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NO: ONE PERSON
GENDER: MAN
AGE GROUP: YOUNG MAN
ETHNICITY: CAUCASIAN
HUMAN BODY PART: HUMAN FACE
TIME: 167 S
DETECTION: 63621 POINTS
POS (X/Y/Z): 1322 / 856 / 21



BEYOND THE MASK....



Facial Recognition (FR) is changing the landscape of security solutions rapidly. It is a groundbreaking innovation with transformative potential. Owing to the increasing accuracy of FR algorithms and ease of deployment, it has become the go-to biometric solution. At Wavesys Global, we tailor the FR solutions according to your needs, with state-of-the-art technology offered via the Wavesys video management platform.

Where FR comes in

What makes FR the most efficient and reliable biometric solution today? The answer to this comes from understanding questions pertaining to how authentication works.

- 1. What is your knowledge base?** This question answers It could encompass a password, code, or response to a security query - something that can be effortlessly deciphered, misplaced, or manipulated through social means. Despite its simplicity, we widely employ it across numerous platforms due to its rudimentary nature and lack of necessity for specialized tools.
- 2. What resources or information do you possess?** The second level of security involves utilizing various authentication methods such as physical cards, electronic fobs, or digital tokens, often employed for two-factor authentication (2FA) when accessing online banking services. While this level provides improved security, there remains a potential for vulnerability. For instance, the risk of misplacing the physical card or fob, or the possibility of someone gaining unauthorized access to the digital token, can compromise the security even without the theft of the actual device.
- 3. How would you describe your identity or nature?** This level of security incorporates biometrics, which are distinct human characteristics that are difficult to alter, making them more challenging to deceive or manipulate. Implementing biometric methods can be complex, as some require specialized equipment such as iris, palm, or vein scanning devices. However, there are also simpler biometric options that can be seamlessly integrated with existing security systems. Analytical techniques like face or voice recognition necessitate sophisticated software but typically only require a routine hardware upgrade to be implemented effectively.

In practice, it is necessary to combine at least 2 security levels. If top tier security is needed, all 3 levels need to come together in different resources.

FR is the easiest level 3 solution that can be implemented. It doesn't require human interaction, works well with existing CCTV solutions. FR algorithms are being continuously improved which has increased its reliability continuously.

The Perfect FR

Extensive analysis has shown us what a good FR system would constitute. Here at Wavesys we offer our customers top notch technologies. This ensures that we are ahead of the curve in terms of ease of implementation and accuracy of detection.

State of the art technologies

Our systems leverage neural networks (NN) to a new generation Facial Recognition algorithm which offer enhanced speed, reduced resource requirements, and improved accuracy simultaneously.





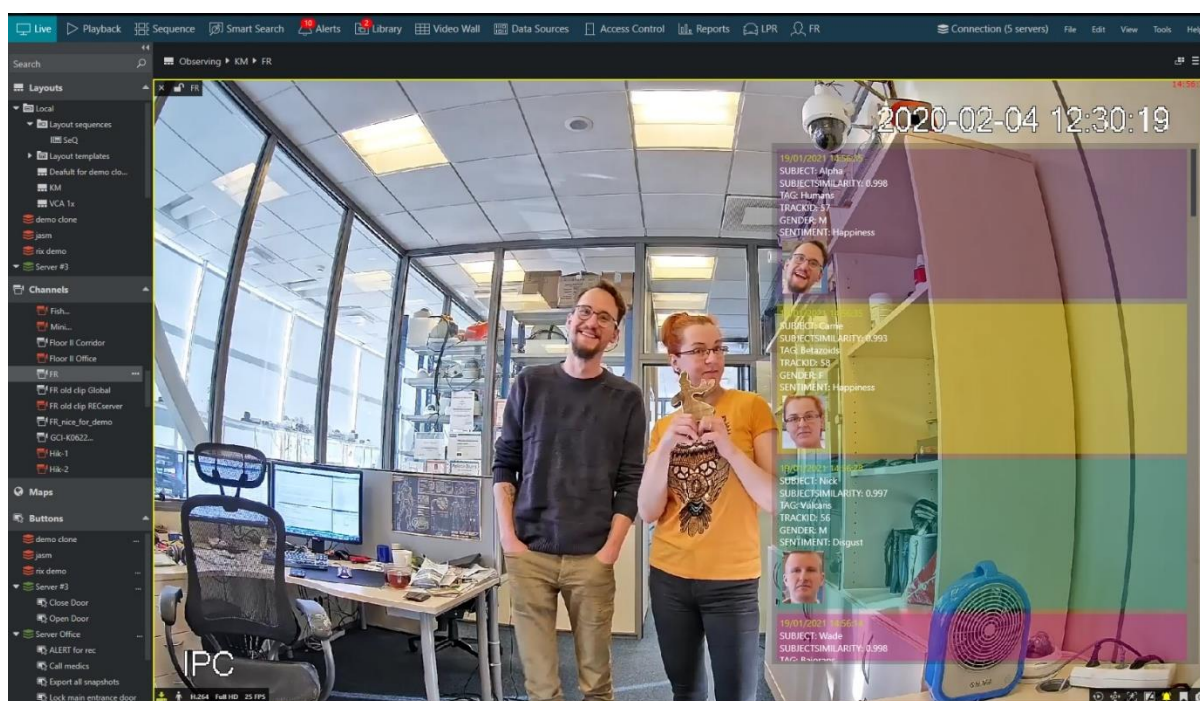
These NN-based systems excel in recognizing partial faces, accommodating individuals wearing masks, and capturing faces from different angles. Furthermore, NNs exhibit forgiveness towards variations in facial expressions, the presence of glasses, diverse haircuts, and the presence of beards.

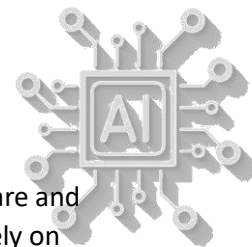
Current facial recognition technologies also introduce alternative approaches to enhance their capabilities. One such method is 3D face modeling, which is capable of accurately representing faces independent of lighting conditions and performing well even at challenging angles. Additionally, an intriguing technique in face recognition involves the utilization of thermal images instead of traditional video. Thermal cameras disregard visual obstructions such as glasses or makeup, and they can operate effectively in extremely low-light environments.

Wavesys Global Face Recognition handles traditional images and is based on neural networks, featuring all the benefits of the cutting-edge FR technologies. Here, at Wavesys Global, we have had experience with older algorithms with our first-generation FR software which gave us an experience of how daunting the task of working with older algorithms can be.

Independent Sources

Various independent institutions conduct rigorous evaluations of face recognition algorithms, and one of the most esteemed among them is the National Institute of Standards and Technology (NIST) in the United States. NIST conducts the Face Recognition Vendor Test (FRVT), which involves comprehensive testing across multiple metrics. The test results are made publicly available, enabling users to assess the performance of their chosen face recognition system in different scenarios. The face recognition engine developed by Wavesys Global FR has achieved an impressive position as the #2 algorithm in the NIST FRVT 1:1 verification leaderboard. This engine exhibits exceptional performance, demonstrating remarkably low false-positive match rates, outstanding accuracy, and top-tier results in the 1:N test for one-to-many matching scenarios. Low false-positive match rate, high accuracy and top performance is guaranteed,





Decide on requirements/bottlenecks

When considering face recognition solutions, it is important to take into account the software and hardware requirements. Certain face recognition systems are designed to operate exclusively on specific hardware or necessitate the presence of expensive GPU units. Additionally, some solutions employ a complex licensing model that requires additional payments for extra functionality. This may include separate fees for features such as mobile application alerts, age estimation, or subject enrollment. While some solutions are standalone, others rely on a fully functional video management system for optimal operation.

It is crucial to consider the distribution of computational load. Certain solutions offer the option to perform calculations on the edge, meaning the face recognition processing takes place directly on the camera side. On the other hand, some solutions mandate the use of specialized equipment, such as powerful GPUs, to handle the computational demands. However, there are also solutions that can efficiently operate on generic computer systems. Understanding the specific software and hardware requirements of a face recognition solution is essential in determining its compatibility, functionality, and overall suitability for a given scenario.

The screenshot displays the Wavesys Global FR interface. On the left, a 'Channels' list includes 'Server Office' and various camera feeds. The main video feed shows a woman with red hair at a reception desk. On the right, a search results table is visible, showing a list of detected faces with their attributes.

TIME	CHANNEL	TAG	SUBJECT	SUBJECTSIMILARITY	AGE	GENDER	SENTIMENT	SEARCHSIMILARITY
19...	FR		Carrie	99.064	25.8	F	Surprise	99.374
19...	FR mas...		Carrie	97.984				97.636
19...	FR_nic...		Carrie	98.380	32.3	F	Happi...	98.759
19...	FR mas...		Carrie	96.613				96.348
19...	FR mas...		Carrie	98.042				97.798
19...	FR mas...		Carrie	96.859				96.278
19...	FR		Carrie	99.053	28.8	F	Happi...	99.328
19...	FR_nic...		Carrie	96.815	31.5	F	Happi...	98.130

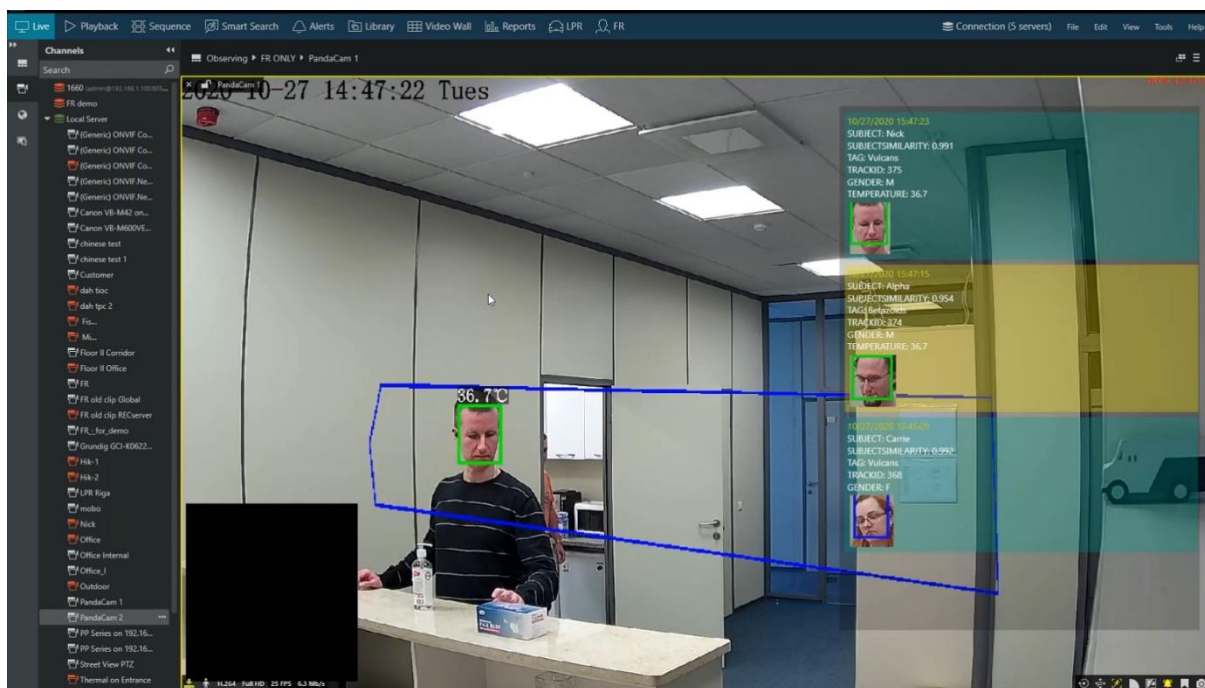
Although the Wavesys Global facial recognition module operates in conjunction with the Wavesys Global WVMS video management platform and is not standalone, it provides numerous advantages as an integrated solution. The licensing structure restricts the number of faces that can be stored in the subjects' database, but allows for unlimited channels, accommodating varying installation requirements. Moreover, Wavesys Global FR is compatible with both versions of WVMS, catering to the needs of both small-scale installations and large enterprises with multiple branch offices.

With its lightweight Web UI, Wavesys Global FR offers the advantage of not relying on a stack of video cards, as it efficiently utilizes the CPU for processing. This means you can repurpose existing hardware for the face recognition software and easily repurpose the former face recognition server for other purposes. Additionally, WVMS is compatible with thousands of devices, enabling you to utilize almost any video source for facial recognition purposes. While there are specific requirements

for video quality and camera placement, you can save money by avoiding the need to purchase specialized cameras.

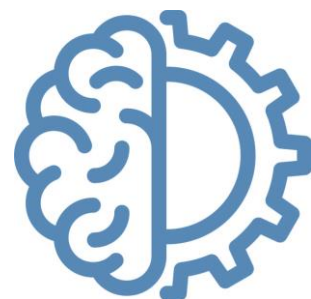
Hunting for Additional Features

After narrowing down your choices to three or four options that offer similar performance, good pricing, and ease of setup, it's important to consider which solution aligns best with your specific project requirements. Critical factors may vary depending on your use case. For instance, if your project involves law enforcement, the ability to work with different types of databases becomes crucial, as there may be a need to search local, country-wide, and international databases. On the other hand, if your client is a bank, they may prioritize features such as customer analysis reports based on age and gender, along with people counting analytics. It's beneficial to assess the additional options and capabilities offered by your chosen solution provider to anticipate and meet your customer's needs.



Wavesys Global FR provides a comprehensive range of features beyond basic face identification and matching. It encompasses live recognition, database search functionality, and various alerts and alarms, including integration with paired access control suites. Furthermore, it offers multiple estimators such as age, gender, and sentiment analysis, with forthcoming mask detection capabilities. Notably, in the pandemic and post-COVID world, the combined reading of face and temperature becomes important, with the added benefit of being able to search temperature reading history. Wavesys Global FR aims to address the evolving needs of businesses by offering a diverse array of features and functionalities.

The Wavesys Global FR solution, integrated with WVMS Event & Action engine, provides a gateway to numerous embedded and third-party events, actions, analytics, and access control modules. This versatility allows you to create a highly flexible solution tailored to the specific requirements of various industries and verticals. By leveraging this capability, you can build a comprehensive and adaptable solution that meets the diverse needs of different sectors.



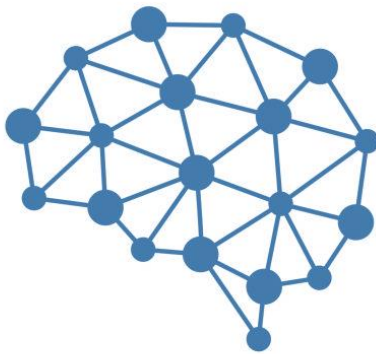
Industries using FR worldwide

1. Security, Government, Law Enforcement, Police Investigations, Access Control
2. Smart City, Finding Missing Persons, Identifying criminals
3. Banking – KYC, Self Check out
4. Schools – Tracking Attendance

Facial Recognition – Ethics and Privacy

Usage of FR also raises privacy related and ethical questions. Events starting from 2011 - starting from Edward Snowden's revelations to Cambridge Analytica, have put the focus on privacy. A careful assessment of circumstances that require FR is crucial. Moreover, sensitive data is stored for such algorithms, which need to be carefully protected.

FR, though powerful, has some inherent risks like every technology today. However, at Wavesys, we work with our customers to arrive at a solution that minimises risks and maximises benefits.



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