TI technology enables Truescore's taekwondo electronic scoring system

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Company:
Truescore Inc.

Challenge:
Taekwondo, a martial arts sport and Olympic event, is traditionally scored by judges. To award a point, judges must determine not just if a blow was landed, but if it had sufficient impact. The game's blazing speed makes this highly subjective. Truescore Inc. decided to improve that with an electronic sensing and scoring system.

Solution:
Using data from an innovative multi-sensor system embedded in a protective vest, Truescore's sophisticated algorithms are executed by Texas Instruments (TI) ultra-low-power MSP430™ 16-bit microcontrollers that also handle baseband processing, creating a highly reliable system that is more accurate than human judges. Truescore's system also includes TI's CC2520 ZigBee® IEEE 802.15.4 RF transceiver, which provides a robust radio frequency (RF) link despite interferences in the 2.4-GHz band, which are resolved with frequency agility.

Customer benefit:
The electronic system is more accurate than human judges and eliminates the subjectivity that creates contention. Truescore's third-generation product also attenuates the RF interference common in competition venues. Using TI's chips, evaluation kits and technical support, Truescore had a working prototype in less than two months.

> "TI has been very instrumental in helping us to move quickly without having to spend months on a learning curve. When we had to evaluate some feature or design concept, they were right there. I've worked with TI for 10 years and technical support has always been phenomenal. In the beginning, when I first proposed my application, they did not ask questions like 'what's your volume?' Instead, I had the kind of response I would normally expect from a small company that really wants to win your business,"
>
> *–Jin Song, Truescore CEO*

The challenge

When Truescore ramped up to design an electronic judging system for the sport of Taekwondo – in which contestants score points by landing foot or fist blows to an opponent's torso or head – the design team was presented with an impressive portfolio of unusual and unique engineering challenges. The impact from a legal strike must be substantial, for example, so points are not awarded for glancing blows, partially blocked kicks, head butts, or elbow contact. The electronic system had to be fast, without compromising the agility of the competitors. It also had to be accurate, lightweight, inexpensive and battery efficient - the battery must last for at least 20 hours of continuous use before a recharge.

The application

Truescore saw a few different opportunities to build from. Contestants are required to wear a protective vest, called a hogu, along with headgear, gloves and footgear, all of which could accommodate an ultra-compact system of sensors, radio, batteries and a microcontroller. Although action is lightning fast (potentially four kicks per second and
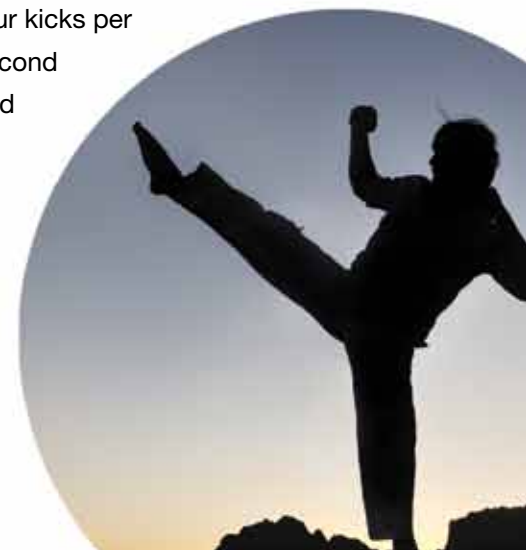
<10 milliseconds of contact per hit) and force-of-impact data readings must be precise and unambiguous, Truescore's design team had a technology arsenal equal to the task, including high-performance microcontrollers, a lightweight protocol and sophisticated sensors. Competitive venues can be difficult RF environments, but Truescore uncovered an effective solution for avoiding interference in the crowded 2.4-GHz band.

The solution

Truescore's core-sensing technology is a combination of a piezoelectric sensors and inductive proximity sensors in the hogu and a strong magnet in the footgear. As a competitor is about to strike another, inductive sensors sense the approaching magnet and open a time window for a valid strike. This eliminates false readings from elbow strikes and other inadvertent contact. Two piezoelectric sensor systems simultaneously log the impact so an average can be used to more accurately calculate the force of the blow. TI's MSP430F5xx series of microcontrollers serve double duty by executing the sophisticated algorithm and handling a customized wireless protocol.

OEM customer benefits

"From the power amplifier to the CC2520 transceiver, MSP430 microcontroller and C2591 radio front-end amplifier, virtually our entire components list is sourced by TI parts," says Truescore CEO, Jin Song. "Being able to quickly integrate the hardware into a system was critical for the company's third-generation E-Hogu product because the design team had just 1.5 months to develop a fully operational prototype. TI's built-in product compatibility made a quick design turnaround possible."

The biggest, new engineering challenges for the third-generation product was to avoid RF interference in the 2.4-GHz ISM band in addition to the lack of time available for development. Since the first-generation product in 2002, venues where competitions are held have become increasingly noisy from Wi-Fi-enabled laptops, mobile phones and other connected devices. Truescore opted to attack the interference problem by implementing frequency agility. TI's technical support proved invaluable. "We had no time to re-design in case of miscalculation, and the system worked the first time," says Song, "which is practically unheard of in my 20 years."

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