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HIGH-SPEED FINGER TRACKING OFFERS NEW INSIGHTS INTO JAPANESE BASEBALL

Next Base, a Japanese sports research lab and data analytics company, is using its Vicon system to deliver laser-focused insights into the biomechanics of baseball.

Mr. Shinichi Nakao, CEO at Next Base

Dr. Tsutomu Jinji, Executive Fellow and Principal Researcher at Next Base

Established in 2014, Next Base uses cutting-edge technology to push performance to new heights. The company is led by Mr. Shinichi Nakao, CEO. "Our aim is to empower athletes to maximize their performance, using efficient and effective training methodology with biomechanics research to back it up," says Mr. Nakao.

Dr. Tsutomu Jinji, Executive Fellow and Principal Researcher for the company, obtained his doctorate by conducting research into the biomechanics of baseball pitching, with a particular emphasis on the mechanism that creates spin on the ball. This granular approach forms part of Next Base's current program. "We provide a pitching biomechanics service, including finger movement on the ball, by capturing and analyzing full body motion," explains Dr. Jinji.

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Next Base uses a custom full-body marker set consisting of 46 markers. "It's a rigid link model with 18 segments from the feet to fingers on the ball. Our calculations are not restricted to kinematics, but extend to kinetics and energetics. With the inclusion of force plate data, we calculate segmental and joint kinetics written in a custom MATLAB script," explains Dr Jinji.

"We rely on our Vicon system to comprehensively evaluate individual movements," Dr. Jinji continues. "In the context of pitching, we have developed a logic tree diagram with seven key elements based on the principles of energy flow. This helps us to understand which movements affect the ball's overall speed, rotation, and distance. We can then provide personalized training recommendations on how to transfer greater energy to the ball by enhancing the skill, strength, and conditioning of the athlete."

For the speed and accuracy Next Base requires, a state-of-the-art motion capture system was the only option. "Our marker model consists of small markers attached to the fingers and the ball," Dr. Jinji says. "We measure at a high rate in order to comprehensively capture the fine points of the movement. To fulfill this requirement, we needed a high-resolution and high-speed motion capture system."

Dr. Jinji says that his Vicon system's acute accuracy is one of the key advantages it offers for their research and is why it was the best system for their lab. "Movement signals are very sensitive in each player. We capture all the tiny details without them being removed, adding custom filters to help sort through the data."

In addition to helping players improve performance, Next Base also aids in making adjustments to their technique to avoid injury. Dr. Jinji gives the example of a visitor who was experiencing discomfort in his shoulder. Next Base's tests revealed excessive muscle contraction in the adduction of the shoulder joint. Dr. Jinji explains how this change in the player's normal shoulder motion was resulting in an increased energy loss through

his pitching. "Our performance and conditioning coaches prescribed a training program to counteract the extra muscle load going through the shoulder, helping him return to his usual performance immediately."

In the future, Next Base hopes to expand in a couple of different directions. "We plan to start online services for those who are unable to visit our labs frequently. We are also expecting to expand our lab network across Japan and overseas. Furthermore, we hope to scale up our Vicon system to use VR for improving hitting performance," says Dr. Jinji.

For more information on Next Base, visit: nextbase.co.jp/en

"Our Vicon technology is a vital part of our lab, not only for motion capture but also for visualizing our data in a way that our athletes can understand - Dr. Jinji."

As well as being similarly well-versed in the biomechanics of pitching and hitting, many of Next Base's staff have played baseball at a competitive level. This hands-on experience of the sport gives them an advantage in explaining the scientific data in practical terms to the players they work with.

Next Base caters for athletes from the Nippon Professional Baseball leagues (NPB) right down to school-age players. Many of the players they assess are pitchers, but the number of hitters coming through is increasing, bringing more variety to the company's practice. "Training requirements vary from player to player," says Dr. Jinji. "Our goal is to provide safe and effective training

protocols tailored to each athlete's personal technique and needs."

THE NEXT BIG SWING

In 2022, a surge in demand for Next Base's services prompted the company to take the next step and build Next Base Athletes Lab. "Prior to opening our lab in August last year, we rented facilities to work with our athletes. With the increase in the number of players we were seeing, we invested on our own to establish a dedicated motion analysis lab, located 30 minutes away from Tokyo Station. The lab is equipped with 14 Vicon Vantage cameras, three force plates integrated through Vicon Nexus, four RAPSODO

baseball tracking units, and an InBody body composition analyzer," says Dr. Jinji.

"The recent advancements in sports technology have been immense," he explains. "Our Vicon technology is a vital part of our lab, not only for motion capture but also for visualizing our data in a way that our athletes can understand. Alongside conventional strength-training methods, we have introduced velocity-based training tools to enable athletes to continuously measure their improvements. On top of this, to enhance hitters' cognitive abilities, we have developed our own virtual reality system."