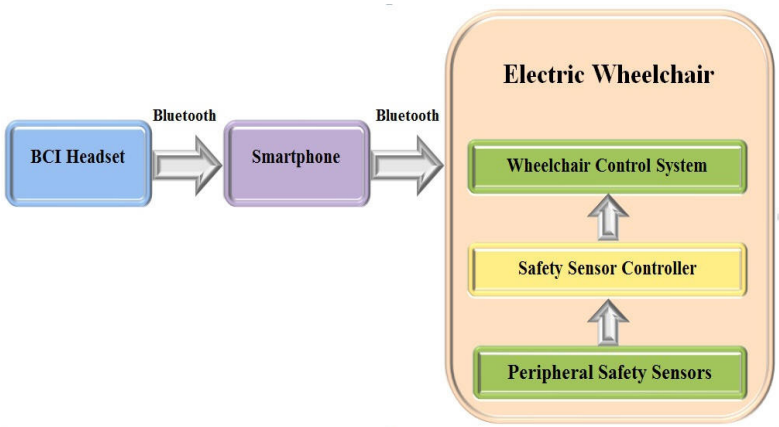
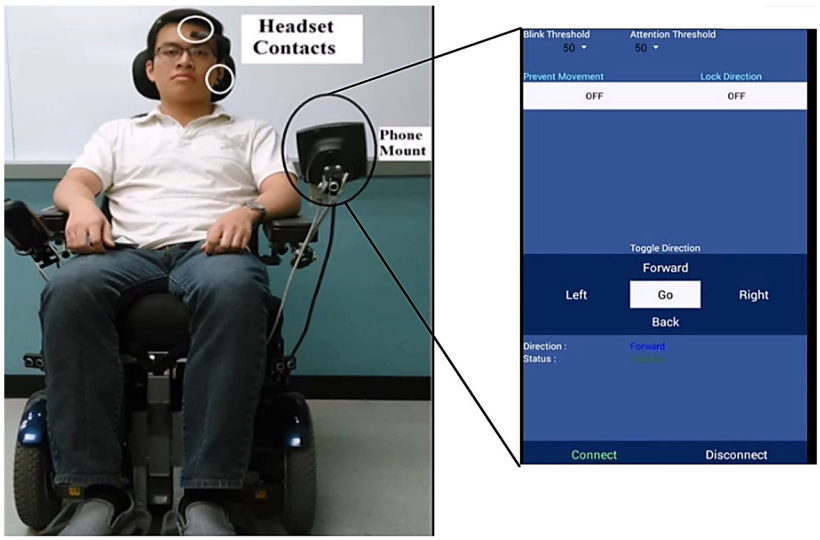
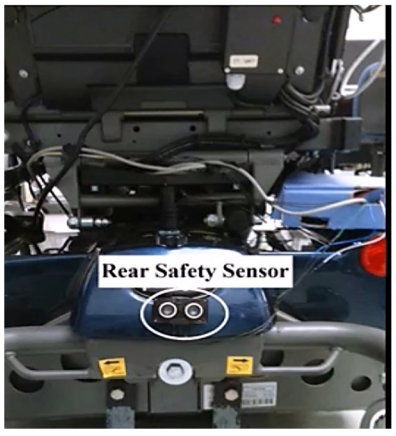
Brain-Computer Interface (BCI) Controlled Wheelchair Driving Aid



- **Enables user to operate an electric wheelchair using mental thoughts (EEG signals) and facial expressions (EMG signals).**
- **Cost per driving aid: less than $200.**
- **Design utilizes off-the-shelf components to reduce cost and development time.**
- **A healthy subject is able to operate the wheelchair with 25 - 30 mins of training.**





CSUF students develop app, hardware for mind-controlled wheelchairs

By ANGIE MARCOS / STAFF WRITER

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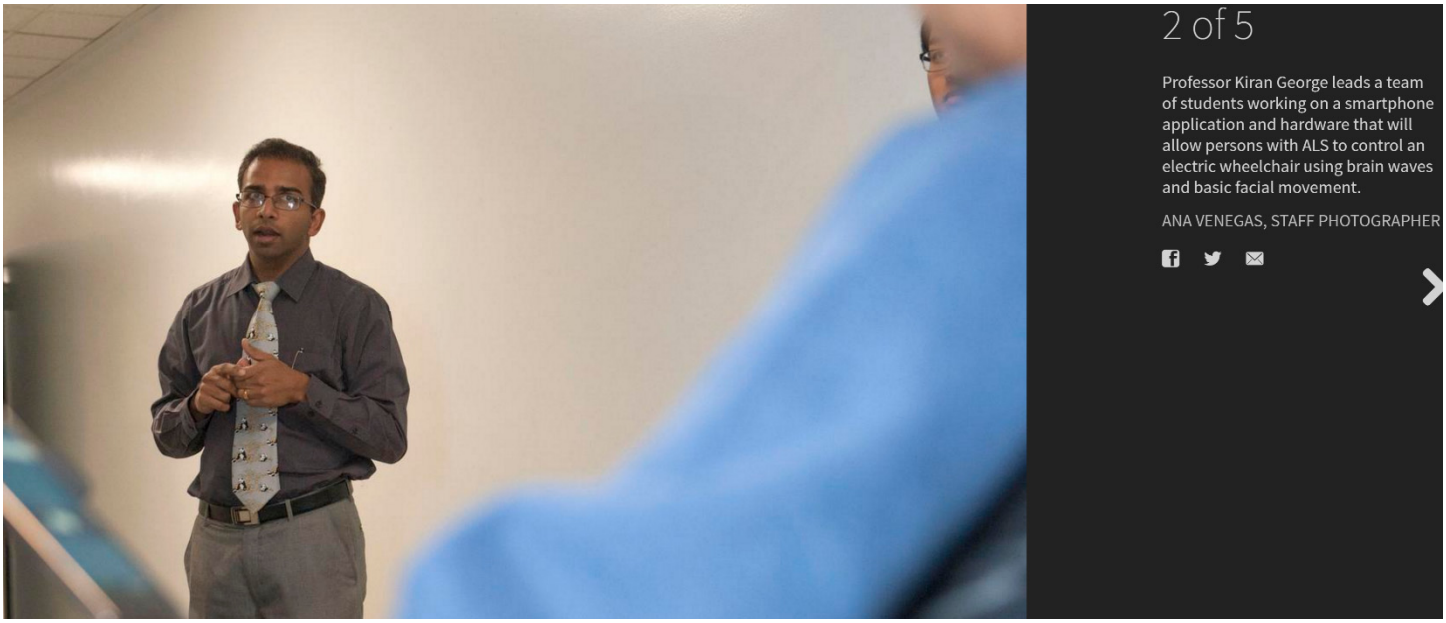
With the aid of a smartphone application and hardware, Cal State Fullerton students have created a low-cost and easily manageable system by which an electric wheelchair can be controlled by brain waves and facial movements.

The project – Brain-Computer Interface Controlled Driving Aid for Electric Wheelchairs – is being led by graduate computer engineering student Nikhil Shinde and undergraduate computer engineering students Graciela Cortez and Rayton Espiritu.

“It is a brain-controlled wheelchair,” said Shinde, 25.

The project is Shinde’s graduate thesis project and focuses on the needs of those with ALS.

Amyotrophic Lateral Sclerosis, or ALS, is a progressive neurodegenerative disease that primarily affects nerve cells in the brain and spinal cord.



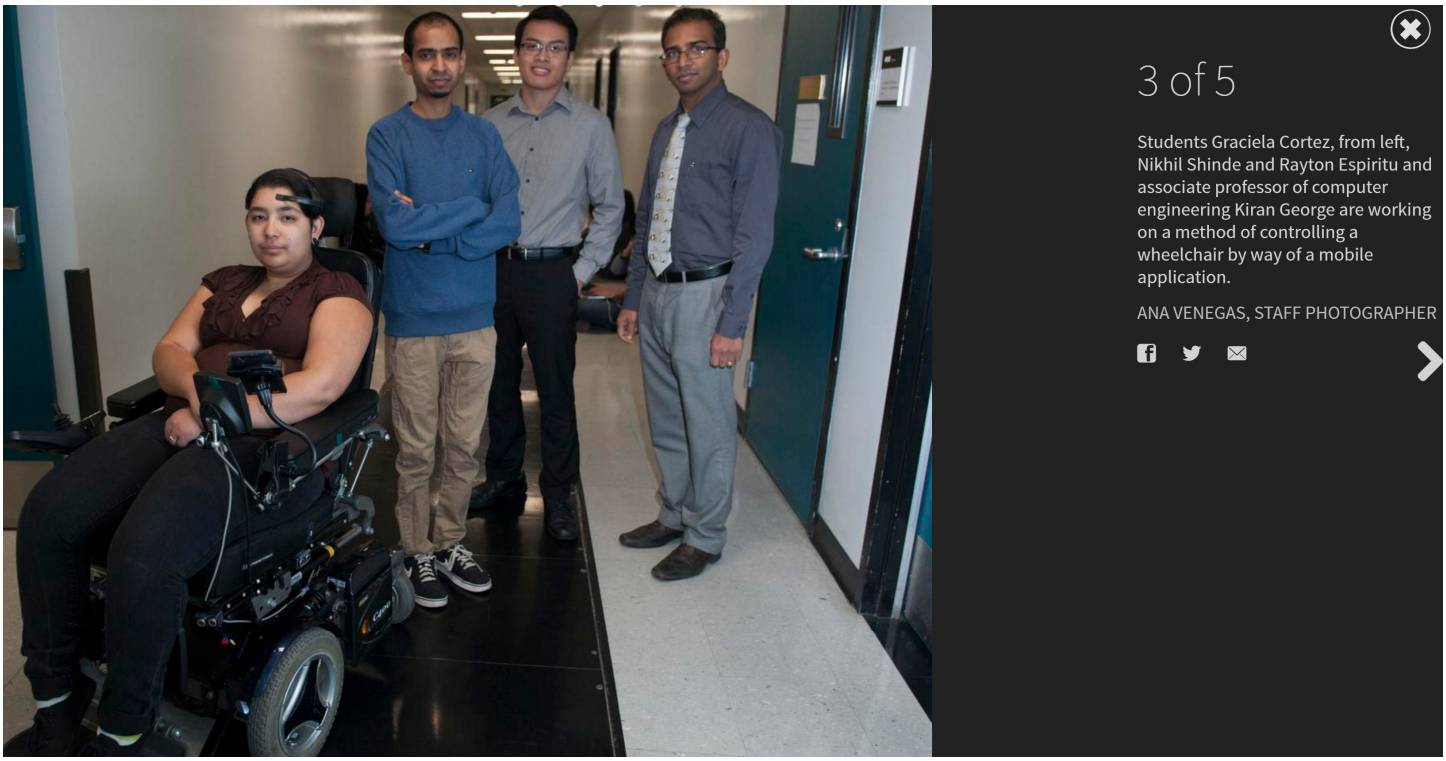
Persons with ALS – referred to as PALS – progressively lose muscle movement and control.

Through the students’ creation of the BCI Controlled Driving Aid, a mobile application that can be used on Apple and Android devices, electric wheelchairs can be controlled by thoughts and basic facial movements like raising one’s eyebrows or blinking one’s eyes.

A headset worn by the individual recognizes the user’s brain electrical activity and facial movements. It then wirelessly transmits and translates those messages into control signals by way of the smartphone application.

“An individual can operate the electrical wheelchair using the driving aid with a combination of mental thoughts and basic facial movements,” said CSUF Associate Professor of Computer Engineering Kiran George, who serves as the project’s faculty mentor.

Electrical activity from the brain is picked up by the headset and separated into different types of waves – for example alpha waves or beta waves – and sent to the application.



“If the level is above a predetermined threshold, the smartphone triggers the controller on the electric wheelchair via Bluetooth, which in turn moves the wheelchair either forward, backward, left, right, based on the state shown in the app,” George said.

Eye blinks can be used to change direction.

The goal of the project, Shinde said, is “to make (individuals with ALS) independent and to improve their quality of life.”

The application is not yet available pending further research and adjustments.

What makes this project unique

The students began working on the Brain-Computer Interface Controlled Driving Aid for Electric Wheelchairs project last spring and will continue to work on it throughout this semester.

While similarly programmed wheelchairs exist, what makes this project unique is the pricing. The group is working to keep the cost of the application and hardware under $150.

“One of the major goals of this project is to make this technology affordable to (anyone),” George said.

It is also the main challenge of the project, he said.

Another unique component is the system’s ability to be retrofitted to any electric wheelchair without any modifications. It also requires little training to understand.

“The system is designed in a way that it requires minimal training to operate,” George said. An individual can be trained in less than 30 minutes, he said.

The students' project currently has four motion sensors installed that prevent the chair from colliding with structures or objects; they plan for a total of 15 safety sensors to be installed by the end of the semester.

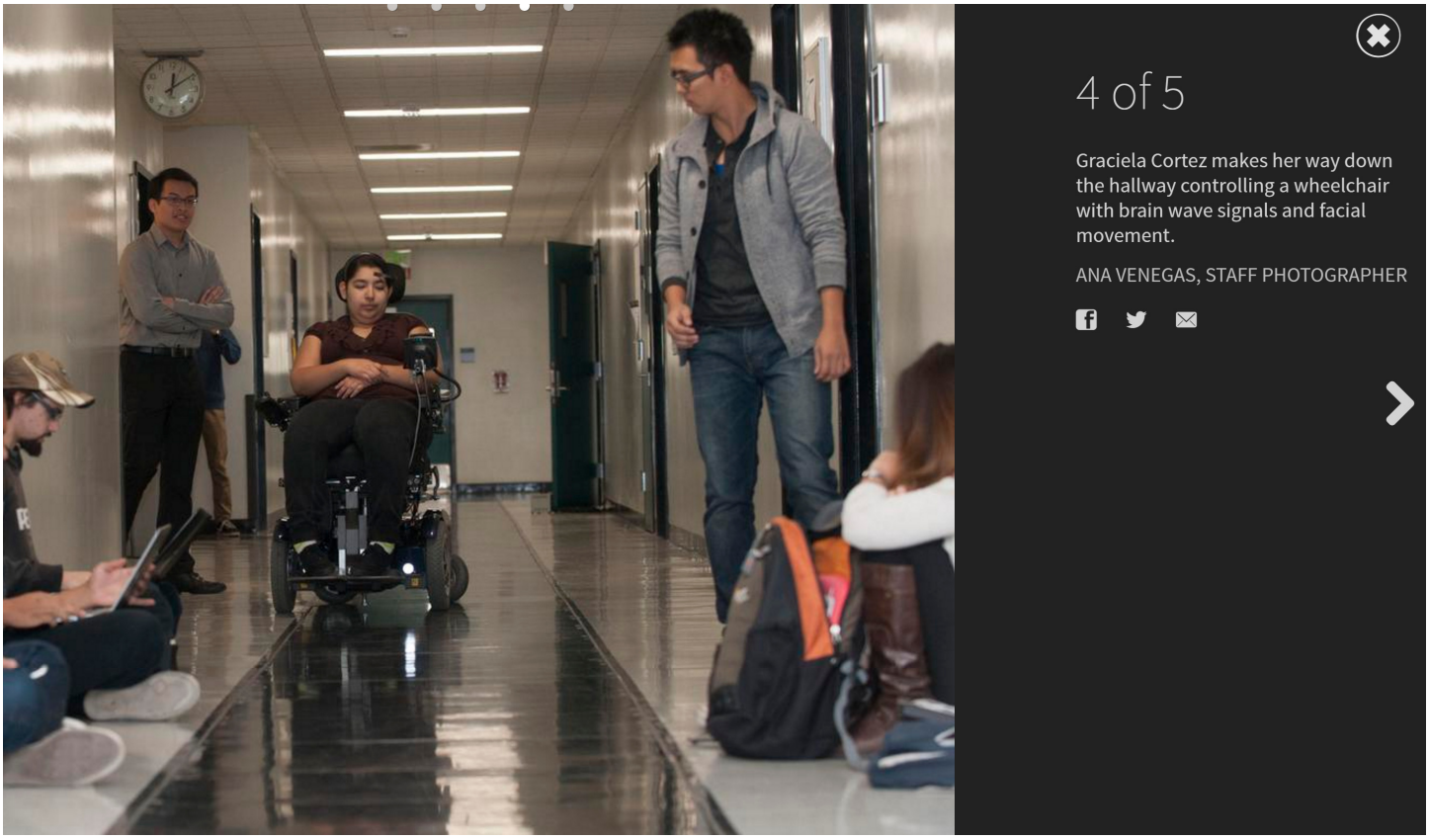
Besides keeping the cost of the system low, the students face the challenge of making the system easily usable for a wide variety of people.

The signal strength recognized by the headset varies depending on the user. Because of this, settings initially have to be customized for each user, George said.

In the future, George would like to see the project expand.

A separate group of CSUF graduate students, also under his guidance, is working on making the electric wheelchair able to recognize verbal commands, as well as navigate using 3D mapping.

His goal is for PALS to be able to type or say the word "kitchen" and subsequently be taken to the kitchen through a 3D mapping program graduate students are working to create.



Making a difference in the lives of PALS

George partnered with the ALS Association of Orange County Chapter last year for a robotic arm project. Around the same time, he proposed the electric wheelchair project idea to the association.

The association responded by donating an electric wheelchair so the students could apply their research.

By modifying existing hardware and software, as well as creating new ones, the computer engineering students are working to make the management of the electric wheelchair as hands-free as possible.

“About 75 percent of persons with ALS experience limb onset ALS,” George said.

“PALS experience difficulty with tasks requiring manual dexterity such as buttoning a shirt, writing or turning a key in a lock,” he said. “As a result, PALS with limb onset are unable to operate an electric wheelchair and have to heavily rely on their caregiver/family member to perform even simple tasks such as moving from one room to another.”

The students’ mobile application and hardware would allow PALS to become somewhat independent, he said.

Last month, Shinde, Cortez and Espiritu presented their project and research at the 28th annual Cal State University annual Biotechnology Symposium.

In the spring, the project will be put to the test when the students bring the chair to the ALS Association of Orange County Chapter to be tested. PALS will test the device and provide feedback to the group.

“The partnership with ALS Society of Orange County Chapter provides the project team with such a unique opportunity,” George said.

For Cortez, knowing her work will be put to use in the coming months has made the project more meaningful.

“I’ve enjoyed working on something that I know will help people with disabilities,” she said. “It’s really fulfilling.”

George hopes the time spent working on the project teaches his students to effectively brainstorm solutions, research problems and implement them, as well as develop interpersonal skills.

https://www.ocregister.com/2016/02/01/csuf-students-develop-app-hardware-for-mind-controlled-wheelchairs/