Intelligence augmentation and amplification: approaches, tools, and case studies

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EDITORIAL

Most experts agree that truly intelligent artificial system is yet to be developed. The main issue that still remains a challenge is imposing trust and explainability into such systems. However, is full replication of human intelligence really desirable key aim in intelligence related technology and research? This is where the concept of augmented intelligence comes into play. It is an alternative conceptualization of artificial intelligence (AI) that focuses on AI's assistive role, emphasizing the fact that cognitive technology is designed to enhance human intelligence rather

than simply replacing it. Visionaries believe that one of the most promising potentials for intelligence augmentation is the creation of a hybrid biological and non-biological thinking as a way to "supercharge" the human brain.

To make the post pandemic evolvement of cognitive society sustainable we have to address the global challenge that can be formulated as the need for increasingly smarter and abler decision-making enhancement and amplification. Help is required in complex problem solving, decision making, and attaining goals. The aim of this Guest Edition of *Cybernetics and Systems* is to address some aspects in this global challenge by proposing intelligence augmentation approaches and technologies which could provide decision-makers with the tools to choose the best outcomes that would promote sustainability, wellbeing, and security to individuals and populations.

The selection of research contributions to this issue opens with the paper titled "*Hybrid Cognitive Interface for Smart Knowledge Engineering with Case Study*". In this paper, the authors show a brief overview of Smart Knowledge Engineering for Cognitive Systems (SKECS), which is based on methods, technologies, and procedures that bring innovations to the fields of Knowledge Engineering (KE), Knowledge Management (KM), and CS. The goal of SKECS is to bridge the gap in the hybrid cognitive interface by the use of deep learning, experience-based knowledge representation, context-aware indexing/retrieval, active learning with a human-in-the-loop, and stream reasoning.

The authors of the following paper titled "*Optimal Deep Neural Network-based model for answering Visual Medical Question*" present a visual question-and-answer system designed to provide direct and precise answers to questions asked in natural language. In this context, they propose an optimal deep learning model based on an adaptive optimisation algorithm, which

takes medical images and natural language questions as input, and provides precise answers as output. The presented model outperforms current visual question-and-answer systems and offers a significantly higher retrieval accuracy rate.

The paper that follows is titled "*Social networks as platforms for enhancing collective intelligence"*. In this paper, the Authors bridge the gap between collective intelligence (CI) and its representation on social networks. First, the paper briefly presents the key characteristics of CI. Then, the Authors brief the recent research results on applications of CI on social networks. After that, a formal framework for CI on social networks using two characteristics including diversity and independence is presented. Some future research challenges have also been introduced.

In the following paper titled "*A blockchain, smart contract and data-mining based approach towards the betterment of e-commerce"* the authors contribute to e-commerce enhancement, trust, and amplification. They propose a hybrid e-commerce architecture where advanced data mining technique has been used to generate accurate rules to determine fraud transactions. The presented system architecture addresses issues from both seller and consumer perspectives while making the e-commerce platform fraud-proof and secure. For future works of this study, the Authors plan to build their own blockchain network and add scalable solutions to the network from a cost, time and complexity perspective.

The next paper is titled "*Smart Virtual Product Development: Process Planning Module*". The paper introduces the concept of enhancing the product development process by providing manufacturing knowledge during early stages of product development process. Results from the case study presented in the paper indicate that the proposed system is capable of

enhancing the manufacturing process by using the previously acquired experiential knowledge of similar products.

The following paper is titled *"Logical Characterizations of Fuzzy Simulations"*. Kripke frames (and models) provide a suitable semantics for sub-classical logics; for example, intuitionistic logic, and the basic logic. Here, the Austhors investigate whether Kripke frames/models could provide semantics for fuzzy logics. In the paper they provide and prove logical characterizations of fuzzy simulations between fuzzy Kripke models that use a general t-norm-based semantics.

The next paper is titled *"Adding Interpretability to Neural Knowledge DNA"*. It addresses in a novel way one of the biggest challenges of Artificial Intelligence – explainability. This paper proposes a novel approach that adds the interpretability to Neural Knowledge DNA (NK-DNA) via generating a decision tree. The NK-DNA is a promising knowledge representation approach for acquiring, storing, sharing, and reusing knowledge among machines and computing systems. The Authors introduce the decision tree-based generative method for knowledge extraction and representation to make the NK-DNA explainable, which is a big step towards trust in Artificial Intelligence (AI).

The paper that follows is titled "*Decisional DNA (DDNA) based Machine Monitoring and Total Productive Maintenance in Industry 4.0 Framework"*. The research presented in this paper employs he concept Virtual Engineering Object (VEO) related concepts, to create knowledge models of various modules of preventive maintenance. Obtained results show that this approach is useful in real time remote machine monitoring and visualization. Furthermore, the Decisional DNA (DDNA) technology empowers the models to predict the preventive measures based on the past experience of the environment.

The next paper is titled *"Towards Knowledge Sharing Oriented Adaptive Control"*. In this paper, the Authors propose an adaptive control method designed to promote knowledge sharing between different robot systems. In order to ensure the target robot's performance in reusing the source robot's knowledge, the Authors propose an add-on module, which is called the knowledge adaption module (KAM). The presented approach uses neural knowledge DNA (NK-DNA) to acquire knowledge of the robot's inverse dynamics and then reuse such knowledge in other robot's control systems by utilizing the KAM. The initial experiment shows that the proposed KAM is promising for knowledge sharing between different robots.

This Special Issue is concluded with a brief communication of an interesting novel knowledge sharing concept titled *"The Development of a Conceptual Framework for Knowledge Sharing in Agile IT Projects "*. The paper recommends a new framework to collect and store conceptual knowledge in IT projects using agile approach. The evaluation of the overall method remains to be improved and supplemented during future advance of this promising research.

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