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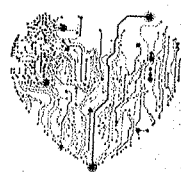
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label that data according to task at hand. After collecting enough data algorithm can be trained to label the data without medical expert. The result is autonomous system that can process inputs sent by patients returning recommendations.

Outcomes. We believe such framework will be able to provide businesses a new way to build consumer level tools for diagnosis of diseases. Also creating opportunities for telemedicine, getting expert opinion on data can be hard, but when algorithm is able to perform at the same level as world experts then more people have access to it.

028 PRACTICAL EXPERIENCE OF APPLYING ARTIFICIAL INTELLIGENCE METHODS FOR DATA ANALYSIS IN MEDICINE

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Medical development in Russia involves active introduction of digital technologies into the practical activities of doctors. The use of mathematical methods for processing medical data leads to medical care quality improvement, reducing medical errors, speeding up diagnosis and providing a more accurate assignment of necessary treatment methods. Artificial intelligence practices have been applied by authors in several branches of medical diagnostics.

The authors propose the following solutions.

Recognition of cancer cells in blood and bone marrow smears (automatic morphological analysis), performed on scanned images of colored smears applied to the glass. Out of 120 known blood cell pathologies, 33 are recognized with 85-90% probability. Over 30,000 images have been processed and "colored" by experts, over 78,000 cells have been marked. It is expected that, by the end of 2018, 50-60 of such pathologies will be recognizable. The limitations, restricting the mass application of this method, are: the complexity of preparing the source material, its choice, coloring, scanning; lack of common standards in preparing the material and in transferring the data; high cost of relevant equipment.

Recognition of pathological changes in the lungs by chest radiographs (automatic interpretation of radiographs). Over 48,000 lung radiographs have been processed, over 60,000 objects have been identified, and the suspected cases of tuberculosis, pneumonia, and lung cancer are recognized with 90% probability. 9 out of 46 pathologies are recognized. The transmitted data are well-formalized in the DICOM format. The method has mass-use potential, allowing to send digitized images for processing out of almost any office. Arranging a mass-use automated screening procedure will allow detecting diseases at early stages.

Recognition of pathological changes in the body by fundus images. An experienced ophthalmologist can recognize over 100 different body pathologies during a fundus exam, from diabetic rhinopathy to hypertensive disease. The authors have studied over 15 thousand fundus images and now the system automatically recognizes 9 pathologies. The method has mass-use potential, as today ophthalmic departments have modern equipment allowing to store and transfer digitized images.

Recognition of urinary bladder diseases by ultrasound scans. The bladder itself and its fullness level can already be recognized with 80% probability. The method can be useful for patients with genitourinary system disorders for remote bladder filling/emptying control when using mobile ultrasound scanners at home.

The results obtained witness the unlimited possibilities of using mathematical methods (including artificial intelligence) for medical data processing. The development and adoption of information exchange standards and the legalization of mathematical methods application will lead to a serious improvement in the quality of diagnostics and in the detection of diseases at early stages.

029 EFFICACY ASSESSMENT OF OUTPATIENT MONITORING CHRONIC HEART FAILURE PATIENS WITH CARELINK TECHNOLOGY DEVICES

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The purpose of the study is to estimate the results of dynamic obsevation for chronic heart failure patients with ICD/ CRT-D devices.

Materials and methods: 118 ICD/ CRT-D/ CRT-P devices were implanted in a period from january 2015 till december 2017 in Surgut Region Cardiocenter. 22 of them were with Carelink remote monitoring system. 44 patients were under the supervision. We divided this patients into two equal groups (10 CRT-D/ CRT-P and 12 ICD in each group). Patients with Carelink system were included in the first group. All patients were visiting hospital 4 times per year. At the same time information from first group patients was receiving continuosly.

There were 86% male patients in our study. The average age of patients was 61±5 years old in first group and 63±7 years old in second group.The average NT-proBNP value was 2799±576 pg/ml in first group and 2567±477 pg/ml in second group. The average ejection fraction value was 36±4% in first group and 35±6 % in second group. 14 patients from first group were in II CHF functional class, 5 patients — in III CHF functional class, 3 patients — in IV CHF functional class. 17 patients from second group were in II CHF functional class, 3 patients — in III CHF functional class, 2 patients — in IV CHF functional class. The ejection fraction, NT-proBNP value and CHF functional class were estimated during this study. All patients were receiving optimal medical treatment. Microsoft Excel attachment was used for statistic processing.

Results: 10 patients from first group and 8 patients from second group has mooved into I CHF functional class. 7 patients from first group and 10 patients from second group has mooved into II CHF functional class. 3 patients from first group and 2 patients from second group has mooved into III CHF functional class. 2 patients from first group and 2 patients from second group has mooved into IV CHF functional class. Ejection fraction has increased to 36±4% in first group and to 35±6% in second group. The average NT-proBNP value became lower: 801±376 pg/ml in first group and 867±408 pg/ml in second group. 4 (18%) patients from first group had tachy AF episodes inside the VT zone. One of these patiens received ICD — therapy. AF paroxysms were recognized for the first time in 3 (14%) patients from first group. 2 (9%) patients from first group had increasing intrathoracic impedance, which could be assosiated with CHF progression. 4 (18%) patients from first group had ICD — therapy (ATP and shock) because of stable VT. 1 (4%) patient from first group had nonstable VT episodes.

Resume: modern methods of CHF patients treatment increase their quality of life. Carelink remote monitoring system gives us information about patients' arrhytmias and ICD-therapies, wich help us to treat these patients better.

030 USE OF NATURAL LANGUAGE PROCESSING TO CLASSIFY MOBILE HEALTH APPS: PERFORMANCE EVALUATION

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Background. Use of conventional keyword-based search (KBS) to find mobile health apps on the app stores has limitations as the user is provided with long lists of apps with little insight into the apps' relevance to the search.

Purpose. The aim of this study was to develop a novel method, based on natural language processing (NLP), able to identify apps in a given topical area more accurately than KBS.

Introduction. The electrocardiogram made on the digital cardiograph is still printed on the classic linear graph paper and described by the doctor by hand. Medical personnel are not able to use the new equipment with all its functions and devices that could facilitate the workflow of the medical worker and reduce the time to make important decisions. Also, in Russia we witness the shortage of doctors specializing in functional diagnostics. The need of the population in the services of functional diagnostics is many times higher than the number of medical personnel which are currently on the staff of a medical organization.

Goal. The first goal is to recognize ECGs from paper and bring them to digital presentation. The second is to make a system where patient can sent the ECG using Internet as digital signal to doctor and then obtain medical opinion fast and easily. We focus on the first task as the kernel of our idea.

Methods. The ECG must be properly scanned and saved as a digital picture after the patient records it. Our Internet service gets this picture and convert image to digital ECG signal.

The primary task is the image segmentation: each ECG channel (I, aVL, aVR, etc) must be marked. Automatic and manual (by human) approaches are possible. We process channels independently and the next discussion is about some selected channel image. The key idea is to extract grid node coordinates (x, y) and try to undistort signal using them.

We need to normalize brightness and contrast over all the axes of the image. It's necessary for the stable classification for background, grid and signal pixels. The classification task using K-Means could be performed successfully if it uses suitable cluster initialization: background is near to white color always, signal is black, grid has middle brightness.

The classificatio n task is done and now we need to detect every grid nodes. The solution is to bruteforce all possible line parameters (angles and offsets) in vertical and horizontal directions and convolve these lines with extracted grid image at classification step. The intersections of such lines gives node coordinates (x, y).

These coordinates allow to undistort the signal from image. We use signal pixels obtained by classification and transform them from distorted to undistorted space where the grid has all lines which are strong parallel and the each cell is square.

Results. Now we built prototype system. It accepts scanned pictures from patients, converts paper ECG to digital presentation, sends it to the doctor. The diagnosis will be sent to the patient back as soon as doctor finishes it.

Outcomes. It's a complex task with a lot of different cases in the algorithm and business logic. We need a high amount of ECG pictures to solve it much better using neural networks and now we are working in this direction.

048 ORGANIZATION OF THE SYSTEM OF CORRESPONDENCE CONSULTATIONS (CARDIO BUREAU) IN CARDIOLOGICAL AND CARDIOSURGICAL PRACTICE OF KHMAO-UGRA

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Remote technologies have been widely used in practical healthcare in the diagnosis and treatment of patients with cardiovascular diseases in KhMAO-Ugra since 2002.

The purpose of this work is to show the effectiveness of the organization of the system of correspondence consultations (cardio-bureau) in the cardiological and cardiosurgical practice of KhMAO-Ugra.

Methods. The chairperson of the cardio-bureau is the chief freelance cardiologist of the Department of Health of KhMAO-Ugra, the main specialist is the chief freelance cardiovascular surgeon of the Department of Health of KhMAO-Ugra, the members of the cardio bureau are leading experts in cardiology and cardiovascular surgeons. The tasks of the cardio bureau work includes: solving expert questions

on the diagnosis and treatment of patients with cardiovascular diseases; selection of patients for referral to Federal centres of Russia; consulting pregnant women with congenital malformations of the fetus. Work with medical organizations of the district is carried out through the system of teleconsultations AMC-Doctor.Net; also consultations are conducted on-line via video conferencing. Commission of cardio-bureau works in 4 groups: congenital heart defects — children and pregnant; heart rhythm disturbances — adults and children; ICD, acquired heart defects (adults, including defects in pregnant women), vascular diseases that does not require surgical interventions (except children) and patients with cardiosurgical diseases. The sessions of the cardio-bureau are held daily for all groups; the commission may recommend further follow-up, pre-examination of the patient, correction of therapy, admission to a hospital for the provision of high-tech medical care, or referral to a consultation with the Federal Center.

Results. The introduction of remote technologies into clinical practice allowed to significantly increase the volume of consultations conducted in recent years and availability of this type of medical assistance (Table 1).

Table 1

Structure of the cardio bureau consultation and patients sent to the Federal Centers of the Russian Federation for 2015 - 2017

Index	2015	2016	2017	Dynamics 2017/2016, %
All patients were consulted, including:	937	986	1491	51,22
* children with congenital heart disease	200	182	327	79,67
* pregnant women, including:	399	436	448	2,75
- congenital malformation of the fetus	79	115	148	28,7
- concomitant pathology of the cardiovascular system	320	321	300	-6,54
* other consultations (heart rhythm disturbances, ischemic heart disease, hypertension)	338	368	716	94,57
Sent to the Federal Centers	129	97	95	-2,06

Comparative analysis of cardio-bureau groups showed that there was a significant increase in the number of consultations of patients with heart rhythm disorders (+35.9% in 2017) and cardiological pathology that does not require surgical intervention (+35.5% over the analysed period). In 2017, 95 patients were sent to the Federal Centres of the Russian Federation for surgical treatment, 43 of them were children. In general, cooperation is carried out with 12 Federal Centres of the Russian Federation.

Conclusions. The use of remote technologies-the application of the cardio-bureau system — increases the effectiveness and quality of medical care for patients with cardiovascular diseases. Application of the technology allows to improve the efficiency of specialists of remote areas of KhMAO-Ugra. Advising patients using remote technologies improves the timeliness of referring patients with circulatory diseases to district clinics and Federal Centres of the Russian Federation.

049 ORGANIZATION OF THE WORK OF CARDIOLOGICAL ON THE TERRITORY OF KHANTY-MANSI AUTONOMOUS DISTRICT — UGRA

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In the message to the Federal Assembly, the President of Russia called the widespread introduction and development of telemedicine one of the priorities in health care. Remote technologies have been widely used in practical healthcare in the diagnosis and treatment of patients with cardiovascular diseases in KhMAO-Ugra since 2002. The four leading institutions of the KhMAO-Ugra conducts more than 4,000 remote consultations annually, both in planned and in urgent order.

The purpose of this work is to show the effectiveness of the organization of the work of cardiological remote-consulting points in the territory of KhMAO-Ugra.

Methods. Cardiological remote-consulting point was opened on the "District cardiological dispensary "Center of diagnostics and cardiovascular surgery" (Surgut) in 2011 with the aim of optimizing the provision of medical care to patients with acute coronary syndrome. From 2011 to 2017 on the territory of KhMAO-Ugra 6 cardiological remote-consulting points were organized: for patients with acute coronary syndrome №1 and 2 ("District cardiological dispensary "Center of diagnostics and cardiovascular surgery", Surgut), №3 ("District Clinical Hospital", Khanty-Mansiysk), №4 ("District Clinical Hospital", Nyagan), №6 ("District Clinical Hospital", Nizhnevartovsk); for children with congenital heart defects — №5 ("District cardiological dispensary "Center of diagnostics and cardiovascular surgery", Surgut). Consultations are carried out round the clock, 7 days a week on-line. In the distantly territories, CardioJet complexes for ECG transmission using GCM operate.

Results. The introduction of remote technologies into clinical practice allowed to significantly increase the volume of consultations conducted in recent years and availability of this type of medical assistance. In 2017 the work of cardiological remote — consulting points has been optimized: the number of consulted patients with ACS has significantly increased. Since 2016 the registration of patients transferred to District cardiological dispensary according to the results of counselling is conducted. In 2017 a total of 1,692 consultations were held (cardiological remote — consulting points №1, 2 and 5), which is 43% more than in 2016; 1,231 patients transferred to District cardiological dispensary (73%), which is 21% more than in 2016 (Table 1).

Table 1
Indicators of work cardiological remote-consulting points №1, 2, 5 for 2015-2017

Index	2015	2016	2017	Dynamics 2017/2016
Consultations were held (№1)	53	251	773	more than 3 times
transferred to District cardiological dispensary on the results of consulting	29	124	349	more than 2.8 times
Consultations were held (№2)	150	773	910	18%
transferred to District cardiological dispensary on the results of consulting		861	880	2%
Consultations were held (№5)		10	9	-10%
transferred to District cardiological dispensary on the results of consulting		3	2	-33%
Total number of consultations		1183	1692	43%
transferred to District cardiological dispensary on the results of consulting		1016	1231	21%

Conclusions. The introduction of cardiological remote-consulting points in the territory of KhMAO-Ugra made it possible to increase the efficiency and quality of medical care for patients with cardiovascular diseases. Application of the technology allows to improve the efficiency of specialists of distantly areas of KhMAO-Ugra. The implementation of patient consultations using remote technologies improves the timeliness of sending patients with cardiovascular diseases to the district clinics to provide them with specialized, including high-tech, medical care.

050   MONITORING USING AMBIENT AND WEARABLE SENSORS FOR PREVENTION AND EARLY DETECTION OF SERIOUS HEALTH EVENTS IN ELDERLY PEOPLE

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Introduction. In our aging society, prolonged independent living is a question of individual preference in addition to an economical one. Recent studies have shown that increasing home care in comparison to institutionalization, may have a significant effect in lowering health-care cost projections. To realize this vision, major threats of healthy aging in the elderly have become a central challenge in recent research.

Monitoring technology provides new possibilities in providing preventive and proactive services to health-care professionals in real-time. These technologies could help in identifying potentially adverse changes in behavior or vital signs before a life-threatening event (e.g. fall or stroke) occurs. More recent ambient assisted living (AAL) technologies allow to unobtrusively and autonomously measure everyday physical activity and changes thereof. Monitoring physical activity, behavior and other vital signs could potentially help to accurately detect early signs of decline in overall health or track the course of an intervention or the effect of certain changes in prescribed medication. Existing systems that rely on single sensor-based detection fail to produce efficient and reliable results. Multimodal sensor-based technologies can provide an objective alternative to existing systems.

Methods. Thirty-four participants (age >70 years, living alone) have been recruited and are currently monitored for year, using a set of wearable and ambient sensors. Wearable sensors include a mobile ECG (Preventice Health-Guardian) and a Fitness Watch (FitBit) for 50% of the participants, while the other 50% of participants will be provided with an armband (Biovotion Everion) and an accelerometer (Axivity AC3). Ambient sensors include motion and door sensors (Domo-Safety System) as well as a piezoelectric bed sensor (EMFIT). Simultaneously, questionnaires and limb strength measures are recorded, while local care givers visit the participants twice a week to get information about lifestyle changes, accidents and other unforeseeable events.

Results. Physical activity and movement between rooms positively correlated with muscle-strength, where by movement between rooms showed strong correlation with hand-grip strength. Initial retrospective analysis of a single subject data prior to an heart failure showed that the subject's breathing rate and average motion during sleep increased significantly. These negative trends emerged several weeks before the actual event, showcasing the potential for early intervention.

Conclusions. Monitoring physical activity and vital signs using multi-modal sensor-based technologies can be a powerful tool for early detection of adverse events, provide accelerated response to events and reduce rescue times which are linked with reduced negative medical impacts.

051   MHEALTH TELEMONITORING IN ADULT PATIENTS WITH CONGENITAL HEART DISEASE

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Background. Previous telemonitoring studies showed conflicting results, with inadequate patient selection being an important factor. Adult patients with congenital heart disease (CHD) seem eligible for