

An illustration of a hand holding a smartphone. The screen of the phone displays a white medical image, possibly a scan or a document. The background is light blue with faint, stylized icons of a person, a heart, and a brain. A teal horizontal bar is at the bottom of the slide.

Mobile Applications for Medical Image Analysis

Mehran Yazdi

Faculty of Electrical and Computer Engineering

Shiraz University

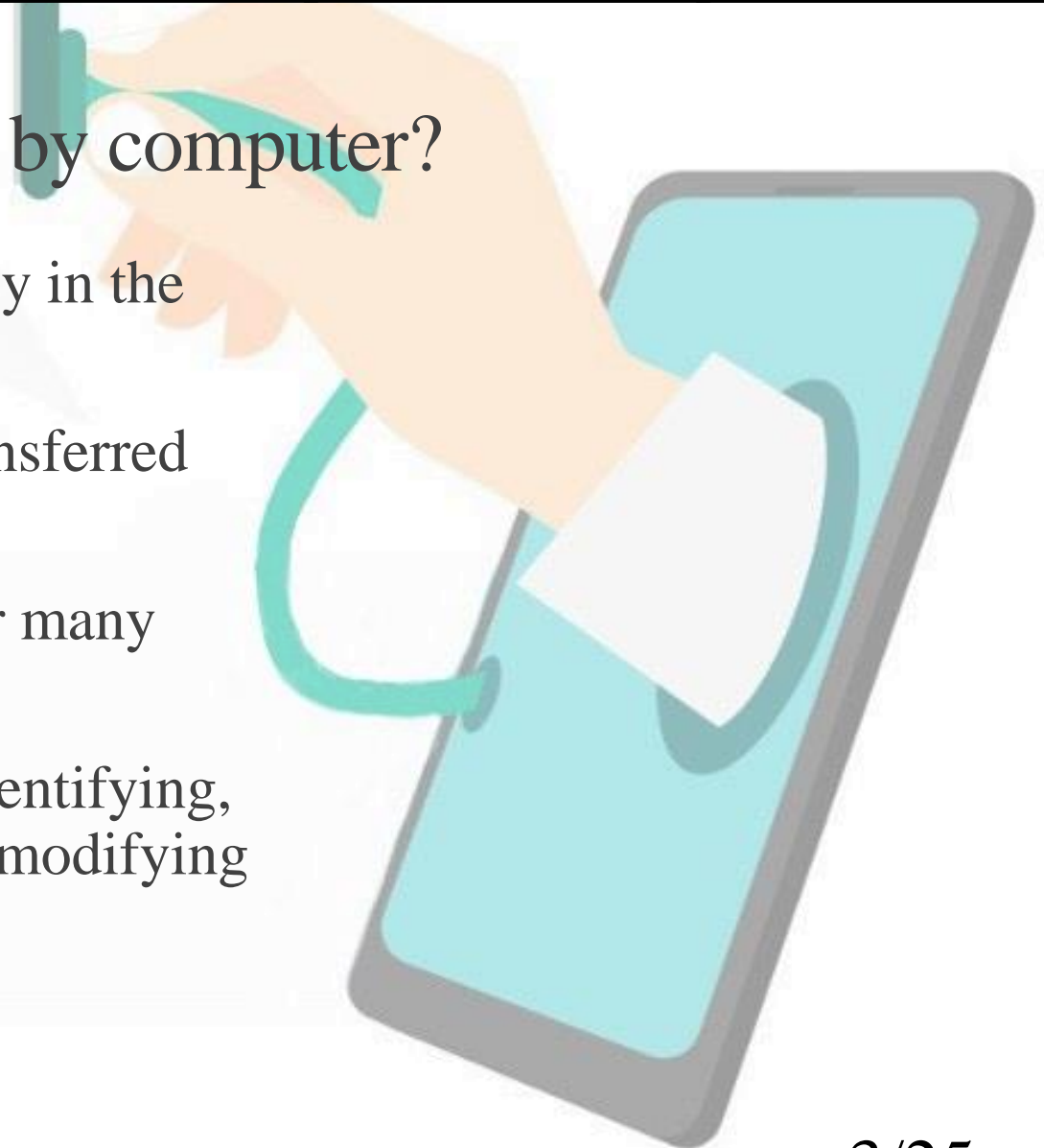
Outline

1. Introduction
2. Challenges in mobile app development
3. Examples of image analysis apps
4. Examples of medical image analysis apps
5. New trends
6. Current projects



What does mean image analysis by computer?

- More and more images are produced daily in the form of digital data by many sensors.
- These huge data need to be archived, transferred and manipulated.
- So, we need tools to handle these data for many purposes.
- Image processing and analysis involve identifying, classifying, compressing, and potentially modifying elements or features of an image.



Why we need to do it on mobile/smart phone?

- Mobile technology has become an intrinsic part of everyday life, with the vast majority of people owning smartphones, tablets or both.
- This means providing anywhere, anytime access to image data.
- More sophisticated cameras allow more production of image data.
- Mobile phone systems and apps grow more user-friendly allowing easy access to image data and sharing.



What does it mean for healthcare society?

- Smartphones and portable (or wearable) devices incorporate sensors and enhanced computing ability, offering a practical, accurate, and low-cost solution for medical diagnosis and monitoring.
- This enables analysis of medical images/sequences for initial self-diagnosis of disease, self-monitoring of health conditions, and preliminary examinations.
- For radiology, this means providing anywhere, anytime access to medical images for radiologists, referring providers and patients.
- The business of healthcare has become more decentralized, as hospital networks build and acquire more locations to reach more potential patients where they are.

What apps can be useful?

- Mobile applications (apps) allow smart devices to become a gateway to the image analysis, and with more companies offering these tools, providers are working to find how best to fit them into their daily workflow (Over 318,000 health apps are available on top app stores worldwide with more than 200 health apps being added each day).



Source: IQVIA Institute, Sep 2017
Report: The Growing Value of Digital Health, IQVIA Institute for Human Data Science, Nov 2017

NOVEMBER 2017

The Growing Value of Digital Health

Evidence and Impact on Human Health and
the Healthcare System



What capacities of a mobile device are required?

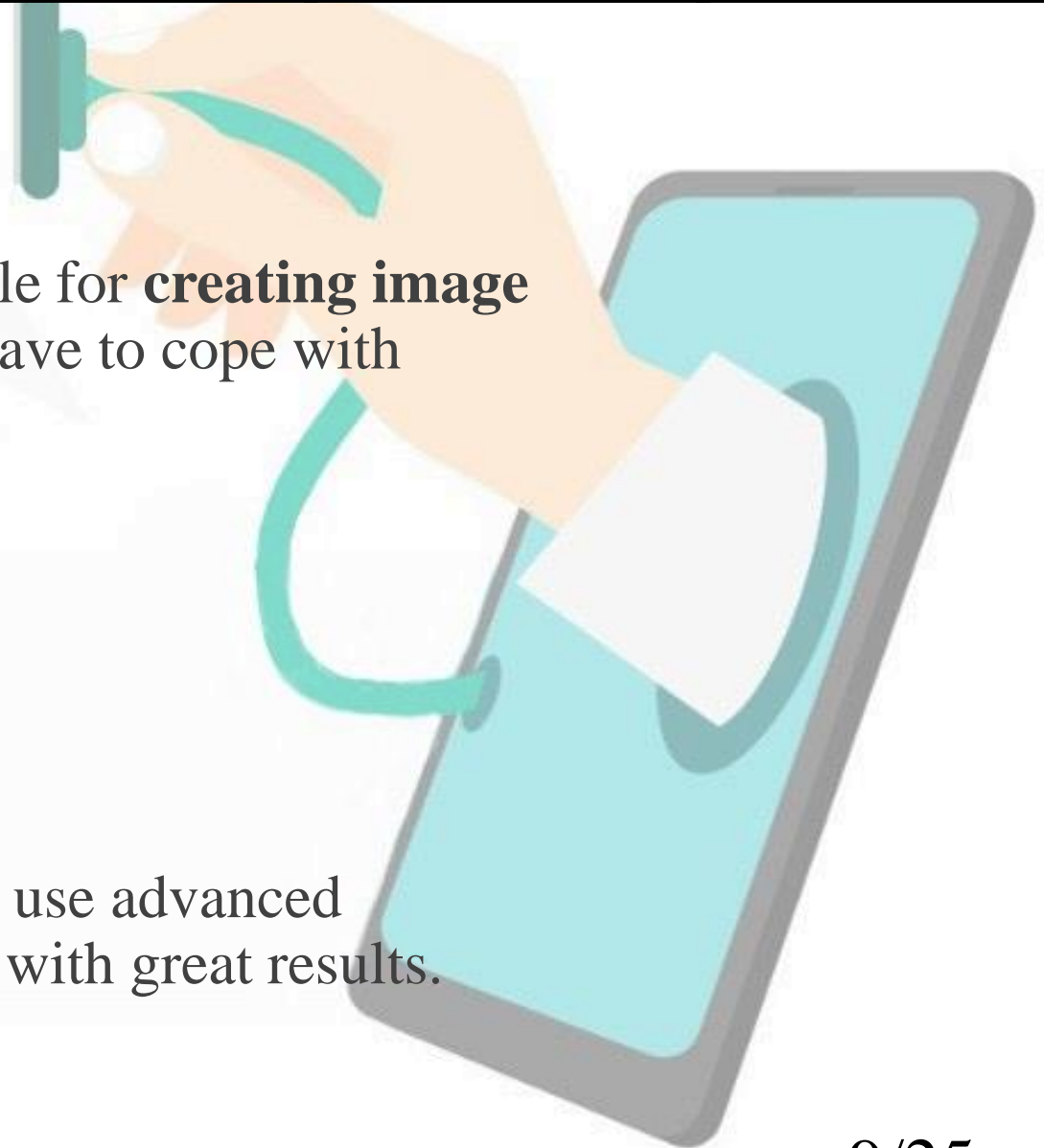
- For creating image analysis apps, there's still a striking difference between the capacities of mobile devices, especially if we compare iOS to Android.
- It is much faster to run an image analysis on iOS devices - mainly because image processing works better when utilizing the power of a graphics processing unit (GPU).
- On the contrary, Android phones use a central processing unit (CPU), which may not work that efficiently with “graphically intense” applications.

What makes it possible to run image analysis with a mobile app?

- **OpenCV library** (Open Source Computer Vision): is one of the most popular components used when developing image processing apps. It's a set of tools that enable analyzing images and videos, recognizing particular objects and modifying them.
- **Metal Framework** (available for iOS): used mainly by game developers, but it makes it easier to create apps that utilize graphics processing unit (GPU).
- **Google Cloud Vision API**: allows developers to easily integrate vision detection features within applications and understand the content of an image.

What are other limitations?

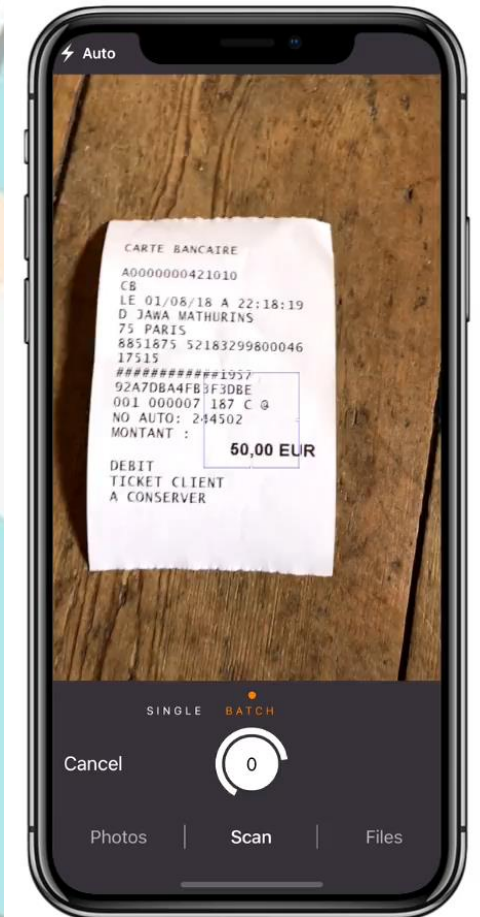
- Although there are different tools available for **creating image analysis apps**, software developers still have to cope with numerous difficulties and limitations:
 - Image resolution
 - Image distortion and noise
 - Processing power
 - Memory available on mobile devices.
 - On-line processing
- Nonetheless, more and more applications use advanced solutions to run image and video analysis with great results.



Examples of successful image analysis apps

Genius Scan

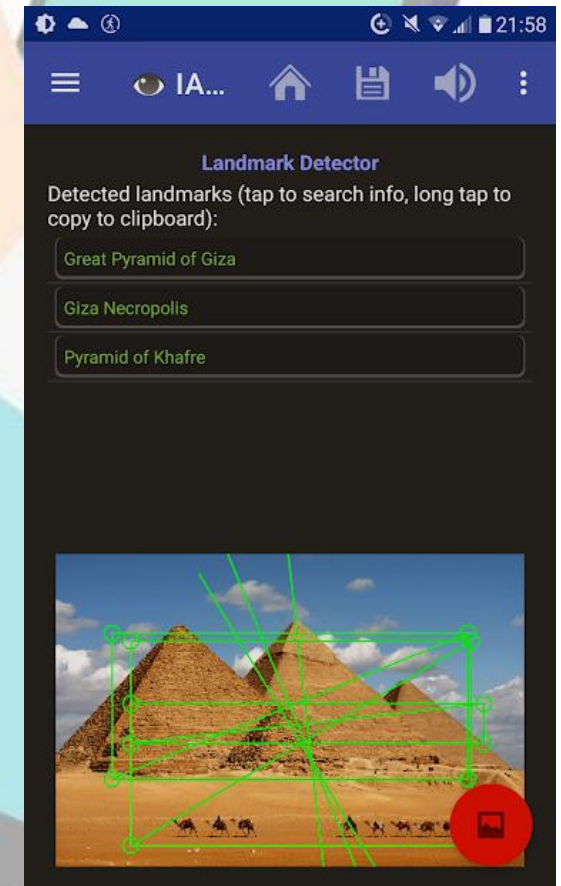
- The app allows you to **digitize any document**. All you have to do is take a photo of it (or choose one from your gallery), and the portable scanner will immediately convert it into text and let you edit it. It also offers automatic perspective correction and quality enhancement.
- <https://www.thegrizzlylabs.com/genius-scan/>



Examples of successful image analysis apps

Image Analysis Toolset (IAT)

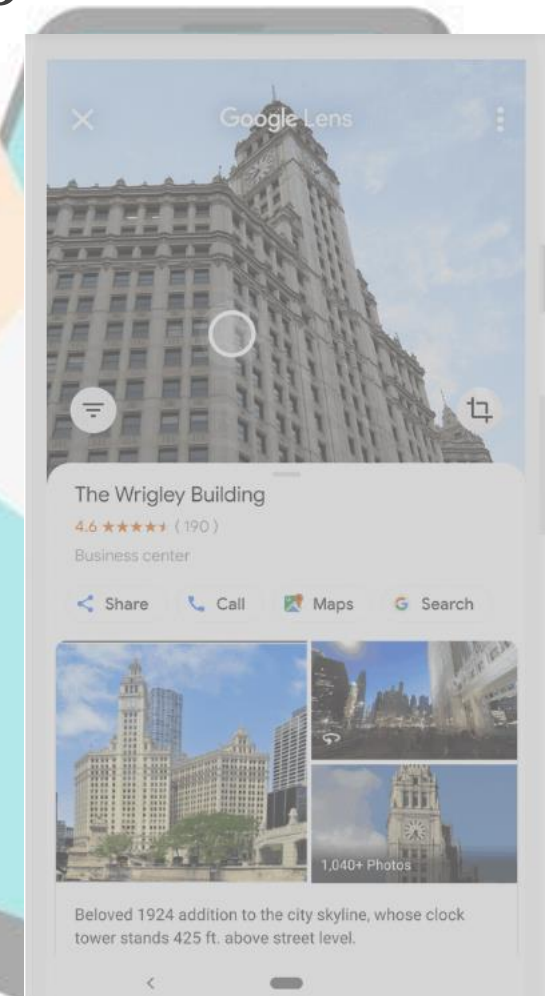
- The app is able to **recognize a variety of objects**, from inanimate to plants, animals, and humans, as well as their facial expressions. It also makes it possible to find out more details about the image, browse similar pictures and web pages, and assess whether the content is appropriate. After running such a detail image analysis, you can export the results as a text file.
- <https://www.play.google.com/>



Examples of successful image analysis apps

Google Lens

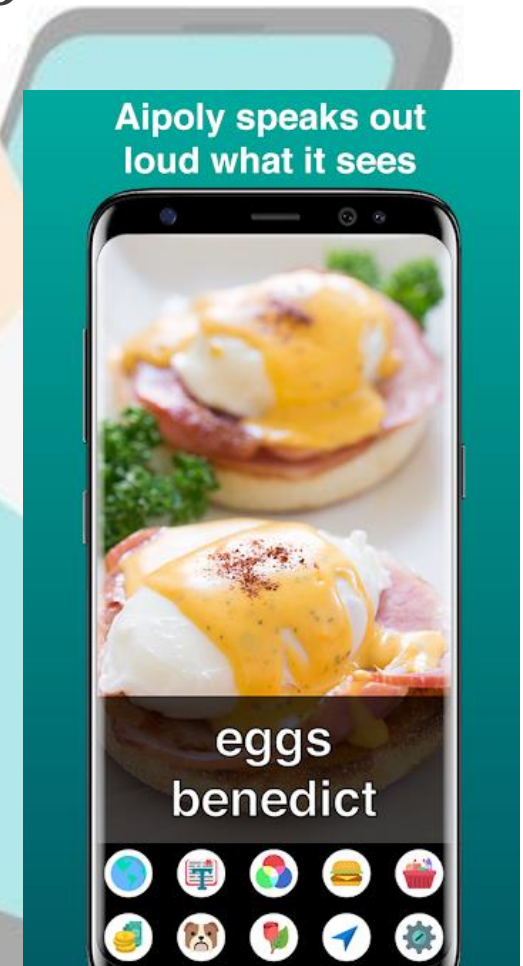
- This app allows capturing images with a smartphone camera and then performing an image-based search on the web. It works just like Google Images reverse search by offering users links to pages, Wikipedia articles, and other relevant resources connected to the image..
- <https://lens.google.com/>



Examples of successful image analysis apps

Aipoly vision

- It is an object and color recognizer that helps the blind, visually impaired, and color blind understand their surroundings. Simply point your phone at the object of interest and press any of the recognition buttons at the bottom of the screen to turn on the artificial intelligence, which will speak out loud what it sees...
- <https://www.play.google.com/>
- TapTapSee is also designed to help the blind and visually impaired identify objects they encounter in their daily lives.



Examples of successful image analysis apps

LeafSnap

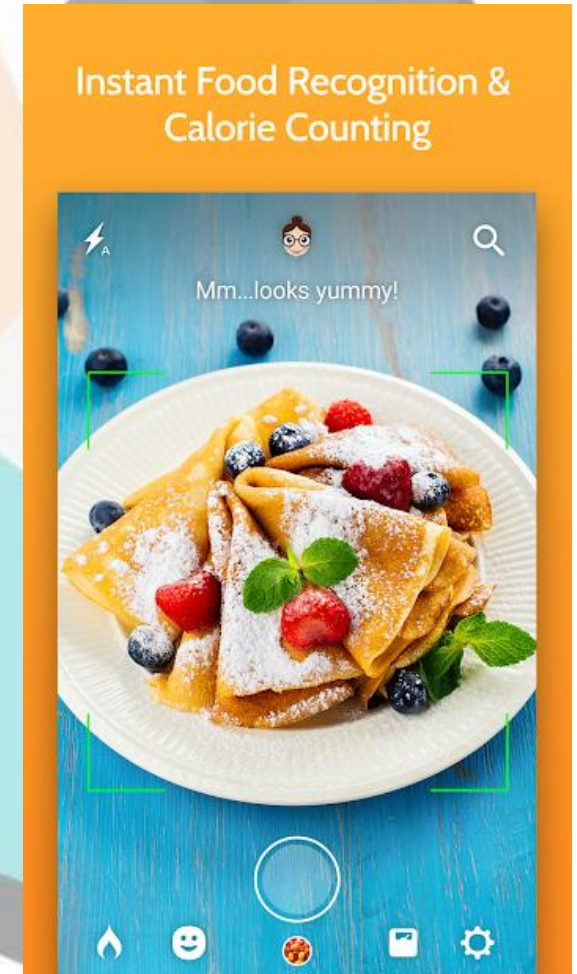
- It was developed by researchers from Columbia University, the University of Maryland, and the Smithsonian Institution, this series of free mobile apps uses **visual recognition software** to help users identify tree species from photos of their leaves.
- <https://www.play.google.com/>
- PlantSnap - plantsnap.com



Examples of successful image analysis apps

CalorieMama

- Combining deep learning and image classification technology, this app scans the content of the dish on your plate, indicating ingredients and computing the total number of calories – all from a single photo! Snap a picture of your meal and get all the nutritional information you need to stay fit and healthy.
- <https://www.play.google.com/>



Mobile Device App Viewing in Radiology

■ U.S. Food and Drug Administration (FDA)

- The agency only regulates apps that 1) could potentially have an impact on **patient safety**, such as radiation dose calculators, or 2) turn a mobile device into a regulated medical device, such as one accessing software that requires 510(k) approval (**marketing clearance**). The remaining category of unregulated medical mobile apps includes those designated for patient **education, fitness tracking**, and apps for clinical reference and/or **training**.
- Perhaps the biggest question with mobile device adoption in radiology is whether they offer sufficient resolution to allow diagnostic-quality viewing.

Mobile Device App Viewing in Radiology

Mobile MIM

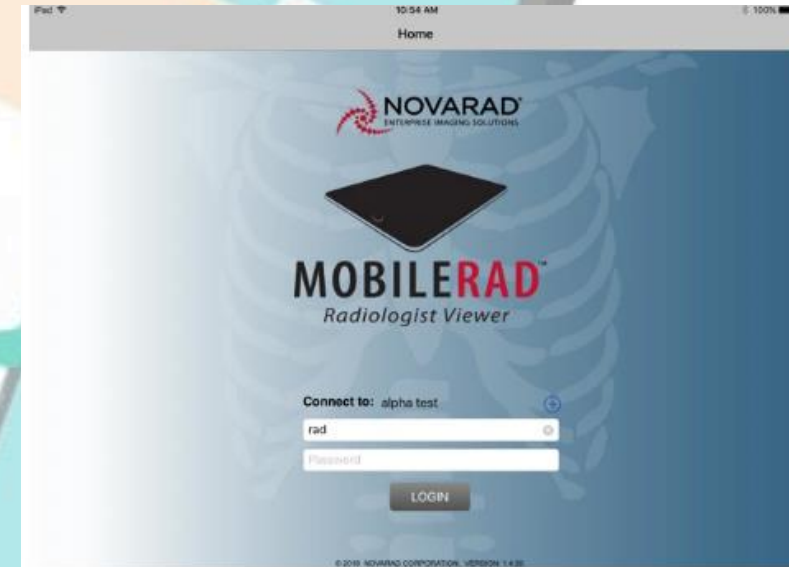
- It was the first U.S. Food and Drug Administration- (FDA) cleared medical imaging app for the Apple iPad and iPhone.
- It provides remote diagnostic viewing of any kind of medical images as well as radiation therapy treatment plan review and approval.
- Apple App Store



Mobile Device App Viewing in Radiology

MobileRad

- It can connect directly to user's NovaPACS server using an SSL connection over the internet.
- It enables secure viewing of patient reports and key images and provides access diagnostic reading and referring physician functions anytime, anywhere.
- Apple App Store



Mobile Device App Viewing in Radiology

ResolutionMD

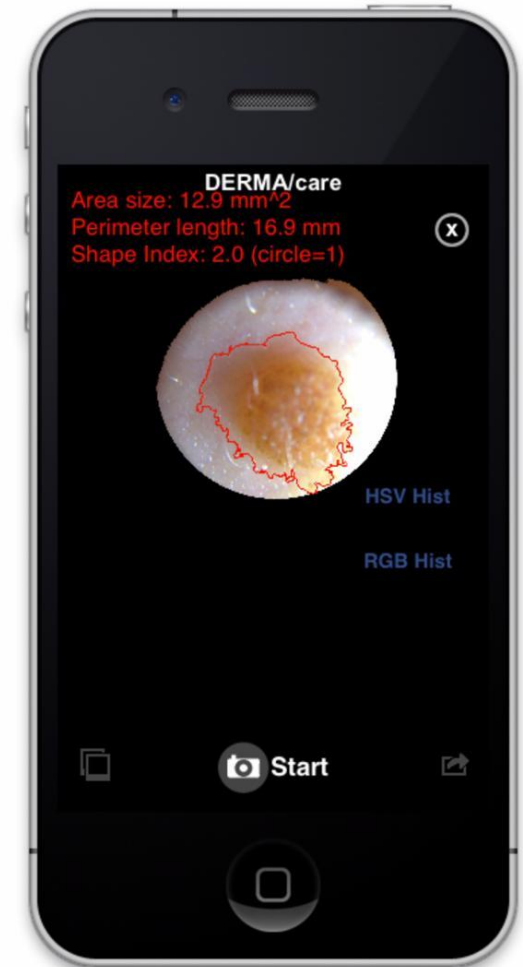
- This medical viewing product provides instant access to radiology diagnostic images and reports from mobile devices. The app streams data from a variety of imaging modalities, with off-site servers preparing it for rapid visualization on a smartphone or tablet. Since most processing is done outside the mobile device, no sensitive patient information seems to be transmitted, making it a fundamentally secure process.
- <https://www.play.google.com/>



Mobile Device App for diagnosis

Derma/care

- It helps to detect skin cancer at an early stage when it's most treatable and has less expensive treatment options.
- Its technology analyzes your photo and gives you an instant risk assessment and advice on what you should do next, so that you can see a doctor in time, if needed.
- <https://www.play.google.com/>
- SkinVision

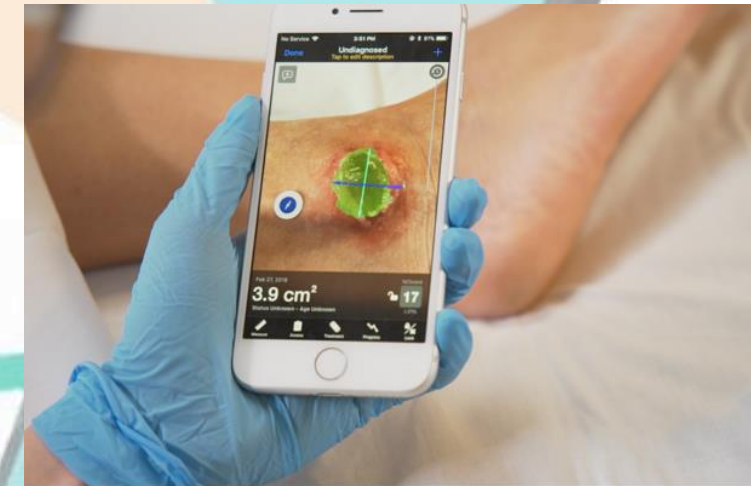


Mobile Device App for diagnosis

WoundMatrix

- It can be used to accurately capture, measure and instantly upload wound images and data elements at the point of care. Data analytics can be immediately shared among providers and organizations to help improve patient outcomes, provider efficiencies, therapeutic interventions and to reduce care costs. anywhere.

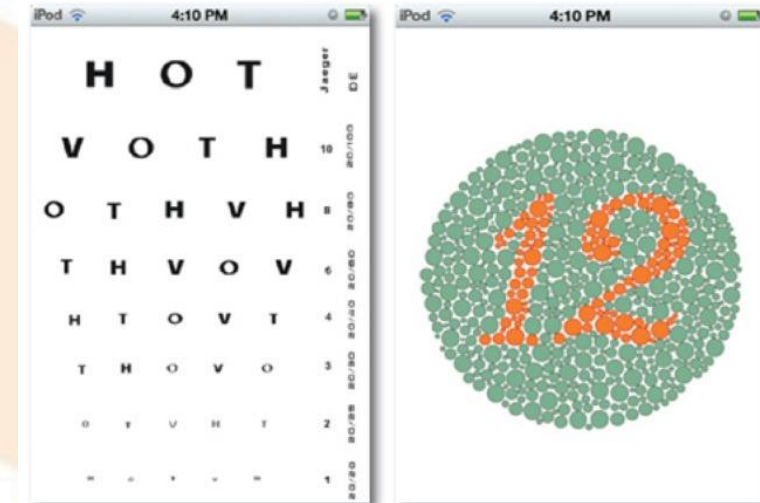
- www.woundmatrix.com



Mobile Device App for diagnosis

Eye Handbook

- Eye Handbook is a comprehensive diagnostic and treatment reference. It includes a wide variety of handheld testing capabilities from color vision to a fluorescein light to pediatric fixation targets.
- <https://www.play.google.com/>
- Apple App Store



New trends for image analysis apps

- Hardware:
 - Using task sharing between CPU and GPUs
 - Optimal use of memory
 - Development of graphics cards on mobile device
- Software
 - Using Parallelism in algorithms
 - Using AI (deep learning)
 - Running apps in the cloud computing platform



Development of mobile apps for medical analysis

- DICOM viewer for Android.
- Secure access to patient information from medical images using watermark technology.
- Evaluation of pigmentation lesion for possible skin cancer detection.
- Newborn jaundice detection.



Thank you for your
attention

