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APPLICATION OF MACHINE LEARNING IN BEHAVIORAL MODIFICATION

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A B S T R A C T

Machine Learning centers on applications that gain for a fact and further develop their dynamic or prescient exactness over the long run. Behavioral Modification is the use of basic learning techniques such as conditioning, biofeedback, assertiveness training, positive or negative reinforcement, aversion therapy to change unwanted individual or group behavior. Behavior change is vital to addressing both the challenges facing human health and wellbeing and to promoting the uptake of research findings in health policy and practice. This paper provides a solution about the utilization of machine learning in behavioral modification by giving some real-time examples. The device based on machine learning is used to develop and evaluate a 'Knowledge System' that automatically extracts, synthesizes, and interprets findings from Brain Computer Interface (BCI) evaluation reports to generate new insights to conduct change and further develop forecast of intervention viability and permits clients to effectively and productively examine the framework to find solutions. Organizations engaged in healthcare are charged with the complex task of keeping expenses down without compromising healthcare quality. The key prerequisite is to focus instead of fix, with the greatest test being the need to follow up on enormous volumes of totaled medical care driven Big Data.

1. INTRODUCTION

Artificial Intelligence has both positive and negative impact on the people as per the research reports. Artificial Intelligence is benefitting us in multiple ways. Machine learning is seen as an important part of AI. Man-made reasoning (AI) has changed businesses all throughout the planet, and can possibly drastically modify the field of medical care. Behavior modification is a significant part forestalling drugs and treatments. The presentation of AI in the field of Healthcare is large help for us (Buntak et al., 2021). AI is being utilized in numerous medical services fields like Disease Recognition, Image Diagnosis, Smart Health Records, and so on.

In today's world, the work pressure and expectation from others are increasing stress, depression and anxiety among the people. This is directly affecting our mental health. During the pandemic scenario, people were locked in their homes. Students were attending their online classes, office workers were constantly on their

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laptops attending meetings, completing their work and so on. Thus, the mental health issue is a very common problem. The majority of the people don't care about their mental health issues and later on suffer a lot. This is a major concern for us. As technology advanced, machine learning came into existence and became backbone for the entire health sector.

In this paper, we are going to discuss about how machine learning will help people to improve their mental health just by predicting the problem from the real time data. Various algorithms, technologies used like NLP, SERF, and many more are discussed. IoT based devices and gesture detecting real-time platforms are used to change people's habits (Nikiforos et al., 2020). A few regions like in - meeting for assisting individuals with understanding the conduct, roll out empowering improvements and comprehend hand-to-mouth motions numerous product like information examination B2B2C programming stage presented by organizations. A recent B2B2C based data analytics company named Somatix has started a ML-based app which detects the gestures from the user's body, understand the unconscious behavior and then make essential amendments to it (Musa et al., 2021; Ding et al., 2014; Mirzaei et al., 2016; Irschara et al., 2009). Adaptive algorithms are used by these organizations to analyze large data sets in order to streamline towards an objective. As they streamline, they learn over the long run to work on their outcomes. Our target is to analyze various issues related to computing, simulating novel investigations and finding how they will be beneficial in an insight understanding of the healthcare scenario.

2. LITERATURE SURVEY

Applications of Machine Learning for medical care innovations furnishes calculations with self-learning neural organizations that can build the nature of therapy by examining outside information on a patient's condition, their X-beams, CT filters, different tests, and screenings (Zerdoumi et al., 2018; Menter et al., 2021; Brick et al., 2020). This is making huge loads of benefits to the clinical world since these advancements are assisting the experts with appropriately diagnosing the infection and relieving them from the roots by helping individuals.

Behavioral modification alludes to the strategies used to attempt to diminish or on the other hand increment a specific kind of conduct or response (Cahyadi et al., 2019). Guardians utilize this to help their kids distinguish between right and wrong. Experts use it to propel sound practices in their patients. Animal mentors use it to cultivate loyalty between a pet and its owner. We even use it in our relationship with friends additionally, perfect partners. Our likes and dislikes are expressed to them through our reactions. Previously, if a person had any behavioral fault unconsciously then it remained unnoticed for a very long time unless it

created a massive impact on the person's health. However, as time passed and technology advanced, artificial intelligence and machine learning brought many solutions to these types of issues.

'Big Data' is a tremendous assortment of information that can work greatly. In the domain of behavioral corrections of a person, varied links for big data carries day-to- day activities of a person, their conscious and unconscious behavior, their lifestyle and various other things, which are later on processed and displayed on the devices. The cost of medicines and treatments are increasing day-by-day. (Zerdoumi et al., 2018; Menter et al., 2021; Brick et al., 2020; Ajala et al., 2019; Burbidge et al., 2001) As a McKinsey re-port states: "After north of 20 years of predictable grows, clinical guide expenses presently address 17.6 percent of GDP — nearly $600 billion a lot greater number of than the ordinary benchmark for a nation of the United States' size and overflow." Clearly, something savvy like enormous information examination is the need of great importance.

Various small start-ups have evolved over time, which are taking initiatives and are making various wearable products like smart watches, smart bands and many other IoT connected devices. These products utilize adaptive machine learning and predictive analytics to inactively screen gigantic volumes of motion information, for accuracy acknowledgment of a scope of physiological and enthusiastic pointers – altogether work with customized, intellectual conduct treatment impetus helped well- being mediation. Some years ago, these products used to be very expensive and normal people could not afford them. Keeping all this in mind, these organizations have reduced the price of these goods so that each person of all age groups can use their products and are benefitted. People can also grow some healthy habits with the help of these commodities. Various research work are also going on in order to improve the performance and efficiency of these IoT embedded devices. New technologies are also evolving over time like NLP (Natural Language Processing), neural networks, big data, etc. so that accuracy of prediction increases and users can remain fit and healthy.

3. METHODOLOGIES USED IN THE PROCESS OF BEHAVIORAL MODIFICATION

Behavioral modification is an integral part of healthcare. Machine Learning enables the gadgets to work automatically without any human intervention. It allows the devices to collect real-time gestures of the person so that it can be processed and displayed to the person correctly. Analyzing a person's behavior is not at all an easy task because human beings are filled with emotions; suddenly they can change their lifestyle, habits which directly affects their health. Therefore, it is

very much necessary to create a complete solution of this particular problem with the aid of a process. There are some steps, which are included in the process (Sturman et al., 2018). They are as follows:

1. Understanding the issue: At beginning, stage get to know what the issue in all actuality and how the arrangement of that issue resembles.
2. Understanding the information: If the information is identified with our current issue, it ought to get what the measure of information is, the thing that is the accessibility and nature of the information.
3. Pre-processing of information: it ought to consider that what information is more significant, to expand the quality and demonstrating of information it should track down the best arrangement.
4. Demonstrating: in this progression, it ought to pick the best model and strategy to track down the best arrangement of current issue.
5. Information advancement: in the event that the picking model finishes the requirements, it should address the inquiries.
6. Arrangement: it ought to foster a model that has approval in genuine applications and this progression likewise incorporate the insights concerning sending of model.

Every step of the process is explained below. Figure 1 gives a holistic view of the complete procedure right from initial to final step. Let's now get a detailed understanding of the methodologies used here.
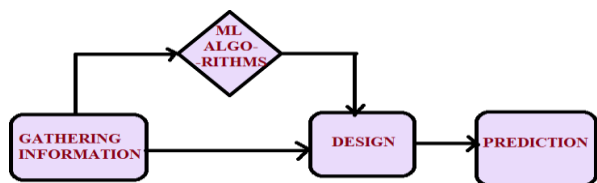

Figure 1. Process Flowchart explaining the entire process from capturing information until prediction

3.1 Passive Monitoring

The essential capacity of the IoT based wearable gadgets is to gather the data of the client. To play out this undertaking, we need such a procedure, which quietly takes data without telling the individual about it. This method is called passive monitoring. Figure 2 provides a detailed explanation about how data is collected from the users (passive monitoring), how they are stored and processed for providing a detailed output. Passive monitoring assists with checking the signals through these wearable sensors. While checking on the off chance that they track down any applicable information from their dataset that was recently caught, then, at that point, it consequently separates that information. This gathered new information is transferred to the cloud with no manual intercession and

the individual does not become acquainted with about these stuffs.
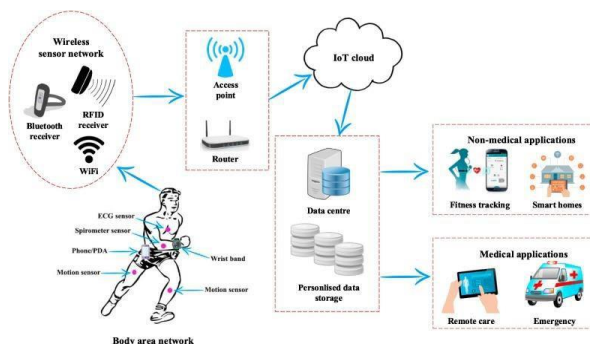

Figure 2. A detailed process view of passive monitoring

The primary advantage of this aloof checking is that undesired or unimportant data isn't at all gathered yet this could occur if manual recording would have been finished. In the event that these gadgets needed to gather the data of any gadget like IP and MAC address, gadget name and so on, then, at that point, active monitoring would be more reasonable. While latent checking is going on, synchronization is totally required when attempting to relate perceptions at various areas in the Inactive checking can assist seniors with remaining autonomous and their relatives can likewise keep a track on their development. At the point when individuals develop old, large numbers of them begin to foster different sorts of infections where they begin to fail to remember everything, lose their faculties and different things. These groups will assist them with staying dynamic since they will continue to give them tokens of each action like taking meds, drinking water, do some activity, etc. If so unusual activity is noticed, promptly it will show alert on the showcase screen. This will empower them to become wary and their relatives would likewise be insinuated about these exercises.

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3.2 Big Data structuring and pattern recognition

Structuring of big data after passive monitoring

After the information collection is done, they are transferred to the cloud for additional investigation and

expectation. The IoT wearable sensors gather a tremendous measure of information of the relative multitude of exercises done by an individual for the duration of the day. This huge information is known as Big Data. Big Data existed well before IoT, and the advancement from straightforward information stockpiling to dynamic information use has made conceivable the investigation and forecast of conduct, which are the essential drivers of IoT gadgets. The information can be gathered in different ways by the sensors, which should be organized, and division for exact investigation and expectation. Enormous information is assisting with figuring out the billions of continuous information focuses gathered by IoT gadgets. Large information examination stages take unstructured information gathered by IoT gadgets and coordinates data into absorbable datasets that educate organizations on the most proficient method to upgrade their cycles.

The Big Data interaction can be applied to conditions that create enormous informational collections just as those that produce little informational collections. These apparatuses have various key components like information structure, driving edge impact, income asset, and last however not minimal significance of volume. Figure 3 explains the entire methodology step-by-step. Information based decisions are the best way to have genuine trust in an organization's essential choices.
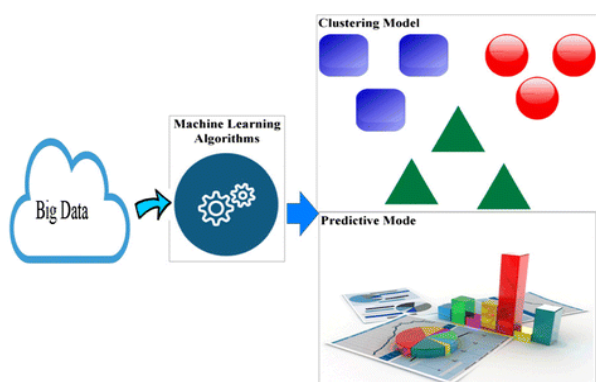

Figure 3. The journey from Big Data to prediction and analysis

Analytical analysis

In the mortal mind, pattern recognition is the intellectual cycle that occurs in the mind, when it coordinates with the data that we see with the information put down in our remembrances. In any case, when we are agitating in computer wisdom, pattern recognition is the invention that matches approaching information with data put down in a data set. Along these lines, pattern recognition is a kind of machine literacy since it utilizes machine literacy algorithms to perceive patterns (Menter et al., 2021). Pattern recognition and machine literacy distinguish courses of action of attributes of information that uncover data about a given instructional indicator or frame and is portrayed by

these four characteristics: it gains from information, it naturally perceives patterns anyhow of whether to some extent conspicuous, it can perceive natural patterns and lastly, the recognition comes from colorful shapes and points.

Pattern Recognition uses two types of algorithms, that is, Supervised Algorithm and Unsupervised Algorithm for collecting information. Recognition provided by image patterns extracts significant data (structures, forms, and so forth) from tremendous measures of random information and furthermore consolidated huge information and example acknowledgment (Menter et al., 2021; Brick et al., 2020). Analytical analysis is well explained in Figure 4.
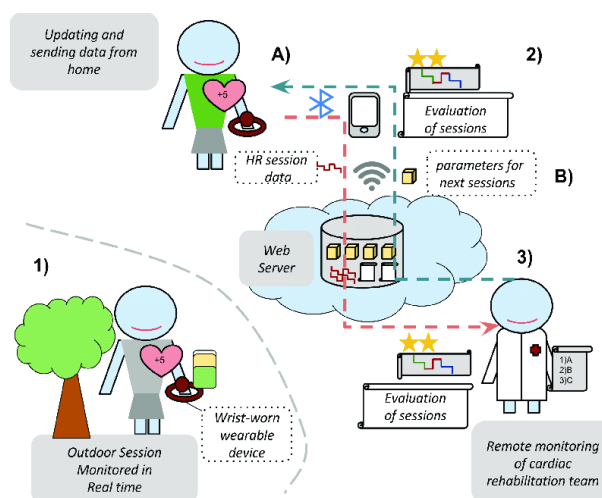

Figure 4. The ultimate process cycle of pattern recognition

The recognition cycle follows the below mentioned way:

- Get-together the information
- Pre-handling and drawing it from the commotion
- Looking at the information and looking for significant factors and normal factors
- Grouping and characterizing the date
- Performing examination to acquire gests
- Disengaging the gests and executing them in practice

3.3 Analytical breakdown on interpretation

Information and examination work off each other to convey significant understanding, or encounters, into our client base. Encounters give central understanding about our clients and uncovers moves we can make to deal with our client's prosperity. In any case, these insights can't be acquired without analytics, and analytics is futile without data.

Analytics is the revelation of trends and patterns gathered from your data. Data is generally futile without analytics. There is huge worth covered in those

monstrous data sets, yet applications and different organizations cannot open that worth without the assistance of analytics. Insight is the worth gotten using analytics. Logical insights are inconceivably amazing and can be utilized to work on the soundness of an individual while recognizing the little subtleties of the issues happening in his/her body.

Now, here in ML based IoT devices, the huge unstructured data need to be analyzed and checked to get a clear understanding of the health status of the patients. Detailed analysis is done with the help of data analytics and then they are crosschecked with the previous data that was recorded earlier. If match occurs, then it will be considered that previous health disorder is continuing and a regular check would be done in order to reduce the problem. On the other hand, if no match takes place, then it would be considered that a new disorder has evolved in the person's day, which needs to be diminished. The platform, which was developed to track the person's habits, contains individual profile of the person and the activity history as well. This benefits the system to generate and continuously tune actionable insights.

3.4 Real time health intervention

Behavioral Modification takes place when an expert gives proper customized recommendations (can be a professional doctor or a trained system). In this step, insight generation takes place. These insights are then converted into Cognitive Behavior Therapy recommendations, which consist of emotional, social, relational and financial motivations.

On the other hand, with regular patient noticing (or a periodic extent of a patient's heartbeat, circulatory strain, respiratory rate, oxygen level, and temperature), predictable perception incorporates the consistent getting of patient information and usages judicious investigation to perceive designs across various information centers for a really long time. In particular, nonstop observation innovation pulls data from Electronic Health Records (EHRs) and different data sources, sorts and examines that data, and, when material, naturally sends appropriate alarms back to clinicians. Predictable surveillance game plans ideally enable facilities to make modified rules reliant upon their necessities, coordinate with their EHRs, offer assistance from a clinical gathering on the merchant's side, and pull information from EHR and various information sources in close consistent.

For instance, if a person has a drinking habit, then it will affect various organs of the body. These devices will make recommendations from the activity history of the person and take real-time data from their body. A proper monitoring is done from time to time, so that eventually that person leaves that habit and return to a normal and healthy life. Blood pressure, heart rate, oxygen level,

stress level and many more things are constantly monitored by these devices just like doctors keep a check on them. This will benefit the person to stay fit and healthy and have a controlled check on their disorder. Alarms are also integrated in these devices so that if any risky condition takes place, then immediately it would be notified to their family members who can urgently take necessary actions. Alarm system is a necessity for old age people who live alone at home and their children go out for work. Their health condition are a constant concern for their children. So these devices are worn by their parents so that they can be constantly monitored.

GPS tracker is an added advantage to these devices. Countless start-ups are cropping up in the fields of cancer prevention and identification, patient treatment, etc. Various tech giants like Amazon, Google etc. are taking this initiative on a serious note and stretching their hands in the field of healthcare (Musa et al., 2021; Ding et al., 2014; Mirzaei et al., 2016; Irschara et al., 2009). They are bringing up new ideas and innovations to help the people of all age groups and this would lead to a huge profit to these companies. Now, we would look into some live examples who have made various innovations in this domain and are still working on their advancements:

Somatix is a B2B2C-based data analytics company which has come forward and introduced an ML-based app named SafeBeing. This AI powered remote patient monitoring platform furnishes guardians and medical services experts with the most impressive arrangement available to recognize changes in the state of their patients, diminish readmissions and work on clinical quality measurements. SafeBeing is stand-out constant motion recognition innovation empowers totally uninvolved in formation assortment inside and outside without outer equipment establishment, demonstrated to expand adherence rates, information dependability and cost- adequacy. Some of the key benefits of Somatix real-time gesture detection platform are:

- Completely passive monitoring – Here, machines automatically records the information accurately.
- High visibility of treatment efficiency – Negative psychological behavior and emotional gestures are automatically recorded and immediately informed to the physicians, care takers with up-to-date real time awareness of the treatment going v/s predefined goals. This increases the efficiency of the software and makes it more reliable to the customers.
- Genuine effect on bad way of behaving - Predictive examination is utilized to expect in proper ways of behaving and the SERF inspiration motor assists with interceding and thwart them with variable blends of altered CBT motivators. Responses to inspirations are assessed and recorded reliably, to additionally

foster treatment reasonability moreover.

- Social driven motivation and support – Here, machines are equipped for relating pertinent motion information with that of friends of decision in clients' groups of friends, adequately making a virtual help local area for data trade and common support.

With all these benefits, Somatix developed the following two products in order to provide digital health solutions. They are as follows:

- SmokeBeat smoking cessation monitoring - A passive smoking observing arrangement empowering ongoing motivating force helped intercession, for further developed adherence with recommended end treatments and ideal treatment sway. This platform is clearly visible in Figure 5.
- Safe Being help for elderly people - An answer adding to further developed flourishing of elderly individuals through confined checking of their ADL (Activities of Daily Living), ID of any sign of disintegrating in their prosperity, and plan of help with emergency conditions.

Figure 5. Smoke Beat real-time monitoring platform.

3.5 Rinse and repeat

The four above processes are the main tasks of the AI-based platform and IoT based devices. But performing these tasks only once is not enough to understand the medical history of a person, their unconscious behavior and their health disorder.

Thus, to fulfil all these requirements, these tasks need to be performed in continuous loop. Constant monitoring is very much essential to understand the person's daily activities. If a regular check is not provided then, the machines won't be able to analyze those records or match with the pervious history. Performing the above steps in a continuous loop would enable the platform to enhance incentive effectiveness and treatment adherence.

For instance, if a person has a smoking habit and he wants to get rid of this habit. So first he has to understand that how many cigarettes does he consume in a day and how long will it take him to get rid of the smoking habit. Now, if these devices conduct the monitoring process once, then they won't be able to detect the daily activities and behavior of the person. Thus, if these tasks are carried out in a continuous loop just like the blood flowing in our blood vessels. The AI-based platform would be able to easily get a regularized data, perform proper analytics and then suggest the person to follow those recommendations so that he can get rid of the habit and get back to his normal life.

When these AI- based devices and platforms are developed, they are constantly tested and checked before they are released. This is done in order to reduce the errors and bugs present in them. Testing them regularly will help these software to work perfectly. Just like a doctor does a regular check up to a person. Similarly, these IoT based devices perform the same task but with more regularity and accuracy. This will cut down the cost of the person who visit the doctor regularly. These devices and AI- based real time platform have proved to be a huge solution during the outbreak of Covid-19 pandemic.

4. RESULTS

Diagnosing a disease is a very difficult work. First, we have to look into the symptoms and then try to understand the disease. In order to reduce human pressure, machine learning has brought about a new innovation in the field of healthcare. We have used imaging and diagnostics in our research work. Automated algorithm is extensively used in this field. The implementation part and the algorithm are explained as follows:

4.1 Imaging & diagnosing as a research based application

With AI progressing at an astonishing pace, it is a functioning execution in the assurance of sicknesses and problems. As ML has a weapon's store of natural calculations, fit for uncovering experiences from a memorable arrangement of information in a comparative space. Medical care experts are meaning to bridle the capability of this innovation in this field by effectively exploring, creating calculations and performing tests giving data and information to the machines that can help in imaging examining patients for irregularities (Menter et al., 2021; Brick et al., 2020; Burbidge et al., 2001; Zhang et al., 2017; Musa et al., 2021).

4.2 Automated algorithms with 3-D modelling

Traditional 3D Modelling becoming very costly and time-consuming; a fast and easier method to get 3D

models of the real-world scene is the need of the hour. The idea is to use visual information of the scene in the form of sufficient photos or videos of the scene from different positions and angles by some algorithm to extract 3D structural information to get 3D models. Considering we have to extract 3D information from 2D images, this method can never be as good as original laser scanner models but is much cheaper and easier to operate and yield significantly good results. Figure 6 shows the result of the research work performed.
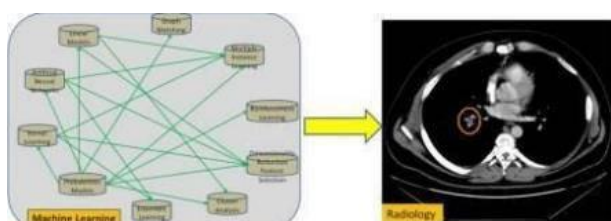

Figure 6. Imaging & Analysis

5. CONCLUSION AND FUTURE SCOPE

The above assessments shows that AI has been in the clinical business from the days since the term man-made mental ability was wrote. A part of the head of brain organizations, Geoffrey Hinton, who was into sensory system science, took the motivation for AI from the human mind as it was a work to imitate the helpfulness of a neuron. The major areas that we covered are – procedure of the working of Behavioral Modification devices, mechanisms, and technologies used, concepts, algorithms, benefits of these devices, and application areas of these devices. An immense area of researchers from medical care and PC offices are cooperatively cooperating to perform novel methodology prompting upgrades in the medical care industry every day. We covered the greater part of the significant regions that are blasting right now in perspectives on medical care. Altered conclusion and treatment of illnesses have been carried out in the medication business. It is undoubted that AI has traversed its foot in the medical care industry and is making it more reasonable and available step by step to everybody.

The domain of machine learning in medical services doesn't lie till here. As new and new calculations are being idealized and being conveyed industrially which bring about the age of more information. The bits of knowledge it produces on the information given characterize machine learning. With the period of new data as yields from sent AI models, this gives the experts one more information for all the fresher trial and

error, remaining for AI to be used in new locales making novel results. This consolidates a more tweaked and customized examination for the patients, giving an edge to the trained professionals and clinical guides to report a drop in misfortunes.

Medtronic is among the clinical contraption associations fabricating into the AI space, and hoping to help diabetics with managing their condition even more gainfully for a predominant individual fulfillment. In 2017, GE Healthcare and NVIDIA reported endeavors to acquire further footing in the clinical gadget area. GE Healthcare said it has 500,000 imaging gadgets on the worldwide market (Lepetit et al., 2009). The two organizations guarantee that they are utilizing AI to work on the speed and exactness of computerized tomography (CT) filters.

Wearable innovation has been a quickly developing space of interest for analysts and gadget producers the same since certain years prior. Nonetheless, there are significant variables that should be viewed as with regards to carrying out wearable in a clinical setting. Philips Healthcare's IntelliVue Guardian Solution is a patient observing framework, which utilizes AI to anticipate when a dangerous emergency might happen in a patient for compelling, early mediation. This is the place where wearable gadgets become possibly the most important factor. For instance, a clinician can put a cable less gadget implanted with sensors on a patient's wrist to follow indispensable signs, for example, pulse. The IntelliVue Guardian Solution programming would utilize AI to distinguish any critical changes in the patient's important bodily functions dependent on calculations prepared on huge datasets of comparable patient information. Here, information would be communicated to IntelliVue screens or cell phones to advise the guardians.

The extent of machine learning lies past the ordinary computerization assignments that are being conjured now and give a help to the medical care industry as far as performing considerably more wonderful things. More advanced features are being tested and thought to be added in these devices like alarming system and many more. New ideas and innovations are cropping up in this domain making it a new era of development and sensational topic. Various start-ups are evolving just to solve these issues from the society. Products are made as per the requirements of the customers and thus bringing huge profits to the companies.

References:

Ajala, J. A., Singh, S., Mukherjee, S., & Chakraborty, S. (2019, December). Application of steganography technique in cloud computing. In 2019 international conference on computational intelligence and knowledge economy (ICCIKE) (pp. 532-537). IEEE.

Brick, T. R., Mundie, J., Weaver, J., Fraleigh, R., & Oravecz, Z. (2020). Low-burden mobile monitoring, intervention, and real-time analysis using the wear-it framework: example and usability study. *JMIR Formative Research, 4*(6), e16072.

Buntak, K., Kovačić, M., & Mutavdžija, M. (2021). Application of Artificial Intelligence in the business. *International Journal for Quality Research*, *15*(2), 403–416. doi: 10.24874/IJQR15.02-03

Burbidge, R., Trotter, M., Buxton, B., & Holden, S. (2001). Drug design by machine learning: support vector machines for pharmaceutical data analysis. *Computers & chemistry, 26*(1), 5-14.

Cahyadi, A., Razak, A., Abdillah, H., Junaedi, F., & Taligansing, S. Y. (2019). Machine Learning Based Behavioral Modification. *Int. J. Eng. Adv. Technol, 8*, 1134-1138.

Ding, H., Takigawa, I., Mamitsuka, H., & Zhu, S. (2014). Similarity-based machine learning methods for predicting drug–target interactions: a brief review. *Briefings in bioinformatics, 15*(5), 734-747.

Irschara, A., Zach, C., Frahm, J. M., & Bischof, H. (2009, June). From structure-from-motion point clouds to fast location recognition. In 2009 IEEE Conference on Computer Vision and Pattern Recognition (pp. 2599-2606). IEEE.

Lepetit, V., Moreno-Noguer, F., & Fua, P. (2009). EP n P: An accurate O (n) solution to the P n P problem. *International journal of computer vision, 81*, 155-166.

Menter, Z., Tee, W. Z., & Dave, R. (2021). Application of Machine Learning-Based Pattern Recognition in IoT Devices. In Proceedings of International Conference on Communication and Computational Technologies: ICCCT 2021 (pp. 669-689). Springer Singapore.

Michie, S., Thomas, J., Johnston, M., Aonghusa, P. M., Shawe-Taylor, J., Kelly, M. P., ... & West, R. (2017). The Human Behaviour-Change Project: harnessing the power of artificial intelligence and machine learning for evidence synthesis and interpretation. *Implementation Science, 12*(1), 1-12.

Mirzaei, G., Adeli, A., & Adeli, H. (2016). Imaging and machine learning techniques for diagnosis of Alzheimer's disease. *Reviews in the Neurosciences, 27*(8), 857-870.

Musa, U. S., Chakraborty, S., Sharma, H. K., Choudhury, T., Dutta, C., & Singh, B. (2021). Vigorous IDS on Nefarious Operations and Threat Analysis Using Ensemble Machine Learning. *Rev. d'Intelligence Artif., 35*(6), 467-475.

Nikiforos, S., Tzanavaris, S., & Kermanidis, K. L. (2020). Virtual learning communities (VLCs) rethinking: influence on behavior modification—bullying detection through machine learning and natural language processing. *Journal of Computers in Education, 7*, 531-551.

Sturman, O., Germain, P. L., & Bohacek, J. (2018). Exploratory rearing: a context-and stress-sensitive behavior recorded in the open-field test. *Stress, 21*(5), 443-452.

Zerdoumi, S., Sabri, A. Q. M., Kamsin, A., Hashem, I. A. T., Gani, A., Hakak, S., ... & Chang, V. (2018). Image pattern recognition in big data: taxonomy and open challenges: survey. *Multimedia Tools and Applications, 77*, 10091-10121.

Zhang, L., Tan, J., Han, D., & Zhu, H. (2017). From machine learning to deep learning: progress in machine intelligence for rational drug discovery. *Drug discovery today, 22*(11), 1680-1685.

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