

CASE STUDY

Intel® Xeon® Scalable processors
Analytics Zoo
Intelligent Logistics



Intelligent Transformation Brings "Qualitative Change" to Express Delivery Industry

Intel® Architecture AI hardware and software core products help China's Yunda Express improve the efficiency of their delivery logistics system



“Taking advantages of AI technology to improve the operational efficiency of delivery logistics systems is one of Yunda's strategic initiatives to develop for the future and implement intelligent transformation. It is impossible without the support of powerful algorithms and computing power. The introduction of advanced products and technologies such as the Analytics Zoo platform and Intel® Xeon® Scalable processors can help us greatly improve the efficiency of the entire express delivery chain, optimize resource utilization, significantly reduce operational costs, and effectively tackle the challenges for future development.”

Peiji Li
Chief Architect of Yunda Express
Yunda Co., Ltd.

Founded in 1999, Yunda Express* has been riding the wave of e-commerce, mobile internet and express delivery and has developed rapidly over more than a decade into an industry giant with a comprehensive service network covering the entire delivery chain.

Whilst advancing along with the industry, Yunda is also aware of the risks and opportunities it faces independently. With a skyrocketing volume of business, its traditional mode of manual operation is now time-consuming, labor-intensive, and unable to guarantee the desired quality. At the same time, the reduction in the demographic dividend has also led to an increase in the cost of manpower and logistics. These factors form a bottleneck that could restrict Yunda's further development.

Using automation and artificial intelligence (AI) to save cost and enhance efficiency of the delivery logistics system has therefore become an important means for Yunda to tackle these challenges. To this end, Yunda actively collaborates with IT industry giants such as Intel to introduce cutting-edge technologies like AI, and integrate them into the traditional express logistics industry bringing-about intelligent transformation for itself and the industry.

In response to Yunda's needs and requirements, Intel not only provided a series of advanced hardware and software products and technologies such as Analytics Zoo, a unified big data analytics and AI platform, as well as Intel® Xeon® Scalable processors, but also carried out an all-level technical collaboration with Yunda. In doing so, Intel has helped Yunda build high-efficiency AI applications for a number of key links including “package size measurement”, “data center anomaly detection” and “shipment quantity prediction”. These applications have been deployed effectively and gained unanimous positive feedback from Yunda's frontline employees and management.

Advantages of Yunda's AI Solution:

- Enable quick development and deployment of end-to-end AI applications and provide strong technical support;
- Significantly improve the operational efficiency of delivery logistics system, shorten delivery time and improve user satisfaction;
- Optimize logistics resources, including the use of freight vehicles, sorters, and packaging materials;
- Greatly reduce labor and logistics costs.

The booming of the Internet and e-commerce has made express delivery an indispensable part of day-to-day life. Statistics from the State Post Bureau of the People's Republic of China show that in 2017, China's annual express delivery business volume exceeded 40 billion pieces, and the daily processing capacity during the period of “Double 11” online shopping carnival has reached up to 330 million pieces¹. The fast-growing express delivery industry has also spawned industry-leading companies like Yunda. With a service network covering the entire nation, comprising more than 4,300 main transportation routes², Yunda is committed to providing high-quality and convenient delivery services to hundreds of millions of users.

However, success inevitably breeds new challenges. As the industry matures, especially when the demographic dividend is gradually worn away, express delivery, a labor-intensive industry, can no longer rely on the traditional model of expanding manpower to achieve linear gains with rising labor costs becoming a burden to the development of businesses. As “Smiling Curve” theory³ proposed by Acer founder Stan Shih shows, an industry can develop rapidly in its early stages even it is at the bottom of the curve, where efficiency is low. As the pressure of competition intensifies, if a company fails to improve technologies and implement leading-edge strategies, the profits of the business will gradually reduce turning, ultimately, into losses.

The introduction of automated, intelligent equipment to improve efficiency has become the consensus of the entire express delivery industry. Yunda introduced technical solutions like automatic sorting, address sorting and collection as well as vehicle license plate recognition into its delivery logistics system some years ago. Improvement in operational efficiency resulted, however, in Yunda's view, these solutions only played the role of “hands” and “feet”; in order to push for more significant technological advancement, it would be necessary to address the “brain”.

The key to a visionary strategy for a delivery logistics system lies in whether an enterprise can build end-to-end resource allocation and optimization strategies. This is exactly where AI technology excels. Drawing on the three elements of AI, namely data, algorithms, and computing power, the high delivery volume of up to 470 million items a year empowers Yunda to have the data foundation⁴ for AI technology research, while the technological collaboration with Intel, addresses Yunda's limitations in algorithms and computing power.

For algorithm and AI software optimizations, Intel provided Yunda with Analytics Zoo, a unified analytics and AI platform based on Apache Spark*. Analytics Zoo helps Yunda to quickly and agilely build AI applications with an end-to-end view for multiple application scenarios such as image recognition and time series prediction. In terms of providing the necessary computing power, Intel's new generation Intel Xeon Scalable processors offer the power to fully unlock AI applications potential.

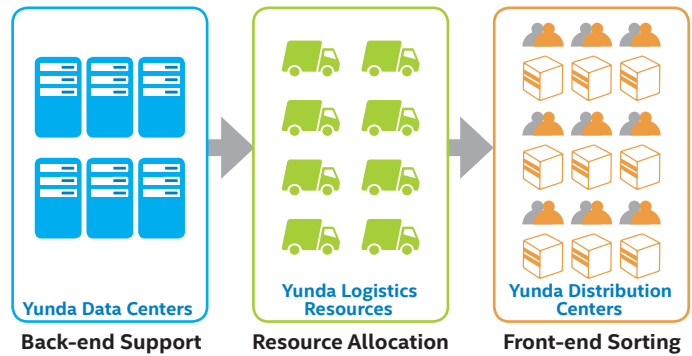


Fig. 1. Three Important Links in Yunda Express Delivery Logistics

As shown in Figure 1, the three most important links in Yunda's express delivery logistics are front-end sorting, resource allocation and back-end support. During the early stages, Intel and Yunda worked together to build AI applications for “size measurement”, “shipment quantity prediction” and “data center anomaly detection”. The results showed that AI applications could not only help Yunda significantly improve the operational efficiency of its delivery logistics system, but also greatly reduce the intensity and cost of manual labor.

Size Measurement

Measuring the volume of shipments is one of the core tasks of Yunda's distribution centers. By pre-judging the volume of shipments, the distribution center staff can better plan for sorting, loading and distributing to reduce the average time taken per delivery and the cost per kilogram. The conventional way to do this mainly relies on manual method, which is not only time-consuming and laborious, but also prone to significant error.

Yunda plans to use machine vision technology to improve the efficiency and quality of measurement. Through high-speed photographic apparatuses equipped on the distribution center conveyor system, an AI application collects the image information on shipments and transmits the image information to the back-end server for size measurement. Once the size measurement is completed, the back-end server sends the data back to the conveyor system where shipments are delivered to the appropriate sorting and loading locations according to the measurement results.

The image classification technology provided by the Analytics Zoo platform plays a key role in this case. Using the built-in image recognition model of the platform, the AI application first extracts the contour of the shipment to be measured, and then carries out the entire AI processing flow from model training, model redefinition to model inference to eventually obtain accurate size of the shipment. The whole process takes advantage of the deep learning frameworks like TensorFlow provided by Analytics Zoo and the potent computing power of Intel Xeon Scalable processors.

Following-on from this, Yunda is further utilizing deep learning algorithms for operational optimization. For example, Yunda abstracted the loading process into a classic issue of “box cutting”, that is, when shipments of different sizes arrive, it is essential to plan the order, orientation and placement of the shipments to maximize the shipment quantity loaded and reduce transport costs. With the help of Intel, Yunda’s AI team adopted deep learning to express the various states of this issue, adding reinforcement learning to learn this heuristic strategy. The results of applying AI in this way are notably better than the traditional operation optimization method.

To build on the initial results, the teams from both sides will work together to unleash further potential of the Analytics Zoo platform and plan to upgrade the size measurement of shipments to “accurate volumetric measurement” with a further optimized AI application, aiming to further improve efficiency and reduce cost.

Shipment Quantity Prediction

The volume of business within the express delivery industry in China is significantly affected by e-commerce promotions such as “Double 11” and “618” (two hugely popular large-scale online shopping carnivals in China). To meet the challenge of surges in business volume brought about by these promotions and to reduce risks such as overflowing warehouses, Yunda needs to assemble logistics resources in advance, including freight vehicles, sorters and packaging materials, etc.

Forecasts of volume based on previous experience are, however, not usually reliable enough. Take the “618” promotion in 2018 as an example. The soccer World Cup in Russia was in full swing at the time meaning many football fans were absorbed in the game, paying little attention to e-commerce promotions. As a result, a large volume of logistics resource was wasted. In view of this, Yunda hopes to implement a more accurate shipment quantity prediction solution using the Long Short-Term Memory (LSTM) deep learning algorithm provided by the Analytics Zoo platform.

LSTM is a time recursive neural network. As LSTM can effectively divide historical information into long-term memory and short-term memory, it is ideal for the development and deployment of predictive AI applications. Using the Analytics Zoo platform, Yunda’s AI team seamlessly extended the AI applications based on the LSTM algorithm to its Apache Hadoop* cluster, using the vast amount of historical logistics data for model training and inference.

Intel Xeon Scalable processors provide strong computing power for this process. Based on the actual needs of Yunda’s AI applications, Intel and Yunda optimized the solution for better performance with the leading technological features of Intel Xeon Scalable processors. Advanced technologies like Intel® Advanced Vector Extensions 512 (Intel® AVX-512) integrated in Intel Xeon Scalable processors deliver outstanding

Analytics Zoo: an “Analytics + AI” platform based on Apache Spark

To help users quickly and efficiently build a variety of AI applications on Apache Spark and simplify end-to-end development and deployment of solutions, Intel and a number of partners launched Analytics Zoo, a unified Analytics and AI platform (<https://github.com/intel-analytics/analytics-zoo>), which seamlessly integrates AI frameworks such as TensorFlow*, Keras*, and BigDL* into the same process, and easily scale horizontally into large Apache Hadoop*/Spark cluster environments for users to implement distributed training and inference.

performance in parallel computing and these technologies can greatly accelerate the training and inference of applications.

Currently, AI-based shipment quantity prediction systems have been deployed in some of Yunda’s distribution centers. Feedback from the front line shows that this deep learning-based solution is approaching the expected goal in forecasting, even surpassing traditional heuristic forecasting solutions helping Yunda achieve better business gains and cost reductions.

Data Center Anomaly Detection

As the core of Yunda’s delivery logistics system, Yunda’s data centers shoulder the responsibility of analyzing, storing and transmitting data throughout the company’s entire business chain. The data centers also take on jobs related to various applications such as data model building, data extraction, transformation and loading, automated reporting as well as algorithm development. Currently, almost all Yunda’s business activities are reliant on its data centers.

With the rapid development of its business, Yunda’s data centers have faced many challenges. The long technology development cycle and high cost make the data centers less efficient at performing advanced analysis of big datasets over time. Improvement in data center efficiency can hardly keep up with the speed of business growth meaning Yunda can potentially struggle during peak business periods like “Double 11” and Spring Festival promotion. Further challenges that the company faces include hacking and data congestion.

Yunda is able to leverage the LSTM deep learning algorithm provided by Analytics Zoo platform to address these challenges. The LSTM algorithm can enhance the performance of the neural network through differentiated memory information, and can more accurately analyze and discriminate information. In this way, the LSTM algorithm offers unique advantages in data analysis and prediction.

For example, in data congestion forecasting, Yunda's AI team deploys servers with LSTM algorithm in the storage system of their data centers. Using the algorithm, the system can continuously reinforce training by using key information in the existing logs such as time and hardware address, while filtering out a large amount of irrelevant information. Through extensive training and inference using this log data, the system can accurately predict the potential risks and weaknesses of the data centers.

During the deployment of this AI application, Intel provided a number of built-in learning models based on the LSTM algorithm through the Analytics Zoo platform and offered a wealth of reference use cases to Yunda's AI team. Intel also provided a team of experienced experts through remote assistance, on-site guidance and telephone communication to assist Yunda to build business models as efficiently as possible, achieving twice the result with half the effort.

Outlook

Through collaboration on building AI applications for “size measurement”, “shipment quantity prediction” and “data center anomaly detection”, Yunda and Intel have established an efficient communication mechanism and accumulated experience in building business models. This collaboration has produced results that have received unanimous commendation from Yunda's staff from frontline workers to management. Yunda plans to push large-scale deployment of these AI applications in cities including Beijing, Shanghai, Guangzhou and Shenzhen within the next two years.

Yunda also plans to develop and deploy more AI applications based on the Analytics Zoo platform and other advanced Intel® products and technologies. One such plan is to introduce natural language processing technology to build a brand new intelligent customer service system. This will not only help Yunda to alleviate the current pressure on its customer service

team and improve service quality, but also enable customer service information to be digitized and become another valuable data asset.

Additionally, Yunda plans to introduce Video Processing Units (VPUs) like Intel® Movidius™ Myriad™ X. The aim here is to improve the quality and efficiency of its Optical Character Recognition (OCR) by equipping the VPUs in high-speed photographic apparatuses and taking advantages of VPUs' powerful edge AI processing capability.

In the future, the application of diverse new technologies such as robots, smart warehouse technology, unmanned driving and intelligent express delivery cabinets will further drive Yunda's intelligent transformation. This will enable Yunda to provide better and more convenient services to hundreds of millions of users to become a model enterprise leading technological and business innovation in the express logistics sector.

To improve the efficiency of development and deployment, Analytics Zoo provides users with rich end-to-end processing flow analysis and AI support, including:

- Easy-to-use abstract models such as processing flow support for Spark DataFrame and ML, conveyance learning support, and POJO style service APIs;
- Common feature operations for images, texts, and 3D images;
- Built-in deep learning models such as text categorization, recommendation and object detection;
- Reference use cases, such as time series anomaly detection, fraud detection, image similarity search, etc.

¹Data cited from “China Express Delivery Development Index Report for the Fourth Quarter of 2017” from the State Post Bureau of the People's Republic of China, http://www.spb.gov.cn/sj/zgkdfzss/201801/t20180112_1467247.html

^{2,4}Data cited from internal statistical materials provided by Yunda.

³Global Brand Strategy—Viewpoint of Mr. Stan Shih. CITIC Publishing House.

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