Implementation of Expert System in conventional and Un-conventional areas: A Review

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Abstract: ***Human intervention in various important areas leads to certain drawbacks pertaining to the accuracy, speed and precision. The procedure follows to perform any task whether in the field of conventional areas or unconventional areas are based on the procedural and process steps for the purpose of enhancement of the precision, accuracy and speed. The expert system which is based on Artificial intelligence is the key factor to implement knowledge that enhance the accuracy and provide the precision for the task. Various important areas of study based on expert system implementation based on Artificial Intelligence are Computer Science, Medical, Agriculture, Banking and Finance, Environment, iOT, Manufacturing, Natural language processing, Image Recognitions etc. These are certain key areas of study and methods and methodology implemented including various algorithms and procedures are important to understand. There are vast areas where the expert systems are implemented to learn the human interaction with machine or procedures and make them self-learning and self-enhancing based on supervised or un-supervised learning. Current paper is pertaining to the reviews of various aspects and important algorithmic procedurals implementing expert system based on Artificial Intelligence.***

Index Terms - Artificial Intelligence, Expert System, Rules and Knowledge

I. INTRODUCTION

An Expert System (ES) is prominent and important area of Artificial Intelligence. It is replacement of human intelligence by application of algorithms to perform desired tasks without human intervention. Basic purpose of the expert system is mitigation of complex and complicated problems which required high precision of intelligence and accuracy to be solved in various domains. There are hundreds of areas where it require high precision and expertise human skills that can be replaced by an expert system. Basic aspects of the ES can be listed as accuracy, reliability, precise performance level, responsive at high precision. The areas of ES are numerous and some of the important areas can be list out as decision making support, demonstration of high skill work, deriving final solution of complex problems, diagnosis of problems with high accuracy, interpretation of complex outputs, predictions wit accuracy, showing the trends and future trends and alternative comprehensive and tangible solutions. There are three important components of ES namely Knowledge base and User Interface which are connected with the interface engine.

Fig.1 Expert system Component

As depicted in Fig.1, four major components that include knowledge base – which is large scale resource available in various forms and termed as knowledge base with high quality and pertaining to the domain. It is most important component to exhibit and derive intelligence. High quality and precise domain pertaining knowledge base is the important factor to derive the intelligence. The knowledge is combination of factual pertaining to the task domain and also heuristic which is based on derived judgements, guess and inferences generated out of it. The knowledge is represented in form of various possibilities for each event. The possibilities are depicted using if-then-else rules. The inferences are based on the conditions including "and" and "or" logic. Multiple conditions together form the decision array and the final inferences are based on parameters and scenario. This can be depicted as shown in Fig.2.

As shown in Fig.2, the facts are conditionally evaluated and series of decisions leads to the final decision process. In present paper, various important areas of ES and the relevant studies made into these areas and published works are narrated. The areas of study include Agriculture, Banking and Finance, Environment, iOT, manufacturing, natural language processing to name some areas.

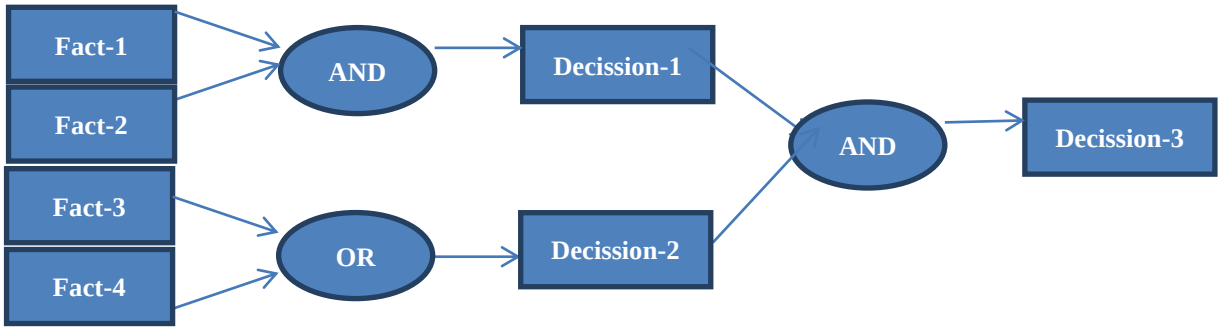

Fig.2 Decision structure

II. LITERATURE REVIEW

As per the study of SajadSabzi et al.[1] in their study pertaining to expert system in agriculture area on the identification of crop related to potatoes. They use meta-heuristic algorithm for the study. The study includes the identification of weed in the crop of potatoes based on expert system. They emphasis on accuracy of identification of precision on spraying on crop and the algorithm is based on minimization of color and texture properties. The algorithm use neural network classifier and its parameters for search purpose. The system obtains high precision and achieved the accuracy level of more than 98% obtained this level having less than 0.8 seconds of time.

In a scholarly paper pertaining to malnutrition and food insecurity analysis related to the rainfall0p as dependent parameter, janinaKleemann et al. [2] depicted in their study using Bayesian Belief network based Expert System. The work emphasis on development of model considering the three important parameters of high and low rainfall and food insecurity. The analysis targets the vitamin A provision as outcome of the crop relevant to the rain fall intensity and gross rain.

As per the study by BenSteward-Koster et al.[3] based on the development of model using ES pertaining to quantify risk factor of rice-shrimp in the region of Vietnam. The study emphasis quantifying the crop outcome using probabilistic Bayesian belief network using expert system. The knowledge used for model development is based on rice-shrimp farming using probabilistic model development. The outcome is reducing the scope of crop failure and improves the output.

In research paper published by Dieago A. et al.[4] is based on use of expert system development which directs and suggest the pests effective and most appropriate for teak plantation in forestry. The developed system is ENTOTECA which is targeting to loss of plantation due to harmful insects. The study is pertaining to the Brazil where the teak plantation is taking place in large scale. The system use mobile as user interface and identify 23 types of insects that suggest the appropriate remedies for the given teak tree or for the entire area in real time.

Considering the studies pertaining to the banking and financial sectors, in a study undertaken by MustafaMenekay[5] suggests fuzzy expert system for authorization of Bank Credit. The study is pertaining to analysing the financial status and current scenario of organization and making decision on the health of company that leads to benefit investors, creditors and other users. It is based on fuzzy expert system that helps to take useful financial predictions and decisions. The proposed system is based on available past decisions taken by experts and specialists and turned into the expert system based on the past knowledge having interface engine to make end outcomes.

Considering the study by DanijelaGrahovac et al.[6], it emphasis on understanding and applying the cost management. The paper mainly talks on the application area of the expert system for cost related decision making and management of cost improvement. The cost management expert system is mainly based on Activity based costing. It focuses on designing the Cost management expert system using the past knowledge of activity based costing.

As per the study by Maria et al.[7] on anti-fraud detection detection enhancement for use of card in e-commerce sites. This study is focusing on an ontology-driven approach. It is proposing semantic conflict detection and classification in rule-based expert systems. It focuses on the critical case of anti-fraud rule repositories for the inspection of Card Not Present (CNP) transactions in e-commerce environments.This study suggests that ontological approaches can effectively discover. It is very much effective in classify conflicts in rule-based expert systems.

In the study pertaining to control engineering practice area, the study carried out by Javier Albusac D. et al.[8] suggests an expert fuzzy system for enhancing and improving the pedestrian crossing based on obtained knowledge database of visual feedback. The study is based on improving pedestrian crossing using the luminous and intelligent barrier. In this study, a path is drawn consists of lights dividing the vehicle and pedestrians. It emphasis on better space management and time management for the vehicle drive and avoid the possibilities of accidents. Another study which is based on Ocean of south china by K.L.Na et al.[9] suggests the alternative selection system for decommissioning and selection of fixed oil and gas assets using expert knowledge based system. It suggests the expert system knowledge based model for the most feasible decommissioning alternative from a techno-operation standpoint.A preliminary screening algorithmic framework is presented to conceptualize an effective database management system. This work used Analytic Hierarchy Process (AHP). It utilized to analyse and find mult-criteria decision making of choosing the best practicable decommissioning alternative.

In study paper by Bhatt and Buch[10] pertaining to expert system of Die design for multi stage deep drawing process. The study is based on die of the deep drawing process which is based on final product. The controlling factors are die and sheet metal properties.

As per the study byAqdaslkarm [11], the work is related to development of expert system using association rule and predicate logic. The study is pertaining to earthquake prediction based on past knowledge. This is achieved by applying association rule mining on earthquake data from 1972 to 2013. These associations are polished using predicate-logic techniques to draw stimulating production-rules to be used with a rule-based expert system. The proposed expert system was able to predict all earthquakes which actually occurred within 12 hours at maximum.

As per the study by GokhanEngin et al.[12] on rule-based expert system to support University students. The study is related to academic advisor to the students. The scope of the paper is pertaining to USA. The paper suggest two expert systems: One is for suggesting course advisory for international universities private in nature and another one is suggestion of availability or possibility of having scholarship at the university for the under graduate level students. Developed systems are implemented and tested using Oracle Policy Automation.

Application and implementation of expert systems in manufacturing can be understood by some scholarly work as follows. One of the prominent work by Toufik[13] depicts the diagnosis of faults in bearings using fuzzy expert system. The work is based on improved range overlaps and similarity methods. The methodology used in the paper is using wavelet packet coefficient. It is used to extract features of

faulty bearings. The feature extraction is done using the improved range overlap's method. The reduced feature set is used to build the fuzzy expert system. It is used to find bearings whether they are localized or distributed.

In another study by AlvineBoaye et al.[14], it is pertaining to integrate rule based control system that execute and manage control strategy and implement its flow. This paper emphasis on an innovative idea of designing distributed expert systems which is able to control rules activation. This approach involves control strategies by supporting selective interfacing with rules. It proliferates concurrently and integrates a set of meta-rules. These meta-rules operate on a blackboard and as a result, they are expressed as an assurance case. It uses a tool called ERESYE and execute on top of it.

In study by Ivan Matin et al.[15] on development of expert system for model simulation for casting metal. The work is pertaining to simulation modelling based on Expert System. The simulation model is generated and proposed for metal substructure for metal-ceramic crowns design. Blackboard architecture is used for this model generation. ES is enhanced using the Blackboard architecture and data modelling. It is aimed to excel the design and minimize time and lead-time. The method proposed for this work includes an integration method which uses common data model approach. It uses blackboard architecture and rule based reasoning as well as iterative redesign method. Using arithmetic mean roughness values mitigates with constant Gauss low-pass filter having cut-off length of 2.5 mm. The result obtained for this study includes the dimensional deviation between the simulation model of the metal substructure and the manufactured cast of 0.018 mm. Result also shows that arithmetic mean roughness values measured on the casting substructure ranges from 1.935 µm to 2.778 µm.

In a study related to sustainable manufacturing performance evaluation for manufacturing units of two different sectors namely small scale and large scale by SujitSingh et al.[16], emphasis on fuzzy rules to develop the expert system. The study includes identification of characteristics and forming metric sets based on the characteristics of small scale and medium scale industries. It forms in total sixteen metrics that includes economic characteristics, environmental characteristics and social measurements. These metrics are processed and linguistic variables are gathered as input. The fuzzy rule-based expert system is proposed based on these characteristic metrics and the sustainability of the industry is measured using triple layered bottom-line framework.

Many ES have been developed to identify diagnosis problem in various sectors like automobile and medical. Taani and Ahmad [24] have developed an Expert System for Car Failure Diagnosis. After that Jiange and Lu Lu [25] have presented a Neural Network based Fault Diagnosis Expert System of Automobile Engine. Tanmay and ravi [26] have examined various fuzzy expert system to identified human diagnosis medical disease.

In another study related to augmented reality, which is very promising field is done by Anna et al.[17] aimed to increase knowledge of adaption and usability of augmented reality for the purpose of skill based operators. New approach of dynamic information content is proposed that is automatically adjusted to individual operator. The basic purpose of the study is to enhance the training skills of operators and enhance their skill using the expert systems which is developed in combination of Augmented Reality and ES based Artificial intelligence Expert system. The study presented the framework describing this concept.

As per the study by Zhaohui et al.[18], based on green cutting process and its applied areas using intelligent expert system highlights on application areas. The study carried out using Matlab® which is used to obtain the empiric power functions. Obtained optimizations are performed using GRA as foundation based on knowledge base. Using this knowledgebase, the Expert System is developed that used to direct efficient green process technology. Finally, optimization of the system is proposed and applied to acquire sustainable process as end result.

In a study carried out by Kashid and Kumar[19] based on life prediction of punches of compound die. The study is based on Artificial Neural Network. The study depicts that the life of punches relevant to compound die are affected by certain parameters which impacts majorly. These parameters include size and material of punches and they are investigated using Finite Element analysis method for this study. Based on this investigation, critical simulation values are determined. Signal to noise approach is used to prediction of number of cyclyes of punches. Based on the obtained number of cycles, total number of sheet metal parts produced is obtained before the failure of the punches of compound die. The ANN model is developed using the results of FE analysis and trained using Matlab®. Using the ANN model, the study predicts the life of punches of compound die in terms of sheet metal parts.

Many expert systems have been developed for face recognitions. Lingjun Li et al. [20] have studied and summarized various technologies for face recognitions. They have categories systems in three groups. First is based on face structure, second is based on perturbation and distribution function of samples and third one is based on sample view points.

Automatic text summarizations expert systems have been examined by Mahak and Vishal [21]. Detail literature reviews have been examined by them.

Database design plays a vital role in the field of computer science. Many researched have applied AI technique, Expert system to build a database design automatically. In Michael and Paul's [22] report, they have examined various approaches. They compared this approaches with various criteria like stage of database design, type of user interface and methods used to driven the database design process. Based on it they have summarised systematic detailed literature review on it.

Validation and verification of Expert system is critical. Robert and Daniel [23] have discussed about the importance of validation and verification process in development of ES process.

III. CONCLUSION

Spectrum of expert system application is very wide it ranges from industrial application to commercial application. It includes publication to manufacturing, space to transportation. You name the areas and the expert system is emerging tremendously in these areas. In financial decision making, the service industry is using it in sectors that include decision making on financial status, decision making in loans of business, industry as well as individual applicants. This sector also includes insurance organizations including vehicles, health, home, industry to decide the right policies and offers as well as understanding the business segment and enhance them. Another important area is of knowledge based publishing. It is very emerging area currently. Primary objective of this area is to deliver knowledge that is pertaining to the problems of individual, organizations and mass benefits based on past knowledge and decisions. The expert system use distributed knowledge across large sectors to decide and design the policies, writing texts, tax advising policies, strategies related to business. Process monitoring and control is also one of the key areas of expert system. Important area of expert system is designing and manufacturing. The expert system assist and guide the areas of physical devices, deciding the processes roles including high level conceptual design of abstract entities. This includes the areas from factory floor to finished goods production of manufacturing, their configuration and controlling the parameters of manufacturing. This research paper includes 19 research papers in various domains including banking, agriculture, manufacturing, iOT and other important relevant areas. It discusses various methodologies used and methods applied using various algorithms to implement Expert System from knowledge domain. Some of the important algorithms used are like Bayesian networks which are probabilistic models based on graphic. Knowledge engineering pertaining to technical and scientific and social areas. Rule based machine learning which is enclosing machine learning methods that recognize identifiers, learn and incorporate rules that are applied to infer the outcomes. Genetic algorithms are meta-heuristic that are used to process natural selection which belongs to evolutionary algorithm class. Various classifiers are also used for the problems of classifier domains. Fuzzy logic is normally used for the machine learning having problems of binary based knowledge domains. Overall the paper covers various methods and methodologies applied in heterogeneous domains of research areas.

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