Modern technologies in medicine

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Areas of use

- Health care
  - Increasing the way doctors and patients interact
- Sports medicine
  - Quick control over changes in athletes' indicators
- Employee health monitoring
  - Reducing the number of accidents and the negative impact of work on employees
- "Self-diagnosis"
  - Raising people's awareness of their own health

Recognizing symptoms using phone and computer sensors

- The phones are almost always at the patients' disposal
- Health control gamification
- Instant transmission of the information received to the doctor / clinic and back
- Using a phone camera, gyroscope, microphone, fingerprint sensor
- Using a webcam, recognizing hand movements with a mouse / keyboard, recording a voice

Recognizing symptoms using specialized devices

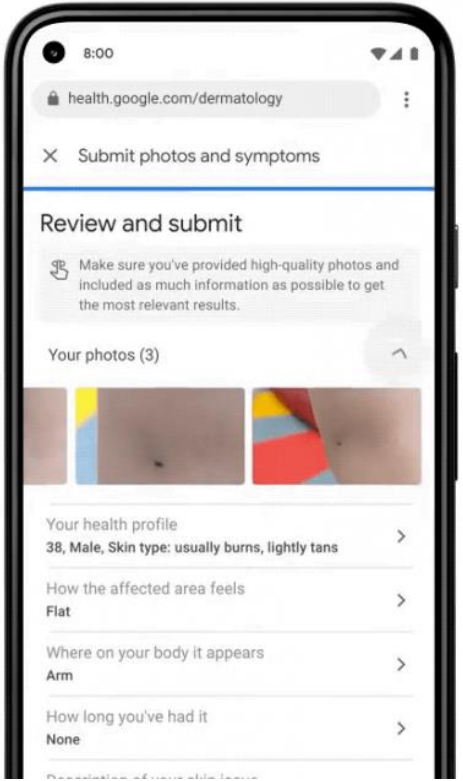
- Millions of people are already wearing additional devices (watches, bracelets, rings) that can collect additional information
- There are a large number of devices that may be needed for specific conditions (glucometers, ECG monitors, blood pressure monitors, oxygenometers, sleep sensors, etc.)

The current state of the market (via medicalfuturist.com)

- AliveCor's Kardia and Apple Watch measure ECG and detect atrial fibrillation with high sensitivity.
- The Wiwe measures blood oxygen levels.
- The Clinicloud, the EKO Core, the eKuore Pro measure heart and lung sounds as digital stethoscopes
- The Swedish Coala acts as an ECG monitor.
- Blood pressure is monitored with the Omron Blood Pressure Smartwatch, the MOCAcare pocket sensor, and blood pressure cuff, the iHealth Clear, the Skeeper, a pocket cardiologist, or the Withings Blood Pressure Monitor, and of course, dozens of traditional blood pressure cuffs.
- The NeuroSky biosensor and the Muse headband use it to understand the mind better and in the latter case allow for more effective meditation.

The Russian online service SberZdorovye has updated the platform for remote monitoring of patients with chronic non-infectious diseases, integrating the automatic collection of data from blood glucose meters and blood glucose meters into the service.

Apple seeks patent on technology that will be used to monitor Apple Watch users' blood sugar readings



Google has unveiled technology that can identify dermatological disease from user photos. It is based on artificial intelligence and analysis of 65 thousand images.

Collection and processing of data, forecasting

- Processing, recognition and analysis of paper documents
- Collection of patient complaints
- Analysis of the results of analyzes and examinations
- Early detection of signs of disease
- Lifestyle / dietary / sports / medical advice
- All information received with the help of such devices (as well as a mobile phone, computers) can be centrally collected on the clinic's server, where it will be processed automatically or by doctors who can transfer information to the patient even without the need for a personal visit to the clinic.

Our project

Cerebrovascular stroke is the second leading cause of death worldwide. Modern diagnostics of stroke is based on time-consuming and expensive neuroimaging techniques, which are unsuitable for areas with limited access to quality healthcare facilities.

We suggest using mobile phones for early detection of signs of cardiovascular events by analyzing images of a person's face. Also, recognition algorithms can be used when working with webcams on personal computers and laptops.

Analysis of facial images looks promising not only for the risk of developing strokes and other pathologies, but also for diagnosing psychological health, identifying signs of developing depression.

Remote Facial Emotion Recognition System

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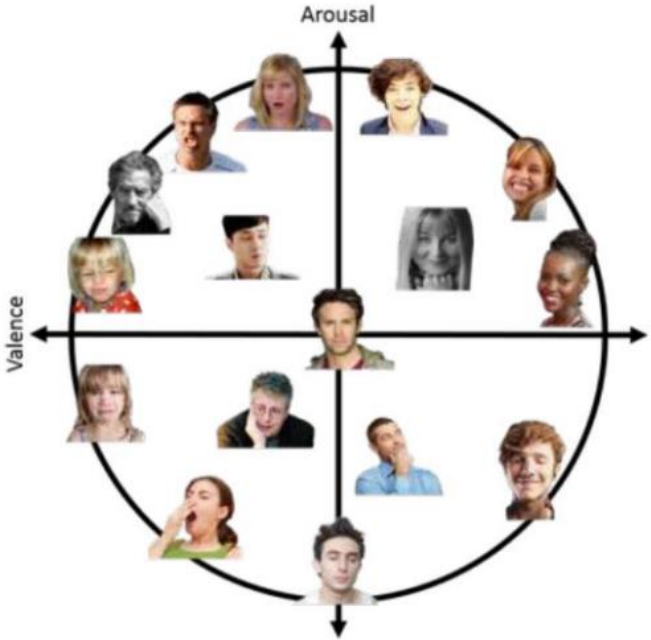
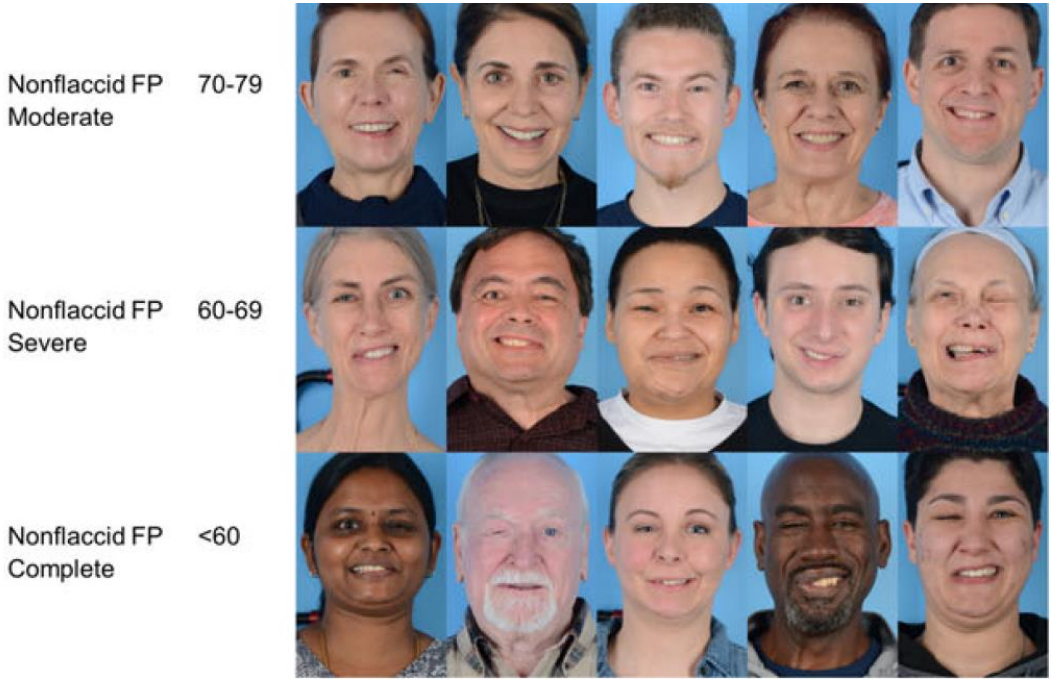


Facial expressions distribution in arousal/valence space.

We have developed a system that allows us to collect various data such as video stream and events of user interaction with the webpage. We also trained a neural network that shows high accuracy. One part of the system is a client library that does not require the user to install any special software and can be easily integrated into the website. The other part is a server application that enables the site owner to analyze the data collected.



We have developed an algorithm that allows us to determine the signs of the onset of ischemic stroke. We used the characteristic stroke that doctors use to define it. The dataset has yet to be expanded and key points to be marked on paralyzed faces, as well as quality metrics for the detection of facial key points and for a stroke classification model to be formulated.

Huawei Face Recognition

Our team, consisting of medical researchers, development engineers with experience in creating medical devices, believes that a smartphone user with **Huawei Face Recognition Engine** using our plug-in can create a personal dataset of his face, and when comparing a new digital face model with the accumulated dataset, the algorithm will inform the user about the presence of characteristic changes and then, depending on the chosen scenario, offer to contact a specialized medical institution or automatically call for help and notify relatives of a possible problem.

Software development for fitness and functional state assessment

Mobile Brain-Computer Interface Application for Mental Status Evaluation

Vasilii Borisov, Alexey Syskov, Vsevolod Tetervak, Vladimir Kublanov

Feature Extraction and Selection for EEG and Motion Data in Tasks of the Mental Status Assessing

Pilot study using Emotiv EPOC+ Headset Signals

Alexey Syskov, Vasilii Borisov, Vsevolod Tetervak and Vladimir Kublanov

Functional State Assessment of an Athlete by Means of the Brain-Computer Interface Multimodal Metrics

Vasilii Borisov, Alexey Syskov, and Vladimir Kublanov

Movement of Head and Center of Mass: Joint Assessment

V. S. Vasilyev[a)], V. I. Borisov[b)] and A. M. Syskov[c)]

Software development for fitness and functional state assesment

The results of series of studies and papers:

- The study for EEG indexes and motion data reflects changes in the mental and functional state of subjects. Verification of those results with HRV indexes and psychological test demonstrates relation to the mental stress and the functional state of the cerebral cortex.
- The relationship between EEG signals and the accelerometer on a wider set of functional samples, when classifying different mental states of a person at short time intervals, was studied.
- Metrics to determine the physiological patterns of changes in the functional state of athletes in the process of training were obtained.
- It was demonstrated that accelerometers can be used as a low-costly and portable alternative to stabilometric systems, and suggest a promising and novel approach to balance control assessment.