 497 days.

CE8 - Santa Gertrudis Creek Bridge

Team Members: Jeffrey Borgstedte, Gannon Comin, Lucas Gonzales, Jaxon Mabile, Mark Moreno

This senior design project is for a vehicular bridge along Santa Gertrudis Street in Kingsville, Texas. We intend to replace the existing roadway crossing over Tranquitas Creek, which is susceptible to flooding. The current crossing becomes hazardous during storm events due to rising water levels that can overtop the roadway. This creates dangerous flow conditions, posing a threat to vehicles and occupants. Our proposed bridge dimensions will be approximately 200 feet by 40 feet wide. The result will be a crossing that maintains accessibility during flood events.

The design centers on structural performance by evaluating load demands and moment resistance under anticipated traffic conditions. Considerable emphasis is placed on hydrologic analyses to assess flood behavior and ensure adequate conveyance beneath the bridge structure.

The project also incorporates engineering elements from foundation engineering. The foundation design is based on geotechnical conditions and the demands placed upon the substructure. Construction engineering aspects are included to support efficient scheduling and cost estimation for the bridge. The final outcome is a structurally efficient bridge design that strengthens public safety and improves infrastructure in the Kingsville area.

Computer Science

CS1 - Visionary
Team Members: Jason Canales, Greg Gomez, Josiah Onwuteaka

Our senior design project focuses on applying computer vision to improve everyday communication for deaf and hard-of-hearing individuals. The goal for our use of Computer vision is to enable your mobile device to be able act a Communication Assistant by using the phone's camera to track complex hand movements and facial expressions in real-time. By tracking hand shapes, movements, and facial expressions, the system will translate signed input into readable text and synthesized speech, the project aims to break down communication barriers and foster more fluid interactions between ASL users and non-signers.

The main goal of this project is to make communication feel more natural and easier outside of school, work, or home. Many current tools depend on typing, but that can be slow and does not always match how ASL users normally communicate. Our app is meant to give users a faster and more direct way to express themselves during simple conversations with strangers or in public places. Unlike basic text-to-speech tools that require typing, this application is designed to support a more natural form of communication for users whose primary language is ASL.

Overall, this project demonstrates how computer science techniques can be used to address real communication challenges and promote greater inclusion within our communities. Our goal is to develop a functional prototype that highlights the potential of sign language translation and ease of communication on a mobile platform.

CS2 - Boar Cast
Team Members: **Isiah Carrizales, Robert Conde, Ricardo Reyes, Nicolas Vazquez**

Low attendance at campus and organization events is a common issue that can be caused by students feeling like outsiders, not being interested in the event, or simply not knowing when and where it is happening. Current methods of promotion, such as flyers, emails, and social media posts, are often not enough to effectively reach students. Many students ignore flyers and emails as there are an abundance of them, and social media posts may not help if students are unaware that certain organizations even exist. Boar Cast was created to improve campus involvement by making it easier for students and staff to discover and plan for events. Planned features include an interactive map for event locations, notifications for upcoming events, the ability to follow organizations, and event editing tools for organization leaders and staff to ensure information stays accurate. Overall, Boar Cast is designed to be easy to promote student activities and shine a light on events with a generally smaller reach.

CS3 - TENOR
Team Members: Damian Arredondo, Tomiwa Olanreweju, Josephine Sanyu

Tenor: An Integrated Platform for Health, Nutrition, and Budget Management

Managing health, nutrition, and personal finances simultaneously remains a complex challenge for students and young professionals. This project presents Tenor, a full-stack mobile application that integrates meal planning, grocery budgeting, and fitness tracking into a unified, data-driven platform. The system is developed using React Native (Expo) for the client and a Node.js/Express REST API with a PostgreSQL database managed through Prisma.

Tenor employs a Model-View-View Model (MVVM) architecture to separate presentation, business logic, and data access, improving scalability, maintainability, and testability. A key contribution of the system is its end-to-end pricing and nutrition workflow, where generated meal plans are transformed into aggregated grocery lists and store-specific cost estimates using a hierarchical pricing engine. This engine prioritizes recent user-submitted receipt data, supplemented by historical trends and baseline pricing models.

In parallel, Tenor includes a fitness module supporting workout template generation, session tracking, and calorie expenditure estimation. These features are integrated into an insights dashboard that provides actionable feedback on calorie balance and budget adherence. Overall, Tenor demonstrates how scalable full-stack architectures can improve decision-making and promote sustainable lifestyle habits.

CS4 - Car Alert Sensor

Team Members: Taylor Garcia, Xitlalli Maravilla

The Car Alert Sensor project presents an energy-efficient detection system that notifies vehicle owners when a child or animal is left in a stationary vehicle. It integrates thermal, infrared, and motion sensors with lightweight AI-based analysis to accurately identify living beings and distinguish them from inanimate objects, minimizing false positives.

Upon detecting body heat or movement, the device instantly sends a mobile notification to the vehicle owner and an optional emergency contact, continuing to issue alerts until safety is confirmed through the app. The system is powered by a 12V $LiFePO_4$ battery via a solar panel, enabling continuous, low-power operation independent of the vehicle's ignition

The project focuses on five key objectives: precise detection, reliable alerting, power efficiency, user-friendly app control, and prevention impact. Hardware components, such as the Raspberry Pi Zero 2 W, will manage sensor data and wireless communication, while the software employs sensor-fusion algorithms to accurately interpret environmental and motion data.

Through a four-phase process—design, prototyping, testing, and final integration—the project delivers a practical and scalable solution aimed at reducing hot-car fatalities. The expected outcome is an affordable, solar-powered alert system that enhances vehicle safety, raises public awareness, and helps protect lives through proactive technology.

CS5 - AR Furniture Visualization

Team Members: Ethan Cuellar, Christian Gutierrez, Jasper Martin, Julian Rodriguez

In our senior design project, we intend to create a furniture app using an AR lens camera with 3d objects movement within their mobile device. Users will be able to create accounts and save 3d models of preloaded future items or be able to create their own. These features can still be accessed by non-account members but more features such as saving rooms and models will need account access.

To achieve these features, we will be using Flutter as our main base to work with as its resources and development tools align more to what we want to achieve. Other aspects such as the database for storing models and room data are still being looked into at this time.

Our main goal to achieve with this project is to have a working app that can: use the device camera to create an AR space of a living space, add and place 3d models or furniture in said space and have an account system where saved data will be stored for new and returning users. Other Goals we set to achieve, if possible, is to have some sort of image to 3d model conversion of a user's desired furniture item as well as cross compatibility between devices.

CS6 - TAMUK Student Organization Ledger (SOL)
Team Members: Devanie Contreras, Emily Cortes, Marcus Silva

Based on what we observed, various groups around campus struggle with managing budgets and expenses while maintaining accurate records of financial transactions. This project explores the challenges of keeping financial information organized for student organizations. Our group proposes developing a user-friendly website that is easily accessible to organization members and provides digital logs of financial records. The platform will include tools to track deposits, withdrawals, and transaction histories, with role-based access for officers, members, and advisors, and administrative staff. By having a main hub tool for keeping financial information, the system aims to improve transparency and accountability between all members involved in student organizations.

The proposed system will function as a web-based ledger, allowing users to monitor financial activity, view summaries, and generate transparent reports. Key features such as a cloud-based database, secure authentication, real-time updates, and permission-based access will support accessibility and data reliability. The development process follows structured planning, database design, user interface implementation, security integration, and testing to ensure usability, reliability, and performance.

Evaluation of the website will be conducted through usability testing and feedback from student organizations or volunteers will be considered and implemented in future updates. Ease of use, effectiveness and access functionality will be the key points to note for future updates. Overall, the goal of this project is to simplify financial management, improve transparency, and enhance efficiency for student organization finances through a secure and accessible web solution.

CS7 - TAMUK Campus Roommate Finder (CRF)
Team Members: Nina Brown, Jake Garza, Elyan Gutierrez

One of the most daunting aspects of the freshman college experience is the roommate assignment process. The uncertainty caused by random roommate assignments, which are often based on limited questionnaires, adds significant stress to an already overwhelming transition. Incoming freshmen, many of whom have never lived independently, may struggle to adapt to sharing a room with an unfamiliar peer whose habits, values, and expectations may differ greatly from their own. These mismatches can lead to conflict, discomfort, and a diminished sense of belonging during a critical adjustment period.

Roommate pairings can have a lasting impact on students' social development, academic performance, and overall well-being. Positive living arrangements often foster support systems and friendships, while negative experiences may contribute to isolation or distraction. This project proposes a student-centered, socially oriented platform designed to improve the roommate selection process. By incorporating detailed personal profiles, preference-based matching, and opportunities for direct communication prior to assignment, the platform encourages more informed and compatible pairings. Additionally, community engagement features aim to create a more transparent and interactive environment, ultimately easing the transition into college life and promoting healthier, more supportive living situations.

Electrical Engineering

EE1 - Light Fidelity (LI-FI)
Team Members: Evan Eden, David Ortiz

Our project introduces a cost-effective 3D mapping module centered around a Raspberry Pi 4 as the core processing unit. The primary objective is to develop a compact device capable of efficiently scanning entire rooms using a 15M/50FT Infrared Distance Measuring sensor mounted on a telescope tripod with stepper motors for controlled movement. The goal is to create a 3D mapping module adaptable to different room sizes, offering accurate and reliable scanning for residential and commercial spaces. The core motivation of this project is to create a spark of re-evaluating room mapping methodologies. Recognizing the importance of safety and compliance, our project will follow FDA or IEC regulations for infrared technology. We ensure that our infrared distance measuring sensor meets classification standards, power levels, and safety measures to guarantee secure operation. While similar products exist, integrating a Raspberry Pi 4 as the core processing unit offers not only affordability but also provides an open-source platform. This enables users to customize the module according to their needs, further enhancing its versatility and appeal.

EE2 - Tank Process Control System
Team Members: Aaron Hernandez, Dawson Roach, Joseph Garcia

This project presents the development of a small-scale automated process system designed to control fluid movement and equipment operation across multiple tanks using a programmable controller. The system continuously monitors critical conditions such as tank levels and device status and responds automatically to maintain safe, stable, and reliable operation while still allowing users to interact through straightforward manual controls and a visual interface. By integrating sensors, valves, a pump, safety interlocks, and an operator display into a unified platform, the project demonstrates how modern control systems combine automated decision making with clear and intuitive human interaction.

EE3 - HoloLift - Ultrasonic Volumetric Display
Team Members: Nathanial Handke, Brian Rodriguez, Matthew Dunlap, Claudio S. Gallegos

Contemporary volumetric display technology utilizes fast-moving LED arrays to visually replicate the appearance of three-dimensional images. The primary limitation of this approach is its reliance on sustained mechanical rotation, which accelerates component wear and reduces long-term reliability. This project intends to explore novel solutions to volumetric display technology without the use of mechanical motion or other stereoscopic mediums. This system, dubbed HoloLift, will use acoustic levitation to replace the need for physically-moving light displays or VR-headsets to view objects in 3D. The system will incorporate two 8 x 8 phased-arrays of ultrasonic transducers (operating at 40 kHz) to create a controlled pressure field that will suspend and contain a small, lightweight particle in space. By continuously moving the focus-point of the pressure field, through signal phase delays, a three-dimensional path can be made to take advantage of the persistence of vision principle; Resulting in a `holographic image' that appears to be moving. HoloLift's hardware architecture consists of two FPGAs that each separately adjust the phase and amplitude of 128 individual ultrasonic transducers. A microcontroller synchronizes both arrays and handles communication and instruction handling. Additionally, the final prototype will comply with FCC Guidelines and IEC / UL standards for Electrical Safety and Electromagnetic Emissions in the lab and classroom, while keeping Acoustic Disturbance Effect (ADE) levels low to avoid harming any audio-sensitive wildlife at the project site. The final prototype will be modular and scalable with a display volume of approximately 80 x 80 x 100 mm. Ultimately, the objectives of Hololift are to familiarize individuals with new methods of realizing true holographic imagery and advance the development of motionless volumetric displays through precise acoustic phase control.

EE4 - Fault Detection in Three - Phase Microgrids
Team Members: Daniel Copas, Craig Gordon, Kody Torres, Tristan Campion

Microgrids provide an efficient and reliable electricity source while also reinforcing critical infrastructure by autonomously switching to islanded mode during outages. In traditional electric grids, fault detection relies on high fault currents and unidirectional power flow. However, in islanded microgrids, inverter-based energy resources have limited fault current and bidirectional power flow, reducing the effectiveness of conventional detection methods. This project is an operator monitoring system for an islanded AC microgrid using the three-phase voltage and current measurements to detect and classify faults. Symmetrical component analysis is applied to extract sequence components, in which fault-induced imbalance appears as negative and zero sequence components. This approach uses the imbalance of components rather than their current magnitudes, and it remains dependable during low fault current conditions. When a fault occurs, the system will determine the fault type and severity based on the measured sequence components and record a time stamp for data logging. This provides insight into the microgrid's condition that might not be detected in conventional protective systems. This supports operators in decision making, where system awareness is needed for reliability and maintenance.

EE5 - Solar integrated Portable Power System
Team Members: Brendan Joyce, Onesimo Rios, Huu Loc Le

The Mobile Vehicular Solar Panel is a portable system that enables users to power low- to moderate-load devices in locations where conventional access to power may be scarce. The main purpose of our project is to provide simple power for people in crisis situations such as a roadside breakdown, dead car battery, or an unexpected power outage. Additionally, it can be used in recreational activities such as camping to power small items such as lamps, heaters, or stoves. This project utilizes 50W monocrystalline solar panels, a 12V lead-acid battery (though system supports lithium-ion chemistries), and an MPPT charger. A battery monitoring display provides feedback while including safety features such as overcurrent protection, a master disconnect switch, and temperature-programmable cooling via a relay. Although the system is foremost designed to be mounted in the bed of a truck for mobile use, it can be reconfigured to a more portable variation that can be carried by an individual to be deployed anywhere. Our goal is to provide people with a practical and durable resource that can help them when electricity is limited, and dependable power is needed most.

EE6 - Single-Phase Power Factor Corrector for Single-Family Residential Structures
Team Members: Jorge Martinez, Charles Moore IV, John-Ryan Lawrence

Low power factor in single-phase electrical systems, commonly caused by inductive loads such as motors and transformers, leads to increased line losses, voltage drops, reduced system capacity, and utility penalty charges. This project presents the design and implementation of a Single-Phase Automatic Power Factor Correction panel intended for residential, laboratory, and small commercial applications. The proposed system continuously measures line voltage and current using sensing transformers and computes real-time power factor through a microcontroller-based control unit. Based on deviation from a target power factor (≥0.95 lagging), the controller automatically switches stepwise capacitor banks via relay control to dynamically compensate reactive power demand. Safety mechanisms including overcurrent protection, discharge resistors, and surge protection are incorporated to ensure reliable operation. MATLAB/Simulink simulations and prototype testing demonstrate improved power factor performance and reduced apparent power demand. The developed system provides a scalable, low-cost, and educationally valuable solution for enhancing energy efficiency and power quality in single-phase environments.

EE7 - Autonomy and Hybrid Communication System
Team Members: Brittany Mounce, Sebastian Trevino, Isabel Wong, Sydney Christopher

This project presents the design and implementation of a low-cost, hybrid communication framework for an Unmanned Surface Vehicle (USV). Reliable maritime telemetry remains a significant challenge due to the range limitations of traditional radio and the high cost of proprietary satellite systems. To address this, we developed a dual-link architecture integrating Long Range (LoRa) modulation for short-range, low-latency telemetry and Starlink satellite connectivity for long-range global access. The system is managed by a Raspberry Pi master controller utilizing Tailscale for secure remote management, coupled with Arduino-based sub nodes for GPS and sensor data acquisition. All electronics are integrated within a custom designed, 3D-printed IP67 enclosure mounted on a polycarbonate chassis to withstand harsh marine environments. Preliminary bench testing confirms successful failover logic and real-time dashboard visualization. Future work focuses on range validation and the integration of waypoint-based autonomous navigation. This research demonstrates a scalable, open-source alternative for affordable autonomous maritime research and environmental monitoring.

EE8 - Digital Effects Pedal
Team Members: Martin Schmitt, Isaac Rosa

The goal of this design is to utilize a microcontroller to perform DSP operations on sampled voltage signals from an electric guitar. Many amateur musicians desire the ability to modify their guitar’s sound, which is typically achieved using separate guitar pedals, each of which perform their own unique sound effect. The downside to this approach is that the user is required to purchase each effect, which can quickly become prohibitively expensive, while also having to manage the bulkiness of multiple pedals. This method of modifying sound signals allows for a portable, low-cost, and simple to use way to apply digital effects to a musician's instrument without the need for multiple physical pedals.

Environmental Engineering

EV1 - Design and Optimization of a Portable, Solar-Powered Direct Air Capture (DAC) System for Decentralized Emissions in South Texas

Team Members: Katelyn John, Jordan Davis, Kristin Trevino, Julian Rivera, Guadalupe Tocci

This project presents the design of a portable, solar-powered Direct Air Capture (DAC) station intended for decentralized emission sources in South Texas. The system integrates renewable energy, solid absorption capture, automated maintenance, along with exchangeable storage and disposal pathways to meet the goal of reducing CO2 emissions in the area. With CO2 concentrations steadily increasing and posing a serious threat to Earth's atmosphere, the design prioritizes mobility, low energy demand, and operational simplicity to support deployment in transportation corridors, landfills, and industrial areas. Evaluation through a morphological matrix and the use of a decision metrics guided the selection of each subsystem to ensure the final design met the project's objectives for efficiency, flexibility, sustainability, cost effectiveness, and regulatory compliance. A cost analysis was conducted to find the optimal pricing of the individual units. Along with the cost analysis, permitting requirements, life expectancies of the units, and overall operation parameters were discussed and documented to find sustainable reasoning and support for our organization's success.

EV2 - Taming Brown Algae in Baffin Bay

Team Members: Elissa Utley, Serenity Fenwick, Cody Fountain

Lack of adequate infrastructure and limited access to resources contributes poses a significant threat to the well-being and safety of residents in Texas colonias. The challenges primarily faced are related to infrastructure deficiencies and flood events. In collaboration with South Texas Colonia Advocates, Cindy Park was selected as an underserved colonia in need of infrastructure improvements. Being an unincorporated community, Cindy Park utilizes septic systems as their primary form of sewage disposal. The current flood prevention practices include the use of shallow open-channel drainage ditches that fail to divert flow away from the residences. This project focused on recommending and designing a commercial-sized septic tank and drain field system to accommodate multiple homes and produce a broad scale implementation plan. To reduce flooding impact, the drainage ditches are recommended to be altered and redefined to accommodate potential overflow. To properly sustain the longevity of the system and considering the economic hardships faced by the residents of Texas colonias, it is recommended that maintenance is conducted by the county and included in the yearly allocated budget, which can be achieved through State and Federal grants.

EV3 - Recovering Water from Mechanical Draft Cooling Towers

Team Members: Jacklyn M Reyna, Maria M Bravo

Water scarcity in inland power plants is a significant challenge, particularly for facilities utilizing cooling towers. Mechanical draft cooling towers (MDCT) experience major water loss through evaporation, which results in an increase in overall water demand. This project describes the design of a retrofit system intended to capture and recover water vapor from cooling tower exhaust while preserving system performance and water quality. The proposed design incorporates a desiccant moisture capture process combined with a condenser unit to facilitate water reuse. In the initial stage, a silica gel desiccant extracts moisture from high-humidity exhaust air. The resulting moist air passes through a microchannel condenser, enabling the collection and return of recovered water to the cooling tower basin. This system presents a cost - effective and efficient solution suitable for implementation across a range of cooling towers. The research advances sustainable water management by reframing evaporation losses as a recoverable resource.

Industrial Engineering

IE1 - Oil Sampling Vessel Reliability Study
Team Members: Ella Atherton, Fernanda Contreras, Hector Reyna, Carlos Ruiz

Oil spills pose a significant threat to marine ecosystems and human health, requiring rapid detection and response to mitigate environmental damage. This project focuses on improving the design and reliability of a small Unmanned Surface Vessel (USV) developed to detect and collect oil samples from water. Previous iterations of the vessel demonstrated effective sampling capabilities but encountered major issues with structural integrity and durability during transportation. The latest iteration utilizes 3D-printed components and PVC piping to reduce weight and enhance modularity, allowing for easier assembly and disassembly in the field. However, testing revealed vulnerabilities such as water intrusion, wiring exposure, and inadequate packaging protection during shipping. The primary goal of this project is to enhance the USV's reliability, maintainability, and transportation safety through industrial engineering methodologies, including cause-and-effect analysis, Failure Mode and Effects Analysis (FMEA), and design optimization. Proposed improvements will focus on developing custom-fit packaging solutions, reinforcing waterproofing measures, and ensuring that the USV's internal components remain protected during transit and deployment. Designs of these solutions will be 3D printed and tested. The expected outcome is a more robust and field-ready USV capable of safe transport, quick assembly, and reliable operation for environmental monitoring and oil spill response.

Mechanical Engineering

ME1 - Manual Transmission Design and Analysis
Team Members: David Calvillo, Jonathan Garcia, Luis Gonzalez, Solis, Thomas Solis, Tyler Walker

This project presents the conceptual design of an alternative manual transmission system for the Massey Ferguson 240 tractor to increase torque output and towing capacity in response to the industry's need for efficient and affordable equipment capable of performing under demanding field conditions without requiring full machinery replacement. Research shows that manual constant mesh transmissions are better suited for high-torque applications.

The team's goal is to achieve at least a 20% torque increase while maintaining system compatibility and reliability, all while following the appropriate ASTM standards within a $3,500 budget. Prototype development will be conducted via 3D printing for cost efficiency. The resulting design aims to enhance performance, maintain serviceability, and provide a practical upgrade option for tractor owners without major modifications.

ME2 - Fin and Tube Heat Exchanger Design and Analysis
Team Members: Gabriel Cavazos, Audrey Garza, Sarena Nesmith, Josue Saldivar, David Salinas

Our goal is to design a heat exchanger that will capture the exhaust heat and use it to raise the temperature of water, so that it may be suitable for use in a hotel. The requirements for this heat exchanger are that it must operate at 85% effectiveness, pressure drop must not exceed 10psi on either side, and the outlet temperature for the water must be at 95°C. To transfer heat more effectively between a gas and liquid, a larger surface area is required. For this reason and several other factors, the choice was ultimately the finned tube for our design. This will also require us to create an enclosure that will house the fin tube heat exchanger. We will be using ASME BPVC section VIII, Division 1. The first iteration has an effectiveness of 79%, which falls below our required 85%. We used log-mean-temperature-difference as our foundation instead of using the number of transfer units. This was done because NTU requires you to have all temperatures, whereas LMTD could give the temperature. However, NTU gives us a more accurate heat transfer area and will get us closer to our desired effectiveness on our next iterations.

ME3 - VTOL Fixed Wing Drone Design and Analysis
Team Members: William Hudspeth, Kristina Nash, Lucas Olivares, James Rodriguez, Jose Torres

The VTOL (Vertical Takeoff and Landing) drone project focuses on the design, fabrication, and testing of a cost-effective hybrid unmanned aerial vehicle (UAV) that merges the long-endurance efficiency of fixed-wing flight with the vertical maneuverability of multirotor systems. This design addresses two major limitations of existing UAV technologies: the limited flight duration of conventional quadcopters and the runway dependence of fixed-wing aircraft. The team aims to develop a lightweight, tilt-rotor system capable of autonomous vertical takeoff, transition to forward flight, and vertical landing, all within an affordable budget constraint of $2,500, which is significantly lower than the cost of current commercial VTOL models. The drone's core application will be search and surveillance, which can be utilized in many industries. The project integrates open-source flight control systems, with aerodynamic modeling, thrust-to-weight calculations, and structural analysis to ensure a stable and reliable platform suitable for both academic research and real-world field use.

ME4 - Oxygen Butane Rocket Engine Design and Analysis
Team Members: Brendon Cavazos, Noah Estrada, Daniel Houf, Nicholas Kawamura, Joseph Tonche

Gas Turbine engines have been used to power many types of machines such as aircraft, electrical generators, gas compressors, and ships. These engines utilize the Brayton Cycle to produce network. The Ideal Open Brayton Cycle is comprised of four phases: isentropic compression (compressor blades), isobaric heat addition (combustion chamber), isentropic expansion (turbine blades), and isobaric heat rejection (exhaust, thrust). The impetus of this project is based on the Brayton Cycle; however, the compressor and turbine components of the process will be combined into one assembly. A commercially available diesel “turbocharger” will be acquired for this purpose. Subsystems to be designed are the combustion chamber, fuel pump, fuel atomizers, exhaust nozzle, and concomitant piping. These subsystems will be designed to satisfy the following objectives: maximize thrust, maximize thermal efficiency, minimize cost, and maximize safety. Lastly, a prototype will be fabricated to prove that the calculations satisfy the problem statement.

ME5 - TSGC Lunar Trencher Design and Analysis
Team Members: Conor Andersen, Kyle Cavazos, Zachary Davis, Marcus Martinez, William Mcbrayer, Diego Regalado

The purpose of team Farscape Engineering Co. is to design and assess the viability of burying fiber optic and power cable in the lunar regolith using a self-propelled battery powered machine. The importance of this challenge stems from the greater goal of a permanent human presence on the moon, which requires lunar habitats requiring both power and the ability to communicate locally without having to use earth as a relay, thus it is imperative to develop a solution that would allow an operator to safely lay fiber optic and power lines in a convenient and reliable manner. To achieve the design goal the team is currently in the conceptual design phase, having determined reasonable constraints and using information from literature review to make appropriate assumptions about the lunar regolith. Currently the team plans to begin 3D modeling various components of the machine and plans on prototyping and testing digging implements in November, with the goal of having a nearly complete design by late March.

Natural Gas Engineering

NG1 - A Natural Gas Well Performance: A Case study of Amistad Field
Team Members: Karson Shepherd, Isiah Brown

Natural gas has had a steady and sizable increase in demand in the past 10 years and is projected to increase another 25% in the next 4 years. Natural Gas wells have many different variables, tendencies, and problems that could arise at any given moment. Natural gas has been the main contributor for American energy since 2011, and largest electricity generator since 2015. We selected a gas field called Amistad, located in the Progresso basin in the Gulf of Guayaquil, off the coast of Ecuador. The field was discovered in 1970 and started producing in 2002. The gas well we selected for our case study as Amistad 8. Our team used Excel to determine the inflow performance relationship, tubing performance relationship, along with the cost analysis, the internal rate of return (IRR), payback period, and benefit cost analysis. In this project, we aim to focus on the well production based on published data, creating curving production rates versus pressures, and then comparing the results to recommend the optimum tubing size, and to determine the attractiveness of the project.