POSITION PAPER

Iris Technology

Using iris recognition for border control and passenger processing at airports



The travel industry is the perfect playground for innovation.

In order to address various challenges, it has undergone a digital transformation over the last few years. The goal of this transformation is to offer a safer and smoother travel experience, ensuring stress-free journeys.



The rise of iris recognition

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As a result of Covid-19, new expectations have led to the emergence of a new paradigm. In order to provide a more hygienic journey, stakeholders have requested contactless processes.

This is necessary in order to reassure travelers that it is safe to travel again, and it advocates for on-the-move biometrics (face and iris). As all travelers are requested to wear facemasks, iris recognition is a surefire contender, even though facial recognition technology has significantly improved over the past months to recognize a person wearing a face mask.

Biometrics are set to be one of the key enablers of digital transformation for the travel industry in the new normal. Various governments are already leveraging this technology to identify travelers and to secure entry/exit movements in their territories. Biometrics help to enhance passenger convenience without compromising on security—from booking a trip to crossing the border at the final destination.

While face and fingerprints are the most popular biometrics currently used, many government agencies and airports have started integrating the use of iris recognition in their infrastructure, and it is forecasted to rise. This is due to the acknowledgment that iris recognition is one of the fastest and most accurate methods of biometric identification. There are also many other benefits to using iris recognition. For example, iris-capture hardware is cost effective and the user experience is convenient and safe since iris recognition can be performed both at a distance and on the move.

IDEMIA, the global leader in Augmented Identity and security solutions, has vast experience in biometrics, notably iris recognition technologies. IDEMIA's iris solution has been tried and tested in the field, and is already in use in many countries, including the United Arab Emirates and Singapore, to secure their borders. It has been hailed as the most efficient solution by technology leaders and international benchmarking organizations.

IDEMIA is ready to assist governments and leaders in the travel industry by integrating iris technology into their infrastructure.

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Key facts



Passengers want more control, less waiting



are willing to share their biometric identifiers

Sources: IATA's 2019 survey



speed things up at the airport



46% would prefer biometric identification instead

of a paper passport



IRIS Technology

The iris is the colored part of the eye that is visible around the pupil. It is created prenatally through a process known as chaotic morphogenesis, making each iris unique. Iris recognition technology provides an unparalleled balance between accuracy and speed—the technology has been rigorously tested.

How does it work?

1. Image acquisition

Capturing the iris is difficult as the images need to be high resolution and perfectly focused. The many unique features of the iris (light or dark) are best seen in near-infrared (IR) light, meaning that the device needs to embed active IR illumination to capture images in the IR spectrum in any environment. IR light is invisible to the human eye, so the user does not experience any discomfort.

Early acquisition devices required the user to stand still with their face firmly placed on the device or very close to the device, which was very uncomfortable. The lengthy acquisition time and inflexible solutions were adding to the acquisition failure rate, and the intrusive systems created an unpleasant user experience.

Today, it is possible to capture the iris using high-resolution cameras for a fast and user-friendly experience.

High-quality image capture can be performed at a distance and on the move with little constraint to the user.



2. Image processing

Iris recognition begins with capturing a photograph of the eye. An iris template - a digital map of the iris - is extracted and, more recently, deep learning. from this image, and can then be easily The iris template is the unique digital computed, in milliseconds. In order to create this map from the original iris

image, you need to use computer vision, pattern recognition, statistical inference signature of the eye.

3. Comparison

Once you have the iris template, it can be automatically compared with others to judge similarity and reach a decision regarding the person's identity.

All biometric modalities – including iris technology – can be used in two modes:

- > Authentication (1-to-1 comparison) is used to check that a person is who they claim to be, i.e., one iris template is compared to another iris template.
- > Identification (1-to-many comparison) is used to identify a person in a database, i.e., one iris template is compared to many, which requires substantial computing resources.

Accuracy and speed are key for biometric matching. For accuracy, we look at:

- > False Acceptance: There is a match but the input iris templates are not from the same person.
- > False Rejection: There is not a match even though the input iris templates are from the same person.

The effects of false acceptance and false rejection depend on the type of system used. There are two types of systems:

- > **Negative:** The person should be stopped if there is a match (e.g. criminal watchlist)
- > **Positive:** The person should be allowed through if there is a match (e.g. frequent traveler program)

A false rejection in a frequent traveler program will cause unnecessary stress. For a criminal watchlist, it could permit a dangerous person, such as a terrorist, to enter the country.



Accuracy impacts the entire system beyond the biometric comparison result. A small difference in accuracy between two systems or two configurations have a direct and significant impact on the efficiency of the global system and its operational cost. If there are too many false negative/positive identifications, people will eventually lose confidence in the system.

Regarding speed, it is not only about potential ease of use; speed of the capture process also refers to the size of the templates generated by the capture technology. Smaller templates take up less memory for processing and less network bandwidth when being transferred. A small template also does NOT mean lower accuracy.

In real life scenarios, it is the trade-off between accuracy and speed that counts. A slower algorithm is more accurate.

Benefits and challenges related to iris recognition

Contrary to a person's hands or face, the iris is a protected internal organ that is easily visible externally. The complex texture of an iris makes it ideal for accurate and stable biometric identification. Furthermore, with new generation technology, both iris capture and recognition can now be performed at a distance and on-themove.

1. What are the benefits of using iris recognition?

- > Unique: An iris has hundreds of complex yet mathematically measurable features. Contrary to a person's hands and face, the random texture of an iris is distinctive, resistant to aging, protected from damage, and virtually impossible to replicate, enabling it to act as an identifier that is unique for each individual.
- Accurate: An iris has a random pattern which means that it has very high dimensionality. This means recognition decisions can be made with utmost confidence.





- > Uncorrelated patterns: The left and right eyes of the same person are completely different. Since no two iris patterns are the same, the margin of error is extremely low. The entropy of the iris recognition algorithm is as high as 240 bits— just 35 bits are enough to discriminate between the entire human population. The iris can also be used to differentiate between identical twins with complete certitude despite their DNA being the same.
- Free from bias (gender, age and ethnicity): Only the detail of the iris is taken into account when verifying a person's identity. The information around the iris, such as the shape of the external eye or whether the person is wearing make-up, is not considered. As all iris recognition images are captured in infrared light even the color of the person's eye is completely irrelevant. Furthermore, iris recognition can be used on children as young as four years old.
- > Convenient: A person simply looks at a camera for a few seconds to complete the verification check. The capture process is non-invasive and safe as well as compatible with glasses and contact lenses. Iris recognition systems have seamless interoperability with different hardware vendors and work well with a wide range of applications.

- Mitigates sanitary and cultural concerns: Iris recognition can be performed on a partially covered face, e.g. users wearing a sanitary mask or covering their hair. Face recognition with sanitary masks can only be performed by a handful of leading biometric providers. However, even the most cutting-edge algorithms will be less accurate when trying to identify a partially covered face. The good news is that a partially covered face has little to no impact on iris recognition.
- > Safe: Eyes are self-cleaning and image capture is performed without physical contact, making iris biometrics a safe and hygienic option. IR light is invisible to the human eye, so a user's eyes are safe during iris capture at all distances and do not experience any discomfort.
- Very difficult to fake: The iris is the only internal organ that is visible externally. People do not leave a physical trace of their iris wherever they go which significantly limits the danger of spoofing. In addition, photo/video attacks can be easily detected, as well as colored/ textured lenses.



2. What are the challenges of iris recognition?

Despite all the benefits that iris recognition offers, its usage involves meeting the following challenges:

- > Not widely used: Existing databases are mainly composed of fingerprint and/ or face biometrics; few countries have iris databases or include iris biometrics in the passport chip. The use of iris recognition requires the enrollment of citizens and third country nationals for travel purposes.
- Requires specific equipment: For both population enrollment and identity verification, iris image capture necessitates the installation of specific IR equipment.
- Must be captured onsite: contrary to face and even fingerprint, iris cannot be captured anytime, anywhere using smartphone technology. A dedicated capture area is needed onsite (airport, city hall, etc.).
- Requires IT retrofit or upgrade: The existing equipment and IT infrastructure may need to be upgraded or complemented with iris capture and matching capabilities. New solutions must interface with the existing IT environment.
- > Can be impacted by physical issues affecting the eyes: Presence of light reflections, colored/patterned lenses, or health issues such as cataract, glaucoma, etc. may impact the capture, processing and matching accuracy of

the iris. Enrollment without glasses is recommended; however, the verification process can be performed with glasses for an enhanced user experience.

- Can be impacted by a partially covered face: With regard to partially covered faces, the less the face is covered, the better/faster the iris acquisition will be. For example, in the case of people wearing a sanitary mask, iris acquisition would be performed in 98% of the cases. On the contrary, in the case of people covering their hair/face for cultural reasons, the detection of the face area could be challenging and close to the limit of the technology.
- Should not alter the user experience: Capturing the iris, especially using self-service systems, should be easy and ergonomic for the traveler. Knowing where to look and how to position oneself must be obvious and straightforward. Iris capture should embed real-time quality control and passive detection of spoofing attempts. This will enhance the traveler's comfort, and will reduce stress and the overall processing time while ensuring the right level of security.



How to measure the efficiency of IRIS recognition technology

International benchmarks

Biometric matching is all about accuracy and speed. Accuracy is measured by looking at the False Rejection Rate (FRR) and False Acceptance Rate (FAR). The two are closely related. For any given biometric modality, lowering the FRR by moving the decision threshold will increase the FAR and vice versa.

Fortunately, customers can rely on independent organizations to test the accuracy and speed of different vendors. The National Institute of Standards and Technology (NIST), is part of the U.S Department of Commerce, and conducts biometric benchmarks. They have an Information Technology Laboratory (ITL), whose mission is to cultivate trust in IT; metrology and research on biometrics is a part of this. ITL develops biometric data exchange formats, sample quality, and acquisition and processing protocols. Furthermore, they test the biometric matching algorithms.

IREX 10 is the latest and largest scale test of iris recognition technology performed by the NIST. It is an open and independent test, using a large and realworld dataset. It is also an ongoing test, meaning that technology providers can submit a new algorithm for testing at any time. It is the accepted benchmark for iris recognition today, providing an objective, quantitative comparison between vendors. Results are publicly available on the website: https://pages. nist.gov/IREX10/



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IDEMIA iris recognition performance

Up to July 2021, IDEMIA's algorithms consistently ranked number one among all studied companies in the IREX 10 Identification Track according to the release of the first results in early 2020.

IDEMIA confirms its leadership in the biometric identification market by proving to have one of the best two-eye accuracy ratings in iris recognition.

One of the strengths of IDEMIA's iris recognition algorithms, confirmed in IREX 10, is its ability to maintain accurate results even when searching a large dataset. IDEMIA's technology is consistently accurate even as the database grows. Another important, although frequently underestimated, aspect is

threshold stability. The threshold is the value of the similarity score between the two iris samples, above which these samples will be considered to come from the same person. This value is usually set with the objective of obtaining a certain FAR/FRR trade off (the socalled operating point).

Our technology demonstrates stable scoring, allowing users to set reliable thresholds that do not require adjustment as the database grows.



Jean-Christophe Fondeur, CTO of IDEMIA (June 2020)

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IRIS Technology to secure and streamline the traveler's journey

Iris technology helps secure and speed up the border clearance process

While more verifications need to be conducted in record time, budgets are being stretched with border agencies sometimes understaffed. The governments and agencies in charge of immigration need to rely on the latest technology to address these challenges. This is key to support border guards in their daily tasks— i.e. accurately identifying travelers and efficiently acting on possible threats.

Automation and self-service solutions combined with iris biometrics will support higher passenger throughput and facilitate legitimate movements without compromising security. This will allow border guards to focus on high-value tasks, provided that manned border counters are still made available where needed.





To use iris recognition for border clearance processes, numerous strategies should be put in place:

The standard manual process allows border authorities to deploy an iris recognition system with minimum impact on operations by upgrading the existing manual border counter.

The two-step process enables a self-service approach for travelers to provide their data. Background checks are conducted prior to the traveler being checked by the border guard. This optimizes the time spent with the latter, thus streamlining the entire

passenger experience.

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The Registered Traveler Program allows border authorities to offer a faster clearance process. Once enrolled and cleared, travelers will be able to use a dedicated fast lane during any subsequent entry/exit movement.

Leveraging iris recognition to streamline the passenger journey in airports

The use of biometrics permits airport operators to streamline processes and the traveler experience from their home to the departure gate while addressing the new sanitary concerns.

Implementing biometric systems was encouraged by international organizations such as IATA even before the global Covid-19 pandemic. The goal was to optimize passenger journeys; especially at large hubs where queuing delays were becoming a major concern. In this regard, various pre-pandemic surveys showed that a significant percentage of travelers were willing to give additional personal details, such as their biometrics, to enjoy smoother journeys that would enable them to benefit from personalized services and obtain accurate/up-to-date travel details (according to IATA's 2019 survey conducted on more than 10,000 passengers from 166 countries, 70% of passengers are willing to share their biometric identifiers and 46% would prefer biometric identification instead of a paper passport).

This is still true in our post-pandemic world and may be needed now more than ever. The international health crisis has, in some cases, accelerated the adoption of biometrics at airports. The entire travel industry, including passengers, would readily accept the use of contactless solutions for which biometrics is key. Iris recognition is the perfect solution for contactless biometrics, and is easy to use even when wearing a protective mask.

We believe that seamless and paperless journeys will become a reality if biometrics and identity management are used alongside automation and self-service systems. This will enable passengers to be securely identified with one look instead of requiring them to repeatedly show their travel documents, thus reducing passenger processing times and increasing the quality of service.

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Airport processing of travelers can be conducted as below:



IDEMIA's experience of deploying iris biometric technology

IDEMIA is a well-established biometric technology provider and is uniquely positioned to overcome any new challenges. We are a trusted partner of more than 30 governments and more than 60 airports worldwide—they rely on us to help protect their borders.

1. UAE - Using iris recognition to strengthen border checks

The UAE is a travel hub for the whole region and beyond, so it is not surprising that over 80% foreign citizens. Managing their borders to know exactly who is in Emirati national security.

The UAE has trusted IDEMIA since 2011 to implement a worldclass Entry/Exit System using of its population is made up of multi-biometrics, including iris recognition, to efficiently conduct border checks while facthe country is mission-critical for ing ever-increasing passenger throughput.





Manned immigration counters at Dubai Airport with a combined iris and face biometric device OneLook™

2. One of the busiest hubs in Asia

The immigration authorities and airport operators at one of the busiest hubs in Asia have relied on IDEMIA's iris recognition technology to secure and streamline their processes since 2018. More than 75 border control gates using iris recognition have been deployed at various locations throughout the country.



Border control gates using fingerprint, face and iris recognition

3. A major European country will create a registered driver's scheme for border crossings using iris recognition

The European country intends to deploy a registered driver's scheme that specifically requires outdoor biometric identification matching capability. Certain factors that could influence biometric performance need to be taken into account such as the environment and lighting. This instigates the need for a pioneering prototype.

As a biometric expert, IDEMIA was selected in 2019 for the pilot project which will compare the use of iris and face biometrics in these very specific conditions.



4. Pilot in the Middle East: seamless travel experience

For the first time, IDEMIA's teams have tested iris-onthe-move technology in real-life conditions. Travelers at a major airport in the Gulf region experienced an innovative airport process.

From check-in to boarding, passing through an immigration tunnel, travelers only needed to use their credentials once.

In the future, all traveler identities will be verified as the genuine owner of the travel documents that are presented at the check-in counter thanks to biometric identification. After that, travel documents can stay in their pockets. A short walk through the immigration tunnel and their identity will be verified using iris-on-the-move technology. At the boarding gate, a facial recognition device will then verify their identity a final time.

Check-in counter where the iris and face biometrics are captured

On-the-move immigration tunnel using iris and face recognition

Takeaways and recommandations

Key criteria to ensure performance and reliability

The main criteria to be considered when making the final choice for a biometric solution (front-end solutions and biometric engine) are:

- State-of-the-art algorithms
- Performance of FAR/FRR (matching accuracy) and target database size
- Speed
 Security

> User experience

> Ease of integration

Very few offers on the market can match the level of security and assurance required for a task as critical as securing borders.

Only a small number of solutions are able to manage millions, if not billions, of biometric data in real time. This is the reason why you should:

- only consider top tier suppliers that have been independently benchmarked by authorities such as NIST
- test available/field-proven solutions in your own environment to ensure they deliver the expected results

IDEMIA always advises the implementation of a realistic test version that allows you to assess the system's performance and prove the accuracy of the biometric matching. We can organize a proof of concept at your borders using your own data to ensure that our solutions meet, or even exceed, your expectations.

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Multi-biometric is also an option to consider

The combination of multiple biometrics enhances security and adds granularity. Iris technology can be used alongside face biometrics. This will further enhance the passenger experience as they can begin their journey remotely from their smartphone. For example, travelers can start the enrollment process from the comfort of their home by registering their face and other necessary data using a smartphone, and then complete the process at the airport by registering their iris to confirm their identity. This not only limits interaction, but it also optimizes resources and streamlines the passenger journey.

IDEMIA's biometric SDK technology can be deployed on a smartphone or tablet app. Using the embedded camera, a traveler can capture their face with liveness capabilities.



Takeaways and recommandations

Easy upgrade of existing infrastructure

Leveraging existing systems and integrating new components is a valid option. You can upgrade your system by integrating biometric solutions to manage the complete process (data capture, quality control, data storing and matching). The service provider's role is to help you adapt to the new system as smoothly and as seamlessly as possible, but also to deliver frictionless solutions for travelers so that they can enjoy a convenient and stress-free journey. Implementing new iris technology will certainly be a significant step, which is why you should seek an experienced service provider who will be able to guide you through the transition.

IDEMIA is the ideal partner for this critical task because we:

- are a border control/passenger facilitation specialist who understands your operations and requirements
- > tailor our solution to your needs
- master all key technologies needed (biometrics, automation, integration, and data analytics) to provide you with a complete set of solutions (equipment, devices, systems and services)
- understand the relevant legislation and can advise on the best systems and technologies
- provide interoperable, easy-to-integrate systems for a smooth transition
- can deliver a solution for all your travelers, not just frequent travelers

Whether it is a full deployment on a national scale, or a phased deployment, IDEMIA adapts to whatever works best for you.

For example:

- You can start with a proof of concept to ensure the system is relevant before deploying the complete solution
- > You can start with as little as one border crossing point before implementing wider deployment
- > You can ask for consultation on the project set up, as well as further consultations during and after the deployment for on-going maintenance, improvement and innovation



One size does not fit all: adapting your solution to your border-crossing points

Each country and border has its own specificities and therefore needs a variety of solutions that are best adapted to its environment. There are vast differences between air, land, and sea borders, as well as their capacity.

Land and sea borders are set to be one of the biggest challenges. Land borders are frequented by pedestrians, cars, trucks, motorcycles, buses and trains, and each of these modalities represent operational challenges.

> If dealing with cars, how many passengers are in the car?

> Does the passenger(s) need to stay in or exit

- Does the border guard enter the bus/ train, or are all passengers asked to exit the vehicle?
 - > Does the border guard stay in a booth?
- Is there a parking lot, or are the vehicles queuing?

the vehicle?

Can train stations be redesigned to incorporate a border crossing point?

The same goes for sea borders. Individuals can enter or exit a country in a variety of vessels. From large cruise ships and ferries to smaller vessels and cargo ships. Again, the possibilities are vast.

These questions highlight the differences in infrastructure and the processes that could be applied, emphasizing that all border crossing points need solutions that are tailored to their requirements and constraints.

IDEMIA has experience in providing solutions for land, sea, and air border-crossing points. We propose innovative solutions that meet the requirements of existing infrastructure. For instance, we can deploy two-way eGates to optimize available space or initiate the border-crossing process before travelers are on their way.

Our broad portfolio of solutions has been developed to address and adapt to various use cases in order to ensure that all scenarios are covered. Whether fixed or mobile, manually operated or self service, we have the solutions that meet your requirements.



IRIS Technology Using iris recognition for border control and passenger processing at airports

idemia.com/easy-and-legitimate-border-crossing



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