

Client/Company/Organization: Kepros Physical Therapy and Performance, PC

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Project Contact: Ted Kepros Email: ted@keprospt.com

Project Title:

Future wearables: Transitioning devices from fitness applications to medical and industrial applications

Project Abstract (include ALL project goal(s), design constraints, and technical approaches and tools):

In just ten years we have gone from primitive cell phones to smartphones with HD screens, multi-core processors. But is computing power the most novel aspect of today's smartphones? Back in 2007 the first iPhone included an accelerometer, an ambient light sensor, and a proximity sensor. Though taken for granted today, this was the first use of miniature sensors in a mass produced computing device.

What future innovations can we expect with the continued improvements in computing power, battery chemistry, and miniature sensors? Wearables! We see it today, an explosion of fitness devices and now smart watches. However just as the first iPhone seems rudimentary by today's standards, so are these initial devices. This senior design project seeks to prototype and research a next generation wearable device with a focus on physical therapy (medical) applications that can also be applied to broader medical and industrial applications:

- Use bleeding edge" technology to objectify targeted, back pain so that the data and related technologies help patients change behavior to prevent and treat the pain.
- Use current and new sensing technology platforms in two key areas: EMG bio sensors for muscle activity and accelerometers for posture (e.g., Lumoback).
- Create a wearable sensing device (e.g., Polar heart rate sensor) that integrates both of the two above sensing platforms. This should provide a more comprehensive understanding of the patient's back movement and related pain.
- The wearable sensor device will have wireless connection with smart phones (e.g., Samsung) for application development.
- The patient data will be collected and analyzed (as part of a personal, electronic health record) to help the patient change behavior, help the care giver treat the patient, and demonstrate patient outcome metrics to 3rd parties to determine reimbursement rates.

The software development company, EnSoft Corp. (located in the ISU research park) will assist on the project.

The ability to measure and adapt low spinal posture has several implications including:

- Reduce the second most common ailment seen in MD's offices around the country
- Objectify ergonomic evaluation during daily function involving lifting
- Provide chair evaluation and fitting for seated jobs
- Sports assessments (e.g., golf and baseball swings) and posture adaptation and similar implications for other sports.

Students need to be "self-starters" to conduct research and design and builds prototypes as well as proactively discuss the technologies and applications with client.

Expected Deliverables (include expected schedule, cannot be open-ended, must list at least one deliverable):

PHASE I- Complete a hardware design including list of components necessary to achieve the job, e.g., accelerometer, gyroscope, electromyography, and how they will be interconnected both physically in hardware and logically in software.
PHASE II- Build a prototype for preliminary trials.
PHASE III- Build final prototype for final review.

Specialized Resources Provided by Client (be as specific as you can):

Client provides EMG bio sensors, accelerometers, and hardware for the wearable device. Client will work with students to acquire other hardware as necessary (e.g., smart phone, micro-controller, battery, mounting strategy, etc).

Anticipated Cost: \$500

Financial Resources Provided by Client (if any): \$500

NOTE: General Resources Provided by ISU/ECpE: MSDNAA software, and access to resources in ECpE teaching and research labs, e.g., electronics, embedded systems, etc.

Enter # Students Preferred/Required:

- Electrical Engineering
- Computer Engineering
- Software Engineering
- Other (specify):

Special Skills Required of Students (be specific):

- Electrical engineer will:
- design wearable hardware to tie sensors to a micro controller and battery.
 - work on micro controller software and/or inform software engineers about the same (e.g. battery management)
 - Work on signal processing code for post processing sensor data (some may reside in the micro controller and some on the smart phone app)
- Software Engineers will:
- Develop micro controller software to log sensor data, drive hardware indicators, and communicate to smart phone via blue tooth
 - Develop smart phone app to download sensor data, analyze it, and interact with use
 - Project members could be Computer Engineers with the requisite skills

Anticipated Client Interaction (estimate):

- 1 meeting per week
 - phone, internet, live
- 1 meeting per month
 - phone, internet, live
- 2 or more meetings per month
 - phone, internet, live
- 1 meeting per semester
 - phone, internet, live

Meeting ABET Criteria

Please rate the following statements as they relate to your proposed project:

0 – Not at all 1 – A Little 2 – Somewhat 3 – A Lot 4 – Completely

On this project, students will need to apply knowledge of mathematics, science, and engineering	<input checked="" type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> 4
This project gives students an opportunity to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	<input checked="" type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> 4
This project involves students from a variety of programs, i.e., SE, EE, and CprE	<input checked="" type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> 4
This project requires students to identify, formulate, and solve engineering problems	<input checked="" type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> 4
This project gives students an opportunity to use the techniques, skills, and modern engineering tools necessary for engineering practice	<input checked="" type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> 4

Project Approval – for use by ECpE Senior Design Committee

Approved Not Approved

Faculty Advisor Assigned: _____

Project Number Assigned: _____