

Case Study

Intel® Core™ Processor
Intel® Celeron® Processor
Intel® Video AI Box
Intel® Distribution of OpenVINO™ Toolkit

The Intel logo is displayed in white lowercase letters with a registered trademark symbol. The background of the entire page features a blue-toned digital network pattern with a central globe-like structure.

Sky Limit Entertainment Partners With Intel to Empower the Intelligent Transformation of XR Theme Park Management

“The XR industry chain is developing at a rapid rate, with improvements to experience bringing about subversive innovations and changes. XR’s demand for huge amounts of computing power, high bandwidth, and low latency networks is directly related to the consumer experience. Through cooperation with partners such as Intel, we have constructed high-performance XR park management solution and provided base computing power support for the smart operation and management of XR theme parks. To meet the market demands of a wide range of enterprises, we have also cooperated with Intel and other partners to launch the 5G VR Thousand Store Program, which will further embed lightweight and efficiency XR experience into small cultural tourism and commercial projects to provide high-quality XR experience to more consumers.”

– Qi Xiao

Chairman of Sky Limit Entertainment

In addition to serving as a key driving force for the development of the social economy, digitalization has also profoundly changed the way we entertain through the provision of more immersive and engaging digital experience. Encompassing innovations such as virtual reality (VR) and augmented reality (AR), extended reality (XR) is considered one of the most innovative technologies in digital entertainment. XR completely transforms the way we see and interact with the outside world, and serves as a key foundation for the metaverse. At present, digital entertainment based on XR technology such as XR theme parks are rapidly emerging.

As a cultural technology enterprise committed to creating the ultimate immersive experience and integrating XR content creation with comprehensive digital solutions and product implementation, Sky Limit Entertainment (SoReal) regards XR as a key part of its development strategy. In addition to launching the first large-scale VR theme park in the world (SoReal VR, Wangfujing), SoReal has also provided rich XR experience to Shanghai Disney Resort, Shougang Park, and Beijing Winter Olympic Village with the aim of creating spaces for players that integrate entertainment, competition, and social functions.

SoReal and Intel have carried out in-depth cooperation in edge computing power, hardware-software collaboration, and other areas of theme park operation. Through a solution based on the Intel® Video AI Box, SoReal provides strong computing power for applications such as gate access verification, AI crowd analysis, and LED screens; realizes efficient processing of data at the edge; and supports loads with high performance requirements such as AI inference. The solution has become a key part of smart operations and management systems, and improves the entertainment experience of consumers through convenient and rapid processes.

The Innovative XR Industry

As a core application of the metaverse, XR can create immersive virtual worlds through technologies such as VR/AR graphic generation and display, multisensing and mapping, dynamic environment modeling, real-time motion capture, and rapid rendering, and has the ability to interact with the physical world to a certain extent. XR provides users with new entertainment experience and is expected to completely reshape man-machine interaction in the future. XR also has applications in sectors such as industry, healthcare, and retail, where they play a key role in training, remote surgery, and remote supervision.

The rapid commercialization of 5G networks has facilitated the development of high-bandwidth, low-latency connections, which in turn has driven the development of the XR industry and the growth of the XR market. Strategy Analytics projects strong growth in the XR market over the next few years. Sales are projected to grow sixfold from 2020 to 2025, with revenue expected to reach USD 27 billion¹.

¹ <https://www.strategyanalytics.com/access-services/media-and-services/virtual-and-augmented-reality/reports/report-detail/summary-covid-19-impact-on-ar-and-vr>

XR is not an isolated application; its development depends on breakthroughs in such areas as cloud computing power, terminals, and networks.

At the computing level, the need for XR applications to deliver sufficiently immersive virtual experience means high demands for screen resolution, latency, and variety of interactive experience. As this involves a huge amount of calculations and data transmissions, the requirements for basic resources are very high, and it is difficult for terminal computing power to meet this demand. Therefore, the base layer demand of XR in the future will be for huge cloud data centers capable of converging basic compute, network, and storage resources and connecting them to upper-layer applications through computing as a service, storage as a service, and network as a service.

At the terminal display layer, a large number of XR applications are affected by bottlenecks such as insufficient display resolution, narrow field of view, and high latency, resulting in defects such as dizziness and insufficient immersion. Future XR applications will realize 16K resolution and a refresh rate of over 120Hz, ensuring a sufficiently smooth visual experience. At the same time, XR devices must make use of technologies such as spatial scanning and modeling, visual capture and rendering, tactile rendering, motion tracking, and multi-sensor rendering to realize the interaction between the virtual world

and physical sensory experience, thereby delivering more diverse and immersive XR experience.

At the network layer, high-speed and low-latency network transmission technologies such as 5G, 6G, and eventually 7G will facilitate the integration of base platforms and terminal equipment.

The Constantly Expanding SoReal XR Theme Park Business Map

With the advent of 5G commercialization and the gradual maturity of XR hardware, the more interactive and immersive XR technology will lead the next technological revolution. As one of the first XR technology enterprises in China, SoReal has led the industry in terms of content creation, development engines, and commercial formats. At present, SoReal's business covers a wide range of large-scale customized tech shows; the design, production, and operation of large-scale physical XR theme parks, VR museums, and revolutionary-themed VR education bases; XR content creation; XR e-sports; and more.

SoReal boasts rich experience in the construction and operation of XR theme parks. In addition to XR games, SoReal has also designed a wealth of XR interactive content. SoReal has developed multiple XR interactive experience areas, each of which has its own



Figure 1. SoReal XR application scenarios

content. In the process of watching a VR movie, a fusion of tactile, auditory, and other forms of perception will complement the visual experience. For example, dynamic seats will vibrate and rotate in a manner that complements the video content. SoReal has also optimized the integration of media and content in areas such as seat vibration and cold air to effectively reduce dizziness and other unpleasant feelings that may arise during XR experience.

In addition to storefronts, SoReal's XR experience can also be integrated with downstream channels to provide physical VR solutions and XR product display formats for applications such as museums, shopping malls, cinemas, and Internet cafes. SoReal works with its partners to deliver excellent XR experience venues and ensure that high-quality XR content can be distributed to end users in the first place.

Innovation in AI technology is also critical to the construction of SoReal XR theme parks. Through applications such as AI entrance and exit management systems, customer flow analysis systems, and equipment control systems, SoReal can enhance the efficiency of business operations, improve management standards, and provide more efficient and intelligent insights into consumer data to support refined decision-making. AI applications also serve as a key way in which XR theme parks can demonstrate cutting-edge technology and enhance brand influence.

Despite these opportunities, SoReal faces numerous challenges in the construction and operation of XR theme parks.

- **Smart Management of Users:** As an entertainment model that is quickly gaining popularity, XR theme parks are often required to serve a large number of concurrent users, with customer flow increasing rapidly during peak periods such as holidays. To ensure the efficient management, analysis, and extraction of insights from large-scale customer flow, high demands are placed on the performance of AI applications.
- **System Stability and Availability:** The continuous operation requirements of XR theme parks demands that key equipment and applications such as XR terminals and entrance and exit management systems must be able to ensure excellent stability and availability, with stable operations under a variety of conditions. The reduction of system data processing delays must also be realized to ensure a smooth customer experience.

- **Integration of conventional and AI Loads:** In order to realize the intensive utilization of resources and reduce the total cost of ownership (TCO), SoReal sought to integrate AI, video codec, and other loads on a unified terminal and utilize computing resources in a more efficient manner.

Edge Computing Based on Intel Architecture Empowers Operation of SoReal XR Theme Parks

The SoReal XR theme park operation and management system has 9 major product lines, realizing one-stop experience for large-scale parks, along with ticket purchasing, queuing, experience, and discounts based on smart bracelets in large entertainment complexes, theme parks, small experience stores, and other venues. The system realizes the real-time monitoring of ticket times, visitor count, rate of arrival, and early customer flow warning, along with indoor navigation and positioning to help users find their way through experience areas. The improvement in process speed and convenience has significantly improved the experience of consumers.

SoReal has developed a front desk scenario control system, game launch platform, and dynamic queuing system to largely reduce personnel costs. SoReal also used artificial intelligence (AI) and other technologies to create customer flow statistics, smart recommendation, and comment analysis, and other systems capable of providing customer order statistics in real time, which when integrated with video recognition and infrared customer flow monitoring, realize the tracking of customer movement trajectories based on image data. These systems can also be integrated with biometric systems for CRM or integrated with POS systems for in-depth data analysis.

In order to meet the edge AI computing demands of SoReal XR theme park operations, Intel cooperated with partners such as XiaoGu Technology and CDXY Tech to provide Intel architecture-based edge AI solutions which are integrated with applications such as 3D biometrics to realize access management, LED screens, smart access control, and more.

● **XiaoGu Technology Smart Access Control**

SoReal XR theme parks have become an entertainment hotspot in many cities. The surging tourist traffic have put greater pressure on the access management of both the park itself and attached hotels. Continued use of conventional access management solutions would result in lowered efficiency and cumbersome procedures that may affect the consumer experience. To tackle these issues, SoReal introduced the XiaoGu Technology smart access control solution based on Intel architecture to its XR theme parks.

The XiaoGu Technology smart access control solution comes integrated with XiaoGu Technology's biometric algorithm to facilitate smart access management and improve convenience while enhancing security. The biometric algorithm realizes precise biometrics in strong light, low light, backlight, and other environments, effectively resolving the major issues of current biometric technology. Compared with the bottlenecks of 2D biometrics in terms of security and adaptability, true 3D biometrics provides protection against biometric spoofing and effectively prevents spoofing attacks such as digital photos, digital videos, and 3D silicone masks at a false recognition rate of one in a million².

The XiaoGu Technology smart access control solution relies on Intel® Video AI Box for data processing. Featuring cutting-edge design, a rich variety of ports, support for multiple communication methods, compatibility with multiple protocols, remote management, scalable memory, management platform access, and other functionality, Intel® Video AI Box realizes multi-channel webcam video access. The computing box also comes equipped with a variety of built-in AI algorithms from XiaoGu Technology for smart multi-channel video analytics and output of structured results to the control center through networks in community, home, and other scenarios.

Intel® Video AI Box uses Intel® Core™/Celeron® processors to provide flexible performance for different loads. Intel® Core™/Celeron® processors offer excellent performance per watt, powerful graphics, I/O integration functionality, support for a variety of image sensors, along with high energy efficiency to enable fanless designs for industrial applications and the development of highly integrated edge platforms.

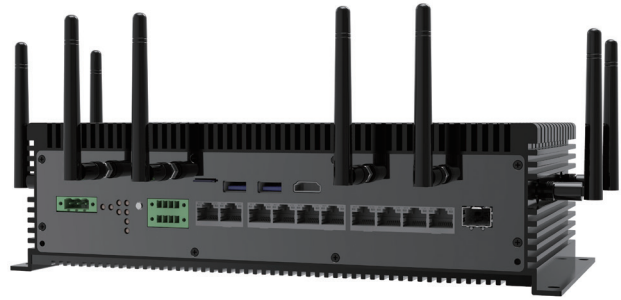


Figure 2. Intel® Video AI Box

Intel® Video AI Box also uses optimizes inference performance through the Model Optimizer and Inference Engine of OpenVINO™ toolkit. Model Optimizer is a cross-platform command line tool that facilitates the conversion of models trained under different frameworks into a unified intermediate representation format, static model analysis, and adjustment of deep learning models to realize high performance on terminal devices; while Inference Engine provides a port that can be dynamically loaded as a plugin for each hardware type, thus realizing optimized performance for a variety of load types by ensuring that users do not need to implement and maintain multiple code paths.

Performance testing on a variety of AI models shows that OpenVINO™ toolkit significantly accelerates the performance of Intel platforms. The application of the XiaoGu Technology smart access control solution to SoReal XR theme parks has effectively improved the access efficiency of gates, hotels, and other venues; reduced the occurrence of congestions and other bottlenecks; and delivered consumers a smarter, safer, and more convenient entry and exit experience.

In addition to XiaoGu Technology smart access control solution, the edge deployment solution based on Intel® Video AI Box provides high-performance computing in a variety of scenarios. Using video analytics as an example, Intel® Video AI Box supports the concurrent real-time data analysis of 109 points of SoReal XR theme parks with the node stream speed of a single Intel® Video AI Box reaching 60FPS/s@1080P. When equipped with Intel® Movidius™ Myriad™ X VPUs, computing power can reach up to 60T and support access to multiple video streams³.

² Data from internal test results of XiaoGu Technology.
³ Data from internal test results of Sky Limit Entertainment.

CDXY Tech VR Integrated Media Display Platform

Content management is a key requirement of XR theme parks, which in addition to displaying the latest media information to provide consumers with timely information services, must also be able to realize the integrated display of relevant operational data for data-based smart operations. At the same time, XR theme parks typically face problems such as difficulties in interconnecting different operational systems, and difficulty in connection data from production to analysis for display.

Through an in-depth partnership, SoReal and CDXY Tech have jointly launched a VR integrated media display platform based on 11th Gen Intel® Core™ processors, pioneering the construction of content generation architecture in complex integrated scenarios. The platform supports the convergence of data from the advertising management, production management, sales management, personnel management, core business, and other systems onto a unified platform for data governance. The data is then uploaded to the data display layer through the MiDS media gateway to realize the display requirements of various VR device paths.

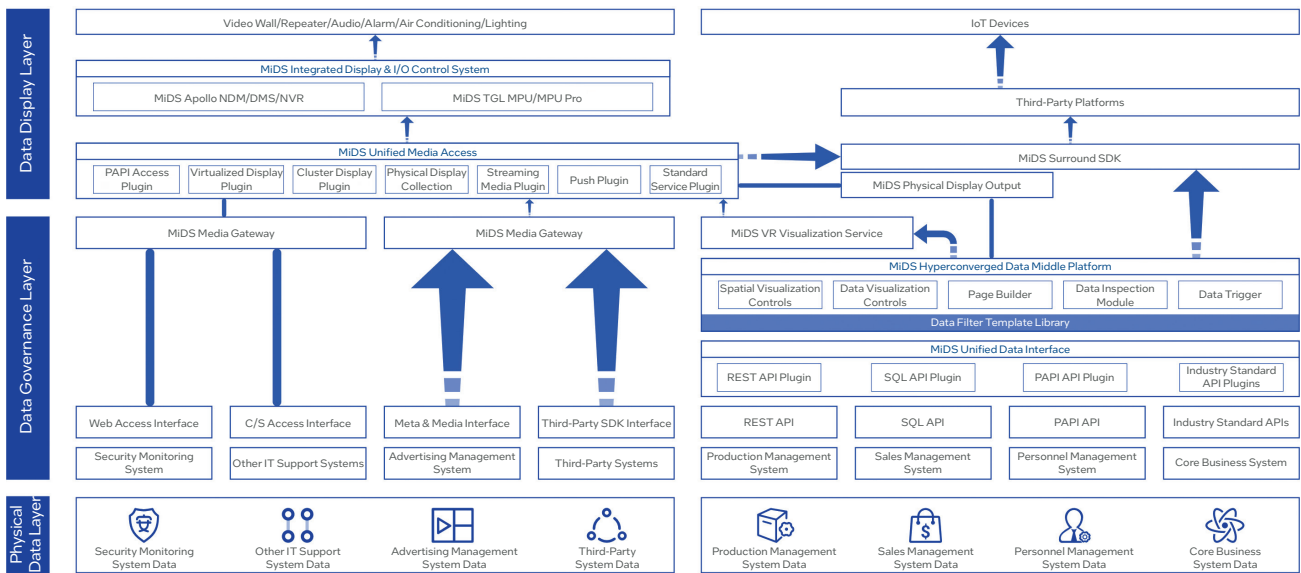


Figure 3. Architecture of the CDXY Tech VR integrated media display platform

The platform utilizes edge servers based on 11th Gen Intel Core processors to support data governance, media data processing, and other loads. 11th Gen Intel Core processors come integrated with Intel® Iris® X^e graphics for complex media loads.



Figure 4. Edge server based on 11th Gen Intel Core processors

Intel also provides a complete software stack to accelerate smart edge development. At the base layer, the edge server provides low-level libraries such as Intel® Media SDK, OpenVINO™ toolkit, algorithm libraries, and operator-level libraries and APIs optimized for Intel hardware to improve performance. In specific, Intel® Media SDK provides developers with standard APIs required to create consumer and professional video solutions; optimized routines with optimal video performance on a variety of platforms; and

simplified video encoding, decoding, and preprocessing operations. Intel® Media SDK also includes excellent functions for optimizing graphics hardware routines, providing development teams with an efficient and feasible means to take advantage of the hardware acceleration functionality of the target platform.

On this basis, the edge server also provides support for media frameworks such as G-streamer and FFMPEG, along with pipelines optimized for video scenarios such as IPC input, decoding/VPP, transcoding, RAID storage, video analytics, splicing/display, and feature matching for easier use and integration.

Through the CDXY Tech VR integrated media display platform, SoReal has realized the interconnection and intercommunication of various application systems along with the convergence of data into a unified platform for management. By preventing application fragmentation and improving the efficiency of content management, the solution lays a foundation for media display and the further extraction of value from data.

Result: Enhanced Consumer XR Experience

Through the implementation of a smart operations and management system based on Intel architecture, SoReal has improved VR game, VR video, VR tourism, and other XR entertainment consumer experience while realizing agile and efficient operations and management. The specific benefits of the solution are outlined below.

Enhanced Consumer Experience

The intelligent transformation of management saves time for consumers and cuts down on the time-consuming queuing process, thereby improving the consumer experience. Smart management also provides experience with a more “modern” feel.

Optimized Management Efficiency

The efficient execution of biometric and other AI algorithms realizes the fully automated gate and access controls, improving management efficiency and reducing personnel costs.

Lower TCO

Integration of functions such as AI analysis and networking at the edge reduces the infrastructure construction and transformation requirements for reduced TCO.

Improved System Stability and Availability

The SoReal edge XR theme park management solution features high reliability in industrial scenarios; fully on-board components; a cable-free design and simplified layout; support for wide temperature ranges; high corrosion, rusting, and interference resistance; and noise and dust pollution prevention, all while providing significant improvements to system stability and availability.

Cases of SoReal XR Theme Park Management Solution

Shougang No. 1 Blast Furnace Metaverse Theme Park

SoReal used 5G + XR technology to restore centuries-old historical and cultural sites, building the No. 1 Blast Furnace Metaverse Theme Park project in Shougang Park. On completion, the project will be the largest VR experience center in North China and the world’s first international cultural and technological park that integrates XR with centuries-old industrial heritage. As an urban cultural space of the “high-end and sophisticated” cultural industry system constructed during the 14th Five-Year Plan period in Beijing, the project will serve as a window into the cultural, industrial, ecological, and vigorous revival of Beijing.

The 25,000m² theme park will provide visitors with a virtual reality museum, immersive theater, VR e-sports, Olympic event experience center, specialty goods shopping, interactive restaurant, holographic bar, and other sci-fi experience.

SoReal has deployed the latest 5G VR edge computing solution to its metaverse theme park, delivering ultra-smooth, interactive, and high-def experience. SoReal also adopted the XiaoGu Technology smart park management solution based

on Intel® Core™ processors and OpenVINO™ toolkit to empower the intelligence of XR theme park management, providing an immersive, comprehensive, and enhanced consumer experience. The intelligent transformation of management saves time for consumers, cuts down on the time-consuming queuing process, and provides experience with a modern feel.



Figure 5. Shougang No. 1 Blast Furnace Metaverse Theme Park

Shanghai Disneytown SoReal XR Space

SoReal used cutting-edge VR and AR experience to create the 5,000m² SoReal XR space on the lakeside of Shanghai Disneytown, creating an ultimate immersive Journey to the West metaverse experience for guests.

In its Disneytown project, SoReal adopted the XiaoGu Technology smart park management solution based on Intel® Core™ processors, OpenVINO™ toolkit, and the CDXY Tech VR integrated media display platform to create a smart operations and management solution to empower XR theme park management, inject new vitality into consumer experience, and provide a truly immersive entertainment experience that covers all the senses.



Figure 6. Shanghai Disneytown SoReal XR Space

Outlook: XR + AI Empowers the Digital Economy of the Future

The 14th Five-Year Plan has clearly stipulated that the XR industry will be regarded as a key industry of the national economy. Technology-driven innovation and construction of content ecosystem is constantly lowering the boundaries between the virtual and physical worlds. More and more enterprises are joining the XR industry; an explosion is right around the corner. On this foundation, SoReal is continuing to expand the commercialization of large-scale offline XR experience (including content development, R&D of large-scale VR vehicle hardware, VR e-sports events, and commercial operation solutions), creating new value for the XR business with its partners.

As a leader in computing innovation, Intel is committed to driving the evolution and development of XR experience from cloud to network to device, and all areas in between. Through powerful

sensor and digital technologies, Intel will facilitate the exploration of more possibilities; support richer, more immersive, and more interactive visual, audio, and tactile experience; and realize truly natural and dynamic virtual reality.

The in-depth partnership between Intel and SoReal in the XR sector is focused on continuously accelerating the industrial application of VR technology, delivering unprecedented experience to global users, and stimulating the convergence between technology and culture to unlock new innovation. The huge data flows generated by these processes will place higher demands for computing and communication capabilities, thereby accelerating the in-depth development of the data economy. SoReal has also partnered with Intel to jointly develop and promote 5G VR/AR technologies in international sport events.

About Sky Limit Entertainment

Sky Limit Entertainment (SoReal) is a cultural technology enterprise committed to creating the ultimate immersive experience and integrating XR content creation with comprehensive digital solutions and product implementation. The company's international brand SoReal is currently the most followed cultural technology brand in the industry. SoReal's business covers a wide range of large-scale customized tech shows; the design, production, and operation of large-scale physical XR theme parks, VR museums, and revolutionary-themed VR education bases; XR content creation; XR e-sports; and more.

About XiaoGu Technology

Changsha XiaoGu Technology Co., Ltd. (XiaoGu Technology) is an AIoT service provider that provides AI edge computing solutions. Focusing on the research, development, and application of computer vision and embedded AI, XiaoGu Technology is committed to delivering high-performance, low-cost, energy efficient, and small-size embedded AI software and hardware solutions to realize the integration of visual perception and computing. XiaoGu Technology has developed smart doors with 3D facial recognition, smart locks, payment terminals, smart lockers, smart vehicle devices, smart light poles, and other AIoT products. Through the deployment of a cloud-edge-end system architecture, XiaoGu Technology helps create a safe, convenient, smart, and sensorless travel and payment experience.

About CDXY Tech

Since its establishment in 2013, Chengdu Xinyu Technology Co., Ltd. (CDXY Tech) has maintained a close partnership with Intel. Focusing on R&D and product innovation in media processing, display control, visualization applications, and other fields, CDXY Tech launched the only complete display and control suite based on x86 solutions in the entire industry. After years of dedicated operations and development, CDXY Tech has built up a portfolio of patents and utility models in related sectors. The company has also developed a variety of cutting-edge professional display products with reliable quality, low costs, and rich industry applications.

About Intel

Intel (NASDAQ: INTC) is an industry leader that focuses on developing technologies that change the world, drive global progress, and enrich human lives. Driven by Moore's Law, Intel is dedicated to the continuous innovation of semiconductor design and manufacturing to provide customers with solutions to major challenges. By integrating intelligence with the cloud, network, edge, and various computing devices, Intel unlocks the potential of data and helps improve both business and society. For more information on Intel innovation, refer to our China News Center at newsroom.intel.com and our official website at intel.com.



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