

A good night's sleep: Engineers develop technology for special needs children

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A Kansas State University engineering team has received a three-year \$400,000 National Science Foundation grant to track the wellness of special needs children at night and relate this sleep data to daytime learning and behavior. Credit: Kansas State University

A Kansas State University engineering team is developing a technology collection that can make a big difference in the lives of children with developmental disabilities.

The team's projects so far have addressed around-the-clock technology: bed-based sensors to track child breathing and heart rates; wearable sensors to track child behaviors; and designs that can improve the quality of life for paraeducators who work with these [children](#).

Now the team has received a three-year \$400,000 National Science Foundation grant to expand these ideas and better establish a link between nighttime wellness and daytime learning and behavior. The project, "UNS: GARDE: Research to quantify the health and development of children with disabilities around the clock," involves several Kansas State University engineering researchers who are combining their expertise.

"While relationships between sleep quality and daytime performance are well-characterized for neurotypical children, these relationships are not well known for severely disabled, autistic children, many of whom are nonverbal and have multiple co-existing disabilities," said Steve Warren, associate professor of electrical and computer engineering and project leader. "Polysomnographs used for traditional sleep studies require electrodes, wires and equipment that are not suitable for these children. We seek alternative nighttime tools that, once hidden in a child's bed and bedroom, can provide effective surrogate data when compared to traditional polysomnographs."

Other Kansas State University researchers involved include Punit Prakash, assistant professor of electrical and computer engineering; David Thompson, assistant professor of electrical and computer engineering; Bala Natarajan, professor of electrical and [computer engineering](#); Charles Carlson, doctoral student in electrical engineering,

Hutchinson; Ahmad Suliman, doctoral student in electrical engineering, Afghanistan; Tianyu Lin, master's student in electrical engineering, China; and Alaleh Alivar, [doctoral student](#) in electrical engineering, Iran.

The project also involves several undergraduate students in [electrical engineering](#): Austin White, senior, Kansas City, Kansas; Shangxian Wang, sophomore, China; and Taishan Li, senior, China.

The university research team is collaborating with Heartspring Inc., a Wichita, Kansas-based nonprofit organization that is a therapeutic residential and day school program. Heartspring uses evidence-based and emerging best practices to serve students who often have multiple diagnoses, including autism spectrum disorders, cerebral palsy, speech and language impairments, and other developmental disabilities.

The NSF grant will help the university researchers to develop more effective nighttime and daytime monitoring tools, acquire data from selected Heartspring children in their residential apartments and use these data to establish linkages between nighttime well-being and daytime learning and behavior.

"In contrast to existing approaches, the goal of our effort is to measure sleep quality and daytime well-being by exploiting advanced signal processing algorithms and fusion of information from multiple low-cost noninvasive sensors," Natarajan said. "The ease of deployment and portability of the sensor suite greatly increases the likelihood of this technology reaching the homes of children with special needs."

Early elements of this project began in senior engineering design courses managed by Warren, Prakash and other university engineering faculty members. These efforts were supported by a previous NSF grant that provided material and equipment funds for senior design projects geared toward children with severe disabilities and their caregivers. Kansas

State University students designed customized devices informed by the needs of the Heartspring children.

Wayne Piersel, a child psychologist and the Heartspring clinical director, is leading the collaborating Heartspring team. Other Heartspring team members include Janine Kesterson, child psychologist; Steve Stoffregen, director of information technology; Dusty Buell, director of marketing; and David Stupay, president and CEO.

Provided by Kansas State University

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