PHASE 1 ~ PROJECT PROPOSAL
Deliverable 1 ~ Project & Personnel Assessment

INSTRUCTIONS. Make a project bid portfolio comprised of your top 3 choices from the potential projects below. Your portfolio is due electronically as a Microsoft Word (DOCX) or Adobe Portable Document Format (PDF) file with the filename convention *yourlastname_del1*.

Laboratory

1. **Pulsed Laser Quantum Biological Stimulation System.** Design and operate a pulsed laser stimulation system that is adaptable to various quantum biological cell culture research experiments. Initial pilot experiments at UT GSM have indicated quantum entanglement-based communication between the DNA of cells in separated cell cultures (https://dc.uthsc.edu/gsmk_facpubs/1). The goal is to induce apoptosis non-locally in separated cultures of HL-60 cells by using pulsed laser stimulation to develop entanglement between separated cell cultures, and then expose one of the ostensibly entangled cultures to paclitaxel (Taxol) and watch for cell death in the other culture.

2. **Non-contact bacteria detection in saline.** Bacteria contamination and infections remain critical concerns worldwide, due to extremely low minimum infective doses for many bacteria and the lack of inexpensive and portable methods to detect at these limits. A novel approach is needed for interfacing passive and low-cost bacteria sensors with a handheld reader. Bacteria sensors are interdigitated electrodes patterned on a flexible substrate, together with an inductive coil antenna. The sensor surface is functionalized with bioprobes specific to the target bacteria. The wireless reader, powered by an AC source, transmits power and receives sensor data from the passive sensor, all via inductive coupling.

3. **Automated Nanoparticle Assembly and Drug Loading.** Our research group has recently patented a novel assembly technique for PEGylated liposomal nanoparticles that results in a drug delivery platform with efficient nucleic acid loading and enhanced cellular uptake. We have optimized parameters for a standard operating procedure (SOP) for nanoparticle assembly that incorporates both the mixing and injection of nanoparticle constituents at defined conditions, along with the dialysis and purification of the end therapeutic. Currently this SOP is being manually performed in our laboratory utilizing a variety of hands-on and technically laborious steps with very limited throughput. An automated, hands-free device/machine that incorporated all of the defined assembly steps in an in-line system would decrease technical variability between nanoparticle samples and increase throughput for experimental application. More importantly, an automated system that increases the precision and specificity of

	assembly process parameters, the reliability of quality attributes for nanoparticle characterization profiling, and higher throughput would increase the potential for therapeutic development of this drug delivery platform and the potential for bench-to-bedside clinical translation.
Patient Care	4. **Pediatric Hospice & Palliative Care Mobile App.** Our team conceptualized this mobile app 6 years ago and we have the framework for it. The goal would be to build and test a prototype mobile app for pediatric hospice and palliative care clinicians.
	5. **Bone Clamp for Reduction of Radius Fractures.** Fractures of the distal radius are challenging because it is difficult to apply existing bone clamps to each fracture segment, maintain reduction of the fracture, and hold the fracture ends in place while applying a bone plate and screws. One idea would be to have 2 bone clamps with a threaded rod to connect the 2 clamps together, with an articulated joint within the threaded rod that would allow manipulation of the fracture segments in three dimensions. In addition, the opening of the clamps should be wide enough to allow the clamp to hold the bone while sliding a bone plate along the bone between the clamps.
	6. **Portable Device for Frostbite Injuries in Austere Medicine Scenarios.** In many search and rescue (SAR) scenarios, victims of cold exposure experience significant morbidity with frostbite injuries. Extractions of these patients are often complicated and result in delays of definitive care. The Wilderness Medical Society (WMS) recommends thawing frozen body parts if the part can be kept thawed and warm until evacuation is complete. Thawing parts quickly limits ischemia-time but carries the risk of re-freeze injury. The only WMS recommended method of rapid field rewarming of frostbite is warm (37-39 C), circulating water-bath immersion. This is usually accomplished by stirring a pot of water. This method is not easily feasible in prolonged extractions. There are no commercially available frostbite devices. The goal is to design either a wearable or portable device to address frostbite injuries of one or more body parts during SAR scenarios. They must keep in mind that the device must avoid refreezing injury and the application of direct heat (fire, space heater, oven, heat packs) is not recommended.
	7. **Enhanced Premature Baby Monitor.** Design and test a noninvasive, remote, heart rate, pulse oximetry, and respiratory rate detection system with the ability to remotely view and talk to premature babies.
	8. **Traffic Light Diet App for Family-based Childhood Obesity Intervention.** Childhood obesity is a major public health issue in the United States, with nearly 1 in 5 American children having obesity. The Traffic Light Diet (TLD) is an evidence-based child weight loss diet that assigns colors (GREEN, YELLOW, or RED) to foods and beverages

	to indicate the frequency with which they should be consumed. GREEN foods are nutrient-dense and low in calories (e.g., vegetables), while RED foods are calorie-dense but low in nutrients (e.g., chips and candies). YELLOW foods are somewhere in the middle and are eaten in moderation to ensure a healthy diet that meets the dietary guidelines. The color of a food is determined by its calories per serving based on established rules for its food group. The goal of this project is to develop an app for families with children with overweight and obesity that is capable of tracking dietary goals related to the evidence-based Traffic Light Diet (TLD). The proposed TLD app will be used by participants enrolled in a family-based behavioral childhood obesity program to track their consumption of GREEN, YELLOW, and RED foods. Additionally, the app will provide feedback on whether participants are meeting their daily goal to consume two or fewer RED servings per day. The proposed app may make tracking TLD dietary goals easier and more accurate, which in turn may increase awareness of problematic dietary patterns and support improved weight loss.
Education	9. **American Sign Language Sample Analysis Tool.** For speech-language pathologists and teachers of students who are deaf and use sign language, assessing American Sign Language (ASL) levels can be tricky. Because this is a visuospatial language that doesn't have a written form, we cannot simply transcribe into English and feed it into a program like we can for children who use spoken languages. This project proposes the development of a user-interface that bypasses the need to transcribe ASL into written English. Within this tool, an educator would need to be able to view a recorded signed story and interact with a user-interface in order to mark the relevant features of ASL that are observed. The selection would then need to be recorded with a time-code into an exportable document for analysis. As part of the user-interface, a set of pre-programmed language feature options would need to be programmed into a nested, branching design with the option of typing in additional unique information.
	10. **Human Middle Ear Model**. The human middle ear is composed of a variety of elements including the ear drum, air space, ossicles and tendons. The goal of this project is to develop a physical and functional model of the human middle ear. At a minimum, the user must be able to modify the model between normal (healthy) and disease states consistent with middle-ear infection (negative pressure and fluid-filled). Ideally, simulation of additional disease states is desired, including: (1) ossicular disarticulation and (2) ossicular fixation. The model must be able to interface with clinical equipment traditionally used to assay middle-ear function and yield results characteristic of the ear's state (healthy or diseased). The model will be used for simulation labs within the Department of Audiology and Speech Pathology. Dissemination of the model to other educational institutions and or commercialization is of interest.

Education

11. **Reusable High-Fidelity Peritonsillar Abscess Simulator.** Peritonsillar abscesses are common deep-space infections of the head and neck. However, due to the poor visibility of the region and the complicated nature of the surrounding anatomy, teaching drainage of these lesions to physician-learners and explaining such procedures to patients is difficult. A drainage attempt in the slightly wrong locale can result in significant pain and damage to important nearby structures. Previous attempts to create peritonsillar abscess models have focused on cadaver tissue that cannot be used repeatedly or low-fidelity models that do not accurately depict the surrounding anatomy. There are no commercially available peritonsillar abscess simulators. The goals of this project are two-fold: 1) to design a high-fidelity peritonsillar abscess model that accurately depicts the surrounding anatomy; this will be used to explain drainage procedures to patients in the emergency department 2) to create a reusable component of the model that can simulate an abscess pocket that physician-learners can practice drainage techniques. Anticipated design issues would include replicating the complicated anatomy of the region (i.e. if a needle goes too lateral, the carotid artery can be punctured), accurately duplicating patient presentation (i.e. patients often present with trismus, causing difficulty in accessing the region) and matching the material properties of the model with that of its simulated tissue.
12. **iTrainer: Emergency Eye Procedures Simulation Model.** Eye emergencies in the emergency department are high-risk, low-volume cases. These medical problems usually require a physician to perform a procedure that is not often performed. The iTrainer has been created by previous groups to simulate being able to perform several eye procedures including slit lamp examination, lateral canthotomy, and fluorescein staining. Other potential applications to the iTrainer would be to create eyes that are ultrasoundable that represent different pathologies including lens dislocation, retinal detachment, and ruptured globe. Other potential projects include creating a different facial model to hold the simulated eye.
13. **Ultrasoundable Peripheral IV Insertion Model.** Ultrasound-guided peripheral IV insertion has been shown to increase patient satisfaction and decrease healthcare costs in difficult IV access patients. Current ultrasoundable peripheral IV task-trainers are expensive and don't necessarily produce the realism that is encountered in the real world situation associated with body contours. There is a need for an ultrasound-guided peripheral IV to simulate difficult access patients with both deep and shallow veins as well as mimic the contour of the antecubital fossa, forearm, and wrist.

14. **Pediatric Trauma Simulation Model.** Trauma is a leading cause of injury in the pediatric population. Pediatric traumas are high stakes situations. There are limited options available on the market to practice trauma procedures on pediatric patients. These trauma procedures include a chest tube. The goal of this project is to create a task-trainer that mimics a pediatric patient in order to practice the performance of chest tube insertion, thoracotomy, cricothyrotomy, and pericardiocentesis. insertion, thoracotomy, cricothyrotomy, and pericardiocentesis.

Project Bid Portfolio Outline

The written outline should include the following five sections:

1. NAME & PICTURE
   Put your name and a small, "professional-style" headshot of yourself at the top of the page 1.

2. PROJECT CHOICES
   List your top 3 project choices (by number and name listed above) in order of your preference at the middle of the page 1.

3. RELATIONSHIP TO GOALS & SKILLS
   Write two thoughtful, single-spaced paragraphs answering the following questions at the bottom of the page 1.
   a. How are these choices related to your goals for course, your design philosophy, and your long-term professional aspirations?
   b. What special skills does your top choice require? What special skills do you have that would benefit this project? What complementary skills would you like to see in other team members?

4. RESUME
   Attach a one-page, updated resume on page 2.

5. PERSONNEL SURVEY
   Write honest, thorough, and thoughtful answers to the following on page 3.
   a. Your name.
   b. Current GPA.
   c. What other course and job responsibilities do you have this year (both semesters)?
   d. How many credits will you be taking this semester and next semester? Which courses?
   e. What has been your level of commitment to previous design projects? What is your level of commitment toward meeting the challenges of this course? Refer to the commitment rubric below. What new and different actions do you intend to implement in your capstone design project?

Commitment Rubric

Leadership. Identifies with the vision. Provides leadership for others to realize the vision.

> *Elevates team performance in creating functioning hardware/software that exceeds customer expectations. Enjoys assuming even ill-defined roles in a team environment. Can be counted on to organize and carry out almost any work assignment with a high level of quality. Provides timely and well-received feedback to self, team members, customer, and advisor/mentor. Regularly makes, rereads, and reflects on logbook entries. Initiates personal improvement.*

Enrollment. Sees the benefits and wants the vision. Willing to be a good team member in realizing the vision, provided that someone else provides the leadership.

> *Voluntarily makes major contributions to functioning hardware/software that meets or exceeds all customer expectations. Enjoys assuming a well-defined role in a team environment. Can be counted on to accomplish most assignments with good quality. Interacts openly with customer and mentor. Regularly makes logbook entries. Responds to prompts for personal improvement.*

Formal Compliance. Sees some of the benefits of the vision, but is skeptical of the magnitude of personal changes required. Willing to do what is necessary within one's job description.

> *Produces functioning hardware/software that meets most customer expectations. Praises team, customer, and advisor/mentor solidarity in public. Privately criticizes other's performance but assumes no responsibility for negative results. Motivated to do the bare minimum on documentation. Has little interest in personal improvement unless compelled by others.*

Oppositional. Sees few, if any, benefits of the vision. Requires constant supervision to do what is expected. Vocally is not on board.

> *Produces hardware/software that does not meet key some customer expectations. Displays fearful or angry relations toward team members, customer, and advisors/mentors in public. Must be prompted by a supervisor to complete most tasks. Maintains personal documentation only under duress and resents doing it. Disrupts improvement efforts by others.*

Apathy. Cannot see the vision and is unable to help realize the vision. Is often tardy or absent.

> *Produces only untested paper designs. Is indifferent toward team members, customer, and advisors/mentors. Devotes no time or energy to personal documentation. Drifts through project without contribution or personal development.*