Senior Design Projects

2026

JOINT DEPARTMENT OF
BIOMEDICAL ENGINEERING

MARQUETTE UNIVERSITY

MEDICAL COLLEGE OF WISCONSIN

Contents

On the cover
A student design team tests the prototype of their wireless EMG sensor as it controls a bionic hand.
For more information, see page 7.

Senior Design Projects
2026

To our Industry Partners

We are pleased to present the Biomedical Engineering Senior Design Projects completed during the 2025–2026 academic year within the joint department between Marquette University (MU) and the Medical College of Wisconsin (MCW).

The Joint Department of Biomedical Engineering at MU and MCW is dedicated to preparing students for success in their professional and personal lives after graduation. Undergraduate students take courses in our curriculum to specialize in biomechanical, bioelectrical, or biocomputing engineering. In addition to courses in engineering, mathematics, and life sciences, students are required to complete several design challenges in the freshman year and a year-long project-based capstone design course in the senior year. Students develop their teamwork and soft skills, learn about the product development process used in industry, and are made aware of the unique requirements and constraints of medical device design. They consider legal and regulatory issues, use standards where applicable, conduct economic analyses, and learn about packaging, sterilization, and testing of medical devices. Several project deliverables, similar to those used in industry, are required. This capstone design experience provides students with the knowledge base and skill sets needed to become effective contributing members of a medical device company, clinical engineering department, or academic research laboratory, and create value for their customers.

This year marks the tenth anniversary of our new Joint Department of Biomedical Engineering between MU and MCW. Faculty from MU and MCW served as advisors to project teams. This year we extended our collaboration with the Milwaukee Institute of Art and Design (MIAD) into its 21st year. Four of our project teams collaborated with industrial design students from MIAD during the spring semester.

In our department, students may enhance their design experience and prepare for careers in the engineering profession through work experience. For instance, at the Les Aspin Center for Government Studies, students can work as interns for the US Food and Drug Administration and learn first-hand how the FDA functions and what is required to market a regulated medical device. Students participating in our highly popular and nationally recognized Cooperative Education Program gain work experience at medical device companies prior to graduation.

As you read through this report and learn of the benefits of industry sponsorship of senior design projects, please consider becoming a sponsor. We recognize the value to our students and program of strong ties to industry, and we are interested in working with additional companies to help us prepare our students for careers in biomedical engineering and jointly develop the next-generation workforce.

Respectfully,

Jay R. Goldberg, Ph.D., P.E.
Professor of Practice in Biomedical Engineering
Senior Design Course Instructor

Hu Yang, Ph.D.
Kern Professor and Chair
Joint Department of Biomedical Engineering

Requirements for Industry Sponsorship of Senior Design Projects

Senior Design Course Sequence

At Marquette University, all senior biomedical engineering students are required to successfully complete a set of project-based capstone design courses (BIEN 4920 Principles of Design, and BIEN 4998 Senior Design).

At the end of these courses, students will demonstrate

- the ability to connect and apply the knowledge and skills developed in previous engineering (and other) courses towards a design solution (to a specific problem) that creates value for a customer,
- the ability to plan and produce a product or service that will meet customer needs,
- the ability to work effectively in teams, and
- written technical and oral communication skills.

Senior Design Project

The major component of the course is a design project that is managed by a multidisciplinary team of three to five students for an entire academic year. During the year, project teams identify customer needs, develop potential designs, construct and test prototypes, and deliver a design and/or working prototype to their industry sponsors. Project teams develop project schedules, maintain project notebooks, conduct economic and risk analyses of their design solutions, and develop and present written and oral project proposals and final reports.

Many of the projects are industry sponsored and provide students with an opportunity to learn about the needs of the medical device market and the operations of a company. Experience gained from industry sponsored projects helps prepare students for careers in the medical device industry. Teams are advised by a biomedical engineering faculty member and a representative from the sponsoring company.

Benefits of Sponsorship of Senior Design Projects

Benefits to companies

- Additional resources at little cost to company. Three to five senior engineering students will be dedicated to each project for two semesters. The sponsoring company can specify the composition of the project team (biomedical, electrical, computer, and mechanical engineering students). This can be very beneficial to companies with limited engineering resources and can allow companies to focus efforts on higher priority projects.
- Involvement and participation in the training of new engineers and potential employees.
- On-campus advertisement of the sponsoring company.

Involvement in the senior design project will provide the company access to and a higher profile among graduating engineers.

Benefits to students

- Opportunity to work on real-world problems important to industry.
- Exposure to the medical device industry and market.
- Experience with project management and product development.
- Familiarity with requirements and constraints of medical device design.

Requirements for Industry Sponsorship

Personnel

Sponsoring companies must identify at least one company representative to act as an industry advisor to the project team. The industry advisor would be the company contact for the project team, advise students on customer needs, provide technical expertise and advice, and approve design concepts and prototypes.

Faculty advisors will be responsible for administrative issues (grading, monitoring progress of teams, dealing with team personnel issues, etc.) and providing guidance to the team.

Time

At a minimum, industry advisors must be available to discuss project requirements, customer needs, and potential designs. Communications can be virtual, in-person, or by phone or e-mail. The industry advisor determines the frequency of communications.

Travel

The industry advisor determines the need for travel.

Funding

Depending upon the needs and expectations of the sponsor, a fund of $1000–$1500 may be necessary to pay for prototypes and testing.

Other

Students have access to Marquette University's computer network, libraries, Discovery Learning Laboratory (machine shop, collaboration space, 3D printers, prototyping resources), faculty expertise, and engineering laboratories. Sponsors may want to provide additional resources (prototyping facilities and/or personnel, laboratories, etc.) to their project teams if desired.

Types of Projects Appropriate for a Senior Design Project

- Lower priority projects for which the company lacks resources.
- Projects that can be completed in nine months or less.
- New products (hardware or software).
- Product improvements (new features, packaging, materials, etc.).
- Process improvements.
- Development of test procedures and/or test equipment.

Protection of Proprietary Information

Sponsors can request that members of their project teams sign non-disclosure agreements to protect confidential and proprietary information.

To Sponsor a Biomedical Engineering Senior Design Project

If you have any questions about our senior design program or if you are interested in sponsoring a senior design project please contact **Dr. Jay Goldberg at jay.goldberg@marquette.edu.**

We look forward to working with you.

Industry Sponsors

2025–2026
Visionary League, Milwaukee, WI
Abbott Laboratories, Abbott Park, IL
EndoPlus, Mundelein, IL
Alt-Bionics, Inc., San Antonio, TX

2024–2025
GE Healthcare, Waukesha, WI
Boston Scientific, Minneapolis, MN

2023–2024
Visionary League, Milwaukee, WI
Tecomet, Inc., Kenosha, WI

2022–2023
eClusion, Milwaukee, WI
GE Healthcare, Waukesha, WI
Medtronic USA, Minneapolis, MN
Fresenius Kabi, Lake Zurich, IL

2021–2022
GE Healthcare, Waukesha, WI
eClusion, Milwaukee, WI
Spectroscopy and Data Consultants, Pty. Ltd., Brisbane, Australia

2020–2021
SeaSpine, Carlsbad, CA
Spectroscopy and Data Consultants, Pty. Ltd., Brisbane, Australia

2019–2020
SeaSpine, Carlsbad, CA
Medtronic USA Inc., Minneapolis, MN
GE Healthcare, Waukesha, WI
Spectroscopy and Data Consultants, Pty. Ltd., Brisbane, Australia
FreedomTrax, Waukegan, IL

2018–2019
GE Healthcare, Waukesha, WI
Spectroscopy and Data Consultants, Pty. Ltd., Brisbane, Australia
Resolution Medical, LLC, Minneapolis, Minnesota

2017–2018
Mortara Instruments, Milwaukee, WI
3M, Minneapolis, MN
GE Healthcare, Waukesha, WI

2016–2017
Siemens Medical Solutions USA Inc., Hoffman Estates, IL
Safe Place Bedding, LLC, Conesville, OH
9 Degrees of Human, Milwaukee, WI

2015–2016
Medtronic USA Inc., Minneapolis, MN
Trek Bicycle Corporation, Waterloo, WI
Cardiac Profiles Inc., Franklin, TN
Zimmer Biomet, Warsaw, IN

2014–2015
GE Healthcare, Waukesha, WI
Medtronic USA Inc., Minneapolis, MN
Rowheels, Fitchburg, WI

2013–2014
Cytophil, Inc., East Troy, WI
DesignWise Medical, Loretto, MN
GE Healthcare, Waukesha, WI
Siemens Healthcare, Hoffman Estates, IL
Medtronic USA Inc., Minneapolis, MN

2012–2103
NeoCoil, LLC, Pewaukee, WI
Gauthier Biomedical, Grafton, WI
3M, Minneapolis, MN

Project Team
Andrew Donahoe
Ryan Jacoby
Mira Kahate-Desouza
Nabil Othman
Jason Zigmant

Faculty Advisor
Dr. Scott Beardsley

Sponsor
Ryan Saavedra,
Co-Founder and CEO,
Alt-Bionics

Wireless EMG Sensors for Control of Bionic Hand

Limb loss is a permanent, life-changing event for amputees. Patients who lose hands may struggle to do basic tasks such as dressing, eating, and bathing, though prosthetic technologies attempt to alleviate this. Myoelectric prostheses use surface electromyography (EMG) sensors as control inputs to motor actuation. EMG is a method of measuring skin electric potentials that arise from propagation of action potentials along axons to muscle fibers. Currently, all clinical-grade EMG systems wire directly into the prosthesis and are embedded in the prosthetic socket.

The sponsor of this project leads a team building such technologies. Their flagship product, the Genesis Hand, is a myoelectric prosthesis aimed at affordable markets. He often demonstrates this product at conferences and tradeshows by wiring EMG electrodes directly into the Genesis hand. He wears a makeshift prosthetic socket that connects electrodes to his skin. While this solution is grounded in the clinical reality of myoelectric prostheses, it physically limits his movement and prevents him from walking around to network and speak to people. He is physically bound by the wired EMG sensors.

The purpose of this project was to develop a wireless-muscle sensing system that the sponsor can use to control his bionic hand. The system should connect directly with the Bionic hand and provide filtered, rectified, and enveloped signals with low noise. It should also have a wireless range of at least 10 meters. Ideally, it would support modular EMG placement with up to eight EMG sensors to give him freedom in developing advanced control algorithms.

The final design includes an elastic sleeve that meets all of the aforementioned specifications. It has eight sensor sites, an indoor wireless range of over 40 meters, and outputs a fully conditioned signal.

The sleeve supports a range of arm circumferences because of its elasticity. All EMG sensors were custom-fabricated using 3D printing and custom PCB design. 3D prints were made out of flexible TPU for easy insertion and removal of sensors. Bluetooth Low Energy (BLE) was chosen as the wireless communication protocol because of its large open-source support, its relatively high throughput to power consumption ratio, and existing compatibility in the Alt-Bionics Genesis hand. An Arduino board with a built in BLE module is used to sample analog outputs and transmit them to the Genesis hand or other BLE receiver.

The system can obtain filtered muscle signals from eight EMG sensors and wirelessly transmit them to a receiver, which uses them as control inputs for external devices. Integration testing verified that the EMG signals are accurate and transmitted fast enough to control the angle and direction of the shaft of a servo motor. This single test simultaneously confirmed proper signal acquisition, processing, and wireless communication.

Improved Cranial Stabilization System

Project Team
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Ihonesty Serrano
Genna Walton

Faculty Advisor
Dr. Adam Greenberg

Sponsor
Dr. Max Krucoff

MIAD Consultants
Andrea Ibarra Cruz
Chole Plautz
Astra Bettanin
Johnny Fairley

2025–2026

This project focuses on the current cranial stabilization systems used in neurosurgical procedures, particularly in interoperative MRI (iMRI) environments. During neurosurgery, the patient's head must be stabilized. iMRI data are often used to determine completion and success of surgery. While existing systems (e.g. Doro Lucent) provide reliable head fixation, its attachment to the iMRI-compatible operating table restricts the range of motion in certain directions and introduces ergonomic challenges. The current stabilization systems lack the full range of motion desired. When transferring patients from the surgical bed to the iMRI bed, the system and patient must be adjusted to prevent collisions with the bed. An increased range of motion would improve this process.

The purpose of this project was to enhance flexibility of the system by adding additional degrees of freedom to the adjustment/movement of the head fixation device. Our design is based on available off-the-shelf products, the Doro Lucent and the Mayfield. The final design includes a screwing mechanism used to raise the platform allowing for height adjustment to avoid bed collisions. Additional improvements include arm adjustments, and head clamp adjustments. Spring-loaded pins allow for easy, one-handed adjustment which then lock in place. The base is designed to fit with the current surgical bed, and the head clamp is a reproduction of the Doro Lucent device. Thus, no changes are required to integrate this device into the current setting.

Testing verified that this prototype allows added motion beyond what is available in the current devices. The prototype was tested with weights (to approximate reasonable load expectations) and analyzed via finite element modeling. Both the bolts and the spring-loaded pin locks allow for minimal adjustment time. This new open design now provides more unobstructed access to the patient.

Project Team
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James Wasilewski

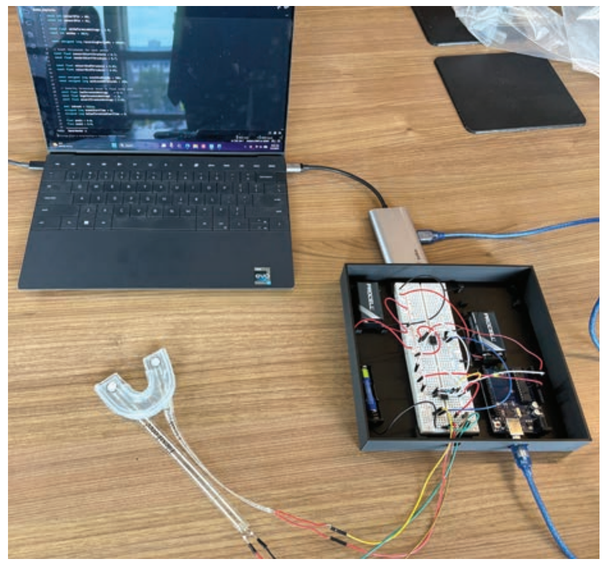
Faculty Advisor
Dr. Guilherme Garcia

Mouthguard for Monitoring of Nocturnal Bruxism

Sleep bruxism is a condition in which patients involuntarily grind or clench their teeth during sleep, potentially leading to headaches, jaw pain, and tooth wear. Treatment involves wearing protective mouthguards to prevent tooth damage, but currently these mouthguards do not quantify grinding events or bruxism severity. Although emerging sensor-enabled mouthguards can monitor bruxism activity, these systems are currently expensive, experimental, and not widely adopted for routine diagnosis of sleep bruxism. This creates a need for an affordable, comfortable, and clinically practical device capable of monitoring bite forces during sleep.

The purpose of this project was to design a low-cost mouthguard prototype capable of monitoring bite forces during the night. The device was required to be comfortable, detect biting and grinding events, and capture the full range of forces exerted during sleep. The final design consists of a mouthguard with two biocompatible layers: a 3D-printable resin and dental-grade ethyl vinyl acetate (EVA). Force-sensing resistors (FSRs) were embedded in the mouthguard to measure bite forces.

A custom signal-conditioning circuit using an inverting operational amplifier was developed to amplify the low-voltage output from the FSRs. Biting and grinding events were identified using a minimum-threshold detection algorithm that requires both sensors to exceed the threshold simultaneously. The system records the timing, duration, and peak voltage of each event and classifies the severity of each event. Testing and sensor calibration demonstrated that the device reliably detects biting and grinding events within the expected force range and accurately records these occurrences.



Overall, the prototype met the key functional requirements, including detecting events, logging events, and classifying event severity. The design addresses customer needs by incorporating biocompatible materials for comfort, capturing the full range of bite forces, and maintaining affordability, with a unit cost of approximately $77. This prototype provides a strong foundation for future development and potential clinical use. Recommended design changes for a continuation of this project include adding a hydrophobic sealing layer to protect the electronic components from moisture and incorporating wireless monitoring via Bluetooth technology.

2025–2026

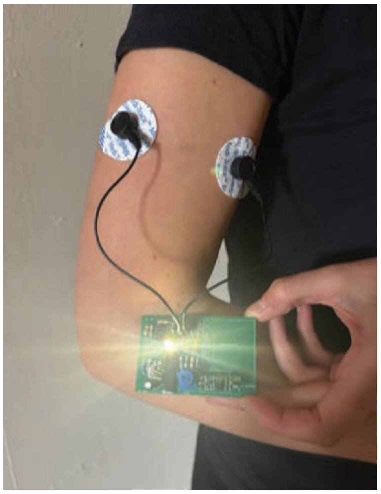
Wearable Visual Feedback System for Real-time Muscle Activation

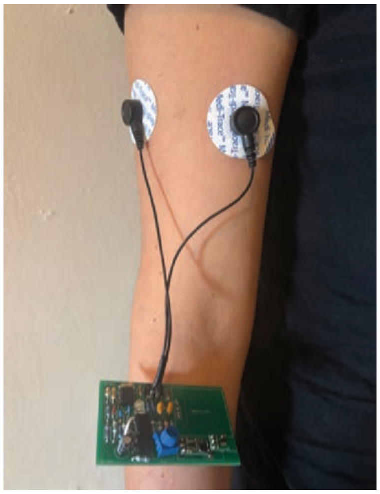
Project Team
Lizzie Littell
Nathan Nichols
Ian Ortega
Paige Spencer
Aden Zager

Faculty Advisor
Dr. Scott Beardsley

Sponsor
Dr. Donald Neumann

Muscle activation monitoring is important in rehabilitation, physical therapy, and athletic training, but current electromyography (EMG) systems are often bulky, expensive, and require complex setup. These limitations make them difficult to use in fast-paced clinical and educational settings. Clinicians expressed a need for a simple, wearable device that provides clear, real-time feedback of muscle activation without requiring additional equipment or technical knowledge.





The purpose of this project was to design a compact, wireless system that displays muscle activation through visible light. The final device uses surface EMG electrodes connected to a printed circuit board that processes the signal and controls an LED. The brightness of the LED changes in response to muscle activity, allowing users to easily interpret the level of muscle activation. The device is lightweight with adhesive electrode pads and designed for comfort during movement.

Testing verified that the device successfully detects muscle activity and provides clear visual feedback through changes in LED brightness. The system operates reliably for the duration of a typical session and meets the design requirements for usability, size, and cost.

Overall, this project resulted in a simple and effective wearable biofeedback device that improves accessibility to muscle activation monitoring. The design has potential for use in rehabilitation, education, and athletic training, with future work focused on further testing and refinement.

Mammography Cushion and Face Shield to Reduce Pain During Mammography

Project Team
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Madeleine Santucci

Faculty Advisor
Dr. Tanya Onushko

Clinical Advisor
Shelley Aronson Sheinkop

Annual screening mammograms are essential for women over 40 to detect breast cancer early. However, the breast compression required for clear imaging can cause significant pain. This discomfort is often worsened by improper positioning and poor patient posture, leading many women to delay or skip their annual exams entirely. To improve patient compliance, there is a need for solutions that enhance comfort and the overall patient experience.

This project involved the design of a two-component system aimed at improving patient comfort. The first component is a face shield designed to curve away from the patient's face, promoting better upper body posture and reducing neck strain during imaging. This component also contains removable side blockers, allowing the patient to decide whether they would prefer to view the procedure or not. The second component is an ultra-soft cushion placed on the detector plate. The cushion increases contact area on the breast during breast compression, distributing the pressure over more of the breast during scans. The cushion is also wrapped within polyurethane leather to provide a warmer contact temperature between the breast and detector plate. The leather is easily sanitized which allows the cushion to be reused between patients.

This system supports mammographers in delivering consistent care while improving the overall mammography experience. By addressing different areas of discomfort, this design aims to reduce pain while delivering reliable diagnostic outcomes.

2025–2026

2025–2026

Adaptive KitchenAid Stand Mixer

Project Team
Hailey Mallmann
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Sophia Saran
Miah Nelson
Owen Mongoven

MIAD Consultants
Ross Monzo
Lizzy Mathew

Faculty Advisor
Molly Erickson

Sponsor
Vladimir Bjelic, Penfield Children's Center

The purpose of this project was to create a therapy switch–adapted standard KitchenAid stand mixer. Traditional stand mixers require fine motor control, grip strength, and other physical and cognitive abilities to operate the mechanical speed switch. As a result, these mixers can present a significant barrier to independent cooking and baking for individuals with physical or cognitive impairments. Although users may rely on assistance from others or use alternative, less powerful kitchen tools, these workarounds can limit independence and participation in meal preparation activities.

The design objective was to replace the traditional mechanical switch and enable users to safely control the mixer's power and speed using therapy switches. Therapy switches are available in a variety of shapes, colors, sizes, and textures, allowing users to select options best suited to their individual abilities and preferences. To support therapy switch control, the adapted mixer integrates an Arduino microcontroller, an AC/DC converter, a TRIAC dimmer module, and 3.5 mm auxiliary jacks connected to adaptive push buttons. The Arduino and TRIAC dimmer module work together to safely regulate the AC power delivered to the mixer's motor. Through the auxiliary jacks, users can connect a wide range of adaptive switches to activate the mixer and cycle through speed settings.

Testing demonstrated that the control system successfully and safely regulated the mixer's motor speed in response to inputs from the adaptive buttons while maintaining the original functionality of the stand mixer. By enabling accessible and independent operation, the adapted design allows users to actively participate in cooking and baking activities rather than simply observe them.

Wheelchair Adaptation to Accommodate Two Children

Project Team
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Jackson Kuehn

MIAD Consultants
Ariana Maza Koubelian
Matt Iding
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Salvatore Scalia

Faculty Advisor
Dr. Jay Goldberg

Clinical Advisors
Amy Morgan,
Dr. Jessica Schnell,
Children's Wisconsin

The goal of this project was to design and construct a wheelchair adaptation to improve mobility and accessibility for families with young children. The project was inspired by the needs of a family seeking a safer, more practical, and easy to use solution for transporting two young children during everyday activities. The team designed and fabricated a custom attachment that integrated with the family's existing wheelchair. The older child (with a disability) sits in the wheelchair, and his younger brother sits in the attached rear-facing seat.

Throughout the project, the team communicated directly with the family and clinical advisors to better understand customer needs and develop technical specifications that served as the foundation for the final design. These specifications included size requirements, maneuverability, usability, structural stability, and the safety and comfort of both children. Using this feedback, the team developed a high-level prototype that provided a rear-facing seat for the younger child and attached securely to the wheelchair through the existing handle slots.

The final design created a practical, safe, and user-friendly mobility solution that could be incorporated into the family's daily life. This project highlighted the importance of user-focused engineering design in the development of assistive technologies that improve quality of life and accessibility for individuals and families with mobility challenges.

2025–2026

Projects

Project Team
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Sam Mrusek
Will Ricamato
Grace Schneider

Faculty Advisor and Sponsor
Dr. Brian Schmit

2025–2026

Multiple Sclerosis App

Multiple Sclerosis (MS) is an autoimmune disease that affects the central nervous system. It leads to the breakdown of the myelin sheath that surrounds neurons. Symptoms can vary depending on where demyelination occurs. Some common symptoms include cognitive issues, motor difficulties, and increased sensitivity to changes in core body temperature. Managing these symptoms often requires continuous monitoring of physical data. However, there is currently no solution that combines biometric tracking, symptom logging, and artificial intelligence (AI) assistance in one platform.

This project aimed to create a mobile app to help people with MS track and manage their symptoms while offering useful insights to both users and healthcare providers. The app combines biometric data, such as step count, heart rate, and core body temperature, with symptom surveys and weather reports. An AI chat agent is included to provide MS-related guidance and to answer user questions.

The app is backed by a database that collects, stores, and processes data.

The app features several functional interfaces. These include a home dashboard that shows daily summaries and trends, a calendar view for analyzing historical data, a symptom-tracking interface, an AI chat agent, and a user profile management page. Users can visualize data through graphs that update dynamically, helping them spot patterns and connections in their health data over time.

Testing showed that the system successfully integrated real-time biometric data collection, accurate data visualization, reliable daily AI summaries, and validated chat agent responses. The app consistently processed and displayed health metrics without losing data. It also provided valuable feedback based on user input. These findings suggest that the system could enhance symptom awareness and aid clinical decision-making for people with MS.

Ergonomic Ultrasound Probe

Project Team
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MIAD Consultants
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Julia Nikolaev
Samantha Christian

Clinical Advisor
Anne Lehman

Faculty Advisor
Dr. Andrew Starsky

An often-overlooked problem facing medical practitioners is acute injury to the hands and wrists after long hours of operating handheld medical devices. Obstetric sonographers often suffer from debilitating musculoskeletal injuries that can force them to undergo surgery, engage in costly therapy, or even forfeit their careers. These injuries are caused by unnatural angles, tight grasping, and the sheer force required to obtain a clear ultrasound image, especially with high BMI patients. These injuries are currently treated as pain arises with dry needling, physical therapy, invasive surgery, and reduced workloads, but little has been done to address the root cause. This project aimed to address those injuries by providing preventive measures embedded into the design of the ultrasound probe itself.

The goal of this project was to redesign the outer housing of a standard maternal ultrasound probe without modifying the electronic components within. This was accomplished by carving an organic design out of foam material that felt comfortable to hold and maneuver while applying continuous pressure on a curved surface. The new housing has a larger surface area designed to allow the user to adopt a more neutral grip in multiple angles and positions. The base of the housing has a wide flare that the user may employ for palm support, allowing them to redirect the necessary force applied to the patient away from their wrists and towards their larger upper arm and back muscles instead. This redirection of force was the main driver in the design process, specifically when considering injuries caused by the scanning of patients with a higher BMI.

The final design was tested by a professional obstetric sonographer with EMG sensors and an electrogoniometer to detect muscle movement and wrist deviation. The results of this testing concluded that the activation of small muscles, specifically in the hand, was reduced in most standard positions and that the new shape was far more comfortable for continuous scanning. Mass production of this new housing would be non-disruptive to current production, as simple injection molds combined with existing electronics would allow production of an affordable and medically safe product.

2025–2026

Confidential Projects

Project 1

Project Team
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Danny Ruffolo
Joshua Scholin
Landon Bartolomei

Faculty Advisor
Dr. Brandon Tefft

Sponsor
Arlando Monk, Visionary League

Project 2

Project Team
Chris Giamis
Garrett Martin
Gabe Alcala
Lucas Wagner

Faculty Advisor
Dr. Said Audi

Sponsor
Andrew O'Reilly, Abbott Laboratories

Project 3

Project Team
Sarah Fino
Melissa Castro
Amelia Winke
Katherine Kowal
Emma Bronikowski

Faculty Advisor
Dr. Lars Olson

Sponsor
Matthew Gudeman, EndoPlus

Faculty

Yang, Hu, Ph.D., Kern Professor and Chair
Nanomedicine, gene and drug delivery, pharmaceutical engineering

Audi, Said H., Ph.D.
Acute lung injury, acute respiratory distress syndrome (ARDS), lung transplantation, pulmonary hemodynamics

Beardsley, Scott, Ph.D.
Neural coding/decoding, neuroplasticity and learning, human visuo-motor processing, functional neuroimaging

Cooper, Robert F., Ph.D.
Photoreceptor mosaic structure and function, image processing, automated analysis tools, clinical imaging

Dash, Ranjan, Ph.D.
Computational systems biology & bioengineering, computational biology and bioinformatics

Garcia, Guilherme, Ph.D.
Respiratory physiology, fluid mechanics of respiratory airflow, virtual surgery planning

Goldberg, Jay R., Ph.D., P.E.
Medical device design and innovation, biomaterials

Greenberg, Adam S., Ph.D.
Cognitive neuroscience of attention, human psychophysics and computational modeling of perceptual phenomena

Guillory II, Roger, Ph.D.
Cellular and molecular interactions of bioactive materials, bioabsorbable metals, vascular medical devices

Hokanson, Jim A., Ph.D.
Urologic function/dysfunction, electrical stimulation/neuromodulation therapies, neural engineering

Joshi, Amit, Ph.D.
Molecular image-guided and remote-triggered therapies, breast cancer imaging and therapy, optical imaging

Kruger, Karen, Ph.D.
Orthopedic biomechanics, pediatric gait kinetics and kinematics using motion analysis techniques

Olson, Lars E., Ph.D.
Mathematical modeling, biomedical instrumentation and optics, cell engineering/cardiopulmonary physiology

Pintar, Frank, Ph.D.
Biomechanics of brain and spinal cord injury, mechanics of spine surgical techniques, motor vehicle crash trauma

Ropella, Kristina M., Ph.D., Professor and OPUS Dean
Signal processing, cardiac and neuro-electrophysiology, functional magnetic resonance imaging

Scheidt, Robert A., Ph.D.
Human motor control, rehabilitation engineering, human psychophysics of sensorimotor adaptation and learning

Schmit, Brian D., Ph.D.
Spinal cord injury, neurorehabilitation, human neurophysiology, biomechanics

Somasundaram, Karthik, Ph.D.
Motor vehicle crash trauma, pedestrian safety, computational modeling of dynamic events.

Stemper, Brian, Ph.D.
Biomechanics of traumatic brain and spine injury, biomechanics of the cervical and lumbar spine, automotive safety

Tefft, Brandon J., Ph.D.
Cardiovascular regenerative engineering and device design, tissue engineered vascular grafts and heart valves

Wang, Bo, Ph.D.
Stem cell engineering, hard tissue engineering and 3D bioprinting, cardiovascular tissue engineering, imaging

Williams, Jordan J., M.D., Ph.D.
Peripheral optogenetics for motor stimulation, brain-machine interfaces and neural prosthetics, motor learning

Yu, Bing, Ph.D.
Optical imaging and spectroscopy, optical endoscopy, cancer detection and therapeutic monitoring, global health

Marquette University and Medical College of Wisconsin Joint Department of Biomedical Engineering

Undergraduate Program

The Marquette University and Medical College of Wisconsin Joint Biomedical Engineering program is founded on one of the longest accredited biomedical engineering programs in the nation and was developed in collaboration with active industry professionals. We offer three selective undergraduate majors to better prepare students for competitive, career-building roles within the biomedical engineering profession. These include biocomputing, bioelectronics, and biomechanics.

Our undergraduate program offers students all the educational opportunities and campus community experiences of Marquette University along with access to the libraries, laboratories, lectures, faculty and clinical settings of the Medical College of Wisconsin and its clinical partners.

Accelerated Degree Program (ADP)

Our Accelerated Degree Program allows qualified students to receive a bachelor's and a master's in biomedical engineering in five years. Students with qualifying grade point averages enroll in the program during their junior year and begin thesis research the summer between their junior and senior years. Research laboratory experiences will continue during the summer before their senior year through their fifth year, culminating in a written thesis and defense.

Graduate Programs

For those considering advancing their career in biomedical engineering by pursuing a master's or doctoral degree, our graduate programs provide engaging clinical and research experiences designed to shape students into leaders in their chosen field.

Graduate School Programs

- Doctoral Program
- Master of Science in Biomedical Engineering
- Certificate in Clinical Immersion in Medical Device Design

Featuring more than 30 dedicated labs designed to facilitate the transfer of new knowledge into innovations directly impacting patient care, our joint program supports student education with a rigorous research practice that offers a dynamic range of novel opportunities for the world's next generation of biomedical engineers. With a focus on collaboration, our research brings together world-class engineers and faculty physicians within state-of-the-art facilities to create solutions for the greater good.

Research Themes

Research themes are provided to help students drive their academic experience, ensuring they are well prepared to pursue their interests upon graduation.

- Biomechanics and Rehabilitation Engineering
- Biomedical Imaging
- Computational Systems Biology and Medicine
- Medical Devices and Bioinstrumentation
- Molecular, Cellular and Tissue Engineering
- Neural Engineering and Neural Rehabilitation

Clinical Partners

The Marquette University and Medical College of Wisconsin Joint Biomedical Engineering programs deliver far more than the reputation of two world-renowned institutions. We also offer valuable opportunities for students, faculty, and staff to conduct research with four equally reputable clinical partners, all located within minutes of campus:

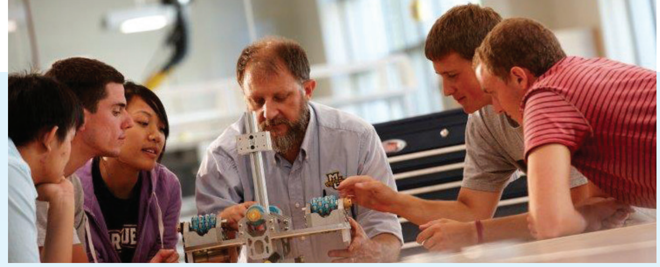
- Children's Wisconsin
- Clement Zablocki VA Medical Center
- Froedtert Hospital
- Versiti Blood Center of Wisconsin

Sponsored Research

Both Marquette and the Medical College of Wisconsin have longstanding histories of successfully partnering on sponsored research supported by federal agencies, for-profit and non-profit entities.

Industry Relations

As one of the first of its kind in the country, Marquette has sustained a proud tradition of connecting students with opportunities for transformative, real-world work experience since our co-op engineering program was founded in 1919. Today, Marquette works with more than 200 leading engineering and technology companies to help students build skills, gain invaluable professional experience, and make key connections that will help them thrive in their careers.



Partnering with Industry

To benefit patients and the future of health care, our joint department fosters collaboration with industry leaders, including such innovators as GE Healthcare, Medtronic, Baxter, and many others.

Collaborations include
- hiring undergraduate students for paid internships and co-op employment opportunities,
- working with senior design and freshman groups on innovative medical device projects,
- joining forces on translational research, and
- developing curricula that respond to industry needs.

Our industry partners value working with us to advance research for their health care products and services while seeking biomedical engineering students and graduates to join their workforces as valued members of their organizations. Our Industry Advisory Board is comprised of active and engaged alumni who are focused on helping to ensure our students are learning industry-leading skills to better prepare them for today's workforce.

The Marquette University and Medical College of Wisconsin Joint Department of Biomedical Engineering stands apart in that it is a true partnership between two institutions with a longstanding history of collaboration and innovation reaching back nearly a century. With unmatched cutting-edge clinical research and benefits and funding that allow students more opportunities for advancement, our joint department is dedicated to delivering an extraordinary educational experience designed to empower the next generation of biomedical engineers, scientists, and physicians.

Undergraduate Design Curriculum

Biomedical engineering students in the Joint Department of Biomedical Engineering learn about design throughout the four-year curriculum.

Freshman Year

Students first gain experience with the design process in the first year during BIEN 1100 and 1110 *(Introduction to Biomedical Engineering Methods I and II).* In these courses, they participate in several team design challenges. These experiences help develop teamwork skills, and teach students about the engineering design process, including technical, legal/ethical, regulatory, and economic design constraints. Students learn to identify customer needs, develop a list of performance requirements and specifications, convert requirements into design concepts, and build and test prototypes. They also learn about basic business concepts and entrepreneurship.

Sophmore and Junior Years

During the sophomore and junior years of the biomedical engineering curriculum, students take courses that include individual and team-based design projects which allow them to apply what they are learning in the course to the solution of a related problem. This helps them relate theory to practice.

In the junior year, students take *BIEN 3400 Clinical and Regulatory Issues in Biomedical Engineering Design*, in which they observe procedures in the clinical environment and learn to identify unmet clinical needs and opportunities for new product development. They hear various stakeholder perspectives on the design and use of medical devices and learn about the regulatory requirements of medical device design, including those of the FDA and ISO standards.

Senior Year

During the senior year, students are required to take BIEN 4920 *Principles of Design* and BIEN 4998 *Senior Design*. These courses require students to apply what they have learned during their previous years of the undergraduate curriculum in a multidisciplinary team-based project experience. They further develop their design, analytical, project management, communication, time management, and teamwork skills. They learn about the product development process, the medical device industry, testing for safety and efficacy, design validation, standards and regulations, risk management, project scheduling, patent issues, and a variety of design issues. Students complete a design project from problem definition to design verification (per ISO 9001 and 13485) and gain experience in generating the same project deliverables as required in industry.

Joint Department of Biomedical Engineering
Marquette University
1515 W. Wisconsin Ave.
Milwaukee, WI 53233

For more information about the Marquette University and Medical College of Wisconsin Joint Department of Biomedical Engineering, scan the QR code or visit **mcw.marquette.edu/biomedical-engineering**

Opus College of Engineering

Since 1908, the Marquette University Opus College of Engineering has been uniquely blending professional engineering preparation with a liberal arts education to provide the world with well-balanced leaders in their profession.

Our mission
The mission of the College is to excel in four critical areas:

- To prepare all students for successful careers based on a strong moral and ethical foundation
- To advance the state-of-the-art in engineering
- To serve our professional and technical communities
- To contribute to our global society

The Opus College of Engineering offers six undergraduate degrees in eleven programs/majors through four departments: Biomedical Engineering; Civil & Environmental Engineering; Electrical and Computer Engineering; and Mechanical Engineering. Marquette also offers a wide range of graduate and doctoral programs.

Accreditation
All undergraduate programs offered by the Marquette University Opus College of Engineering are accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, 410-347-7700.

The University
Founded in 1881 in Milwaukee, Wisconsin, Marquette University has been educating people of faith to be leaders in their professional lives, their communities and in society. Since the first graduating class of five men were awarded bachelor of arts degrees in the 1880s, Marquette has grown into a modern coed campus of more than 11,000 students who learn and grow through nationally admired undergraduate, graduate and professional programs.

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JOINT DEPARTMENT OF
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