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VIRTUAL REALITY THERAPY

Application of Virtual Reality in phobia treatment

Keywords: Virtual Reality, mental healthcare, phobia treatment

Virtual Reality (VR) is a 3D environment generated by computer which can be explored and interacted with by a person and where various experiences can be simulated. It can increase the efficacy of psychotherapy treatment for anxiety and other mental disorders.
A phobia is a type of mental disorder causing an irrational fear of something (a situation, living creature, place, object, etc.) that's unlikely to cause harm. The exposure to the fear source in a safe environment, known as exposure therapy, is a very effective phobia treatment.

VR exposure therapy (VRET) is a form of exposure therapy that uses VR technology and it proved to be very useful in the treatment of the most types of phobias. VRET enables very authentic experiences for the patient and gradual exposure, under the complete control of the therapist. Other important benefits of VRET are:

- enables mental health specialists to design highly individualized treatment plans
- allows patients control over their own exposure
- can offer lower costs than conventional treatment programs
- provides a more engaging and more authentic experience, resulting in greater effectiveness
- enables highly interactive experiences, allowing patients to maintain a sense of control even as they experience anxiety triggers

These advantages and the increasing availability and affordability of VR technology caused a massive growth in the use of VRET by the mental health specialists.

Source: CogniHub. Retrieved from: https://www.cognihab.com/blog/vret-exposure-therapy/

Application of Virtual Reality in phobia treatment

Images retrieved from https://medanima.ro/

Med Anima is a Romanian medical centre specialised in neuropsychiatric disorders that offers medical consulting in psychiatry, integrative psychotherapy and cognitive behavioural psychotherapy, clinical psychology, psychological counselling. They are a promoter of innovation and research in their field of activity, including the implementation of VRET for treating various forms of phobia. Some approaches used by Med Anima are presented below.

Hemophobia, or fear of blood, is treated by gradually exposing the patient to situations such as blood collection, in a virtual environment, under the control of a therapist. During the VRET session, the therapist includes various situations and anxiogenic stimuli.

Fear of flying is best treated through exposure combined with relaxation and cognitive restructuring techniques. VR is a very suitable tool because offers significant reduction of the costs and efforts comparative to in vivo exposure.

Acrophobia (fear of heights) is treated by exposing the patient to heights using VRET. VR offers huge advantages, such as multiple exposure parameters, acceptability for the patient, costs reduction, etc.

Other phobias treated with VRET: **claustrophobia** (fear of confined space), **agoraphobia** (fear of places or situations where escape might be difficult), **glossophobia** (the fear of public speaking), **fear of driving** a car, **fear of animals**, **social phobia**, etc.

Application target audience:	• Mental health specialists such as psychiatrists, nurses, psychologists; • VET trainers for mental health specialists; • Managers and policy makers from mental health sector.
Resources used:	https://medanima.ro/servicii/terapia-prin-realitatea-virtuala
Further reading:	• Albakri, G. et al. (2022) Phobia Exposure Therapy Using Virtual and Augmented Reality: A Systematic Review. Appl. Sci., 12, 1672. https://doi.org/10.3390/app12031672 • Gottlieb A, et al. (2021) The Efficacy of a Virtual Reality Exposure Therapy Treatment for Fear of Flying: A Retrospective Study. Front. Psychol. 12:641393. doi: 10.3389/fpsyg.2021.641393 • Chung OS et al. (2022) Implementation of Therapeutic Virtual Reality into Psychiatric Care: Clinicians' and Service Managers' Perspectives. Front. Psychiatry 12:791123. doi: 10.3389/fpsyt.2021.791123

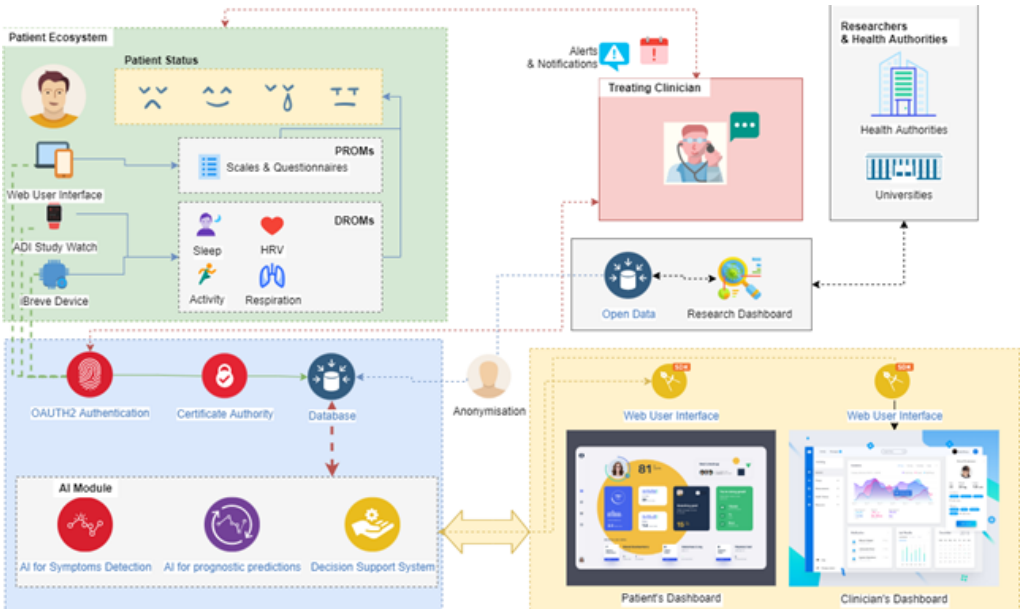
WEARABLES FOR DEPRESSION

Application of wearable devices for depression management

Keywords: Wearable devices, mental healthcare, depression, machine learning

Depression is one of the leading causes of the global burden of disease (Vos et al., 2016) due to its severity, its prevalence, and its mostly recurrent and sometimes chronic course (Richards, 2011). In spite of the availability of efficient treatments (mainly antidepressant medication and psychotherapy), the effect of each treatment on each patient is not the same and normally takes time to have an impact. Depression patients tend to experience long periods of uncertainty and clinical decisions are made with limited subjective information which ends up having implications in that the vast majority of patients do not receive guideline-oriented treatments (Thornicroft et al., 2017). Health systems have to make efficient and effective use of their limited resources which currently is translated, on many occasions, into long waiting times until patients get an appointment with a psychiatrist or psychotherapist. Improving self-management/awareness and increasing the efficiency of the communication of the patients with the treating physicians, psychotherapists or health care providers is crucial to reduce the present disease burden and therapeutic deficits.

Wearable and smart mobile devices are equipped with sensors that can unobtrusively collect personal depression related data. By applying Artificial Intelligence (AI) and machine learning models to the wearable and mobile sensor data, it is possible to compute depression related markers and extract meaningful time patterns that are able to assess the severity of the symptoms, better understand the personal implications for each depression patient and predict near future episodes. Based on AI extracted knowledge, personalised information can be tailored to each depression patient helping them to better handle depression episodes. AI based extracted knowledge, together with visualization tools, provide a powerful mechanism for clinicians to help them in their decision-making process, having objective measures for personal treatment response and objective data for personal forecasting.



Wearable AI enhanced depression management

Application of wearable devices for depression management

Images retrieved from https://www.analog.com/en/thought-leadership/how-advances-in-sensor-and-digital-tech-yield-better-patient-care.html

ADI's innovative Vital Signs Monitoring (VSM) Study Watch is a 4th generation platform able to sense vital signs and provide raw data for AI models to extract depression related information.

Several behavioural and physiological parameters have been found to be associated with depression and the course of depressive disorders, comprising physical activity, sleep, heart rate variability, skin conductance (Lee et al., 2021), and speech (Low et al., 2020). Having reliable, easy-to-wear devices, optimizing battery life and machine learning algorithms to provide continuous assessment is crucial for the final success and user acceptance of these technological solutions. Another important aspect for user acceptance is guaranteeing the data privacy, security and user control over it.

Based on the sensors on ADI's wearable device, several depression markers can be computed such as the quality of sleep, physical activity patterns and stress.

Application target audience:

- Patients suffering depression;
- Clinicians taking decisions to optimize depression treatments;
- Managers and policy makers from mental health sector.

Resources used:

https://www.analog.com/en/technical-articles/transition-from-wearable-to-medical-device.html

https://youtu.be/x4ASmJZ7LjM

Further reading:

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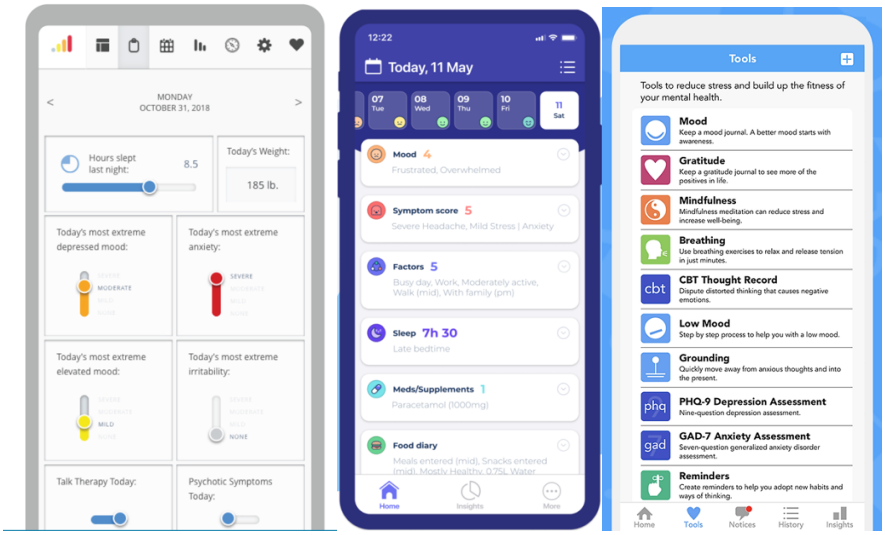
MOBILE TECHNOLOGIES FOR MENTAL HEALTH

Mobile apps for the monitoring and management of mental health and emotional well-being

Keywords: Mobile applications, Android, iOS, mental health, tracking

mHealth consist in the use of mobile devices to collect aggregated health data, such as many fitness apps currently do. There are some mobile applications that collect information from patients and provide some clinical information about themselves for illness self-management purposes or for the monitoring by professionals. Examples of these apps are eMoods (https://emoodtracker.com), Moodfit (https://www.getmoodfit.com), Bearable (https://bearable.app) or eB2 MindCare (https://eb2.tech/products/?lang=en#mindcare). There is a lot of relevant data that can be collected by these apps from sensors or information from other apps installed on the patient's phone. This information includes, for example, patient location (e.g., to know whether he/she leaves home and the travelled distance), actigraphy (rest/activity cycles, such as steps and type of physical activity as well as sleep time), applications used by the patient (e.g., social networks), calls made (e.g., to know whether he/she contacts other people). These indicators can be presented to the patient in the form of visualizations for self-awareness or sent to a professional so that the patient can be monitored.

The use of smartphones is nowadays ubiquitous. As a result, there are numerous mobile applications that have been developed in the field of health, and in particular in the field of mental health. These applications use mobile devices and technologies to collect data from patients in order to assess their condition and make a better diagnosis and monitoring. Interventions using apps on mobile devices have several advantages: 1) low threshold in their use, as they are portable and can be easily installed; 2) smartphones are part of our daily lives; 3) these apps can collect large amounts of data per patient leading to a more personalized monitoring; 4) these apps can collect large amounts of data from multiple patients leading to large-scale studies and interventions.



Three examples of commercial mobile applications for mental health: eMoods (left), Bearable (centre), and Moodfit (right)

Mobile technologies for mental health

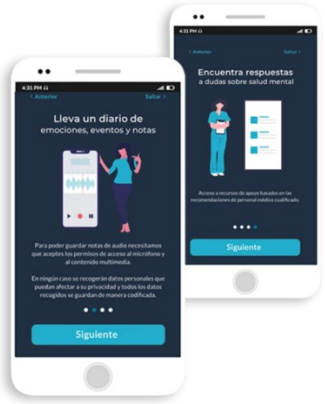


Image retrieved from https://eb2.tech/products/?lang=en#mindcare

eB2-MindCare is the result of more than 10 years of research work by a multidisciplinary team of engineers and psychiatrists, promoted by Universidad Carlos III de Madrid. eB2-MindCare is an eHealth application that provides physicians, patients, family members and caregivers with an objective and functional assessment of the condition of psychiatric patients. eB2-MindCare provides useful and interpretable information through customized, objective, and automated behavioural assessment tools that are easily, flexibly, and cost-effectively integrated into any health care service system. It is not just another application, it is a comprehensive solution; it works by collecting in an automatic and continuous way, through the smartphone or any other smart device, the patient's activity in the digital world.

Application target audience:

- Patients with mental health problems who install the app for awareness or monitoring by a professional
- Professionals tracking patients through the data collected by the apps.

Resources used:

https://eb2.tech/products/?lang=en#mindcare

https://getmoodfit.com

https://emoodtracker.com

https://bearable.app

https://mobile.va.gov/app/ptsd-coach

Further reading:

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ARTIFICIAL INTELLIGENCE FOR MENTAL HEALTH PREDICTION

Use of Artificial Intelligence (AI) technologies for the diagnosis and treatment of patients with mental health disorders

Keywords: AI, Machine Learning, Big Data, mental health prediction and treatment

Artificial intelligence is increasingly being used in all kinds of industries (including e-commerce, entertainment, education, and also medicine) and for different purposes (including understanding and predicting the condition and behaviour of individuals). In the context of mental health there are different AI technologies that can be useful: 1) machine learning and deep learning, to make better predictions in the diagnosis of mental health disorders and predict the outcomes for a patient of certain treatments; 2) natural language processing, for speech recognition and text analysis via chatbots and conversational agents to better understand and monitor patients; and 3) computer vision, for understanding non-verbal cues, such as facial expressions, gestures, or eye gaze in the patient. Notably, prediction and treatment of patients with mental health disorders are the uses of IA with the greatest potential in the field.

Artificial intelligence in medicine is a field that is still in its infancy, on which there is a lot of research work but in which it is still necessary to develop applications that can have a significant impact and that can be incorporated into regular procedures for both physicians and patients. For example, there have been developments on AI-based analytics systems that enable doctors to create more effective personal healthcare plans based on the patient's characteristics, such as lifestyle and other factors. There have also been developments on the use of AI as part of intelligent algorithms that provide crucial information for accurate diagnosis that is extracted from patient test results, medical images, and sensor data from patient monitoring equipment. Regarding mental health, AI is being used to analyse patient data to assess the probability of developing mental health conditions, classify disorders, and suggest optimum treatment plans, conduct self-assessment, and therapy sessions, or make psychological interventions by automatically giving appropriate information to the patient, among others.

Source: https://daystech.org/doctors-using-ai-supercomputer-to-predict-and-prevent-50-of-mental-illness/

Use of AI for the diagnosis and treatment of patients with mental health disorders

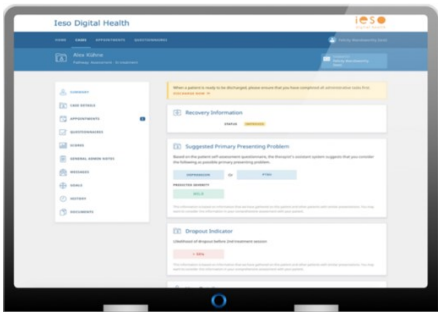

Image retrieved from https://www.iesohealth.com/en-gb/news/world-s-first-ai-enabled-mental-health-treatment-platform-goes-live

Ieso (https://www.iesogroup.com). First AI-enabled mental health treatment platform. They collected over 500,000 hours of therapy sessions. They use AI, machine learning and deep neural networks to recognize patterns in conditions and treatment.

eB2 Behavioral Analytics (https://eb2.tech/products/?lang=en#behavioral). It is a solution composed by the user's data aggregation services, behavioural biomarkers computation services, and integration services on third-party platform. This solution has three processes: passive data collection with mobile applications, modelling data using artificial intelligence, and displaying the information obtained.

Application target audience:

- Professionals diagnosing and treating patients with mental health disorders

Resources used:

https://eb2.tech/products/?lang=en#behavioral

https://itrexgroup.com/services/ai-for-healthcare/#

https://itrexgroup.com/blog/ai-mental-health-examples-trends

https://www.iesohealth.com/en-gb/news/world-s-first-ai-enabled-mental-health-treatment-platform-goes-live

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DIGITAL MEDICINE SYSTEMS

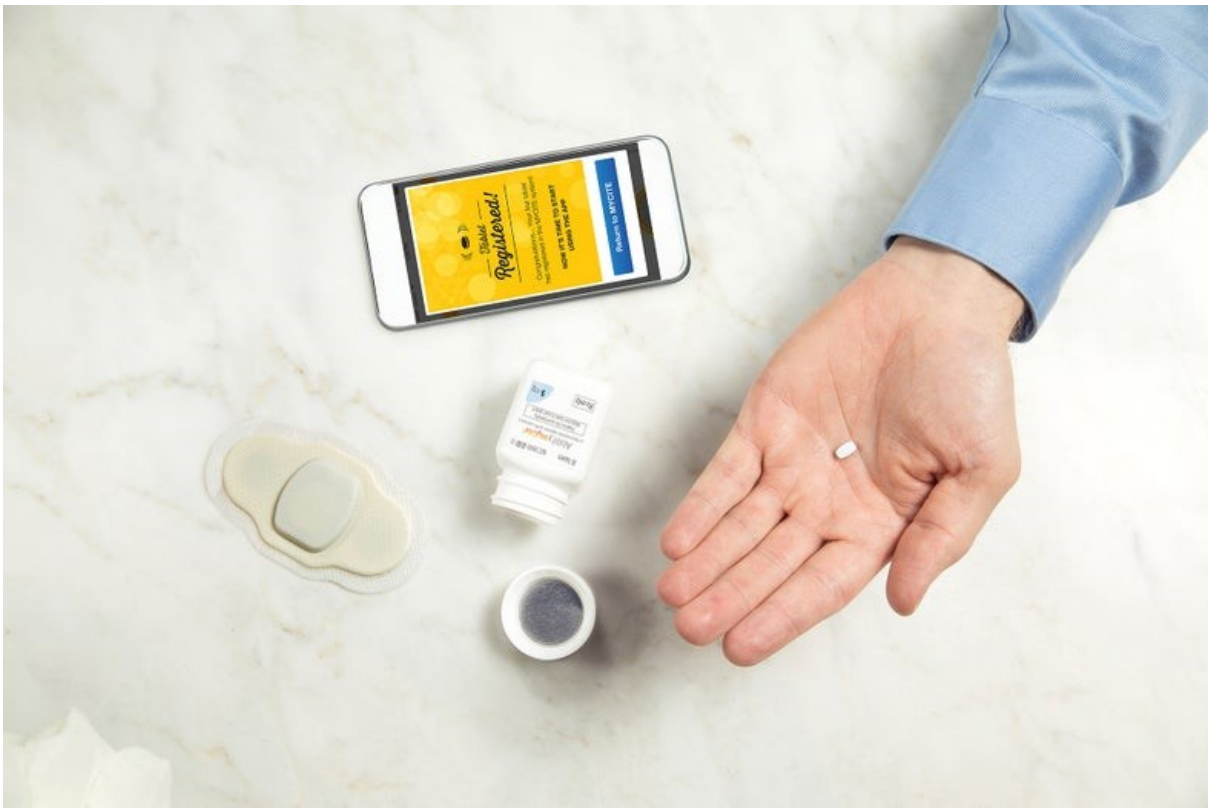
Application of Digital medicine systems in schizophrenia and bipolar disorder treatment

Keywords: Digital medicine system, mental healthcare, schizophrenia treatment, bipolar disorder treatment, medication adherence

Digital medicine systems (DMSs) are a combination of an active pharmaceutical and an ingestible sensor component that communicates to a web or mobile application. DMSs are providing objective medication ingestion information enabling psychiatric care teams to make more informed treatment decisions. In addition, DMSs can improve the medication adherence, especially for patients with serious mental illness, such as schizophrenia and bipolar disorder.

Poor medication adherence (the extent to which patients take medication as prescribed by their doctors) is a major public health problem worldwide, leading to reduced effectiveness and increased healthcare utilization. Digital medicine systems (DMSs) can improve the patient adherence and can signal the successful medication ingestion events, which allows timely and impactful interventions by the doctors.

Lack of medication adherence is of particular concern among patients with schizophrenia or bipolar disorder, with some reports estimating rates of nonadherence as high as 60%.

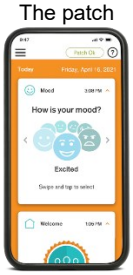


Source: Proteus Digital Health. Retrieved from: https://www.popsci.com/best-health-innovations-2018/

Application of Digital medicine systems in schizophrenia and bipolar disorder treatment

The pill


The patch



The app


The dashboard

Images retrieved from www.abilifymycite.com

ABILIFY MYCITE is the first digital medicine system approved by U.S. Food and Drug Administration (FDA). It is a drug-device combination product comprised of an aripiprazole tablet with an Ingestible Event Marker sensor. The IEM sensor activates when in contact with stomach fluid and communicates to a wearable sensor (MYCITE Patch). The IEM sensor is then digested and eliminated from the body. The MYCITE Patch detects and records the date and time of the ingestion of the tablet, as well as, certain physiological data, and communicates to the MYCITE APP on a compatible mobile device.

ABILIFY MYCITE is an atypical antipsychotic indicated in adults for the treatment of schizophrenia, acute manic and mixed episodes, and maintenance treatment of bipolar I disorder as monotherapy, and as adjunctive therapy to lithium or valproate, and the adjunctive treatment of major depressive disorder.

ABILIFY MYCITE DMS has the following functions:

- Records medication ingestion and communicates it to the patient and healthcare provider
- Records daily data about the patient's activity level and time spent resting.
- Allows recording data on the patient's mood, resting quality and the reason for not taking the pill
- Allows sharing this data with the healthcare team and selected family or friends.

This DMS can help patients keep track of when they take their medicine, thus improving the medication adherence and the effectiveness of the treatment. It also helps patients and care teams to address the challenge of objectively measuring medication ingestion for patients with mental illnesses, such as schizophrenia and bipolar disorder.

Application target audience:

- Mental health specialists such as psychiatrists, nurses, psychologists;
- patients and family caregivers;
- VET trainers for mental health specialists;
- Managers and policy makers from mental health sector.

Resources used:

https://www.abilifymycite.com/
https://www.otsuka-us.com/discover/articles-1075

Further reading:

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INTERNET OF THINGS (IoT)

Application of IoT in research on depression

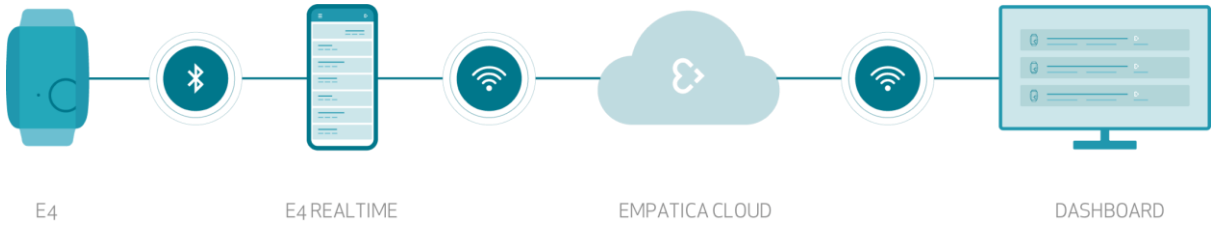
Keywords: Internet of things, IoT, mental healthcare, wearables, depression

Internet of things (IoT) is the network of connected objects (things) able to collect and exchange data using embedded sensors, software, and other technologies. Depression (major depressive disorder or clinical depression) is a mental disorder characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-respect, disturbed sleep or appetite, tiredness, and reduced concentration.
IoT-enabled medical wearables are increasingly used for assessment, monitoring, or prediction of depression.

IoT-enabled medical wearable devices can collect physiological data related to mental health thus enabling monitoring and assessment of patients in real time and in a non-invasive way. The collected data can be monitored by the patient, and used by mental health specialists to deliver personalized, interactive, noncontact healthcare in a cost-effective manner.

It is expected that the real-time objective monitoring of symptoms and new approaches for diagnosis and treatment using wearable devices will revolutionise the management of patients with depression.

a) Recording mode



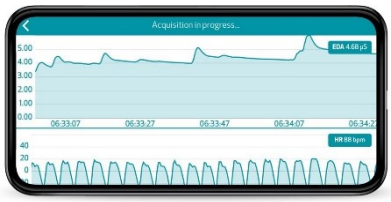
b) Bluetooth® Streaming Mode

Source: Empatica. Retrieved from: www.empatica.com/research/e4/

Application of IoT in research on depression

E4 wristband

E4 manager



Bluetooth® Streaming Mode

Images retrieved from www.empatica.com

The Empatica E4 wearable is a wristband used for data recording and management as well as real-time streaming to an app (Empatica Realtime App). It is designed for researchers and physicians who are conducting research on physiology and can be used in a wide range of applications related to mental health.

E4 is equipped with sensors designed to gather high-quality data. It combines EDA and PPG sensors, simultaneously enabling the measurement of sympathetic nervous system activity and heart rate. The list of sensors includes:

- **PPG sensor** - Measures Blood Volume Pulse (BVP), from which heart rate variability can be derived
- **3-axis Accelerometer** - Captures motion-based activity
- **EDA Sensor (GSR Sensor)** - Measures the constantly fluctuating changes in certain electrical properties of the skin
- **Infrared Thermopile** - Reads peripheral skin temperature

The E4 has an internal memory that allows to record for up to 60 hours with 5s synchronization resolution. The E4 wristband connects to a smartphone or a tablet via Bluetooth® enabling real-time data viewing. Data are automatically uploaded to E4 Connect after a session ends.

E4 was used in several studies related to depression, for example to assess physiological symptoms of depression, to distinguish activity patterns between adults with depression and bipolar disorder, compare activity in the day and night to classify depressive episodes, to monitor changes in depressive symptom severity of patients, etc.

Application target audience:	• Mental health specialists such as psychiatrists, nurses, psychologists. • VET trainers for mental health specialists; • Managers and policy makers from mental health sector.
Resources used:	https://www.empatica.com/research/e4/
Further reading:	• L. Seunggyu, K. Hyewon, P. M. Jin and J. H. Jin, "Current Advances in Wearable Devices and Their Sensors in Patients with Depression", Frontiers in Psychiatry, vol. 12, 2021. • Pedrelli, P. et al., "Monitoring Changes in Depression Severity Using Wearable and Mobile Sensors", Frontiers in Psychiatry, vol. 11, 2020. • S. Monteith et al., "Internet of things issues related to psychiatry", International Journal of Bipolar Disorders, vol. 9, no. 11, 2021.

NEW TECHNOLOGIES FOR SUICIDE PREVENTION IN OLDER AGE

Application of ICT in Suicide Prevention

Keywords: ICT, suicide prevention, older age, cognitive behavioral therapy

The application of technology to geriatric psychiatry is an area of rapid growth and exciting possibilities. The promise of ICT-based mental health interventions in later life includes social connectedness, increase in life satisfaction, lower depressive and anxiety symptoms, and better coping with functional impairments. Many of these are well established risk or protective factors for late-life suicidality. The question is whether the reported benefits could be applied and translated into effective suicide prevention efforts.

Technology-based interventions can effectively address common barriers to care, such as high cost of treatment, limited access to a specialist, mobility limitations, and stigma. But it is important to ensure that such digital advantages are available to older people in high-suicide-risk groups, such as older adults living in residential facilities and those with lower socioeconomic status. Their physical and cognitive impairments, along with limited financial and community resources, may preclude them benefiting from standard ICT services and devices. First, substantial caveats and challenges need to be addressed. Of particular importance is the digital inequality and the "grey digital divide", that is, the drop in Internet use with increasing age, related to generational and life-cycle factors, educational achievement, and income. Any suicide prevention efforts should be fine-tuned to address the various aspects of the grey digital divide.

It would be naïve to assume that the Internet or any other technology is a panacea for late-life suicide, or suicide in any age group. Nonetheless, it seems the right time to carefully consider possibilities and caveats related to this area. A variety of individual, technical, and environmental factors enhance or inhibit the use of web-based and mobile technology in older adults. These include age-related changes in individuals' physical and mental capabilities (e.g., visual impairment, hearing loss, deterioration of fine motor skills), their knowledge of and experience with technology, and the design features of devices. Environmental factors, such as the financial cost of devices or services/interventions, social influences (e.g., motivation to connect with younger generations), and psychosocial concerns (e.g., fear that technology will replace face-to-face interaction), also play a role.

Source: Sabine van Erp. Retrieved from: https://pixabay.com/it/users/sabinevanerp-2145163/

Application of ICT in Suicide Prevention	
     Images retrieved from websites of referring organizations of authors	Suicidality in old age is related to various risk factors, such as psychiatric disorders, particularly depression, physical illness, psychosocial stress, functional impairment, and loneliness. Suicide prevention programs in older age are aimed at depression screening, recognition and treatment (involving primary care physicians), and offering community-based support and telephone counselling. Most of these interventions are successful in reducing the rate of suicidal ideation in patients and the suicide rates in communities. Although the use of new technologies among older age groups is increasing, the level of usage is currently by far lower than in younger age groups and not equally distributed. There is a substantial digital divide among older people related to age, socioeconomic status, and educational level. In general, technology adoption is much higher among younger seniors, especially the aging “baby boomers,” and in people with higher educational achievement and higher income. There are also remarkable differences across cultures and countries. There is an overall positive association between Internet use and indices of mental health in later life, such as depressive symptoms, loneliness, and impairments in (instrumental) activities of daily living. Further, interventions aiming at training to use computers and the Internet can increase life satisfaction and perceived social support as well as lower depression scores. The use of ICT is also related to better psychological and physical well-being among the oldest-old who use technology to connect with friends and/or family rather than to search for new information.
Application target audience:	• Mental health specialists such as psychiatrists, nurses, psychologists; • VET trainers for mental health specialists; • Managers and policy makers from mental health sector.
Resources used:	“Older Age and New Technologies in Suicide Prevention” by Karolina Krysinska, Saška Roškar and Merike Sisask, https://pubmed.ncbi.nlm.nih.gov/31510781/
Further reading:	● Bauer, R., Glenn, T., Strejilevich, S., Conell, J., Alda, M., Ardau, R., Bocchetta, A. (2018). Internet use by older adults with bipolar disorder: International survey results. International J. Bipolar Disorders, https://doi.org/10.1186/s40345-018-0127-7 ● Bucher, T., & Helmond, A. (2018). The affordances of social media platforms. In J. Burgess, A. Marwick, & T. Poell (Eds.), The Sage handbook of social media. London, UK: Sage Publications. ● Bum Lee, S., Hun Oh, J., Ho Park, J., Pill Choi, S., & Hee Wee, J. (2018). Differences in youngest-old, middle-old, and oldest-old patients who visit the emergency department. Clinical and Experimental Emergency Medicine, https://doi.org/10.15441/ceem.17.261 ● Chen, Y. R. R., & Schulz, P. J. (2016). The effect of information communication technology interventions on reducing social isolation in the elderly: A systematic review. Journal of Medical Internet Research, http://doi.org/10.2196/jmir.4596

REDEFINING MENTAL HEALTH SUPPORT FOR CHILDREN

Application of a gamification app in coping with everyday stressors and traumatic events

Keywords: app, Triumf Hero, gaming, children, mental healthcare

In the aftermath of the COVID-19 pandemic and the current war in Ukraine, psychological well-being is something that everyone has struggled with.

It is important to start taking care of our mental health already in childhood, the earlier - the better. Children's psyche is very susceptible, and the most crucial period in children's development lasts approximately to age 14. Unfortunately, there are not enough mental health professionals to help everyone who already needs help, and in the long run, it is more efficient to focus on prevention.

This is why an Estonian-based tech start-up - Triumf Health, has developed a fun and engaging mobile game Triumf Hero, that helps children learn to recognize and regulate their emotions, cope with everyday stressors and traumatic events, and understand themselves and others around them better.

When playing Triumf Hero children go into a magical world, Triumfland, where they have to help its' inhabitants. This narrative is interesting and empowering for children because they are encouraged to find their superpowers and realize their full potential. At the same time, they are getting evidence-based mental health support. Nowadays children do not use anything boring, and they just want to be normal. They don't want to fill in any boring diaries that a psychologist gives them. Self-discovery and learning can be interesting, and this is what our game provides.

As a response to the war in Ukraine Triumf Health translated their solution to Ukrainian in addition to previously existing languages: Estonian, Russian, English, Swedish, and Finnish, because the effect is much stronger if delivered in the native language. The game is available for free in Ukraine, Poland, Lithuania, Latvia, Hungary, Moldova, Romania, Slovakia, Finland, Sweden, Norway, and Denmark.

Source: Eureporter. Retrieved from: https://www.eureporter.co/uncategorized/2022/05/02/estonian-health-tech-startup-redefining-mental-health-support-for-children

Application of a gamification app in coping with everyday stressors and traumatic events

Images retrieved from www.triumf.health

When Triumf Health launched its first mobile health game Triumf Hero for chronically ill paediatric patients, the website included all the necessary information for hospitals and doctors.
After the coronavirus crisis took off, Triumf Health realized that our platform could also benefit healthy children by helping to cope with the changing environment the pandemic has caused. This is how the concept of Triumfland Saga was born.

The Triumf Hero platform supports mental wellbeing of children and helps them:

- learn how to cope with everyday stress
- recognise their emotions
- heal trauma
- decrease anxiety

The platform is divided into two health games:

Triumf Hero: light version of the Platform that aims to ease the mental burden that current events have on children by providing psychological support including psychoeducation and coping techniques.

Triumfland Saga: full version of the Platform designed specifically for and with children to offer personalized behavioral support and help break unhealthy habits. Recommended for every child.

Application target audience:	Children with health issues
Resources used:	"How to take care of mental health in crisis situations?" by Natali Kutsõk
Further reading:	https://www.triumf.health/news

PROVIDING DIGITAL EDUCATION SOLUTIONS TO UKRAINIAN CHILDREN

Application of technology to the development and application of tools (including software, hardware, and processes) intended for education

Keywords: Education innovation, learning languages, software

Education Technology (also known as "EdTech") refers to an area of technology devoted to the development and application of tools (including software, hardware, and processes) intended for education.
EdTech Estonia brings together and represents Estonian EdTech companies, to make Estonia the leading EdTech country.

Estonia is not market big enough to sustain most educational technologies. Thus, designing solutions which extend cultural and national borders is essential to be able to provide best education both locally and internationally. The representative organisation of educational technology companies, MTÜ EdTech Estonia, includes 34 educational companies. Over 190 countries around the globe use Estonian EdTech solutions. Each in their own way, Estonian EdTech's are committed to support Ukrainians in continuing their education. Be it helping with communication between schools, parents and children, or offering tools for learning new languages when it comes to refugees.

EdTechs mentioned below are offering their services for free to Ukrainians and many of them are working to provide their services in Ukrainian language. At present, 17 Estonian EdTech companies have joined the education innovation community initiative who are prepared to make their solutions available free of charge to children and teachers who remained in Ukraine and also to those who were obliged to leave Ukraine. ELIIS, the online information system for pre-school organisations; Edumus, a platform providing electives to schools; CoNurse, a training platform for medical professionals; Triumf Health, a game supporting mental health – all of these companies are providing their learning environment or service in Ukraine and have already translated their service into Ukrainian. Multikey provides Estonian language and culture courses to get better acquainted with Estonia.

Source: https://news.err.ee/1608520391/on-estonia-s-southern-border-police-greet-ukrainian-kids-with-cuddly-toys

Application of technology to the development and application of tools (including software, hardware, and processes) intended for education	
Images retrieved from https://www.edtechestonia.org/members	Estonian Minister of Education and Research Liina Kersna said it is essential to support the families and children arriving in Estonia from Ukraine as a consequence of the war. “We must give families arriving here time to adapt as well as support their mental health. Thereafter we can slowly integrate children into the education system and offer them feasible and versatile support,” said the minister. “I am eternally grateful to our companies who have already started translating their digital learning platforms into Ukrainian – this helps us to rapidly support Ukrainian teachers and students who have arrived in Estonia and also those who are in Ukraine.” EdTech solution Edumus offers additional electives to schools. The company launched their free solution in Ukraine in 2021. “Prior to the outbreak of the war, approximately 20 Edumus teachers taught a variety of electives in Ukrainian schools. We are establishing a ‘distance learning school’ in co-operation with displaced students and teachers in order to help Ukrainian students and teachers. This is the quickest way for us to get students back into their everyday learning routines and accomplish it in their mother tongue with familiar content,” said Edumus founder Maria Rahamägi.
Application target audience:	Education professionals, pre-school organisations, medical professionals
Resources used:	“Estonian companies are providing digital education solutions to Ukrainian children free of charge” by Kadi Kolk

VIRTUAL REALITY USE FOR PATIENTS WITH DEMENTIA

Application of virtual reality (VR) in dementia healthcare

Keywords: Virtual Reality, cognitive impairment, dementia patient management, simulation

Virtual reality (VR) is one of the greatest tools for creating a simulation environment helping students in nursing to take care of patients with dementia. Also, its practical use in the diagnosis of dementia is known. But the effectiveness of VR uses in treating patients with this diagnosis is still in study, and there are more ethical dilemmas (Hirt & Beer, 2020).

Usually, dementia is associated with memory loss, but what is stressed as important is that people who are suffering of dementia deal with much more than its cognitive effects on them or on the persons who care for them. The caregivers and the patients with dementia family have to know that the psychological impact of dementia is enormous and can take various forms of psychological responses like anxiety, depression, agitation, and aggression. It is very important to have these in mind because these symptoms negatively impact the well-being of people with dementia and make the condition challenging for caregivers and their families.

Dementia is affecting more people worldwide (Kim et al., 2019), underlying the need for new and innovative methods for prevention but also for a better understanding of how people with this diagnosis can feel. In this context, the simulation can be a perfect way to create virtual realities where students in nursing or patients' relatives can experience similar situations as people suffering from dementia. It is a challenging way to make people understand the complexity of the symptoms and their effects on people.

But VR can be not only a way of developing empathy also create contexts for helping students in nursing to learn about how to give care to the patient with dementia using virtual reality simulation (Hirt & Beer, 2020), which can help them develop critical thinking and clinical judgment in a safe learning environment.

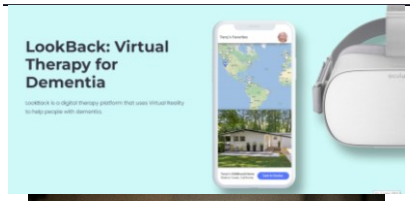
Source: **RossHelen**, retrieved from elements.envato.com

Talking about VR as a simulation perspective in nursing education, it needs to be mentioned that simulation has different meanings in the literature, "as the possibility for copying all, or almost all, important aspects of a clinical situation so that it can be easier understood and handled, if a similar situation actually occurs in practice or, more specifically, a method to imitate part of or all aspects of a situation, in order to make the learner experience the situation as credible and realistic – and train theoretical understanding and bridging through use of knowledge, action, and reflection" (INACSL, 2016). Low fidelity simulation doesn't necessarily involve technical aspects, and it can be used, for example, for soft skills development, while VR is a high-fidelity simulation because it implies the use of technical equipment and, even if it is more expensive, brings the student into a very realistic environment (Pinto et al., 2019) where he can experience dementia as a disease or taking care of a patient with dementia.

Using VR with dementia patients was approached in many studies. One of the studies conducted by Kim et al. (2019) made a literature review on the use of VR in Mild Cognitive Impairment (MCI), which is an intermediate stage of dementia, and in dementia and it was proved that VR interventions has small to medium positive effects on physical fitness, cognition and emotions by stimulating patients' brains (Garcia-Betances et al., 2015; Kim et al., 2019; Lee et al., 2014).

Application of Virtual Reality in managing patients with dementia

aixr The Academy of International Extended Reality



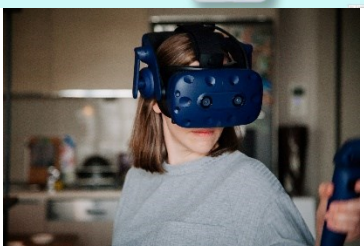


Image retrieved from: https://elements.envato.com

Dementia, is approached, using VR exposing the patient to virtual environments to help them remember events and places from their past. In Romania, there is a platform mostly dedicated to games, but shows the results of a study from UK, where there were involved eight people with Alzheimer and Huntington disease between 41 and 88 years old and were exposed to some virtual locations and it was proved that it was helpful for the participants bringing back some memories, but also for the families and the caregivers, who were able to understand better the symptoms and the difficulties brought by these diseases.

Look back: Virtual Therapy for Dementia is a digital therapy platform that uses VR to help people with dementia. https://www.virtue.io/lookback/#lg=1&slide=0

Transforming dementia care is a digital platform to help caregivers improve the health and wellness for people with dementia.

How it works?
The platform can be used from a smartphone and offers the chance to re-visit any location in the world stimulating memories or can be created more virtual travel to known locations and also can be personalized by saving preferred places and creating new specific tours.

Application target audience:	• Mental health specialists such as psychiatrists, nurses, psychologists; • VET trainers for mental health specialists; • Managers and policy makers from mental health sector.
Resources used:	https://www.virtue.io/lookback https://www.gvpvp.ro/realitatea-virtuala-vine-in-ajutorul-persoanelor-care-sufera-de-dementa
Further reading:	• García-Betances, R. I., Jiménez-Mixco, V., Arredondo, M. T., & Cabrera-Umpiérrez, M. F. (2014). Using Virtual Reality for Cognitive Training of the Elderly. American Journal of Alzheimer's Disease & Other Dementiasr, 30(1), 49–54. https://doi.org/10.1177/1533317514545866 • Hirt, J., & Beer, T. (2020). Use and impact of virtual reality simulation in dementia care education: A scoping review. Nurse education today, 84, 104207. https://doi.org/10.1016/j.nedt.2019.104207 Source: CogniHub. Retrieved from: https://www.cognihab.com/blog/vret-exposure-therapy/ • Kim, O., Pang, Y. & Kim, JH. The effectiveness of virtual reality for people with mild cognitive impairment or dementia: a meta-analysis. BMC Psychiatry 19, 219 (2019). https://doi.org/10.1186/s12888-019-2180-x • Lee, J.-Y., Kho, S., Yoo, H. B., Park, S., Choi, J.-S., Kwon, J. S., … Jung, H.-Y. (2014). Spatial memory impairments in amnestic mild cognitive impairment in a virtual radial arm maze. Neuropsychiatric Disease and Treatment, 653, https://doi.org/10.2147/ndt.s58185 • Pinto, M., R., Jensen, K., H., Hviid, H., … Emre, U. (2019). How to write good scenarios. Guidelines, retrieved from https://empact.ipsantarem.pt/atividades/imp_act3.php?reg=-1&lingua=en

NANOTECHNOLOGY

Application of Nanotechnology in Diagnostics and Therapeutics of Alzheimer's Disease (AD)

Keywords: Nanotechnology, mental healthcare, nanomedicine, neurodegenerative diseases, Alzheimer's Disease

At present, we are experiencing outstanding technological breakthroughs, and it is hoped that these modern technologies will help scientists to innovate and find practical solutions to major health issues.

There are two directions in nanotechnology. One that seeks to turn the big into the small by extreme miniaturization. In this way, nanorobots could be reached, those nanomachines capable of manipulating objects made up of only a few atoms. But it would be much simpler to approach a second direction based on imitating the living. In recent decades, nanotechnology has found countless applications in the medical field, the pharmaceutical field (targeted therapy) and continuing with the field of regenerative medicine (nanorobots and devices used in cell regeneration), disease prevention, diagnosis (including high-performance imaging methods), and therapies based on nanotechnology.

The possibility of diagnosis and treatment of the diseases from their molecular stage will allow clinicians to treat the cause/origin of the disease and even replace the affected tissues. Through the use of nanoengineering, artificial tissues can be obtained and used to replace affected organs (kidneys, liver) or regenerate nerves or produce implants that restore lost senses, such as sight or hearing.
More specifically, scientists are focusing on nanotechnological medical applications in order to cure health-related issues involving neurodegenerative disorders (NDD) such as Alzheimer's disease (AD), the most common brain disorder and dementia type affecting already more than 35 million people all over the world, with serious risk to become a major health and also economic problem until 2050. AD is mainly characterized as cognitive memory impairment and expressed through behavioral changes resulting from several brain lesions and neuronal dysfunctions.

At present, the development of nanotechnological tools for early-onset AD diagnosis is encouraging. Despite promising scientific results, the research regarding the regeneration of the central nervous system is only in an incipient stage. Since AD pathophysiology is irreversible and up-to-date approved medications mainly offer symptomatic relief, only the application of early diagnosis protocols will increase the efficiency in adaption of disease-clinical treatments. In fig.2 – current AD treatments and targets.
IN VITRO nanodiagnostics approaches for AD include the already known atomic force microscopy, single molecule fluorescence, and 'Nano Secondary Ion Mass Spectrometer' microscopy, but also the recently proposed solutions that mainly concern bio-barcode assays, localized surface plasmon resonance nanosensors, quantum dots, and nanomechanical cantilever arrays. Applications of nanotechnology in AD treatment offer neuroprotection against oxidative stress and anti-amyloid therapeutics, as well as drug delivery beyond the BBB.

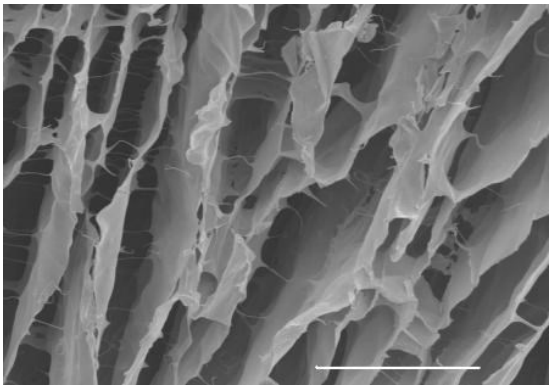
IN VIVO nanodiagnostics and therapeutic approaches for AD include the already known Iron oxide nanoparticles application as 'Magnetic Resonance Imaging' contrast agents, but also the use of monocrystalline and ultra-small superparamagnetic iron oxide nanoparticles for in vivo detection of amyloid peptide plaques, the optical imaging techniques using individual near-infrared fluorescent

contrast agents that can be applied for biomarkers detection. The QDs can theoretically be used for the identification and visualization of pathophysiological events, but their utilisation is questionable because of their toxicity.
Work is currently underway to create nanogels to reduce the toxicity of nanotechnologies, while increasing their efficiency. In order to increase the therapeutic potential of AD through nanotechnology, the therapeutic agents must be enhanced with advanced bioavailability properties, including both neuroprotective and neurodegenerative approaches.

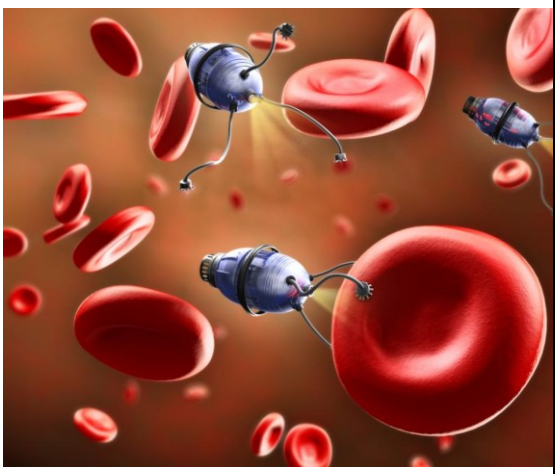
There are common and related factors within metabolic and biochemical reactions that can probably influence drug delivery at the nanoscale. Therefore, current drugs can be dissolved, absorbed, or dispersed in nanoparticle matrices. In addition, there are nano drug delivery systems that utilize various energy sources for the activation or drug release. For NDD like AD, nanomedicine can offer innovative treatment possibilities to conditions like neuroinflammation and misfolded proteins as well as monitoring of the therapeutics effects and mainly the brain drug delivery. There have been efforts for direct brain drug delivery that is affected by AD in order to decrease the symptoms and restrict neurodegeneration progress. It seems that very soon, it may be possible to diagnose AD early on in the disease's progress. Early diagnosis or even prognosis must precede the pathophysiological lesions that occur through unpleasant symptoms and daily dysfunctions. While the well-known biomarkers cannot offer a secure survival analysis, nanotechnology seems to offer a variety of sophisticated and efficient solutions for an accurate diagnosis. For AD, nanodiagnostic tools based on multilevel in vitro or in vivo biophysical interactions can target A oligomers, ROS, metal ions, tau phosphorylating kinases, and even cell cycle proteins.

The spectrum of nanomedicine applications covers a wide range of applications in various branches of medicine and is rapidly increasing. The public awareness seems unstructured. An approach to the multiple challenges of an ethical and legal order, taking into account the current progress of medical technologies, would be highly recommended. The main challenges in the field are related to issues such as quality assurance, risk assessment, nanodevice programming, or the molecular challenges of the molecular industry, particularly biocompatibility, side effects, and toxicity associated with their release in the CNS and the human brain. The ethical guidelines and declarations for nanotechnological applications in humans can make nano drugs accessible and safe to the population.

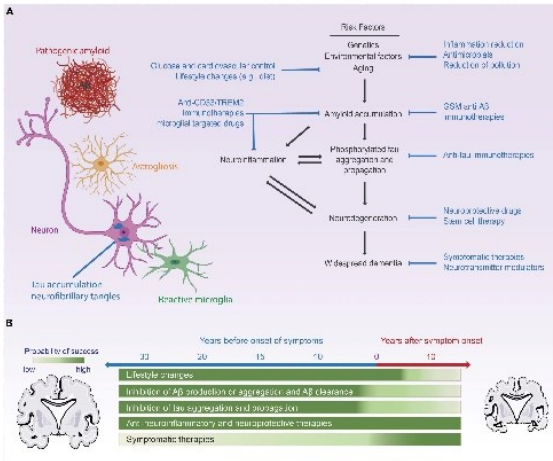
Application of nanotechnology in diagnostic and treatment of AD



Increased hydrogel scaffold structure for the study of brain tissue and nerve regeneration engineering
(D Nisbet, University Monash, NISE Network, www.nisenet.org, authorised in conditions of NISE)



Researchers inform that they have designed new nanorobots capable of moving through bodily fluids with relative ease.
https://newatlas.com/nanobots-blood-drug-delivery/38064/



Current AD treatments and targets

Panel (A) commonly accepted AD disease progression pathway while highting commonly targeted pathways in AD therapeutics, (B) visualization of the time point those therapists are tackling in respect to the progression of the disease. Parts of the figure were designed with BioRender.com

https://www.frontiersin.org/articles/10.3389/fnins.2022.854992/full

List of abbreviations AD = Alzheimer's disease / ADDL = Amyloid- Derived Diffusible Ligand / AuNPs = Gold Nanoparticles / A = Amyloid/ BBB = Blood-Brain Barrier / CNS = Central Neural System / DA = Dopamine / EGCG = Epigallocatechin-3-gallate/ Lf = Lactoferrin / NDD = Neurodegenerative diseases / NPs = Nanoparticles/ QDs = Quantum Dots/ OL = Odorranalectin

Application target audience:	Mental health specialists such as psychiatrists, nurses, psychologists; VET trainers for mental health specialists; Managers and policymakers from the mental health sector;

Resources used:	www.researchgate.net/publication/285470002_Applications_of_Nanotechnology_in_Diagnostics_and_Therapeutics_of_Alzheimer's_and_Parkinson's_Disease https://www.frontiersin.org/articles/10.3389/fnins.2022.854992/full
Further reading:	Georgia Soursou, Athanasios Alexiou, Ghulam Md Ashraf, Asad Ali Siyal, Gohar Mushtaq and Mohammad A. Kamal - Applications of Nanotechnology in Diagnostics and Therapeutics of Alzheimer's and Parkinson's Disease, Current Drug Metabolism, 2015, 16, 705-712 Nazem, A.; Mansoori, G.A. Nanotechnology for Alzheimer's disease detection and treatment. Insciences J., 2011 Alam, Q.; ZubairAlam, M.; Karim, S.; Gan, SH.; Amjad Kamal, M.; Jiman-Fatani, A.; Damanhouri, GA.; Abuzenadah, AM.; Chaudhary, AG.; Haque, A. A Nanotechnological Approach in Management of Alzheimer's Diseases and Type 2 diabetes. CNS Neurol. Disord. Drug Targets, 2014 Iqbal, A.; Ahmad, I.; Khalid, M.S.; Nawaz, M.S.; Gan, S.H.; Kamal, M.A. Nano neurotoxicity to nano neuroprotection using biological & computational approaches. J. Environ. Sci. Health C. Environ. Carcinog. Ecotoxicol. Rev., 2013 Sahni, J.K.; Doggui, S.; Ali, J.; Baboota, S.; Dao, L.; Ramassamy, C. Neurotherapeutic applications of nanoparticles in Alzheimer's disease. J. Control. Release, 2011 Gendelman, H.E.; Mosley, R.L.; Boska, M.D.; McMillan, J. The promise of nanoneuromedicine. Nanomedicine, 2014 Hu, K.; Shi, Y.; Jiang, W.; Han, J.; Huang, S.; Jiang, X. Lactoferrin conjugated PEG-PLGA nanoparticles for brain delivery, Preparation, characterization and efficacy in Parkinson's disease. Int. J. Pharm., 2011

THE IMPACT OF VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE

Keywords: Virtual Reality, augmented reality, visual realism, virtual patients

The last few years have been increasingly challenging for health systems, and mostly today, considering the epidemic context that demonstrated to the world that we need better technology to keep up with the fast changes in the world.

One of the innovations in healthcare is presented by VR. Virtual reality has emerged as a potential healthcare solution in the healthcare sector with increasing technological advancements. The technology provides an entirely new way of visualizing information and can show 3D images and enhanced reality.

Virtual reality in healthcare can be utilized in several applications that allow healthcare to move from a reactive to a proactive, preventative world. VR can help doctors perform hands-on surgeries in a safe and controlled environment. A surgeon can train on virtual models that behave just like reality and practice complicated procedures, giving patients a better chance. Because it is challenging for the doctor to see the whole picture at a distance and can only infer a patient's health status from their behaviour, VR has proven to be a valuable tool for evaluating a patient's vitals, symptoms, and general physical condition. VR can be utilized to diagnose illnesses by examining a patient's vitals, the symptoms, and the physical exam right on a virtual screen that we can place wherever we need it. We can use this technology to re-enact currently impossible and impractical procedures to perform in the operating room and provide a teaching experience in medical procedures and medications. These developments are possible due to the visual realism of the technology.

From simple and basic applications like displaying patient information in a patient's medical records to complex applications such as lifelogging and virtual waiting rooms to even having software developers and medical professionals design virtual operating rooms to even games that patients can play, virtual reality can be used in several ways to enhance the patient experience.

VR has the ability to increase efficiency in performing procedures. Virtual reality can be used in places of examinations in which a patient must stay in one location and cannot move around. In some cases, patients may experience increased side effects if exposed to an unfamiliar environment. However, due to the increased comfort, anxiety patients can now experience the environment virtually and, this side effect has become negligible.

Also, due to the safety and comfort that VR offers, patients are able to increase their exercise, reduce medications, and often do not have to go through a painful procedure that might result in haemorrhaging.

It is estimated that VR may revolutionize all aspects of medicine and healthcare within the next ten years, from simple patient comfort and discomfort to drug prescriptions and even surgeries.

Virtual reality is a future healthcare solution that may be able to drastically reduce the cost and length of hospital stays and expand the range of procedures available to physicians and medical students.

Through a combination of advancements in 3D imaging and software processing, VR may soon provide the world with an authentic virtual experience.

AR represents another helpful technology. Augmented reality has been a reality for over half a decade, thanks to smartphones and other devices that incorporate the technology. It is only now that the technology is advancing to a point where it can become a viable solution for health care. The field of AR is still new and in its infancy. The variety of ways AR is being utilized varies greatly and depends on the degree to which the solution is integrated into the healthcare organization.

Innovative applications were developed to allow doctors to talk to patients without looking at them and guide them around the hospital. This could be a key factor in providing high-quality, efficient, and safe healthcare that meets patients' needs better.

Augmented reality will be used more in healthcare as it becomes a 'normal' part of patient treatment. Another AR application helps the staff with problems like locating a certain room in the hospital, to follow a particular route. Also, this gives the patient the possibility to show precisely what they need. It's easier than explaining.

Also, using AR, a doctor could point out where he's located on the floor and guide a patient around. This could help reduce distractions for the healthcare professional and help the patient stay calm and focused on their treatment. It can explain procedures to patients, make the treatment processes more straightforward and more intuitive, and guide them around the hospital.

The biggest hurdles the technology has to overcome are the stigma attached to using it and the high cost. Although the technology is a bit out there, more and more users are now adopting it, and the price of the devices is dropping.

Augmented reality in the healthcare market is expected to generate a very high growth potential due to increasing technology applications in healthcare devices. However, augmented reality in the healthcare market is expected to be restrained due to concerns regarding data security and degradation in machine learning algorithms for the diagnosis of diseases.

Gathering all the data from these technologies will allow us to compare it to real patient data.

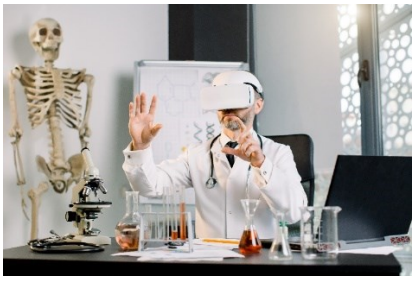
In the future, we could use human-focused simulated data that will recreate the real world even in photo-realistic details. The fact that we can use these data types to generate cases to be solved in classes is fantastic. The possibility to study becomes unlimited. This technology already exists. We just need to put it to work.

In conclusion, there are many applications for VR and AR in healthcare, but most of them are either overlooked because of the cost or concerns regarding data security.

Most of the research shows that both technologies could be beneficial to patient care and medical improvements. As we stated before, we could use this technology in many ways, and it could entirely change how we use and visualize data.

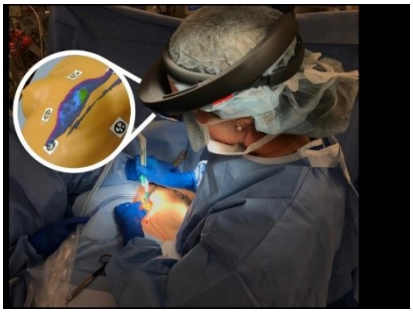
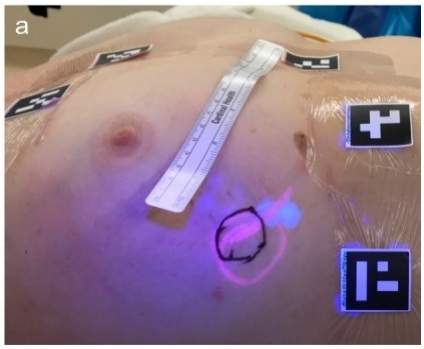
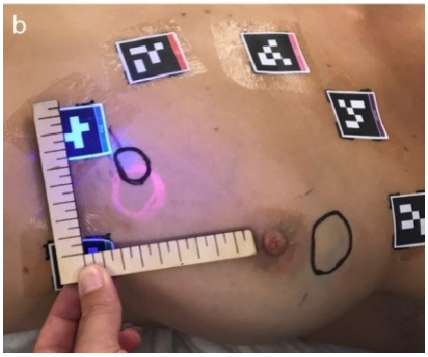
VR shouldn't be used on its own, and it should be interconnected with other advanced technologies, such as robotics, Internet of Things. In healthcare, several studies were performed, and proved VR to be a suitable option for treating specific health problems or an additional tool, for example, in pain alleviation.

Application of AR and VR in breast surgical planning



The growth of breast imaging market is primarily due to the rising population of women with breast cancer and growing awareness about breast imaging technology. Cancer is a leading cause of death in women across the globe. Breast cancer is expected to kill nearly 1.7 million women in the U.S. by 2030. Further, it is also estimated that nearly 300,000 women develop invasive breast cancer and nearly 40,000 will die from the disease. Breast cancer can be diagnosed only if it is detected early and consequently, early detection can help patients to survive breast cancer and save their lives. However, poor survival rates for early-stage breast cancers due to lack of availability of screening services, late diagnosis and inadequate treatment options are expected to hamper the growth of breast imaging market.

Application of AR and VR in breast surgical planning by future end users is increasing rapidly due to advancements in the way these technologies are used in medical procedures. Future use cases for AR and VR in breast surgical planning may include education, training, documentation, communication and live imaging. All these various ways in which the applications of AR and VR could be leveraged in

   	breast surgical planning will change the way in which the technology is used in breast surgical planning. AR applications will be used to document the clinical results of these major surgical procedures and the assessment of the results. AR technologies such as the Synthetic Eye (i.e., Augmented Reality) and the HeartGuide (i.e., Virtual Reality) will be used to analyse the trajectory of a surgeon's hands. A clinical survey of the outcomes of the VR technique for breast surgery will be undertaken and data will be used to improve and document the potential for AR-based surgical planning applications. Clinicians are rapidly adopting new technologies to improve the quality of patient care. AR and VR technologies provide an opportunity to improve the quality of breast cancer care in a variety of ways: For example, planning breast surgery; in addition, learning about breast cancer survivorship care and how to manage and lower the risk of breast cancer progression. VR has great potential for enhancing patient outcomes for breast cancer survivors. While early studies have evaluated the use of VR-based cancer therapies for metastatic breast cancer, researchers will soon begin to explore the potential of VR technologies for improving breast cancer survivorship care. In this scenario, VR technologies will create a lifelike simulation of breast cancer patient's conditions that enable them to feel and respond in real time to any new symptoms. This is especially important for breast cancer patients who are at increased risk for chronic conditions such as cancer or pulmonary embolism. This improved capacity for detection and response to new symptoms, along with enhanced understanding of individual risk and an enhanced relationship between the patient and her caregiver, will result in improved outcomes for these individuals. There are many innovations that will allow better surgical planning and even prevention in patient care.
Application target audience	Medical specialists such as nurses, doctors, surgeons; VET trainers; Medical students;
Resources used:	Dyer, Martin. (2012). Safety and efficacy of ofatumumab in patients with fludarabine and alemtuzumab refractory chronic lymphocytic leukaemia. Therapeutic advances in hematology. 3. 199-207. 10.1177/2040620712445329. Perkins SL, Lin MA, Srinivasan S, Wheeler AJ, Hargreaves BA, Daniel BL. *A mixed-reality system for breast surgical planning*. 2017 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), Nantes, France, 2017, pp. 269-274, doi: 10.1109/ISMAR-Adjunct.2017.92.
Further reading:	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2217859/ https://www.virtalis.com/case-studies/using-virtual-reality-for-surgical-room-layout-and-scenario-planning

EVENT-RELATED POTENTIALS IN PSYCHIATRY

Application of signal acquisition and processing electronics to mental health level assessment

Keywords: Event-related potentials, mental healthcare, electrode, electronics, signal processing

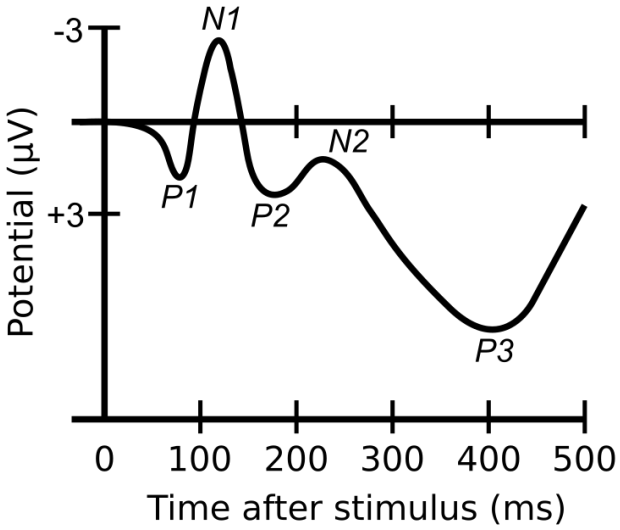
The practice of clinical electrophysiology in psychiatry has been and remains a complementary act for the clinician, not only for some diagnostic situations, but especially for the global management of the patient in the prescription of medication and in the follow-up. Event-related evoked potentials are a non-invasive method derived from electroencephalography that allows the analysis of the functioning of cognitive processes. The event-related potentials belong to two paradigms of neurobiology: the electrical paradigm, which is that of electrophysiology, and the cognitive paradigm, which is that of experimental psychology with its specific methods. We could say that the event-related potentials are experimental psychology experiments carried out under electroencephalogram (EEG) recording and obtained by averaging event related potentials explore cerebral functions as defined in the framework of cognitive psychology.

In psychiatric, the most commonly cognitive evoked potential protocol used is the P300 wave. Event-related evoked potentials can be used with adults as well as with children. Event-related evoked potentials can also be useful tools for the management of patients such as in certain eating behaviors. Indeed, the analysis of cognitive processes uses event-related evoked potentials which measure conduction times, amplitudes of potentials and evaluate reaction times according to the tests. Event-related evoked potentials are related to the mechanisms involved in selective attention, memory storage, choice of behavioral responses and understanding of stored prior information. One component of the evoked potential signal, such as the N2, may be altered earlier than the P300, reflecting the early alteration of information processing.

Event-related evoked potentials are modifications of brain activity induced by specific and controlled stimulations. The principle is to extract a specific brain response, auditory, visual or related to a cognitive process, from the global electrical activity of the brain to which is added the background noise. This response, generally of low amplitude, is extracted from the EEG signal by averaging; a general method of signal processing that allows the signal-to-noise ratio to be reduced in proportion to the square root of the number of averaged signals. The stimuli can be visual or auditory. They are due to a modification of a perceptual state or a mental state in response to a task proposed by the experimenter.

The recording system consists of electrodes connected to an amplifier and to digitization board. The acquisition system is controlled by a computer. The digitized signals visualized on the screen in real time and saved in the computer. The computer that drives the acquisition is synchronized with the computer that displays and executes the stimulation protocol like P300 protocol or oddball protocol.

It is important for the psychiatric staff to understand this technique and its procedure in order to be able to reassure the patient before the session of acquisition of event-related potentials.



A Event Related Potentials components including P300 wave (https://www.researchgate.net)

Acquisition of event-related evoked potentials (https://hospitals.aku.edu/)

Application of signal acquisition and processing electronics to mental health level assessment

Images retrieved from https://eu.nihonkohden.com

Thanks to their modular and intelligent concept, the acquisition system of EEG and cognitive evoked potentials are equipped with an amplifier module and digital acquisition conversion. It can record 256 signals. Each acquisition channel is connected to an electrode. It is equipped with a computer to control the acquisition and a powerful signal processing software to analyse, process the data, plot the signals and allow the doctor to write his report.

Application target audience:

- Patients suffering depression, autism and Parkinson;
- Clinicians and neurophysiologists;

Resources used:

https://natus.com/fr-fr/produits-et-services/systeme-eeg-nicoletone

https://www.youtube.com/watch?v=vcCcDjXYXhs

https://eu.nihonkohden.com/fr/products/neurology/neurofax.html

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SCHOOLING OF THE AUTISTIC CHILDREN IN MAINSTREAM SCHOOL SYSTEM

Computer science for school learning

Keywords: Autism, neurodevelopmental disorders, computer, school learning

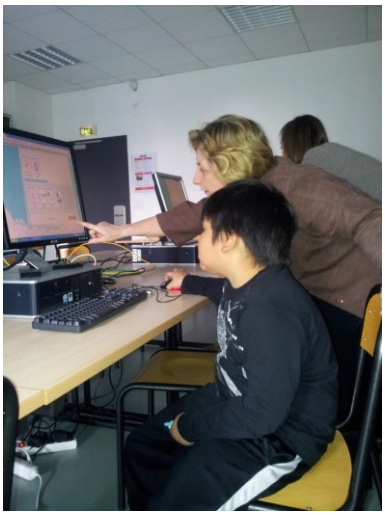
Autism and related disorders constitute a group of syndromes grouped together in the International Classification of Diseases (ICD 10) under the term "Pervasive Developmental Disorders" (PDD). These syndromes are varied, in terms of clinical manifestations, associated deficiencies, age of onset of the disorders or evolution. Nevertheless, they are all characterized by

- ***a significant and early qualitative impairment in the development of social interactions and verbal communication;***
- ***the presence of repetitive behaviours and restricted Interest.***

Developmental components are common in these disorders, but appropriate educational management can strongly counteract the learning difficulties induced.
The pervasive nature of these disorders, which usually affect several areas of development simultaneously, distinguishes them from those in which only one area is affected, such as dysphasia (specific to oral language) or hyperactivity (primarily affecting attention). The disorders usually appear before the three years.
Clinically, the autistic triad characterizes pervasive developmental disorders: a deficit in social interactions, communication and disturbances in interests and activities that hinder the child's development and generate, throughout his life, severe handicaps with heavy consequences for himself and his family life.

Inclusion in ordinary educational establishments is a solution that will mitigate the progression of the disease. Among the difficulties that hinder inclusion in ordinary school are the understanding of words and language and difficulties in writing. Indeed, the contribution of digital tools such as computer, tablet, digital board, voice synthesis and software adapted to learning communication, exchange and learning school promotes inclusion in the school environment. These tools are deployed in addition to human assistance. Human assistance allows the child to be guided and to remain seated and focused during school tasks and facilitates the child's use of the computer and software. The second important benefit of school inclusion is socialization. Indeed, the contact of the autistic child with other ordinary children discovers the rules of life in a given society.

In order to allow autistic children to go on to secondary school, it is important to put in place the above-mentioned devices. The implementation of these tools has led to encouraging results.



Autistic children in a learning session on a website at ECAM-EPMI

Computer science for school learning	
 Images retrieved from https://www.appliedbehavioranalysisprograms.com/faq/how-do-you-become-an-autism-support-teacher/	Structured education is a learning method that helps children with ASD to evolve in and understand their environment. It is essentially based on the use of the TEACCH program, which offers students with ASD an education adapted to their difficulties and particularities. The TEACCH method will notably consist of using visual and temporal cues to improve autistic children's understanding of the environment around them teaching them new skills and maintaining those already acquired (language, social interactions, autonomy); promote the development of appropriate behaviours.
Application target audience:	• Children; • Teachers, Pedo-psychiatrists, Psychologists.
Resources used:	https://teachingautism.co.uk/ https://www.waterford.org/education/15-activities-teaching-strategies-and-resources-for-teaching-children-with-autism/
Further reading:	• Hoy, K., et al., Inclusive school practices supporting the primary to secondary transition for autistic children: Pupil, teacher, and parental perspectives. Advances in Autism, Vol. 4, 2018. • Galton, M., et al., A transition Odyssey: Pupils' experiences of transfer to secondary school across five decades. Research Papers in Education, Vol. 33, 2018. • Stack, K., et al., The perspectives of students with Autism Spectrum Disorder on the transition from primary to secondary school: A systematic literature review, Research in Autism Spectrum Disorders, Vol. 84, 2021,

EARLY DIAGNOSIS OF AUTISM IN CHILDREN AND INFANTS

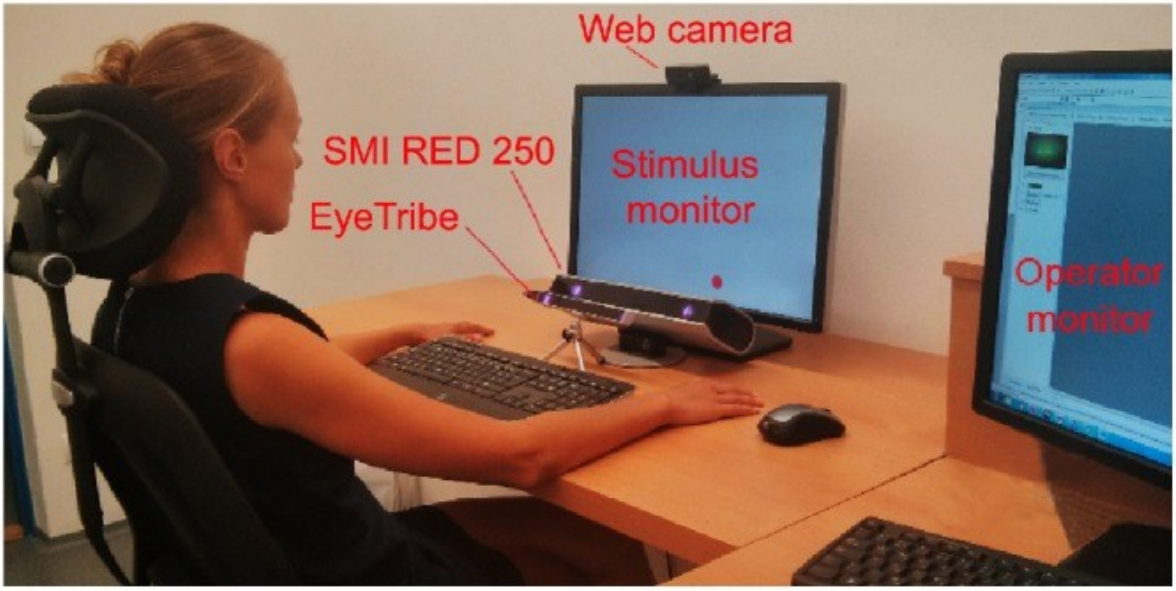
Application of imaging to autism diagnosis

Keywords: Autism, neurodevelopmental disorders, Eye-tracking

Autism Spectrum Disorder (ASD), also known as Autism, is a neurodevelopmental disorder affecting approximately 1% of the world's population. The disorder is characterized by a more or less severe attention deficit and a set of defects in the person's social skills. In general, a person suffering from ASD shows more difficulty in maintaining a verbal and visual exchange with another person, especially in a conversational setting. We are talking here only about the ASD situation in children. The term Autism Spectrum Disorder is used because what the general public tends to call Autism is actually made up of a very wide variety of disorders. The term Autism Spectrum Disorder is used because what the general public tends to refer to as Autism is in fact a wide variety of disorders, graded according to several broad diagnostic items, as listed in the Childhood Autism Rating Scale (CARS). These items include social relatedness, imitation, emotional response, body use, object use, adaptation to change, visual responses, auditory responses, taste-smell-touch, fear-anxiety, verbal communication, non-verbal communication, activity level, intellectual level, and homogeneity of the intellectual functioning and general impression. For each of these categories, the child corresponds to a criterion, from typical to severe, and we then say that the child presents, or not, certain autistic traits. All of these responses allow us to make a diagnosis of the child and his or her place on the Spectrum, summarized in three broad classes of disorder severity: "Mild", "Moderate" and "Severe". Depending on the result obtained, the child can then be followed up in order to provide the necessary help to the child and to his entourage, in order to adapt the environment to the child and vice versa. These diagnoses are generally made between the ages of 3 and 5, an age that is already advanced for the child's development to be truly effective. Furthermore, given the number of points to be observed in the child, making a correct diagnosis requires a significant investment of time, knowing that this disorder must be dissociated from other neurodevelopmental disorders such as hyperactivity or other disorders belonging to the Pervasive Developmental Disorders (PDD). As these other disorders are not the target of our work, only ASD children and children without neurodevelopmental disorders were taken into account.

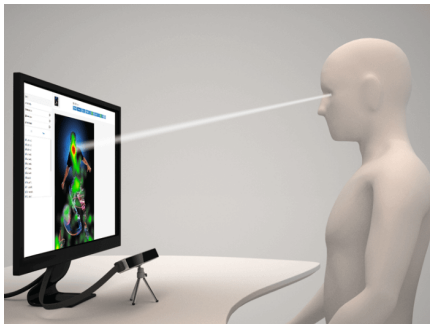
ASD is a disorder that creates a handicap situation, particularly because of the deficit in social skills. ASD can also sometimes be the source of abilities that are superior to those of typical children, children with no autistic history. These abilities include the arts and science, and exceptional memory skills. The case of Asperger's autism is representative of these abilities.

The eye-tracking technique is attracting increasing interest from researchers interested in the difficulties that people with autism spectrum disorders (ASD) encounter in terms of communication and social interaction. It is a technique that lies at the interface of cognitive neuroscience and developmental psychology. By providing a direct, objective and precise measure of the deployment of visual attention, the eye-tracking technique makes it possible to characterize deficits in social perception in ASD children. It is therefore a unique method of investigation. This technique makes it possible to estimate the position of the gaze from the pupillary center and the reflection of an infrared light on the cornea. The basic principle consists of analyzing the image of the eye captured by cameras up to several hundred times per second, using image processing algorithms that will detect the corneal reflection and the center of the pupil.



Eye-tracking room. Source: https://europepmc.org

Application of imaging to autism diagnosis



Images retrieved from https://europepmc.org

When we look at an image, the eye captures it and transforms it into nervous messages, which are transmitted to the brain. The brain interprets the information received, identifies the priority information and instructs the eyes to move and focus on specific points to obtain new data and continue the visual exploration. Thus, the places where our gaze rests and its movements during the analysis of a scene are useful characteristics for understanding the processes we use to acquire and process information.

Eye tracking allows us to access this data by measuring where and how a person looks. In concrete terms, an infrared light is emitted in the direction of the eye. It is reflected and a camera records the reflections, allowing a real-time calculation of the position of the gaze. Harmless and non-invasive, the method is used in many fields, from marketing to web ergonomics, including biomedical research.

Application target audience:

- Children and infants;
- Child psychiatrists and doctors

Resources used:

https://www.definitions-marketing.com/definition/eye-tracking-2/

https://www.tobii.com/learn-and-support/get-started/what-is-eye-tracking

Further reading:

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