Doosan Heavy Industries & Construction: Identifying defective welds and extending manufacturing equipment lifespan with Google Cloud

With GPUs on Compute Engine, Doosan Heavy Industries & Construction is accessing the compute power needed to improve the accuracy of its AI model to 98%, while Google Cloud provides the flexibility to make the solution available to industry through a Software as a Service model.

Doosan Heavy Industries & Construction is using digital transformation to change the industrial sector, with the large volumes of data generated by industrial businesses a key focus. The business's activities include using AI and deep learning to deliver efficiencies and create opportunities.

Introducing deep learning and computer vision to welding inspection

Doosan Heavy Industries & Construction has developed a quality-improvement solution that applies AI to non-destructive testing for manufacturing facilities. While there is a common perception that all industrial products are made to the same quality standards, a number of variables may affect final products. Reducing the impact of these variables, that include weather and temperature, construction materials and the staff involved in the manufacturing process, is one of the greatest challenges facing industrial

businesses and locations.

Companies like Doosan Heavy Industries & Construction that have built large facilities, such as industrial plants and power plants, all deal with these issues. Consequently, various testing regimes, including non-destructive tests, are implemented on-site to confirm whether final products reach appropriate quality standards. This often involves using radioactive rays or ultrasonic waves to penetrate the interior of a completed product to determine whether it is finished based on the approved blueprint.

At Doosan Heavy Industries & Construction, plant facilities, tubes, pipes, plates and other components undergo a considerable number of welds. After radiographic scanning of a component, an expert inspects the image to determine whether the welding area is free of defects. Just as doctors analyze photos of a body

after radiography, decoding experts analyze each photo to determine whether the welding has been properly carried out. However, if the number of images that need to be reviewed increases, the higher workload makes it more difficult for experts to discover defects. While Doosan Heavy Industries & Construction has few faulty components, a difference of 1% in defect rates on-site can have a huge effect on time and expense, while the defects can cause facilities and equipment to become less reliable over long periods of time.

The business decided to resolve this issue using AI and built a model based on data captured by experts when they read radiographic images, with the aim of using computer vision to review the images for weld defects. After receiving the radiographic images, AI examines weld areas at extremely high speeds and alerts experts about areas that need further inspection. Introducing this solution enables experts to inspect welds more quickly and reliably, increasing the volumes of data they can process. The AI model can even standardize weld shapes and categorize defect types based on international standards for welding quality.

Model training now completed within hours

Doosan Heavy Industries & Construction first developed its non-destructive testing model in its on-premises IT environment. However, this infrastructure could not support the business's objective to improve the accuracy and performance of the model.   "To increase the accuracy of the deep learning model, the training must be repeated and the parameters revised countless times," says Jang Se-young, Digital Solutions Manager, Doosan Heavy Industries & Construction.

The hundreds of thousands of images involved required around 20 days of training, and the business had to rerun training each time it changed the parameters. Obtaining optimal results with limited computing power was a difficult task.

To improve speed, stability and expand the service, Doosan Heavy Industries & Construction migrated the solution to Google Cloud and with GPUs on Compute Engine removing the restrictions on compute, began achieving compelling results. Rapid learning using hundreds of thousands of images requires vast resources, so Doosan Heavy Industries & Construction employed parallel computing using GPUs to process this huge quantity of data, to great effect.

"In the past, it took around 20 days of training for the model to process tens of thousands of pieces of data, but since we migrated to Google Cloud, we can finish the training within hours," says Se-Young.

"GPU computing is primarily applied during training, but only when required," says Se-young. "Consequently, it's incredibly useful and also lowers costs. Introducing GPU in the on-premises environment involves various difficulties, including financial and operational ones, but by using Compute Engine, and scaling out the required GPU computing, adequate training can be quickly completed during crucial moments."

Doosan Heavy Industries & Construction continues to develop the non-destructive testing model to accommodate ever-changing situations on-site, differences in weld shapes and the wide range of defect types. Once an image is added to the model, variations are created through enlargement, rotation, and flipping to increase the model's accuracy. Several examples are added simultaneously during the process of feeding in just one piece of weld defect data. Upon discovering a defective weld, the model crops the image so that only the weld area is visible to avoid any environmental interference.

Accuracy rate of 98%

Compute Engine from Google Cloud provided the flexibility and scalability to make Doosan Heavy Industry & Construction's innovation possible. The non-destructive testing model for welds produced a 98% accuracy rate in finding areas requiring further analysis, and a 96–98% accuracy rate in picking out defective welds. Through continuous learning, the model is increasing its accuracy and applicability to more diverse kinds of welds.

Doosan Heavy Industries & Construction is now establishing a strategy for releasing its non-destructive testing solution as software via the cloud, as it can be applied on-site at any time in heavy industries or shipbuilding where the quality of welds is critical. Compute Engine's computing power made it possible to comprehensively improve the model's accuracy through iterative training, so now the completed model can be distributed as a Software as a Service (SaaS) offering via Google Cloud.

Google Cloud's flexibility provides businesses using this solution with the compute and reliability they need. The nature of heavy industry means sites are typically not located in one country, so Google Cloud's global service provides consistent speed, quality, and stability across a range of markets. Se-young has high expectations of the solution's positive impact on industries, due to Doosan Heavy Industries & Construction's extensive experience in the field.

"While the model was created based on Doosan Heavy Industries & Construction's experience and technology, I would like to use it to benefit various industrial sites that deal with the same issues," he says. "Especially since many companies hesitate to adopt AI technology due to the complications involved in implementing the systems and infrastructure, providing a subscription-based offering using Google Cloud will lay the foundations and allow for more active collaboration with more and more firms."