NIMBIX
CASE STUDY

With deep learning, the power of JARVICE ™ and the Nimbix Cloud, Tanmay Bakshi develops Heart ID, a brand-new type of biometric authentication

"We knew there was a unique pattern to every individual's ECG, but finding it computationally was next to impossible without developing deep learning algorithms and a new neural network. That required rapid iterations of research and testing on huge data sets. With the bare metal speed and ease of use of JARVICE and the Nimbix Cloud, all I had to do is spin up an instance, and just like that, I've got all my software, I run my program, and I shut it right back off. Try that with other cloud providers."

Tanmay Bakshi
Engineer, IBM Champion for Cloud, Google Developer
Expert for Machine Learning, and Inventor of Heart ID

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INTRODUCTION

Tanmay Bakshi has developed a brand-new kind of biometric authentication—Heart ID—to address the limitations and drawbacks associated with existing biometric solutions. Fingerprints, iris scans, and facial recognition either require complex hardware, aren't practical in all situations, or are fraught with bias and privacy concerns. Heart ID uses the unique electrical impulses in a person's heartbeat—the electrocardiogram or ECG—to identify and authenticate a subject with superior accuracy. Heart ID shifts biometric solutions' dependence off of specialized hardware and onto software and data, allowing its implementation on any platform for the broadest number of applications. But to isolate the subtle patterns that make each heartbeat unique, he needed the computing resources of an HPC partner: Nimbix JARVICE and the Nimbix Cloud.

CHALLENGES

Healthcare professionals have long used the ECG patterns visible to the naked eye to identify heart conditions. But sifting through the mass of noisy data recorded by a portable ECG device to find what makes it unique to each person requires a lot of computing power, the kind only HPC and accelerated computing can deliver. However, a dedicated supercomputer to develop, test, and refine his deep learning algorithms for Heart ID was cost-prohibitive, especially for an engineer in the 10th grade.

Another challenge was architecting a new neural network to support his project since earlier research in this field did not use neural networks. Which type of neural network would work better—convolutional or recurrent? Which parameters—filter size, number of kernels, stack depth—would give the necessary accuracy and precision? This was all new territory, and for Tanmay to architect the best neural network and toolkit, he needed to iterate rapidly to examine all the possibilities, each time building on what worked or did not work.

TECHNOLOGY USED

Tanmay used the Nimbix Cloud powered by JARVICE to accelerate the development of his new neural network, the algorithms, and machine learning models for both identification and ECG data analysis. With the Nimbix Cloud, Tanmay could spin up new instances, do his processing, and tear them down in minutes (not days) with no configuration or software installation required. The bare metal speed of running Keras and TensorFlow on IBM® Power computers with the PowerAI toolkit and NVIDIA® DGX™ let him power through each data set in minutes.

ENGINEERING SOLUTION

The initial implementation of Heart ID used an iOS mobile app and a handset containing two strips of metal. The handset collects the subject's ECG data and sends it to the Heart ID app, which then sends it to be stored and analyzed. Heart ID uses two different machine learning models, one to perform the authentication function, the other to analyze the ECG data itself. After developing and training the models on the Nimbix platform, Tanmay converted them to Core ML which provides high performance running on a mobile device in real time.

Heart ID's neural network analyzes the ECG data until its quantity and quality are sufficient to uniquely identify a person. It then sends it to the second model where it can:

- Identify a person based on previously encountered patterns;
- Flag a person with no Heart ID identification on file;
- Authenticate an identified person against a white list; or
- Disallow the person that appears on a blacklist.

BENEFITS

Heart ID can now automatically identify a person based solely on their heart's unique electrical activity. It can be applied singly or integrated with other authentication methods wherever accurate identification is required, including corporate facilities, public safety, point of sale, and banking. Since Heart ID is software- and data-driven, it needs no complex, expensive hardware. And the mobile app's small footprint will allow it to run on almost any device, including smartwatches which already have ECG sensors built in.

With JARVICE and the Nimbix Cloud, Tanmay was able to build, verify, and refine the ML models and neural networks that power Heart ID in weeks, not years. Tanmay will continue refining the technology to ensure its robustness in large-scale, real-world use cases.

Heart ID might be used to secure corporate facilities, barring unknown persons from entry and restricting identified visitors to authorized areas.

INVENTOR BIO

A resident of Ontario, Canada, Tanmay Bakshi started coding at age five and has been working with machine learning since he was 11. Tanmay loves applying machine learning to areas where he feels he can make a lasting impact, including healthcare and education. His mission is to make technology more accessible and affordable to people around the world by developing more robust, versatile, and affordable alternatives to existing technologies—including biometric authentication. Tanmay is an IBM Champion for Cloud, a Google Developer Expert for Machine Learning, a TED Speaker, and has his own YouTube channel. As of 2019, he is working on his third book.