A STUDY ON ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING

Author Shailendra Kumar Vimal (lecturer civil engineering department)
Digambar jain polytechnic Baraut Distt. Bagpat (U.P.)

ABSTRACT

Artificial Intelligence is a very sensitive section of computer science which has a detailed study about certainty and application of various technology advanced machines. To solve variety of difficult problems, bulk of processing power is required, but the technology based an artificial intelligence will solve it very quickly and correctly along with the suggestive instruction and automated remedial measures also. It is the new emerging ideas based methodology with regards to development and implementation of artificial intelligence in the field of civil engineering activities. Artificial intelligence is being used in various sector of civil engineering successfully. With the availability of various data in bulk and deep learning methodology based on machine learning technique. The prime research area of artificial intelligence in civil engineering is management and maintenance of structural engineering as well as the optimization of design engineering. The advantage of application of artificial intelligence in civil engineering provides the various data for analysis and further concise decisions with regards to sustainable to productivity. Now a days the construction technology oriented with sustainability has been developed due to availability of various digital data & digital technology due to application of artificial intelligence in civil engineering. Basically the civil engineers used computer in civil engineering for numerical & algorithmic calculation for solving the structural problem which was in adequate but at present they use the artificial intelligence technique to detect and take the proper remedial measures to avoid the structural failure.

INTRODUCTION

A very sensitive section of computer science is artificial intelligence which deals with research, progressive development and proper implication of computer

intelligence for digital technique to solve and improve the productivity on sustainable base as well as it plays a very important role to connect the physical and digital construction link. The main function & target of artificial intelligence is to search and indicate the problems along with suggestive measures to minimize it. With the help of artificial intelligence a civil engineer can create technological advancements. Since the artificial intelligence was used in 1950 and after then the engineers has more and more expectations for artificial intelligence in civil engineering as well as in other fields also. The new emerging technology is artificial intelligence which accepted widely to solve the various challenges and very difficult problems along with suggestive indication methodological technique to solve it and provide sustainable productivity. The main objective of artificial intelligence is to use it for identification, forecasting and optional control of complex system modeling. The artificial intelligence is categories in five various phase. The incubation, formation, dark and knowledge application phases were before 1956. The fifth phase is the integrated development phase since 1986 to present days with progressive development. A unique machine learning technology has been developed and used in artificial intelligence known as deep learning system (DL) due to data collection in bulk and advanced processing hardware. The construction/ productions sector is backbone of economy and development of country which is long term progressive sector and that's why the government of each and every country of world are very keen & interested with hardworking to introduced & implement the artificial intelligence to have a significant status in competitive edge. Data In bulk is being used for algorithmic analysis by artificial intelligence which is beneficial for building/construction industries.

A system trained with artificial intelligence technological technique is more capable for sustainable progressive production in the field of digital building/construction as well as it helps to analysis and advice to dissolve the various problems and other functional issues. The civil construction engineering includes different technological technique such as (i) civil engineering materials (ii) building/ construction materials (iii) carious type of mechanical accessories and equipment (iv) several surveying techniques (v) many type of design techniques (vi) variety of civil construction and maintenance techniques etc. the artificial intelligence is necessarily used because of its vast capability & ability to research in the field of civil engineering/ construction industries. For analysis of data relates to structural technology/ construction technological techniques, health protection, planning and managing the risk and concise decision making,

the artificial intelligence is used widely. The artificial intelligence is more capable and helpful for enhancement of civil engineering productivity as well as maintain the stander protection/ safety in the field of building/ construction. We know that neural networks are very much capable to store various data as well as numeration capacity to process & evaluate in bulk of data. The artificial neural network (ANN) is also required to repair a pavements & assessment of structural hazard as well as the road/ other big civil projects , risk degradation , progressive performance and its application along with its massive computing power, categorical estimate etc.

REVIEW OF LITRATURE

The various studies in context with the intelligent technologies in civil engineering/ construction technological technique are concluded and finally comes to the point that artificial intelligence technology & technique has vast potential in the field of civil engineering/ civil construction engineering. The artificial intelligence has a vast and progressive future in the field of civil engineering along with a progressive improvement in the area of individual and collective productivity. Another study on commencement & progressive implication of artificial intelligence in the field of civil engineering/civil construction technology was carried out and finally comes to the point that due to high performance computing power calculation followed by algorithmic and civil neural networks being used in the field of civil engineering/ bridge engineering, health monitoring, optimization of structural problems & its health evaluation, the artificial intelligence is one of the most emerging technological methodology based mechanism/ system. Recently, bulk data storage& analysis technology and its deep learning is being used in various field of civil engineering. Artificial intelligence includes bulk data storage capability as well as computer is used deep learning and advised in context with structural health and its maintenance procedure is more significant advanced technological improvement. The study also includes that bulk data storage and deep learning is an emerging area to study about integration of both for further improvement in artificial intelligence. Now a days, automation in civil construction/ production requires sustainable productivity based on artificial intelligence technology/technique.

Some of the studies in this regard is oriented about the safety measures of workers working in civil construction industries. With the help of artificial intelligence system, safety management to be adopted such as prevention

planning, response and other safety incidents in civil engineering construction. With the help of artificial intelligence system, the actual relationship between coordinates and distances of image can be determine and to be further investigated for safety measures. The study also oriented with the design of typical structures such as long suspension bridges and finally come to the conclusion that artificial intelligences systems is more helpful to design such typical structures with high accuracy to avoid the failures due to its designs.

Knowledge Based Expert System (KBES) is one of the methodology in civil engineering which provides a very prices frame work with reference to typical problems in civil engineering which will not be easily dissolve with the help of traditional techniques regarding programing of designing, planning and scheduling based on well structured, algorithmic formulations. The requirement of KBES is categorized in four different categories such as (i) reasoning with geographical relation and features (ii) algorithmic components interaction and interface with databases. The new generation of KBES is revised traditional engineering knowledge. The advancement of computer added civil engineering incorporated with true reasoning computation will be greatly contributed by KBES.

Some studies comes to the point that artificial intelligence system needs more advancement in technological development because of its flaw with reference to use for the bulk data learning in civil engineering. Teachers related to civil engineering can make expert there student by applying the advanced & technically developed artificial intelligence in particle aspects which can develop new group of engineers as an expert to use and develop the artificial intelligence to overcome the problems of civil engineering constructions.

Artificial Neural Networks (ANN) is being efficiently used with other traditional approaches to dissolve the civil engineering problems including forecasting, decision making, Analysis of risk & optimization of resources as well as classification choices among others. Civil engineering as various critical problems which are extremely complicated and some of the problems are of complex behavior which cannot be simply analyzed. So it comes to the conclusion that artificial neural networking is the only tools & technique to solve these critical problems of civil engineering construction and in future based on bulk data input and output data to have outcomes to the extent possible.

The application of artificial intelligence has a open scope in the field of work review and further investigation on application in a particular field of civil

engineering construction such as hydrological engineering, structural engineering, construction management, transportation etc.

The optimum accuracy for estimating the accurate amount of concrete and reinforcement to construct the integrated bridges, the artificial neural network model having three stages neural architecture is most applicable.by increasing the number of data to bulk data, the accuracy of predicting model be increase data. the study comes to the conclusion that prediction model could be applicable to the extent possible if the database is in bulk in context with the structural feature such as various cross- section , the height of construction , number of spans, numbers of piers, and structural system.

VARIOUS TYPE OF TECHNIQUES AND METHODOLOGIES

(i) Genetic algorithms

The Darwinian Theory optimization evolution and to know the sustainability of the fittest is known as evolutionary algorithms. Though it has several applications in the area of civil engineering construction but it needs more research/study & development. Various emerging mathematical tools which is one of the best possible application as developed & and created with the development of genetic algorithms. Construction planer can generate and do the optimal assessment or nearby optimized construction schedule planes which can save the time & money of project with the help of genetic algorithms based optimized model for linear construction projects.

(ii) Artificial Immune System

To solve the critical engineering optimization problems, the artificial immune system will activate the active part/organ of the adaptive immune system. So we can say that artificial immune system is such a methodology which can dissolve the lacks of the artificial neural network- based approaches which would be useful for analytical approach of civil engineering system by evolutionary algorithm and minimum square method combined which help to know the structural feasibility and its relevant constants. But the immune system in

context of civil engineering needs more advanced and progressive development.

(iii) Expert System

Expert system is the prime successful research of artificial intelligence which is designed on the base of human expertise & knowledge systems. This technological system is being used in different field of civil engineering construction such as bridges, roads, geo technical engineering, material engineering, petroleum & chemical industries and some other sensitive and inflammable areas. The use of expert system in civil engineering is daily increasing order due to use of artificial intelligence technics and intelligent scenario these systems may help as construction management tools and assist the engineers such as a human assistant.

(iv) Artificial Neural Network (ANN)

Artificial neurons which is capable to carry out bulk data computation for knowledge and data processing in parallel. This is simplified technically designed biological neural network whose basic target is to generate and artificial neural network system according to biological neural networks theory and some applied technical intelligent acts by human knowledge with reference to practically problems. The Artificial Neural Network (ANN) is frequently being used in the field of structural optimization, health monitoring, structural control characterization & modeling of structural material, construction engineering, road /highway engineering etc. the technology of this network is of three layer such as input, hidden and output which are expert for jobs without adequate data, missing information and for extremely critical problems where human brains intuits frequently.

(v) Big data

A lot of discussion in various areas of science, technology, industries and even governance has been created due to advance ness of bog

data technology. Engineering needs the adaptive data from new numerous sources such as sensors wireless devices. GPS and wireless communication in between machine to machine. Various type of building material such as continuous, unstructured and free end structure of rows and columns which generates a lot of data to challenge the traditional approaches relates to dissolve the problems of civil engineering and that's why the application of big data is required urgently. The autonomous data with decentralized controls is the fundamental feature of big data application. Since each data source is capable to create and collecting various information whether they are required or not depending on centralized control system.

(vi) Deep Learning

Deep learning system is some short of machine learning methodology. Which requires three layers of neural stating from raw input to gradually processed up to the final stage/ up to the end of features. The basic use of deep learning in civil engineering is to know the health/sustainability of structure.by the use of deep learning methodology can create more data with regard to training and various architectural network to dissolve the different civil engineering issues. The pavement failure/cracks and other types of failure identification can be find out with the help of deep learning based algorithmic detection methodology/technological technique. With the help of deep learning methodology, the structural health of the tack bed on passing train can be detected by monitoring the vibration of the track structure and the analogous signals identification network in railway engineering.

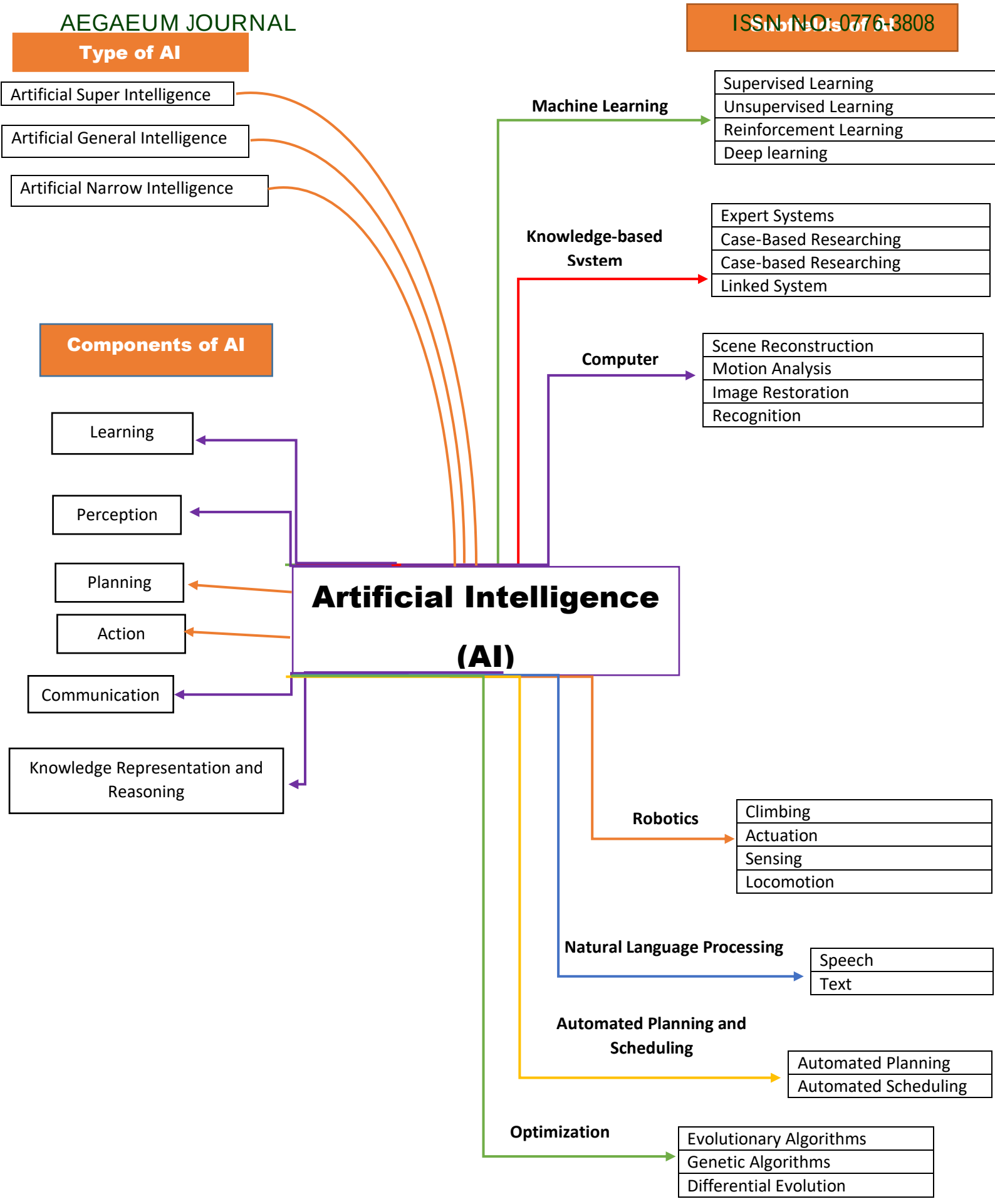

Fig - 1 - Frame work of AI civil engineering construction industry

APPLICATION OF ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING

1. Constructional Engineering and Management

The Neuro-Fuzzy Inference System is known as the behavioral aspect of cement based civil engineering materials subjected to single, double or multiple cracks modeled by using complicated structures with known input and output bulk data using computerized methodology based on artificial intelligence(AI) which can be utilized to generate construction management plans to optimized the cost & time of projects.at initial stage of planning for civil engineering projects, the computerized auto-machine can check a construction potential at sight for collective bulk data to generate three dimensional models, blue prints and planning's related to the project concern. Earlier to this it takes more time near about weeks to complete but now a days within a day it is being completed with the help of artificial intelligence system.

2. Structural Engineering

Artificial intelligence is applied to generate computational components which analyze the human brain processes. The recognized approaches and static & dynamic sub structure methods to estimate the quantity of damaged elements on the basis of full or partially estimated are applying on large scale of artificial intelligence management in the field of civil engineering construction.

3. Transportation Engineering

The most suited model is required in context with the frequent failure of the Highway Slops which can assess the most possible failure of highway slops. Agent based modeling (ABM) in the

context of massive transport network is an efficient model with respect to traditional modeling system. A Knowledge-Based System (KBS) is being applied to dissolve the various problems related to transportation technology.

4. Detection of Structural Failures

Various type of surface damages, metallic corrosion, steel bar corrosion, concrete cracking and other causes responsible to structural failures can be detected instantly with in real time with the help of Faster Region-Based Conventional Neural Network (Faster R-CNN) which is structural visual inspection technique based on neural network.

5. Quantity surveying

The suitable tools &technique for building material decision is Artificial Neural Networks (ANN) which has the analogical ability to solve the surveying problems. The Genetic Algorithms technique is generally used for model designing, training and testing of civil engineering works.

6. Geotechnical Engineering

The capability for dissolving the non- linear issues, a general model of neural network can be used by geo technological method which can dissolve & evaluate the issues related to civil engineering works.

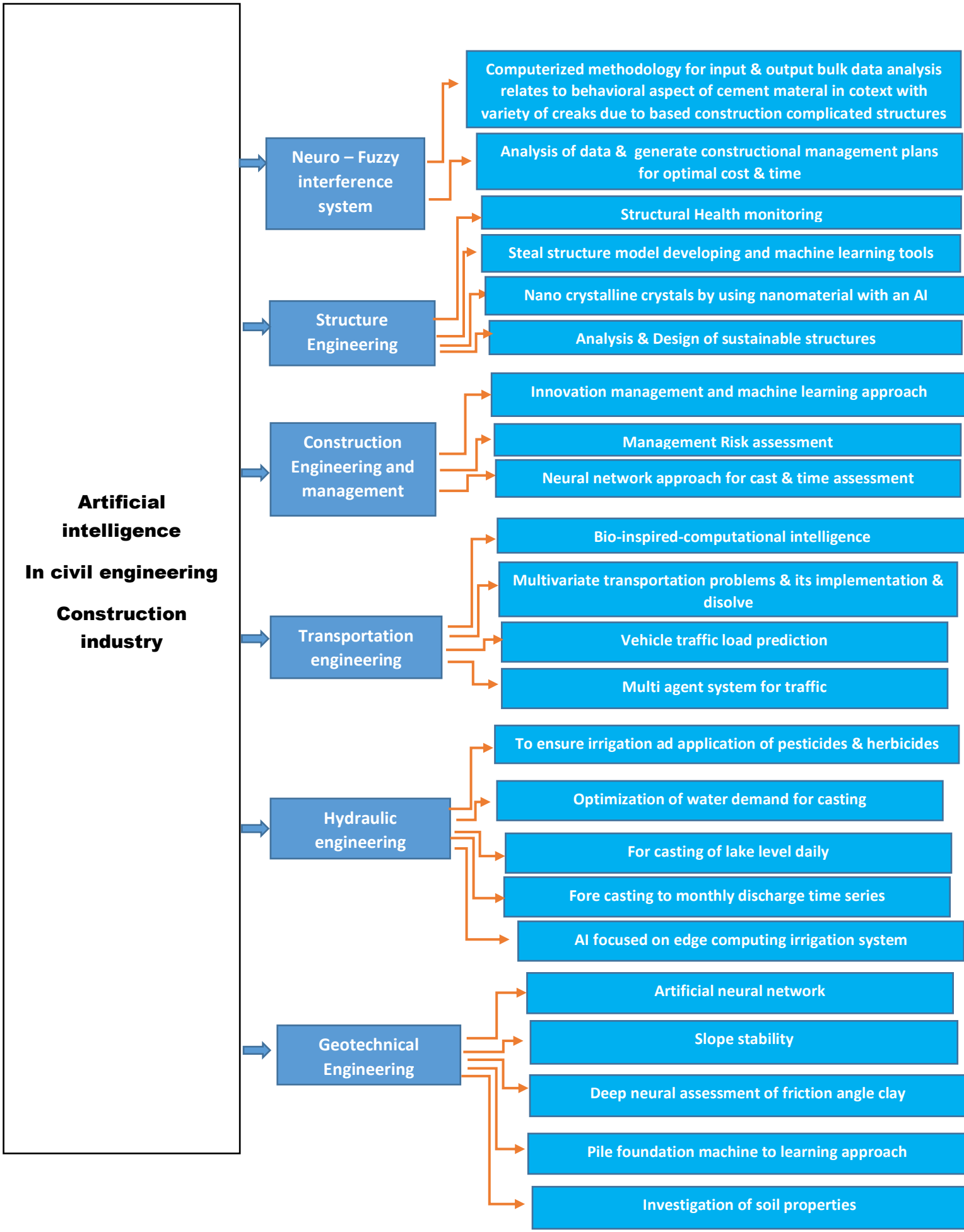

Fig – 2 – Application of Artificial Intelligence in civil engineering

CONCLUSION

The study consist the review of various studies in context with the application of artificial intelligence in the field of civil engineering and also the various tools & technique and methodologies related to use of artificial intelligence and finally comes to the conclusion that there is a vast scoop to research in context with the advanced development in Artificial Intelligence require in civil engineering construction works.

REFERENCES

[1] Pengzhen Lu, Shengyong Chen and Yujun Zheng; Artificial Intelligence in Civil Engineering (2012)

[2] Youquin Huang, Jiayong Lil and Jiyang Fu; Review on Application of Artificial Intelligence in Civil Engineering (2019)

[3] Bilal Manzoor, Idris Othman, Serdar Durdyev, Syuhaida Ismail and Mohammad Hussaini Wahab; Influence of Artificial Intelligence in Civil Engineering towards Sustainable Development- A systematic Review (2021)

[4] Yuting Zhang; Safety Management of Civil Engineering construction based on artificial intelligence and machine vision technology (2021)

[5] L. Sgambi; Artificial Intelligence: Historical Development and Applications in Civil Engineering Field (2008)

[6] S. Fenves; Role of Artificial Intelligence and knowledge-based expert system methods in civil engineering

[7] Yoram Reich; Machine Learning Technique for Civil Engineering Problems

[8] Ming Xie, Fanbing Meng, Jinhya Zou, Wei Feng and Shaohua Ma; Application of artificial intelligence in civil engineering education (2020)

[9] Vikash Singh, Samreen Bano, Anand Kumar Yadav and Dr. Sabih Ahmad; Feasibility of artificial neural network in Civil Engineering (2019)

[10] Shrikant Kate, Vidula Swami, Sanjay Doiphode and Vijay Singh; Advanced Applications of artificial intelligent systems in civil engineering: A review (2021)

[11] Tu T. Nguyen, Hoa Pham Duy, Tung Pham Thanh and Hoang Hiep; Compressive strength evaluation of fiber reinforced high strength self-compacting concrete with artificial intelligence (2020)

[12] Zeljka Beljkas, Milos Knezevic, Snezana Rutes and Nenad Ivanisevic; Application of artificial intelligence for the estimation of concrete and reinforcement consumption in the construction of integral bridges (2020)

[13] Tayfun Dede, Murat Kankal, Ali Reza Vosoughi, Maksym Grzywinski and Moacir Kripka; Artificial Intelligence Applications in Civil Engineering (2021)

[14] Nikos D. Lagaros and Vagelis Plevris; Artificial Intelligence (AI) Applied in Civil Engineering (2022)

[15] Tzuping Chiang; Estimating the Artificial Intelligence Learning Efficiency for civil Engineer Education: A Case Study in Taiwan (2021