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**Machine learning applications for injury prevention and prediction**

Injuries have a determining impact in various industries such as construction or sports. Due to their apparent unpredictable nature [1], they are seen as a tangible hard to influence beyond what is accomplished through physical training common in sports or periodic check-ups that have already been established in several industries. The influence that injuries hold is not limited to sports results or costs related to the necessary medical procedure, they can influence an individual's entire life like a Lateral Epicondylitis, better known as Tennis Elbow, will perpetually handicap a tennis player’s arm. A variety of innovative machine learning techniques are currently in use to improve the accuracy of injury prediction and prevention, this is possible thanks to AI-based methodologies which can approach Multifaceted problems at a much greater rate [4]. Machine learning models like Random Forest (RF) and Stochastic Gradient Tree Boosting (SGTB) along with others are chosen to analyze and predict with greater success the possible lesions on an individual [4] with the help of huge data streams of information extracted from sensor tracking, video feed and other sources [3]. The purpose of this research paper is to explore and assess the effectiveness of the diverse ML methodologies used to prevent and predict injuries related to various fields.

Successful non-contact injury prediction in soccer can be achieved using machine learning. Firstly, a single-dimensional linear model widely used by experts is applied to give out a prediction of probable lesions throughout the season. These injury risk benchmarks generate non-accurate results [3] due to the limitations of the model itself. On the other hand, when approached with a multidimensional machine learning model, contingent on the individual’s recent injury history, its metabolic load distance, and the sudden decelerations happening [3], which trains a decision tree classifier, it correctly predicts 76% of the injuries at the halfway point of the season and impressively reaches a 94% accuracy at the 16-week mark [3]. The most precise decision tree is analyzed to withdraw a useful set of instructions and make them available for discussion between medical experts. Thanks to the abolition of previous strict rules regarding the use of tracking sensors during official matches imposed by FIFA [3], this model can now be used extensively, which means that it will yield greater results. Breaking down the outcome of this research shows how proficient ML models already are in predicting injuries in sports.

The construction industry is greatly impacted by lesions and injuries, research has shown how the effectiveness of the majorly studied techniques appears to be quite low when compared to an ML-based prediction system [5]. The application of ML methodology to security-related concerns has been proved able to predict with certain accuracy three parameters of the lesion like the injury type, energy type, and body part. This approach did not work properly when determining its severity level. With the extensive past research considered when revising literature on the application of ML to the construction industry, its application to security concerns is minimal [4]. Thanks to an extensive dataset gathered of more than five thousand cases conforming millions of hours of information, the application of the RF model and the SGTB model has been analyzed. Positive prediction skills, especially shown using gradient trees, indicate how construction attributes are indeed useful predictive assets, for example yielding an increase of 276% when predicting the energy type of a certain trauma [4], which means that ML is a useful resource that is also capable of improvement through further research. Implementation of innovative AI technology can be instrumental to a positive change regarding the safety of construction workers.

Acute kidney injury is a common mishap in hospital patients and even more so in critically ill patients [6], this can evolve into chronic kidney disease and even death. Early diagnosis of this condition is crucial to properly treat the patient. At this point, Machine learning algorithms can play a big role in improving the success rate of these interventions. A data collection process where extensively available health data history like demographics, vital signs, interventions, and other metrics, is analyzed to create a machine learning risk prediction algorithm that comfortably outperforms the current gold standard (SCr). This algorithm shows its positive results across multiple departments like the ICU as well as the emergency room, yielding results like a two-day advancement on AKI (Acute Kidney Injury) diagnosis when compared to the SCr [7]. The precision and prematurity of the diagnosis that this AI model permits together with the ability to use this algorithm with a real-time data stream [7] clearly displays the improvement that can be achieved through the implementation of itself into the diagnosis process of AKI.

Throughout this paper, the effectiveness of diverse machine learning implementation on injury prevention in a wide range of fields has been articulated and assessed. The three main fields where machine learning models are being implemented to achieve trauma prevention have been tackled each focusing on a specific research study made. Although results are overall very promising, a common factor can be found between the three applications, and that is that indeed machine learning algorithms have been shown very effective but in a limited fashion. When applied to soccer, the results were reduced to “non-contact injuries”, or in the case of construction workers, any result that affected more than one part of the body was dismissed due to the overly complex reasoning when assessing such instances. This does not mean that machine learning applications in injury prevention are not useful, they are immensely useful as shown in this paper, but it also means that more research is needed to better understand their effectiveness.

**References**

[1] G. Kakavas, N. Malliaropoulos, R. Pruna, και N. Maffulli, ‘Artificial intelligence: A tool for sports trauma prediction’, Injury, τ. 51, σσ. S63–S65, 2020.

[2] C. Huang και L. Jiang, ‘Data monitoring and sports injury prediction model based on embedded system and machine learning algorithm’, Microprocessors and Microsystems, τ. 81, σ. 103654, 2021.

[3] A. Rossi, L. Pappalardo, P. Cintia, F. Iaia, J. Fernández, και D. Medina, ‘Effective injury prediction in professional soccer with GPS data and machine learning’, stat, τ. 1050, σ. 23, 2017.

[4] A. J.-P. Tixier, M. R. Hallowell, B. Rajagopalan, και D. Bowman, ‘Application of machine learning to construction injury prediction’, Automation in Construction, τ. 69, σσ. 102–114, 2016.

[5] M. M. Lehtola *κ.ά.*, ‘The Effectiveness of Interventions for Preventing Injuries in the Construction Industry: A Systematic Review’, *American Journal of Preventive Medicine*, τ. 35, τχ. 1, σσ. 77–85, 2008.

[6] R. Bellomo, J. A. Kellum, και C. Ronco, ‘Acute kidney injury’, The Lancet, τ. 380, τχ. 9843, σσ. 756–766, 2012.

[7] D. A. Martinez κ.ά., ‘Early Prediction of Acute Kidney Injury in the Emergency Department With Machine-Learning Methods Applied to Electronic Health Record Data’, Annals of Emergency Medicine, τ. 76, τχ. 4, σσ. 501–514, 2020.