ΕΠΑνΕΚ 2014-2020
ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΑΝΤΑΓΩΝΙΣΤΙΚΟΤΗΤΑ • ΕΠΙΧΕΙΡΗΜΑΤΙΚΟΤΗΤΑ • ΚΑΙΝΟΤΟΜΙΑ

Ευρωπαϊκή Ένωση
Ευρωπαϊκό Ταμείο
Περιφερειακής Ανάπτυξης

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ
ΟΙΚΟΝΟΜΙΑΣ & ΑΝΑΠΤΥΞΗΣ
ΕΙΔΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΕΤΠΑ & ΤΣ
ΕΙΔΙΚΗ ΥΠΗΡΕΣΙΑ ΔΙΑΧΕΙΡΙΣΗΣ ΕΠΑνΕΚ

ΕΣΠΑ 2014-2020
ανάπτυξη - εργασία - αλληλεγγύη

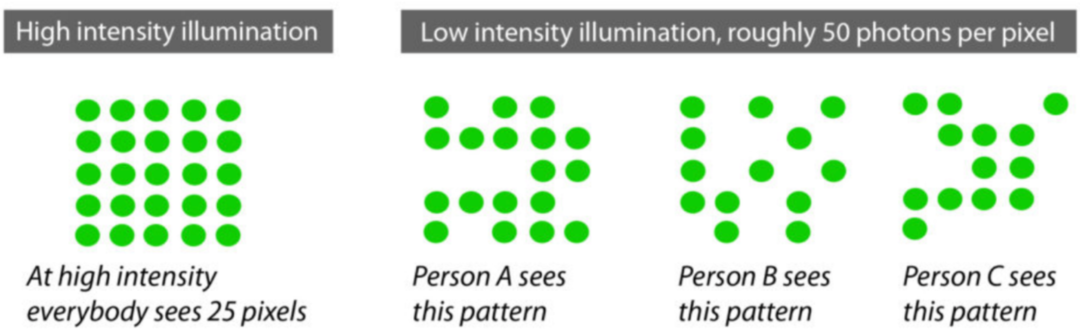
Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

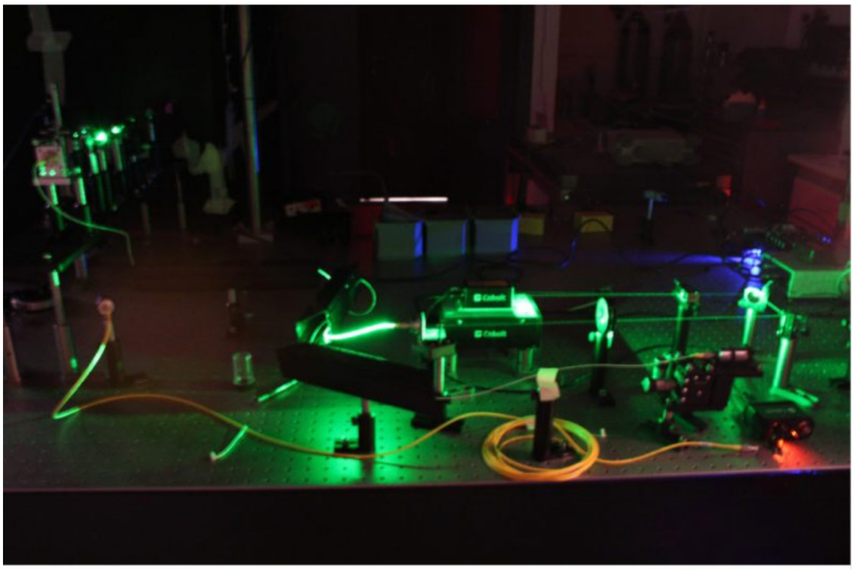
Photonic analysis of retina's biometric photoabsorption

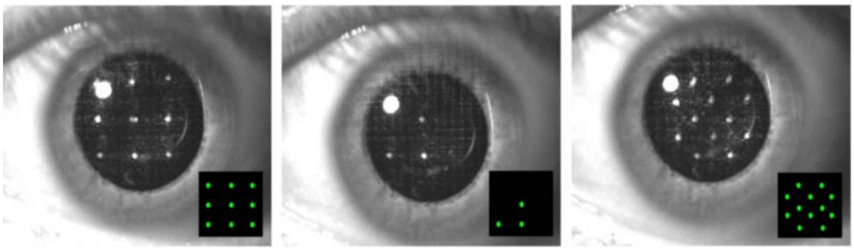
The project is a collaboration between the University of Crete Institute of Theoretical and Computational Physics, and the University of Crete spin-off company Quantum Biometronics.

The project is about addressing the human visual system with modern photonic tools, towards developing novel biometric identification methods. Biometric identification, that is, identifying people through some unique characteristics, is since a long time tied to security and law enforcement at the national and international level. The biometrics market is growing at 20% and currently stands at $4b. A traditional method for biometric identification has been fingerprinting. State-of-the-art methods are based on retina/iris imaging. The geometric formation of blood vessels on the retina, or the particular patterns of the tissue on the iris are unique for each person. The common disadvantage of all existing biometric modalities is that there is no physical law preventing their foil, which might be technologically demanding, but certainly not impossible. Hence a technologically apt impostor can in principle intercept and foil them. Moreover, the security of all existing methods cannot be quantified. It can just be stated that "it should be difficult" to foil them, without anyone being able to quantify this difficulty.

We have recently introduced a new biometric method, the first that can be termed "quantum", which promises to overthrow the above limitations. The new identification method is based on the quantum physics of photodetection by the photosensitive cells of the human retina. It is a complex "fingerprint" including the eye, the retina and the optical lobe of the brain. The ultra-high security of the method is of similar nature to other quantum technologies like quantum cryptography. Our method is based on the measurement of the optical losses light suffers in its path from the eyeball to the retina. These losses are unique for each person, and can be measured given the user's response on the perception of weak light flashes containing a known photon number.







It is shown that the probability for an impostor impersonating somebody else and passing the test is less than 1 part in 10 billion, for a test time of less than 1 minute. Moreover, we prove that an impostor must be equipped with quantum technology not expected to appear for many decades in order to non-invasively infer the biometric signature of the user and foil the test, which for all practical purposes is thus rendered unbreakable.

To illustrate the workings of our quantum biometricmethodology, suppose we illuminate the eye with all 25 pixels of the light source we have produced. At high intensity everybody will see 25 pixels. But at low enough intensity every person will see a different pattern, because the optical losses along the beam's path towards the retina are different for different individuals. Thus we can address the visual perception of individuals.

Within this project, co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call “RESEARCH-CREATE- INNOVATE,” with project title “Photonic analysis of the retina’s biometric photo-absorption” (Project Code T1EDK-04921), we have developed technology to realize the above methodology.

Our work is covered in the following publications:

- *Margaritakis, G. Anyfantaki, K. Mouloudakis, A. Gratsea, I. K. Kominis,* Applied Physics B 126, 99 (2020).
- *I. K. Kominis and M. Loulakis,* Journal of Applied Physics 131, 084401 (2022).
- *A. Pedram, O. E. Mustecaplioglu, I. K. Kominis,* arXiv:2111.03285
- *K. Kominis, M. Loulakis and O. E. Mustecaplioglu,* Recent Advances in Biometrics, edited by M. Sarfraz (IntechOpen, 2022)