Case Study:
A Smart Video Camera that Understands Sleep

A Qualcomm® Snapdragon™ 410E Processor Case Study
Featuring Knit Health and Intrinsyc Technologies

Case Study Highlights

+ **BACKGROUND** — Knit Health, a video technology company based in San Francisco, CA, wanted to change the way parents manage health at home by developing a camera that intelligently monitors and tracks children's sleep.

+ **SOLUTION** — Using the Open-Q™ 410E System on Module (SOM) from Intrinsyc Technologies featuring the Snapdragon 410E processor, Knit Health was able to design and develop a truly smart video camera that not only detects a child's sleep and movements, but also tracks room temperature, humidity, light and sound levels, and works seamlessly with its software app to stream directly to the user's iPhone.

+ **RESULTS** — Knit tracks sleep, breathing, and health symptoms that affect sleep so that parents can stay on top of their child's sleep wellness, keep them comfortable, take action to improve sleep and know when to reach out to an expert.

> "**With Knit, we (my husband and I) would sleep more.**"
>
> **- Mother of 12-month old**

Introduction: The Intelligent Sleep Monitor for the Whole Family

Families are not getting enough good sleep and this poor sleep is affecting daytime behaviors, school performance, long-term health and overall happiness. After experiencing these issues with their own young families, Knit Health co-founders David Janssens, Paul Silberschatz and Evan Shapiro set out to help families understand and improve the entire family's sleep by building a new class of smart cameras called Knit.

Starting with children under 10, the mission of Knit is to take away the mystery of the night, providing clinically accurate sleep insights to parents that leads to understanding and improvement. With just a camera, Knit helps parents answer two questions; does my child have a sleep issue? And if so, what steps can I take to improve their sleep?

Powered by the Snapdragon 410E processor, Knit uses a technology known as computer vision to understand what's happening at night. The Knit camera detects the child's presence, and can interpret nuances of their pose and position – even when they're under blankets, in a swaddle, or surrounded by stuffed animals. It sees what people can't. The camera is designed to amplify motion that is undetectable to the human eye so it can track a child's sleep and breathing – all without wearables or sensors.

By intelligently tracking sleep, breathing, and health symptoms that affect sleep, Knit has changed the way parents can manage sleep health at home. Knit can see how well a child is sleeping and identify sleep trends. It records important clips and measures sleep so parents have an automatic record of how easily their child fell asleep, when they woke up, and all the significant details in between. Daily insights and 7-day trends help parents keep tabs on their kids' overall sleep levels – illuminating patterns, such as optimal bedtimes and sleeping conditions. Over time, Knit's sleep intelligence can assess a child's sleep disorder risk, recording video clips of important sleep behaviors that can be reviewed with your pediatrician or sleep expert.

Keeping data secure is critical for everyone, especially when it comes to children. Knit's security is focused on the safety of users' video information. An authenticated video stream runs only on the user's secure, local network with data processing directly on the camera – a closed loop system entirely controlled by the user, designed to keep Internet hackers out.

The Power of Snapdragon 410E

+ Integrated Wi-Fi/WLAN, Bluetooth, and GPS for portable applications

+ Superior CPU architecture is capable of both 32-bit and 64-bit processing – designed for an improved user experience

+ Supports popular codecs including H.264, MPEG4, MPEG2, and VC1 for better software compatibility

+ Qualcomm Adreno™ 306 GPU with support for multiple APIs including: OpenGL ES 3.0, OpenCL, DirectX

Working with the Snapdragon Processor

Like many startups, Knit Health wanted to hit the ground running, but faced the challenge of not knowing how much processing power they really needed. Fortunately, they were able to work with Intrinsyc, a company that's part of an ecosystem of Snapdragon technology providers who offer commercial-ready modules and integration services that help take manufacturers from initial concept all the way to commercialization.

"As a startup, it was important to be able to procure and prototype with the product and get some level of support," explained Paul Silberschatz, cofounder of Knit Health. "We want to be developing the application at the same time we are kicking off the hardware, so going with the Snapdragon 410E allows us to streamline the process. Being able to start with the DragonBoard™ 410c and move to a ready-to-go platform from Intrinsyc saved a lot of time and money." Knit started their product evaluation with the DragonBoard 410c community development board manufactured by Arrow Electronics, which is compliant with the 96Boards consumer edition open hardware specification. From the DragonBoard 410c, Knit moved on to Intrinsyc's Open-Q 410 SOM. Powered by the Snapdragon 410E processor, the Open-Q 410 SOM runs a customized Linux implementation and uses AWS cloud services, supporting advanced computing on edge devices.

Enabled by Intrinsyc

Why work with a custom partner at all? Why not use an off-the-shelf camera or white label?

Knit decided to use Intrinsyc's Open-Q 410 SOM, an ultra-small (44mm x 26.5mm), production-ready module based upon the powerful Snapdragon 410E (APQ8016), quad core processor, from Qualcomm Technologies, Inc. (QTI). The SOM's small form factor, advanced technology, and extensive range of supported peripherals are designed to provide the perfect platform for creating low-cost, high performance embedded devices.

Knit streams continuous video to the user's iPhone. Since the video must be compressed so that it's small enough to be sent and stored on the server, it makes sense to push that processing towards the edge so that information is sent to the Internet only when needed, such as for long-term storage or remote viewing.

"Getting a new SOM cheap enough to put in a consumer product is a very new thing," explained co-founder Silberschatz. "For us, as a startup scaling in the 1,000s to 10,000s of units, it's not breaking the bank for us.

About Intrinsyc

+ **Company Name:** IntrinsycTechnologies Corp.

+ **Description:** QTI licensee and a leader in product development for the embedded systems market based on Snapdragon

+ **Location:** Vancouver, BC, Canada

We can still make a little margin on the hardware. It's a game changer compared to 10 years ago when it would cost 10 times as much to get that level of processing in that form factor for a SOM. That's a really big deal for a startup."

Historically, Snapdragon processors have only been accessible to large manufacturers of smartphones and tablets. Knit Health, a startup bringing their product to market through a Kickstarter campaign, is an example of just how attainable Snapdragon embedded solutions have become.

On the Horizon:
Intelligent Audio Analysis

According to Knit's co-founders, "Most of what we're focusing on right now is on the vision side of things, but we also have a microphone in our hardware so we will be working on intelligent audio analysis and doing even more processor-intensive audio analysis to understand different sounds and to distinguish between different types of coughs, or distinguishing between a cry and a laugh."

Ultimately, Knit's goal is to build a sleep service that benefits the whole family and replaces current methods of sleep assessment and monitoring. Knit's simple and intuitive experience is enabled by advanced technology that learns and understands people – starting with kids to sleep better and stay healthier.

" It's the single best predictor of how his day is going to be. "

- Dad of 2-year-old

" With Knit, we know how well his sleep treatment is working and his teachers rave about the huge improvement in his performance at school. "

- Dad of 10-year-old with ADHD and Sleep Apnea

For More Information

+ Visit **www.knithealth.com** for more information on Knit Health and the Knit Learning Health Monitor.
+ Visit **www.qualcomm.com/products/snapdragon/embedded-computing** and **https://developer.qualcomm.com/getstarted/embedded-computing** for more information on Snapdragon processors and development kits for embedded processing.
+ Visit **www.intrinsyc.com** for more information on Snapdragon product development.

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