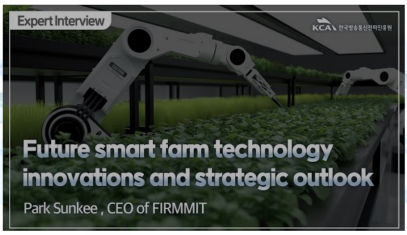
Expert Article

Future smart farm technology innovations and strategic outlook

Park Sunkee , CEO FIRMMIT

#SmartFarm #Farming #Robotics #Environmental Protection #Food Security



1. The smart farm industry's latest developments

Figure: Autonomous tractors, harvesting and lifting robots

The smart farm industry in Korea has experienced remarkable growth and development in recent years, driven by a variety of factors. The smart farm industry is contributing to optimising the growth conditions of crops and improving productivity by applying advanced technologies such as precision agriculture technology, IoT (Internet of Things), big data analytics, and artificial intelligence to the agricultural sector, as detailed below.

1) **Precision agriculture:** Increasing adoption of precision agriculture technologies that incorporate IoT sensors to monitor soil moisture, temperature, and nutrient levels in real-time to enable optimised irrigation and fertiliser planning, as well as leverage technologies such as GPS, drones, and satellite imagery for more precise crop management.

2) **Robotics and automation:** Advances in robotics have led to the development of autonomous agricultural machines for tasks such as sowing, weeding, and harvesting, and robotic systems equipped with artificial intelligence (AI) and computer vision technology are helping to reduce labour costs and increase productivity by enabling targeted and efficient crop management.

3) **Data analytics and AI:** The expansion of data analytics platforms and AI algorithms for predictive modelling is helping farmers make data-driven decisions, and AI-based solutions are analysing vast amounts of agricultural data to predict yields, detect diseases, and optimise crop inputs to improve overall efficiency and profitability.

4) **Vertical farming and controlled environment agriculture (CEA):** The growth of vertical farming and CEA systems is enabling year-round crop production in controlled indoor environments, integrating smart sensors, LED lighting, and climate control systems to create optimal growing conditions and maximise yields and resource efficiency.

5) **Blockchain and traceability:** Blockchain technology can be implemented to increase traceability and transparency in the food supply chain, which enables farmers to track the movement of their products from farm to fork to ensure food safety and quality assurance for consumers.

6) **Remote monitoring and management:** Remote monitoring and management solutions have been expanded to enable farmers to monitor operations from anywhere via mobile devices, providing real-time insights into farm activities through remote irrigation systems, surveillance cameras and drone monitoring to improve operational efficiency and safety.

2. ICT innovations in smart farms

ICT technology has brought about various innovations in smart farms. It enables farmers to monitor the growing environment of their crops in real time and make optimal farming decisions based on data. In addition, automated systems are improving agricultural productivity by efficiently delivering water, fertiliser, and controlling pests.

Figure: Controlling the farm environment through sensors

1) **Sensors and IoT technology:** Environmental monitoring is used to monitor the environmental factors of crops in real time. Temperature, humidity, soil conditions, etc. are measured to provide optimal conditions and respond quickly to any problems. In addition, IoT automation technology can be used to automatically perform watering, fertiliser application, temperature control, etc.

2) **Big data and machine learning:** Smart farms collect data to predict crop growth, pest outbreaks, harvest timing, and more. This allows farmers to make optimal decisions, and machine learning algorithms are used to predict crop growth and yields.

3) **Drones and robotics:** Drones are used to take pictures of farmland and monitor crop health. Drones are also used to spray pesticides. Automated robots make farming more efficient. For example, automated harvesting robots harvest crops accurately, and tillage robots manage soil.

4) **Artificial intelligence (AI):** AI can be used to diagnose diseases, pests, and nutritional status of crops and automatically adjust crop management based on environmental conditions.

3. How automation systems in smart farms can improve agricultural productivity

Figure: Strawberries being grown using automation systems and ICT technology

Automation systems used in smart agriculture play an important role in increasing agricultural productivity. By automating repetitive tasks such as sowing, irrigation, and harvesting, farmers can streamline operations, reduce labour costs, and improve overall efficiency. This not only increases yields but also helps farmers manage their crops more efficiently.

1) **Automated irrigation systems:** Smart farms monitor the moisture status of crops in real time and automatically water them as needed. This minimises water wastage and supports continuous crop growth.

2) **Automatic temperature and humidity control:** Smart farms use sensors to detect the temperature and humidity of the crops, and automatically adjust to maintain optimal environmental conditions to improve crop growth.

3) **Automatic fertilisation:** Smart farms can provide crops with the exact nutrients they need, optimise fertiliser use and control the growing environment to increase productivity.

4) **Data-driven decision-making:** Smart farms collect and analyse sensor data to support farming decisions. This support can be used to plan the optimal work schedule, taking into account crop growth, soil conditions, weather, etc.

4. Smart farms and sustainable agriculture: importance and linkages

The importance of smart farming for sustainable agriculture cannot be overstated. With the global population expected to reach 9 billion by 2050, there is a growing need to produce more food with minimal impact on the environment. Smart farming technology can help us to keep the following aspects sustainable

1) **Environmental protection:** Smart farms leverage advanced technologies such as precision agriculture techniques, the Internet of Things (IoT), big data analytics, and artificial intelligence to optimise growing conditions for crops and maximise the efficiency of resource use. This can increase crop yields while reducing the negative environmental impacts of agriculture, such as maintaining soil health on farmland.

2) **Maintaining food security:** Smart farms can monitor crop growth in real time and make optimal farming decisions based on data. Extreme weather conditions and natural disasters caused by climate change have a major impact on agriculture, and precise management of the growing environment can help mitigate these impacts.

3) **Economic benefits:** Smart farms provide economic benefits to farmers by maximising the efficiency of farming operations by increasing crop productivity and reducing costs. This helps farmers to sustain farming.

Figure: Capabilities covering all aspects of agriculture

In FIRMMIT's view, the most important strategy for competing in the smart farm market is to have the capability to handle the entire agricultural process, from construction to seed cultivation, farm inputs supply, and distribution. Managing the entire agricultural process allows a company to control every aspect of agricultural production to increase efficiency. Specifically, oversight at each stage ensures that consistent quality standards are maintained throughout the production process, providing consumers with high-quality products. Furthermore, by streamlining operations and eliminating intermediaries, businesses can become more cost-effective, which can lead to profitability and better quotes for consumers.

To secure this competitiveness, FIRMMIT is building smart farms, developing and distributing wireless ICT, developing and discovering competitive agricultural inputs, and distributing Cinderella strawberry (white strawberry) varieties to farmers from 2022, and has completed the development of new strawberry varieties (FIRMMIT 1943 and Tinkerbell) and filed for varietal applications earlier this year.

Another important strategy is to develop solutions for high-value crops. Developing solutions for high-value crops is critical to contribute substantially to agricultural revenue, meet consumer demand for healthier and fresher produce, drive technological innovation and enhance agriculture's global competitiveness.

To this end, FIRMMIT has and is continuously improving and developing specialised growing solutions for strawberries, a high-value crop, and is currently producing and distributing strawberry growing calendars and textbooks so that anyone can learn from the experts.

Figure: Researching different training and technologies to develop solutions for high-value crops

Industry Trends

Cutting-edge technology revolutionising the future of agriculture: Introducing smart farms

With the recent global food security challenges, the smart agriculture industry is growing day by day, driven by technological innovation and global trends. While there are external factors such as population growth and climate change behind the expansion of the market, it is also being driven by increased investment from governments and private companies. In particular, the EU is promoting smart agriculture initiatives under the 'Green Deal' strategy, and policy support from governments is strengthening, including subsidies and regulatory frameworks. Smart agriculture is also contributing to sustainable agricultural practices by leveraging sensor technology, big data analytics, artificial intelligence (AI), and Internet of Things (IoT) devices to maximise crop productivity and improve resource utilisation.

The revolution that smart agriculture will bring is a departure from the classical method of simply ploughing fields. It is about developing sustainable farming practices by leveraging AI convergence technology and information systems to streamline food production, optimise resource utilisation, and protect the environment.

#Future of Agriculture #Autonomous Tractors #Drones #Vertical Farm #Precision Agriculture

Smart farm technology as a sustainable farming method

The first axis directly related to sustainability issues is global warming. Under warming weather and resource constraints, it is necessary to increase yields, improve resource utilisation efficiency, and produce crops reliably. While conventional agriculture requires the use of large amounts of chemical fertilisers and machinery, smart agriculture is playing an important role in sustainable agriculture. Along with eco-friendly efforts such as reducing CO2 emissions and protecting biodiversity, energy-saving facilities and closed-loop hydroponic systems have been developed to reduce the impact on global warming.

The other pillar is the global food crisis. According to the Food and Agriculture Organisation (FAO), the world's population is expected to reach 9.7 billion by 2050, requiring at least a 70 per cent increase in current food production.

Smart agriculture relies on reliable data

Market trends in the smart agriculture market are focusing on the need for reliable data analytics. Recent statistics from international research organisations and experts have demonstrated that technological innovations such as AI, IoT, and big data analytics are contributing to increased agricultural productivity. For example, official reports from the World Bank and the Food and Agriculture Organisation (FAO) confirm a positive correlation between the amount of investment in precision agriculture technologies and the growth in crop yields.

The rise of autonomous tractors and agricultural support robots

Source: Clipart Korea

Firstly, a major issue in the smart farm technology space is the emergence of autonomous tractors and agricultural support robots. They work within information systems to enable efficient cultivation management. Autonomous tractors and harvesting support robots can save time and money while providing high accuracy.

Next is the introduction of Internet of Things (IoT) technology. Big data collected by sensors, unmanned aerial vehicles (drones), and satellite imagery is enabling precision farming and improving crop productivity. In particular, real-time monitoring of soil moisture and nutrient levels has led to more efficient water management and optimised fertiliser use.

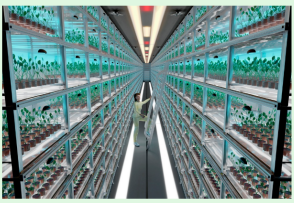
In addition, artificial intelligence (AI) technology, from data analytics to decision support, is helping farmers as the "invisible hand" in pest prediction and crop timing, enabling them to accurately predict market demand. AI technology is being used in conjunction with pest prediction models to help optimise the timing of harvest and irrigation. In particular, AI is being used to determine the quality of fruits and vegetables at harvest time, and systems are beginning to be introduced that can identify maturity and size from image data captured by cameras and harvest them with speed and accuracy comparable to or better than human labour.

Example: Utilising drones

The United States and China are using agricultural drones to efficiently spray pesticides over vast tracts of farmland, reducing labour time. Once the drone's route is set, it flies automatically to apply pesticides, eliminating the need for real-time operation and enabling it to reach places that are difficult for humans, such as slopes.

In addition to spraying pesticides, the drone's far-infrared camera can also be used to monitor crop growth. Other indicators of crop health include NDVI (Normalised Difference Vegetation Index), which is measured from the wavelengths of light reflected by crops using sensors on the drone that can detect visible and near-infrared light. This allows for quicker response to pests and other situations, and can increase yields and improve productivity.

Source: Clipart Korea



Source: Clipart Korea

Example: Vertical farm

In vertical farming, crops are stacked vertically in a completely enclosed indoor environment and illuminated by LED lights from above. This allows for the production of high-quality, highly nutritious crops without the need for natural light or soil nutrients.

In the Netherlands, despite limited farmland and a variable climate, the country produces a large amount of high-quality vegetables and herbs. They utilise vertical farms with automated control systems to create the best environment for their crops. By installing sensors to measure temperature, humidity, and carbon dioxide levels in the growing spaces, which are linked to an automated control system to ensure the best possible conditions at all times, they reduce the risk of external factors such as weather, pests, and disease affecting production.

In the Compton district of California, USA, a vertical production system has been established with a plant factory. Since it does not require extensive land, it can be produced even in the suburbs of large cities, saving on transport costs. They have partnered with large distribution chains to ship their vegetables and fruits.

Example: Precision Agriculture

The concept of precision agriculture is being realised through the convergence of artificial intelligence (AI) and robotics. AI analyses large amounts of data to find the optimal growing conditions for crops. Detailed information collected through sensor technology, such as soil humidity, pH value, temperature, and plant growth status, is analysed in real time to accurately adjust the amount of water and nutrients needed, allowing for optimised management of each crop. The aim is to increase yields and reduce costs by applying resources at the right time, in the right amount, and in the right place.

In Japan, precision agriculture is being practised in large rice fields using drones and satellite data. Specific image analysis software is used to monitor the health and growth patterns of crops and develop plans to distribute fertiliser and moisture appropriately. This technology is notable because it not only maximises yields but also reduces resource waste.

This means that real-time weather and soil conditions can be identified to create optimised planting plans based on precision agriculture, and risk management is enhanced through simulation in a virtual space called a 'digital twin'.

Source: Clipart Korea

Global status

From a global perspective, smart agriculture is being deployed in different forms around the world. In the Nordic countries, precision agriculture is gaining traction as a sustainable production method and is actually being used as an adaptation to climate change. In the US and Australia, large-scale farming operations are being automated and remotely monitored to improve efficiency and productivity.

Meanwhile, emerging countries are also adopting smart farm technology for resource management and food security. In India, for example, small-scale farmers are using low-cost sensors and mobile devices to monitor crops and predict crop health and water needs.

In China, the government is stepping up investment in smart agriculture, introducing AI-enabled livestock management systems and high-accuracy weather information services. This is not only to address local challenges but also to enhance competitiveness in the global market.

Smart agriculture technology is a combination of information and communication technology (ICT), artificial intelligence (AI), and Internet of Things (IoT) devices, and is regarded as a sustainable way of growing food. It is essential to increase agricultural productivity while reducing the burden on the global environment.

Precision agriculture, for example, utilises sensors and satellite data to monitor soil conditions and crop growth in real time. This ensures that only the minimum amount of water and fertiliser needed is applied at the right time and in the right place.

Automated irrigation systems also reduce water waste, and drone technology is helping to optimise pesticide use in pest management. These smart farming technologies are not only environmentally friendly, but they are also expected to increase crop yields and improve quality.

In addition, investments in driverless tractors and crop monitoring systems using drones are helping to alleviate labour shortages and increase production efficiency. Smart farming as a sustainable cultivation method with the convergence of ICT technology is expected to be a strategy to respond to various external environments.

Reference

- Smart Farm_Introduction to the cutting-edge technology revolutionising the future of agriculture

4IND Co., Ltd.

Core Technologies and Achievement Highlights

- Registered as a research institute through investment attraction from the Electronics and Telecommunications Research Institute (ETRI)
- Obtained 1st grade of GS certification for AI solution (BOM Platform)
- AI vision inspection solution (BOM Inspection) achieved KRW 599 million in sales
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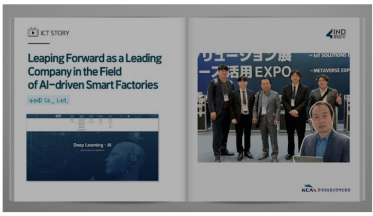
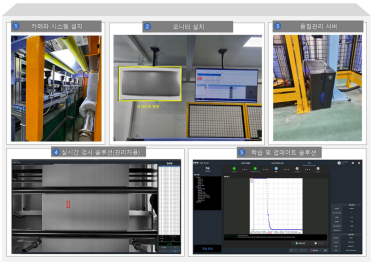


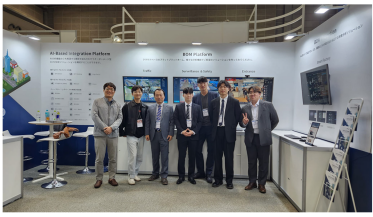
Plunging into a market full of possibilities



Steel surface inspection through the BOM Inspection system

4IND specializes in big data,5G,and visual perception AI technologies within the imaging field,with specialization in DNA technologies,including data processing,network integration,and AI algorithms.For the past six years since its establishment in 2017,4IND has been running with the vision ofleaping forward as the global number one company in the field of visual perception AI solutions.Based on the self-developed integrated platform'BOM Platform',we now provide optimal services in the field of smart cities and smart factories that apply video AI technology.4IND that needed a specialized AI model for each type of manufacturing at the request of Aju Steel,a mid-sized steel company based in Gumi,participated in the ICT Funding Project to develop a purely domestic vision inspection system to replace foreign equipment.Thanks to this,we were able to provide the client company with AI-based smart factory services it needed to overcome its limitations as a mid-sized company.Machine vision is a key element of industrial automation systems and is expected to play an important role in the development of smart factories in Industry 4.0.Currently,it is mainly used in the field of visual inspection of key components that make up advanced precision materials and products,such as semiconductors,electrical and electronic equipment,and automobiles,as well as traditional PCB inspection.According to Frost&Sullivan,a global research firm,the global machine vision market is expected to grow.The domestic machine vision inspection system market is estimated to be worth KRW 1.2 trillion in 2021,and it is expected to grow at an average annual rate of 6.4%down the road with a market size of more than KRW 1.6 trillion by 2026.4IND aims to align its corporate development with the expanding market.

Found the optimal solution to achieve outstanding results



In order to improve work quality and reduce defect rates at Aju Steel,the client,we carried out a smart factory supply and diffusion project along with a project designed to strengthen the competitiveness of industrial clusters.When we achieved a successful outcome and completed the project,we judged that the domestically developed solution was more competitive than foreign ones in terms of the quality improvement of the new equipment and the scalability of the intelligent engine.Thus,we applied for the AI Voucher Support Project to address the issue of quality defect identification for HMFJ,a recently established CFM production facility.The task was promoted to improve product quality through an AI-based intelligent system by solving the problem of relying on people for post-production quality control due to a lack of an appropriate system to identify quality defects in steel production facilities.When various atypical defects occurred on the steel surface,the system enabled AI to recognize in real time and give an alarm,thereby preventing the continuous occurrence of defects and preventing entire steel rolls from being discarded as defective products.It also enabled us to analyze big data on defects that occurred during the production process and use it as valuable data.However,while carrying out the task,we had difficulties optimizing the AI algorithm model due to the insufficient amount of steel defect data.At the end of the day,we were able to achieve great results by finding the optimal algorithm through the development of labeling minimization technology and lightweight technology,etc.and providing the client with a vision inspection solution for detecting microdefects on steel surfaces.

Successful technology development leading to overseas market expansion

After participating in the Fund Project,the client Aju Steel created 34 new jobs and achieved related sales of KRW 22.6 billion while 4IND generated 6 new jobs and attained KRW 950 million in sales in addition to 8 commercialization cases.In addition,we applied object recognition and identification technology to production facilities while securing real-time performance by applying lightweight technology to the automation system.We also improved the employees'job satisfaction by reassigning personnel who previously conducted simple inspections to specialized jobs.Through R&D related to AI and deep learning-based image recognition and intelligent processing,4IND has secured the original technology that can be used by similar industries that require object and event recognition technology based on image and video data.The machine vision technology applied to the project can also be used as an integrated control system.The intelligent CCTV integrated control solution can prevent crime by identifying signs of crime so it is expanding in conjunction with the mission of the National Police Agency in the areas of surveillance and crime control.The solution is expected to play a role as a security service for the overall social safety field by supplying video information needed for public safety,crime prevention,traffic control,and weather forecast.Furthermore,it can be applied not only to the production and manufacturing fields,but also to various other fields such as autonomous mobile robots,driver assistance systems,industrial drones,biometrics,and medical imaging.4IND is aggressively marketing BOM Platform,an integrated control system developed by the company,not only in Korea but also for overseas markets such as Japan and Indonesia.For the steel surface defect detection and data management solution developed through the project,the company currently receives many orders from related companies in Korea.The solution can be applied to similar fields.Being pilot tested with several manufacturing companies,the solution delivers meaningful sales outcomes to the company.As there are orders from domestic companies/overseas factories in Vietnam,among others,4IND plans to steadily advance with the goal of making inroads into overseas markets.

ICT Funding Project

- **Dedicated Institution** National IT Industry Promotion Agency
- **Business Objective** Creation of intelligent information industry infrastructure
- **Business Description** AI voucher support

Company information

- **CEO** Lee Chaesoo
- **Type of Business** System software development/supply business
- **Year of Establishment** 2017. 02.
- **Website** www.4ind.co.kr

TIME LINE

2017. 2.
Founded 4IND Co., Ltd.

2018. 9.
Received the certificate of venture business

2019. 6.
Established a company-affiliated research institute

2020. 8.
Obtained ISO9001 and Inno-Biz certification

2020. 11.
Selected as a military service-designated entity

2022. 3.
Selected as an excellent supplier of AI Voucher

2022. 10.
Obtained GS (Good Software) certification (Level 1)

2023. 3.
Selected as a research-based spin-off company (Korea Innovation Foundation)

2023. 4.
Selected as a strong domestic company eligible for the Export Voucher Program

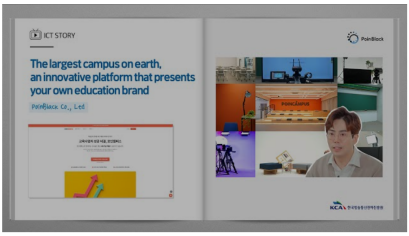
Selected as one of the top 100 companies in materials, parts and equipment

The largest campus on earth,an innovative platform that presents your own education brand

PoinBlack Co., Ltd

Core Technologies and Achievement Highlights

- Advancement of the artificial intelligence-based learning management system: it has surpassed 2,000 clients of 'PoinCampus.'
- Establishment of 'Creator Town,' a studio specializing in educational content production.
- Selected as a government voucher business supplier for four projects.



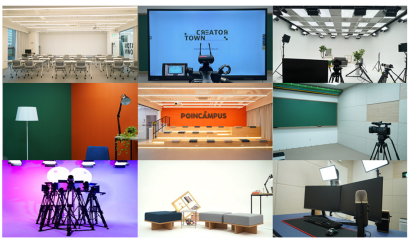
NPoinBlack, leading the innovation of digital education, resolves learning disparities

Non-face-to-face daily life that COVID-19 brought about and the development of digital technology have changed how we communicate with the world.The same goes for the field of education.Nowadays,many places where education is needed,such as universities,public institutions,and companies,provide remote education optimized for non-face-to-face learning,enabling learners to conduct self-directed learning without time and space constraints.However,online classes have limits in continuously improving learning outcomes.In addition,since distance education,the educational gap among learners has widened.PoinBlack Co,.Ltd.was founded in May 2020,when COVID-19 was in full swing,As educational institutions across the country changed from face-to-face learning to non-face-to-face,they had to provide educational services that fit the change.In line with this,PoinBlack has developed an online education service called'PoinCampus,'which is a Software as a Service(SaaS)model.PoinBlack's core service is the Learning Management System(LMS),accelerating the digital transformation of the education industry by providing low cost,excellent convenience,and strong scalability.Recently,by combining deep learning and machine learning-based artificial intelligence technology using a large amount of customer data,it analyzes learners'learning patterns in detail and derives personalized learning paths,preparing measures to achieve learning goals and improve achievement.

Creating my own online campus easily for everyone

PoinBlack created'my unique online campus that anyone can easily make(all-in-one education solution SaaS)'through a fund project.At that time,schools introduced'EBS online classes'to replace on-site classes,while most other educational institutions were closed.They considered developing their own LMS but faced cost and time barriers,and existing rental services were difficult to reflect the characteristics of each educational institution due to the standardized user interface(UI).PoinBlack spotted a market opportunity here.It launched'PoinCampus,'which allows all users to easily build educational services under their own brands and customize them for each educational environment.As a result,PoinBlack was able to secure various customer companies.Through this support project,PoinBlack moved into the Digital Content Company Growth Support Center with support from the Ministry of Science and ICT,Anyang City,and the National IT Industry Promotion Agency.The goals were:to enhance the platform's scalability by advancing the'PoinCampus,'and to build a profit-generating customer model through e-commerce systems.

Leading the future of education in the era of artificial intelligence



In the first half of 2020,when PoinBlack started its business,customers had difficulty adapting to suddenly changed online classes and digital tools.However,in the second half of the year,customers gradually adjusted to the new environment,and learners also expressed satisfaction with the convenience of non-face-to-face classes.Along with these changes,users'requirements have also evolved.Firstly,since the operational methods of educational institutions vary,there has been a growing demand for the development and customization of various learning tools.Secondly,the need to establish an e-commerce system to generate profits for educational institutions has increased.Customers wanted to sell their content and expertise and monetize them.In response to these customer needs,PoinBlack swiftly integrated payment,refund/cancellation,and settlement management systems into PoinCampus.As a result of these efforts,PoinCampus achieved rapid growth in a short period of time.The number of customers,which was 75 as of the end of 2020,surpassed 2,000 by 2022.Additionally,PoinCampus attracted KRW 2.8 billion in pre-series A investment from the Korea Startup Investment Database(VC)and listed companies.Another significant development was the utilization of artificial intelligence technology for analyzing educational content and learning data gathered from each client company's campuses.This project enabled us to provide personalized learning paths tailored to each learner's learning style,speed,and comprehension.By analyzing learning behaviors,patterns,and progress,we were able to identify areas of weakness or improvement,thereby increasing motivation.Furthermore,we analyzed large-scale learning data to provide educational institutions and instructors with valuable information for enhancing learning content.Currently,we are in the process of developing a system that utilizes generative AI technology to generate optimal educational content and automatically create suitable quizzes.We also have plans to launch an AI tutor that can automatically answer learners'questions.

Unceasing challenges for co-growth with our clients!

In September 2022,PoinBlack opened "Creator Town,"a 1,000 square meter facility in Pyeongchon,Anyang City.This specialized educational space offers various concept-driven areas,including studios,lecture halls,seminar rooms,and Horizon.It provides comprehensive support for video production,live broadcasting,online and offline education,as well as consulting services.PoinBlack's future business strategy is to expand to the education IP business by integrating educational content production studios called'PoinCampus'and'Creator Town.'This focuses on providing new revenue generation opportunities for customers by combining educational content production capabilities with its expertise in launching online brands.Through Value-Chain established in this way,customers can launch independent educational services using PoinBlack's infrastructure.Furthermore,customers can expand into a premium educational business cooperating with PoinBlack.In the second half of 2023,we are planning to launch more than five educational projects.To this end,it is co-developing educational IP in cooperation with world-class companies in various fields such as star1-up,asset management,sports,and coding education.Moreover,the blueprint for entering the global market has been completed to a degree.To enter the global market from 2024,PoinBlack has developed technology to supports all elements of educational content,such as video audio,subtitles,and text,in various languages.

ICT Funding Project

Dedicated Institution	National IT Industry Promotion Agency
Business Objective	Activation of digital content industry ecosystem (informatization)
Business Description	Activation of digital content industry ecosystem (informatization)

Company information

CEO	Lim Jihwan
Type of Business	Database and information provision
Year of Establishment	2016. 6.
Website	https://poincampus.com

TIME LINE

2016. 6.
Established PoinBlack Co., Ltd.

2017. 4.
Attracted the Angel Investment

2018. 1.
Launched PointTime, a timetable management solution

2018. 12.
Venture company certification

2019. 8.
Launched PoinOn, a subscription-type online education OTT platform

2020. 5.
Launched PoinCampus, a SaaS-based education management solution

2022. 5.
The 19th Korea Education Fair 'Education Industry Influence' Award

2022. 6.
Established "Creator Town," a studio specializing in educational contents

2023. 4.
Selected as a supplier for distributing and spreading cloud services

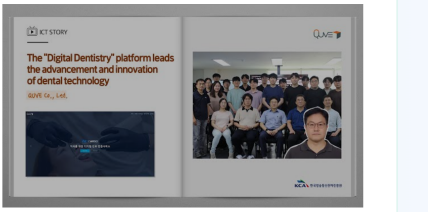
2023. 5.
Selected as a supplier for SME smart service support project

The"Digital Dentistry"platform leads the advancement and innovation of dental technology

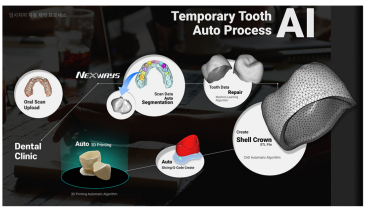
QUVE Co., Ltd.

Core Technologies and Achievement Highlights

- Advancing the One-Stop Service Platform through the Digital Dentistry Center
- Introducing a remote-controlled solution for producing temporary teeth using Fused Deposition Modeling (FDM) printers and eco-friendly materials
- Acquiring and utilizing 50,000 tooth AI data along with advanced processing technology
- Developing in-house dental CAD software and implementing design automation for enhanced efficiency



Innovative dental technology: Digital Dentistry



AI-enabled temporary teeth automated design and remote control output process

The domestic market for dental equipment and materials has been experiencing steady growth,with an average annual growth rate of 8.5%.As of 2021,the market is estimated to be valued at KRW 1.8 trillion.Notably,the domestic dental 3D printing industry,which plays a crucial role in producing temporary teeth,is growing at an even faster pace with an average annual growth rate of 21%.This growth is expected to accelerate further due to the rapid adoption and expansion of digital dentistry practices across the industry.By digitizing the entire dental treatment and therapy process,and where a dentist scans a patient's mouth with a 3D scanner,Digital dentistry automates analysis,design,and production based on professional modeler and AI technology and even provides a digital guide for the procedure.In other words,it maximizes accuracy and convenience in the entire dental treatment process.QUVE Co.,Ltd.,established in 2015,initially focused on the mobile survey business.However,in December 2019,the company expanded its scope by venturing into the digital dentistry sector.Through its Digital Dentistry Center,QUVE offers a comprehensive one-stop service that encompasses equipment procurement,CAD design,dental laboratory connections,logistics,and financing.The aim is to enable regular dental clinics to implement and utilize one-day clinics,which were previously limited to comprehensive hospitals and larger medical facilities.In addition to its digital dentistry endeavors,QUVE has also developed specialized mobile survey solutions tailored for the hospital sector.The company has implemented an online survey system for evaluating patient experiences at university hospitals and large medical facilities,seeking to achieve synergy between digital dentistry and the field of hospital services.

Data collection and AI analysis through the Digital Dentistry platform

AR glass, voice-recognition dental diagnosis video

Intelligent information technology,which combines advanced information processing capabilities with ICT(Information and Communication Technology),plays a pivotal role in driving"innovative growth"in the era of the Fourth Industrial Revolution.It is a critical factor not only in enhancing people's quality of life by addressing long-standing social issues but also in fostering innovation across all industries,including the dental sector.As part of the effort to promote private intelligence information services,QUVE Co.,Ltd.participated in the"real-time 3D oral information artificial intelligence measurement and prosthetic design service development project based on the Digital Dentistry platform."This project was supported through the ICT Funding Project.While the domestic 3D oral information AI analysis service was not initially available,the company recognized its significance for treatment and research purposes.Aligning with its goal of developing a comprehensive one-stop solution through the Digital Dentistry platform,QUVE Co.,Ltd.proceeded with the project in collaboration with NexWays(www.NeXways.kr).With the increasing availability of intraoral scanners and 3D printers,the groundwork for the widespread adoption of Digital Dentistry is being laid.However,the utilization of digital devices in dental practices remains relatively low,with many still relying on traditional analog methods such as impression takings and creating gypsum models.Accordingly,QUVE Co.,Ltd.collected intraoral scan data by developing"NeXways,"a digital dentistry platform that provides prosthetic design CAD work and temporary prosthetic remote output services to enable digital dentistry even in small private hospitals.And it automated the process of separation/measurement,diagnosis,and design of individual teeth using artificial intelligence.By shortening the treatment process and time,it realized a one-day clinic.And in the mid-to long-term,it established the foundation that scan data collected and accumulated are analyzed and used in various fields such as research,treatment,commercialization,policy,etc.

The potential for utilizing AI data grows as oral and dental data is organized into databases

After the support project,QUVE Co.,Ltd.successfully collected and organized a significant amount of oral data from an increasing number of hospitals utilizing their platform.This enabled them to create a comprehensive database,leading to a reduction in workforce and time burdens at dental clinics.Additionally,by specializing dental laboratories,they were able to achieve cost savings and lower medical expenses.The sales of their digital dentistry platform services have shown a steady upward trend,with remarkable growth rates.In 2022,there was a substantial increase of 308%compared to the previous year,and in the first half of 2023(expected),the growth is projected to be 243%compared to the same period in 2022.The accumulated intraoral scan data can be used for various dental treatment studies through AI analysis,etc.,and medical services optimized for patients'oral conditions can also be provided.In particular,data processing technology,artificial intelligence models,and services can be applied to other industries that use 3D scanners.QUVE Co.,Ltd.also commercialized a model that remotely outputs temporary teeth from dental clinics and applies them to patients by utilizing 3D printers that can automatically design temporary teeth by using AI data.

Expanding global services and developing dental education content based on achievements

QUVE Co.,Ltd.plans to distribute the Newways platform,which is currently being used in about 25 dental hospitals nationwide,including university hospitals such as Yonsei University Dental Hospital and Seoul National University Dental Hospital,to 100 dental clinics in 2023,500 dental clinics in 2024,and 2000 dental clinics in 2025.From the second half of 2023,to spread digital dentistry platform services,it plans to launch a global service,NeXways.ai,by establishing joint ventures(JV)with local dental companies,starting in California,the U.S.Based on this,the service will be spread to Japan and the UAE by the first half of 2025.It also plans to develop dental education content using already established dental AI data and use them to train dental professionals and educate oral hygiene by target and level,such as children in kindergartens and the elderly.In addition,it plans to develop additional dental AR/VR services to commercialize device linkage.

ICT Funding Project

Dedicated Institution	National IT Industry Promotion Agency
Business Objective	Spread of private intelligence information service
Business Description	Fostering companies specializing in industry-linked digital transformation

Company information

CEO	Kim Jinsu
Type of Business	Application software development and supply
Year of Establishment	2015. 12.
Website	www.quve.kr/www.NeXways.kr

TIME LINE

2015. 12.
Establishment of "QUVE SEVENTEEN" Co., Ltd.

2019. 12.
Start of Digital Dentistry Center Service

2021. 5.
"Expansion of private intelligence information service" - NIPA project commencement (2 years, 1 billion/year)

2021. 12.
Attracted Pre-A investment (Maple□, "Shinbo NBK", "Enlight Ventures", etc.)

2022. 2.
Medical device manufacturing certification: Temporary crown resin PLA (GA1) and 2 other cases Ministry of Food and Drug Safety No. 7972

2022. 6.
Started PLA material-FDM printer remote control provisional crown manufacturing service

2022. 10.
Selected as 2022 baby unicorn 200 fostering project (Startup & Entrepreneurship Development Institute)

2022. 11.
New selection of companies designated for military service (research institutes) in the second half of 2022

2023. 6.
Designated as an excellent company research institute in 2023

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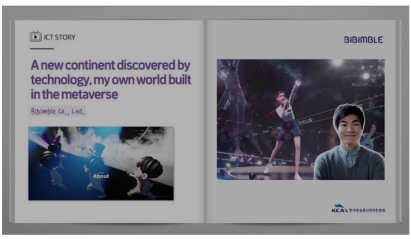
Bibimble Co., Ltd.

Core Technologies and Achievement Highlights

- Patented and commercialized 'HoloMR' technology, a hologram technology that allows you to see interactive virtual reality with your naked eyes

- Operate multiple metaverse virtual exhibition halls, such as the Ministry of Science and Technology's 'Metaverse Alliance Open Conference' and the Ministry of Land, Infrastructure and Transport's 'Smart Geo Expo'

- Operate multiple talk concerts using historical figures and digital humans



Metaverse, imagination becomes reality

Metaverse 'Vickers main play space screen

The metaverse,familiar from movies and games,has taken root in our daily lives in the aftermath of the COVID-19 pandemic.It has expanded its influence ranging from social media using avatars to exhibitions,university festivals,job fairs,and school classes without missing a beat.Bibimble Co.,Ltd.,a company specializing in metaverse,was established in 2018 by first-generation VR technology experts to deal with new technologies from a convergence perspective and provide innovative services.The name'bibimble'is a portmanteau of'bibim',a colloquial Korean word meaning technology convergence,and'able'meaning the possibility to do something.The goal is to create a new user experience,culture,and lifestyle by converging cutting-edge digital media technologies with the motto,Imagination becomes reality. when our technology meets your imagination.Bibimble is leading the convergence market by providing innovative technology-based experiences to users through convergence contents such as virtual reality,augmented reality,hologram,metaverse,and AI digital human.Since the pandemic,we have built and operated metaverse exhibition halls and showrooms for various institutions/brands,and currently provide customized B2B and B2C solutions and services driven by metaverse original technology.

Can't everyone experience virtual reality together?

Bibimble's main service is called'HoloMR'.It is a mixed reality'technology that compensates for the shortcomings of existing VR,AR,and holograms,and projects virtual objects in the form of holograms around VR users.This technology,which was conceived from a shift in thinking that envisions the possibility to see and experience virtual reality together without wearing a VR device,immediately drew keen attention upon its release to the market.Since then,we unveiled'HOLOBEATS',a VR game that applies HoloMR technology,at the Busan International Film Festival,receiving a warm response,and have also operated a number of talk concerts using historical figures and digital humans.One of them is the'Baekbeom Kim Gu Hologram Talk Concert',which restored national hero Baekbeom,Kim Gu through HoloMR in celebration of the 100th anniversary of the establishment of the Provisional Government and the March 1st Movement.Using this metaverse technology,Bibimble has promoted non-face-to-face digital transformation in all industries.It provides metaverse solutions and services in various fields,and endeavors to bring a new type of brand experience by opening the metaverse exhibition market.In particular,we decided to participate in this ICT Funding Project to lead the next-generation business where content experience is more accessible by implementing the browser-type metaverse that users want.As value-oriented consumption is trending recently,there is a prevailing trend in the industrial field to express brand values using pop-up stores and flagship stores.Following this trend,Bibimble has developed a service solution that provides customized spaces and contents for brands.In keeping with the MZ generation's propensity to express themselves,it is expected that technology using'digital humans'will be able to meet the various demands of the market.

Implementation of an experiential metaverse that communicates and shares

During the pandemic,metaverse was the representative keyword for non-contact solutions.However,it is true that there were concerns about the industry given that the solutions developed by the existing front runners showed their limitations with disappointing quality,and the services that domestic and foreign companies scrambled to launch has not received a great response.At this time,Bibimble formulated a strategy to take a different approach.What people are cheering for is not the'metaverse'itself,but it is the capturing the concept of'expressing oneself'using the digital infrastructure.The service for this purpose is the special pop-up store booth Blocsat Seoul Fashion Week held at DDP,Dongdaemun in March 2023.Under the theme of a platform to express myself,it was an event where OOTD(outfit of the day)3D scanning was conducted for onsite visitors and captured in a metaverse like a figure,attracting large crowds who gathered to experience the service firsthand as if reflecting the need for self-expression.The goal of Bibimble is to complete a browser-type metaverse that anyone can easily create and connect together,unlike the existing metaverse method.During the last World Cup in Qatar,a metaverse exhibition was implemented as a pilot in which 240 soccer-related collectibles owned by the E-Land Group were scanned and exhibited in 3D.From soccer all-time greats Pele and Maradona to superstars Messi,Neymar,Kevin de Bruyne,Suarez,Son Heungmin,and retired star Park Jisung,the winning trophies,medals,uniforms,equipment,and World Cup collections of famous players were on display,attracting the keen attention of companies and institutions.When the technology test is completed,our plan is to expand into a digital platform that integrates digital channels into one,along with the implementation of a complete metaverse browser.

Bibimble's digital land, a new metaverse world

There is a metaverse world that Bibimble dreams of.It is a brand metaverse where users themselves become brands through these services and express their own content.Through the technology and know-how of Bibimble,we are creating a new paradigm for interaction in Digital Land by creating spaces for B2C in the form of one's own metaverse and B2B as a digital showroom metaverse for promoting companies.To this end,Bibimble is preparing a store-type digital showroom service for companies and brands.With browser-like accessibility,users can not only directly produce branded products as metaverse content,but also sell branded services through UGC(user-generated content)through metaverse.Another service is the creator economy solution for users and prosumers.We plan to create a service that implements various creator economies,enabling content to be recreated in the role of a prosumer that produces and provides metaverse content,not as a user as a one-sided participant.Through these services,we aim to contribute to creating a new economic ecosystem by continuously connecting with various industries.

ICT Funding Project

- **Dedicated Institution** National IT Industry Promotion Agency
- **Business Objective** Advancing the VR/AR contents industry
- **Business Description** VR/AR contents industry

Company information

- **CEO** Yoo Miran
- **Type of Business** information service, software development and supply
- **Year of Establishment** 2018.
- **Website** www.bibimble.com

TIME LINE

2018.
Established Bibimble Co., Ltd.

2020.
Hosted the 'Performing Art Market in Seoul' Art Metaverse Exhibition

Hosted in 'Seoul Career Job Fair Dream-On Service', an education-type metaverse exhibition

Hosted in 'BTS POP-UP Online Exhibition: MAP OF THE SOUL1,' a metaverse entertainment-type exhibition

Selected for 1st Year agenda of the 5G Flagship Development Support Project (Digital Exhibition Corner Metaverse)

Operated metaverse virtual exhibition platform Vibetech REALs

2021.
Awarded the Metaverse Korea Award by the Minister of Science and Technology, and selected as the Metaverse of the Year

2022.
Attracted seed-level investment from the E-Land Group of companies (E-Land Ventures, E-World)

Metaverse digital showroom platform 'Bicus' opened

Opened and operated the world's first metaverse soccer exhibition hall 'The Greatest Players'

2023.
Selected for the 2nd year operation of the metaverse platform development support project (metaverse browser WITRACLE)

Selected for the 1st year agenda of the Support Project for Metaverse Leading Project (Metaverse Media Studio)