An Expert AI System for Professional Neurological Patients Care

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Computers are incredibly fast, accurate, and stupid: humans are incredibly slow, inaccurate and brilliant; together they are powerful beyond imagination.

— Albert Einstein —

AZQUOTES



Sub-fields of AI

- Neural Networks e.g. brain modelling, time series prediction, classification
- Evolutionary Computation e.g. genetic algorithms, genetic programming
- Vision e.g. object recognition, image understanding
- Robotics e.g. intelligent control, autonomous exploration
- Expert Systems e.g. decision support systems, teaching systems
- Speech Processing e.g. speech recognition and production
- Natural Language Processing e.g. machine translation
- Planning e.g. scheduling, game playing
- Machine Learning e.g. decision tree learning, version space learning





NeuroAdvise

An expert system as a clinical decision support tool, for professional neurological practice

Problems

- Doctors high work load, low time to study, and unwillingness to consult
- False or delayed diagnosis
- Misuse of diagnostic tests
- Wrong or delayed treatment
- Absence of widely-accessible clinical databases
- Poor medical documentation
- Patient morbidity and mortality
- High healthcare costs



Precise Documentation



Widespread Availability



NeuroAdvise

NeuroAdvise, A Single Solution for Multiple Health Problems





- I began to work on NeuroAdvise idea since 2011 with data collection from hundreds of resources (first with the aim of publishing a book)
- I began to cooperate with a team of IT experts since 2016
- They helped me convert my idea to several expert system algorithms and organize the database
- They helped me to organize this pathway:

Symptom Lesion Approach Disorders Investigations

- I began to cooperate with a team of medical students Since 2018
- They helped me extract data from databases and enter them into excel tables

- We have published android version of NeuroAdvise at September 2018 on Google Play
- iOS version has been published at May 2019 on App Store
- Both versions are Published from Hungary and are available for free
- System debugging and improvement is currently under progress



- Users are medical doctors involved in neurology patient's care; including neurologists, neurosurgeons, psychiatrists, pediatric neurologists and all other medical doctors or medical students
- Radiologists and neuroradiologists are potential users
- Current edition is not suitable for patient's



Clinical Approach

- This feature helps you perform a goal-directed neurological examination.
- Based on your entered data, the system will provide anatomical localization, a list of differential diagnosis (in order of probability) and a list of diagnostic investigations (in order of priority).
- If your patient has many problems, you can enter all of them and search for a common explanation.

Clinical Approach



Clinical Approach



Q Search

Note: You can search or select an item

- Impaired consciousness
- Sleep-wake system dysfunction
- Neuropsychic impairment
- Visual system dysfunction
- Auditory system dysfunction
- Vestibular system dysfunction
- Olfactory system dysfunction
- Gustatory system dysfunction
- Somatosensory system dysfunction

Anatomic Approach

- This feature is useful when you know the exact location of lesion within the given patient's neuraxis, either based on clinical or paraclinical ground.
- Based on your entered data, the system provides a list of differential diagnosis (in order of probability) and a list of diagnostic investigations (in order of priority).
- If your patient has multiple lesions, you can enter all of them and search for a common explanation.

Anatomic Approach



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Q Search

Note: You can search or select an item

- Cerebral hemispheres
- Diencephalon
- Brainstem

Cerebellum

- Cranial nerves and skull base
- Spinal cord

Spinal nerves, roots and ganglia

Plexus

Peripheral nerves

Radiological Approach

- This feature provides a list of differential diagnosis for common neuro-radiologic abnormalities.
- Based on your entered data, the system will provide a list of differential diagnosis (in order of probability) for that test results.
- If your patient has multiple abnormal test results, you can enter all of them and search for a common explanation.

Radiological Approach



Radiological Approach



Note: You can select one or more items

- Contrast-enhanced brain CT
- Contrast-enhanced brain MRI
- Contrast-enhanced spine MRI
- Conventional brain CT scan
- Conventional brain MRI
- Conventional spine MRI
- Diffusion-weighted brain MRI

- The user must be online during working with the app
- Questions are automatically generated by the system and are asked from the user (passed through multiple filters). Any answer is directed to the server and analyzed. The next step completely depends on the previous step.
- If answers are incomplete, system directly asks some limited possibilities from the user and then proceeds.

Based on the following items, the system computes an index for each possible underlying disorder:

- Patient's demographics (age, gender, geographic location)
- Main clinical syndrome
- Prevalence of each clinical syndrome in any suggested disorder
- Anatomical lesion location
- Temporal profile
- Past medical history
- Drug history
- Exposure to toxins or trauma
- Family history

- Final list of disorders is classified based on pathophysiologic groups and is sorted in order of probability
- Top three causes are seperated
- The system also recommends some diagnostic tests in order of priority
- The result can be saved for later review and can be shared in all social media networks

Sample case: An old-aged man with excessive daytime sleepiness with past history of hypothyroidism



- A comprehensive database, currently covering more than 3000 disorders, 1400 drugs, 1500 clinical features, 600 anatomic locations and 263 different approaches (numbers are growing)
- Innovative algorithms that are simulations of clinician's mental diagnostic process (NeuroAdvise is pioneer from this point of view)
- Helping our users reach from symptoms to causes and make better clinical decisions with several user-friendly features
- Helping our users localize the lesion within nervous system

- Very fast data processing (within few seconds)
- Ability to store and share clinical data with other doctors
- Unlimited capacity for growth with an easy and fast update process
- Improving neurology patients care through improving doctor's clinical skills





- We have 2040 downloads (until 20th August 2019) for android version, with about 50% active users
- Users are mainly from India, Egypt, Iran, United states, Brazil, Pakistan and France.
- User's population are growing gradually and we are trying to accelerate the process.
- Users mainly see us via our website and social media networks

• We have been invited and participated in VivaTech 2019 event in Paris at May 2019, as the only start up from Iran.

124,000 visitors from 125 countries 13,000 startups 3,300 investors 2,500 journalists 450 international speakers, the latest tech innovations Among 4000 start ups submitted their project to Sanofi, only 21 teams were selected and participated in Sanofi's Tech4Health Lab



Statistics



SANOFI

ech4Health

- We have conducted a pilot study for system's diagnostic sensitivity with amazing results:
- More than 95% sensitivity for the diagnosis of acute ischemic stroke as the first cause
- 100% sensitivity for the diagnosis of acute ischemic stroke within top three cause
- A larger study is under progress

Challenges

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Challenge 1: Sanctions & Filtering

- 1. We are not able to have Google or Apple developer account
- 2. We cannot transfer our money (income or investment)
- 3. We have not access to some software developing tools
- 4. We have not access to analytic tools
- 5. We cannot condcut a complete product test from inside of our country, for example we cannot test in-app purchase capability
- 6. We cannot receive our users feedback and experience easily
- 7. Foreign investors and companies don't accept the risk of working with Iranian people. We are isolated from global market making our business strategy quite difficult

Challenge 2: Unfamiliarity with data systems

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Challenge 2: Unfamiliarity with data systems

- 1. Doctors have medical knowledge but not data knowledge
- 2. IT experts can work with data but are not familiar with medical knowledge
- 3. Medical data specially medical advices are quite sophisticated and critical. Wrong advices can be life threatening to the patient.
- 4. Making such an interface between medical knowledge and computer is very difficult
- 5. Editing the database also needs attention, one wrong code can lead to a completely wrong output

Challenge 3: Limited financial resources

- 1. Our priorities differ from developed countries. We have focused on treatment and they have focused on future health problems
- 2. We have limited access and connection with global companies that can fund in such a project
- 3. We have limited connections with medical publishers and universities

Challenge 4: Limited human resources

- 1. Al projects are team work
- 2. To have an expert team we need money, motivation and time
- 3. This is more important if we want to develop a comprehensive medical decision support system. We will need more scientific editor's and data collecting and organizing people



- Several effective features will be added to the current version to meet most of users' needs (Current system consists 30% of the final NeuroAdvise product)
- Textual information and media will be added



- NeuroAdvise can be expanded to all other medical fields and I have named the final product MedEx24, that is a comprehensive clinical database for all healthcare professionals
- We can be a potential competitor for current medical databases such as uptodate, ...
- New technologies such as VR and AR can be included

Business model









Accepting advertisement from drug companies

Promoting hospitals information systems Collecting epidemiological data for WHO & healthcare systems

Market

- Total Market size for NeuroAdvise:
 - 500.000 medical doctors, mainly neurologists, neurosurgeons, psychiatrists, radiologists, general practitioners as well as medical students
 - 200 drug companies
- Total market size for MedEx24 (the final comprehensive product):
 - 14.000.000 medical doctors in all degrees and specialties
 - 10.000 university and institution
 - 2.000 drug and instrument companies
 - 20.000 hospitals

Market

• "The easiest way to get one million people paying is to get one billion people using."

Phil Libin, Evernote



"Your time is limited, so don't waste it living someone else's life. Don't be trapped by dogma which is living with the results of other people's thinking. Don't let the noise of others' opinions drown out your own inner voice. And most important, have the courage to follow your heart and intuition."

- Steve Jobs



NeuroAdvise will proceed stronger



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