Enhancing the Human-computer Interaction through the Application of Artificial Intelligence, Machine Learning, and Data Mining

S. O. Owoeye[1, *], K.I Adenuga[2], H.A Mustapha[1], A.S Akinade[1]

[1] Department of Mechatronics Engineering, Federal University of Agriculture, Abeokuta, Nigeria

[2] Farnborough College of Technology, University Centre Farnborough, United Kingdom

Abstract

Machines have become an essential part of day-to-day human activities; their volume and frequency of usage have rapidly increased in every sector. These machines, especially the computer system, are well known for their speed, accuracy, repeatability, and use to execute tasks that can be harmful to humans. However, these machines lack intelligence, as they do not possess the ability to think like humans. The quest for producing machines with thinking capabilities led to artificial intelligence; thus, many efforts were channeled towards developing devices that can communicate with their surroundings, making a logical decision on what has been perceived, and then provide the proper solution to the problem. To achieve this feat, machine learning is utilized by subjecting the system to a series of training using algorithms and data mining techniques, which is similar to how humans learn from infancy till adulthood and then execute tasks based on knowledge and the experiences they have gathered growing up. While these technologies opened a creative horizon for technological development, there is a current demand for intelligent user interfaces with high usability that can sustain the mode of interaction depending on users, tasks assigned, and the environment. This chapter attempts to present an overview of how data mining can be incorporated with machine learning to produce a machine with artificial intelligence and how both can improve the intelligent user interface.

Keywords: Algorithms, Artificial intelligence, Data, Data mining, Database management, Database, Decision tree, Human-Computer Interaction, Human Intelligence, Information mining, Intelligent machine, Internal node, Knowledge mining, Machine learning, Multimedia database, Neural network, Regression, Relational database, Spatial database, The Root node.

* **Corresponding author Samuel O. Owoeye:** Department of Mechatronics Engineering, Federal University of Agriculture, Abeokuta, Nigeria; E-mail: owoeyeso@funaab.edu.ng

INTRODUCTION TO DATA MINING

In daily human activities, many data are generated and stored in different formats on various platforms. Over time, these data accumulate, and the database becomes massive and quite overwhelming. The advent of information and technology has led to an efficient data collection method, storage, and management to generate tangible details and make other decisions [1]. The database management system (DBMS) has been very useful in managing the large volume of data generated in various human sectors. This has provided a lot of information retrievals even more than humans can work [2]. As technology improves, there is a growing need to obtain information (patterns) capable of predicting the future from available past data rather than the usual information retrieval (from past data) for present use only; thus, this led to the concept of 'Data mining.' Data mining is the process of discovering and decoding information that may be in the form of patterns, associations, anomalies, *etc*., concealed in a large volume of data [1, 3]. It is an analytical tool employed in investigating a massive database to find unique trends embedded in the data sets. The obtained trends or patterns can provide relatable descriptions and, more importantly, reliable and accurate predictions.

The term data mining was coined from gold mining. This is due to similarities between looking through a big data warehouse for important information and digging through rocks for mineral resources like gold. Since gold mining involves extracting valuables (gold) from the rock and therefore, is not termed 'rock mining', data mining should have been referred to as 'knowledge mining' or 'information mining' from data. Nevertheless, the name data mining is generally accepted [2].

KNOWLEDGE DISCOVERY FROM DATABASE (KDD)

Data mining is sometimes referred to as knowledge discovery in a database (KDD). Data mining is only one step that makes knowledge discovery from the database [3]. It is a very crucial step that must be passed through to discover the knowledge embedded in data. Fig. (**1**) highlights the steps involved in KDD.

KDD is an iterative process to uncover or extract new and unknown information set from the database. The steps involved include:

i. Cleaning of Data

The database is usually voluminous and contains many redundant data that are irrelevant to the situation under analysis. It is therefore expected that only targeted or relevant data are extracted from the big database. Also, raw data are characterized by many errors and inconsistencies, often referred to as noise in the database. These noises must be eliminated; hence, removing redundancy and noise from the database is called data cleaning.

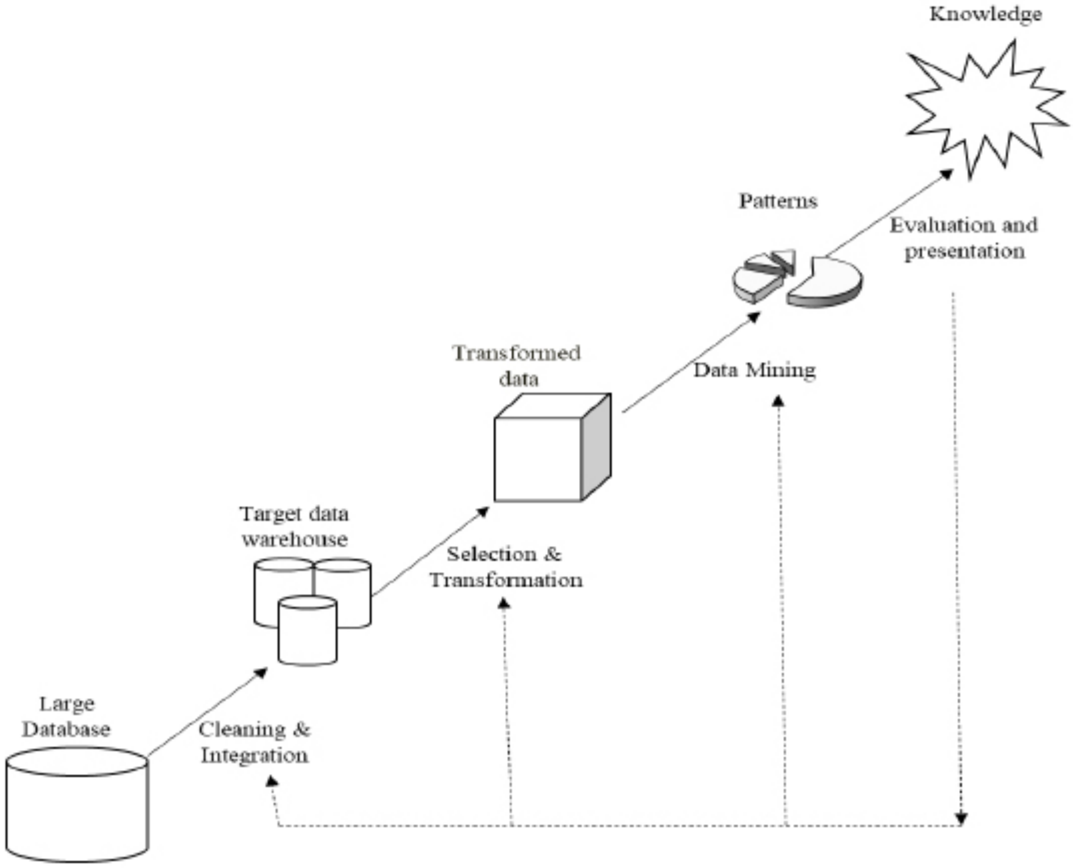

Fig. (1))

Steps Involved in Knowledge Discovery in Database (KDD) [1, 3].

ii. Integration of Data

It is common to have various (different) data sources that contain data that describes or is related to the same situation or area of interest. The process of collating and combining these databases to form a comprehensively new database of relevant and noise-free data is called data integration.

iii. Selection of Data

After the collection of various target data, for further processing, it is necessary to reduce the data by selecting data that are most relevant to the task at hand from the data warehouse. This is done by performing a reduction in data dimension or selection of specific features [4]. This step helps prevent the high computation cost and remove non-relevant associations and rules pertinent to preparing the mining data.

iv. Transformation of Data

This is the conversion or consolidation of data that has been selected into formats that are suitable for mining. It can also be referred to as data consolidation.

v. Mining of Data

This is a crucial stage where various algorithms, rules, *etc.*, are employed to uncover hidden trends and patterns. This method is critical as it is the stage where new or unknown information is exposed in patterns. These patterns will further be broken down and interpreted for simplification and more precise information. Therefore, it is necessary to choose a suitable mining technique for the type of data being mined to provide a successful investigation and extraction.

vi. Evaluation of Pattern and Presentation

After pattern extraction has been completed, the next step is to examine the patterns and interpret them to ascertain if they provide meaningful or reliable information that can further generate new insights into the situation at hand. Once the interpretation is completed, the next step is to provide a visual format of the patterns in a method easily presented to and understood by users.

TYPES OF DATA THAT CAN BE MINED

Data mining can be applied to various types of data repositories. It is not limited to a specific kind of database. However, the type of algorithm used in processing or mining may differ since the data structure and challenges encountered by various data repositories differ from one another. Some of the most common types of data being mined are briefly described below.

Flat Files

These are the most popular source of data that are used for data mining algorithms. They are non-complex data files that exist in either binary format or text. The structure of the data is well known and suitable for data mining algorithms. Examples of flat files include scientific measurements, records of financial transactions, time-series data, *etc*.

Relational Database

This type of database involves table collections with a unique name being assigned to each of the tables. Each of the tables consists of several fields (attributes) which store an extensive record (tuple). In other words, it contains tables that store values of facts obtained from a unique entity. The table columns represent the attributes, while the rows have the records. Each tuple in a relational database table, as shown in Fig. (**2**), stands for an object identified by a unique key and can be described by a set of attributes.

customer

cust_ID	*name*	*address*	*age*	*income*	*credit_info*	*category*	...
C1	Smith, Sandy	1223 Lake Ave., Chicago, IL	31	$78000	1	3	...
...	...	...	...	...	...	...	...

item

item_ID	*name*	*brand*	*category*	*type*	*price*	*place_made*	*supplier*	*cost*
I3	hi-res-TV	Toshiba	high resolution	TV	$988.00	Japan	NikoX	$600.00
I8	Laptop	Dell	laptop	computer	$1369.00	USA	Dell	$983.00
...	...	...	...	...	...	...	...	...

employee

empl_ID	*name*	*category*	*group*	*salary*	*commission*
E55	Jones, Jane	home entertainment	manager	$118,000	2%
...	...	...	...	...	...

branch

branch_ID	*name*	*address*
B1	City Square	396 Michigan Ave., Chicago, IL
...	...	...

purchases

trans_ID	*cust_ID*	*empl_ID*	*date*	*time*	*method_paid*	*amount*
T100	C1	E55	03/21/2005	15:45	Visa	$1357.00
...	...	...	...	...	...	...

Fig. (2))

Fragment of a Relational Database [3].

Time-Series Database

This is a type of database whereby the data are a function of time, *i.e.*, they are related to time. For example, data collected over a stock exchange market. Since they are contained in respect to time, the data inflow is continuous. Thus, the mining technique must provide real-time analysis that involves changes in patterns concerning time and the correlation between the changes. If the research is accurate, it becomes easier to forecast the outcome at a particular desired time. Fig. (**3**) shows a graphical representation of the time-series data.

Multimedia Databases

The algorithms used in processing require the interpretation of images, computer vision, and graphics. These are visual data in the form of images, audios, videos, *etc*. they are usually enormous (in terms of dimension) compared to other data types; hence its analysis becomes more challenging. These types of data can be stored in a file system, extended object-relational or object-oriented format.

World Wide Web

Organizations such as Google and Yahoo provide extensive online data services of different disciplines. This type of database is the most dynamic and heterogeneous. It gets updated daily with content from different backgrounds and has massive users sourcing information from time to time. The data objects on this platform are linked together to allow interactive access. The data can be in any format such as audio, texts, images, *etc*. the World Wide Web is based on the main three (3) concepts, which are:

1. How the web is structured. (hyperlinks and data relationships)
2. The documents or data uploaded on the web (content)
3. When and how the data on the web is being accessed (usage)

These concepts form the basis of the type of mining (web structure, web content, and web usage mining).

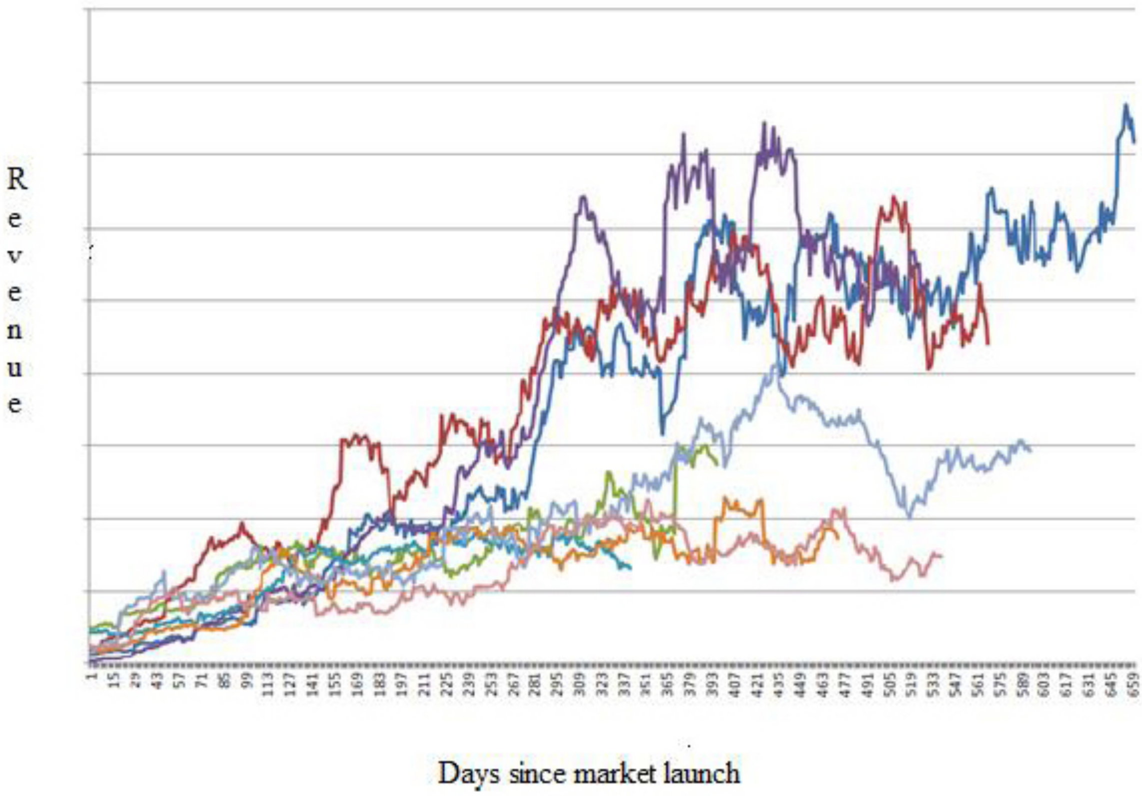

Fig. (3))

Graphical Representation of Time-Series Data [5].

Spatial Databases

This deals with the storage of geographical data like global positioning, maps, landscapes, *etc. A*n example is shown in Fig. (**4**).

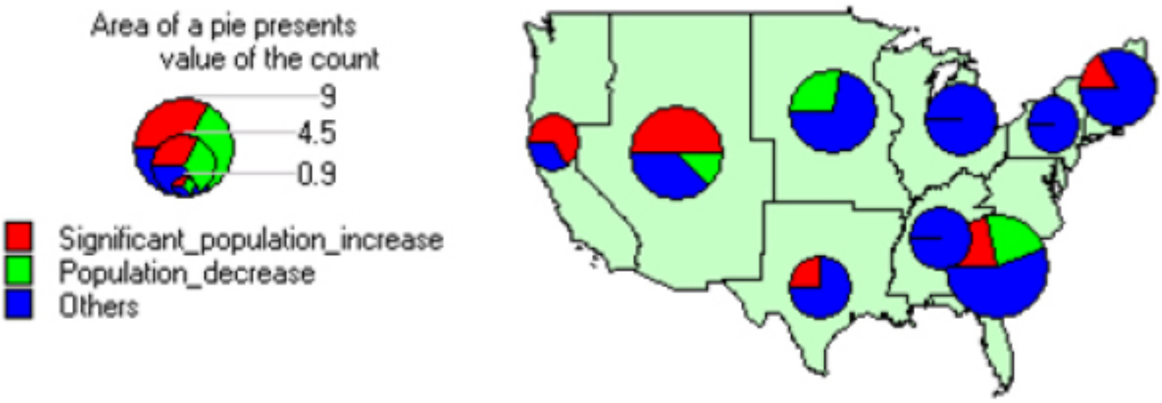

Fig. (4))

Virtual Representation of Spatial Databases [6].

TARGET BENEFITS OF MINING DATA

The two primary data mining tasks are descriptive data mining and predictive data mining. The descriptive data mining task describes the characteristics and properties of the data in a data warehouse. In comparison, the predictive data mining tasks carry out inferential database activities to make reliable predictions. The two tasks attempt to provide an unknown trend or pattern unique to the type of task employed. Various knowledge and functions obtained from data mining include data classification, characterization, clustering, association, prediction, outlier analysis, *etc*.

TECHNIQUES USED IN DATA MINING

Classification by Decision Tree

The decision tree is a step-by-step classification of a response variable hierarchically and sequentially to the dimensions of one or more input (forecaster) variables. The decision tree presents data sets that have consistent attributes which vary concerning the dependent variable. Its structure consists of a root or parent node, branches linking root or parent nodes to split (internal) nodes, and the least indivisible nodes called the leaf nodes. The root node comprises the input variables, while the branches are entries in the input variable. The leaf node represents the output variables. As shown in Fig. (5), the decision tree is a form of supervised learning algorithm based on the divide and conquers principle in which a state of if-then rules guides the relationship between nodes.

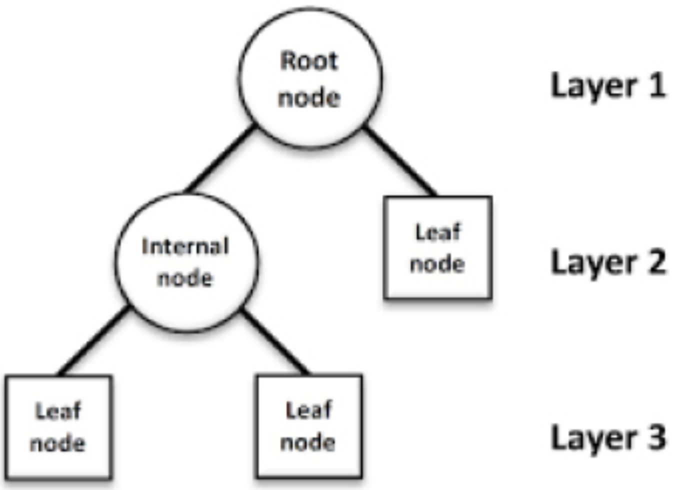

Fig. (5))

Structure of a decision tree [7].

Artificial Neural Network (ANN)

Human-Computer Interaction and Beyond: Advances Towards Smart and Interconnected Environments (Part II), edited by Nirmalya Thakur, and Parameshachari B, Bentham Science Publishers, 2021. ProQuest Ebook Central, http://ebookcentral.proquest.com/lib/monash/detail.action?docID=6886035.
Created from monash on 2025-05-17 15:29:25.

This is a processing technique that was developed based on human and animals biological neural networks. The artificial neural network comprises three sequential layers (input, intermediate, and output). Each of these layers consists of several neurons capable of processing information (see Fig. 6). These neurons have weights assigned and are interconnected to transmit the processed data in a signal through a communication link. The artificial neural network is capable of parallel processing and distributed memory, and learning is carried out by adjusting weights to obtain the desired output. Hence, they are suited to pattern detection and extraction from complex data.

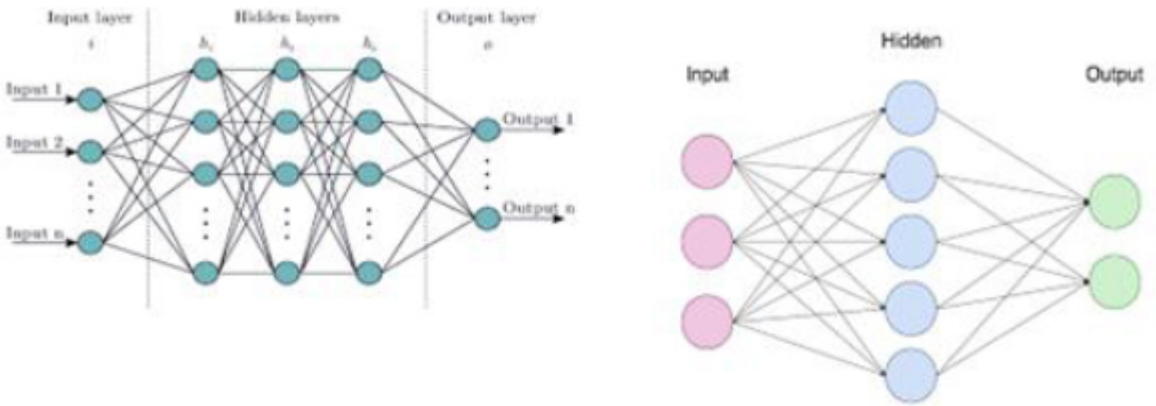

Fig. (6))

Neural networks [7].

Clustering (K-Nearest Neighbor, KNN)

When humans encounter a new challenge, they try to relate it with a similar problem and then predict that the same solution used in the past will work for this current challenge. This is the technique on which KNN clustering is based. It is the method in which identical objects are determined and grouped into classes. Whenever a new unlabeled or unknown object is to be classified, the object is compared with historical data, and depending on the determinant k (an integer), which is selected randomly; the class of the unknown object will be estimated by closeness (in terms of distance) of the k-historical objects (referred to as neighbors) to the new objects, as shown in Fig. (7). This technique helps to determine the pattern of a database and the correlations between the data objects. To determine the k nearest neighbors, the estimated distance of the unknown object from each historical object can either be Euclidean or Manhattan.

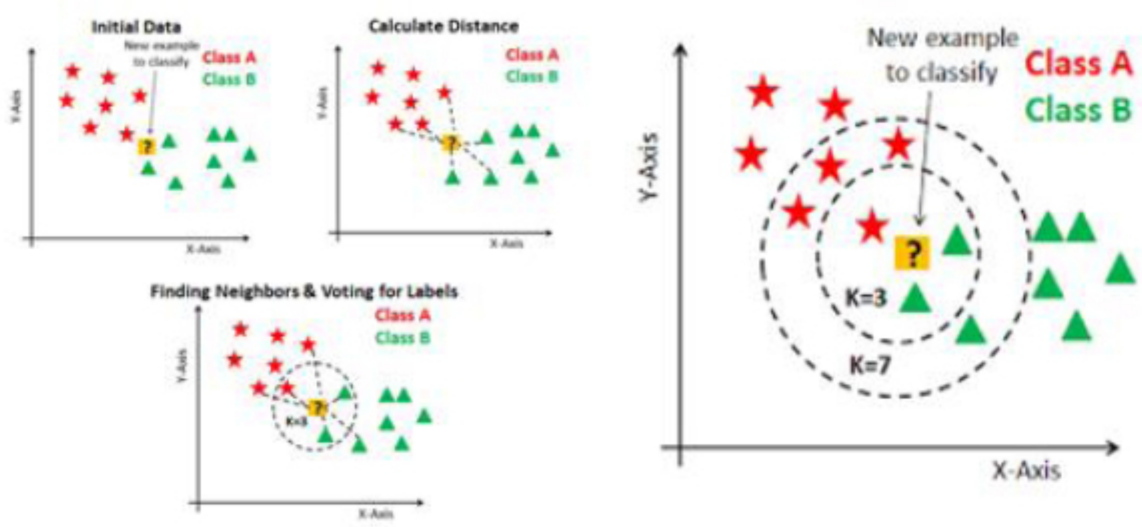

Fig. (7))

K-Nearest Neighbor Clustering [8].

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING OVERVIEW

Since human inception, a lot of tools have been employed to carry out several tasks. In a bid to find a more straightforward way of executing tasks, the invention of machines started. The creation of machines brought ease to day-to-day human activities in different sectors ranging from transportation, banking, computing, industrialization, *etc.* With the fast growth of devices, there has been a significant flaw in the usage of machines, which lacks intelligence. Machines cannot think and gather the information required to carry out tasks [6].

In the mid-twentieth, Alan Turing first brought up 'thinking machines,' which led to artificial intelligence. Artificial intelligence (AI) history can be traced back to 1943 when Warren McCulloch and Walter Pitts introduced the first neural networks model. Alan Turing's B-type neural network followed this in 1950 before the usage of computers for pattern recognition in 1955 [6].

In 1956, John McCarthy coined the term Artificial intelligence. He described Artificial intelligence as the engineering and science of developing machines that are intelligent [9]. It is a field that deals with the design of machines that can perceive their surroundings and take action single-handed.

Artificial Intelligence (AI) can be defined as the synthesis of computer-like systems capable of carrying out activities that generally require human intelligence. It is a branch of computer science that equips machines with human-like intelligence to allow them to behave like humans. Some of the desired human characteristics include speech recognition, language translation, perception of vision, and decisions [10]. With AI, machines can hold several ideas at once and still possess the ability to choose the best idea suitable for the task at hand.

Machine learning is an application of Artificial Intelligence in which machines can study their environments without human intervention or explicit programming. During the learning process, they gather experiences and improvements in knowledge. Machine learning involves inspecting and analyzing data, learning from the analysis, and applying the results of understanding (knowledge) to solve a problem *via* prediction or assertion. Rather than programming the machines to execute specific tasks, a series of algorithms and a large volume of data are used to train a machine, enabling the machine to perform various studies [11]. For example, the usual motion-activated door or gate cannot differentiate between a car moving along the road and a car trying to enter through the gate. In both scenarios, the gate will open, and this signifies its lack of intelligence. The gate can be trained with different visual frames. After learning from this data, it can then carry out its opening and closing activity with intelligence. Hence, machine learning deals with learning from past data (experience) and solving complex and ambiguous problems by making decisions through reasoning and priorities.

MACHINE LEARNING TECHNIQUES

The methods by which machine learning can be deployed are grouped into four categories: supervised learning, unsupervised learning, semi-supervised, and reinforcement learning.

Supervised Learning

This is a method of machine learning in which a function or mapping is inferred from trained (well labeled) data; in this type of learning, each of the training examples (data) is a pair of vectors (input vector and output vectors). The output vector, also known as the supervisory signal, explains its respective input vector, thereby producing an inferred function employed to map examples [6]. The various stages involved in supervised learning are shown in Fig. (**8**). The algorithms used under supervised learning can be classified into two, namely regression and classification.

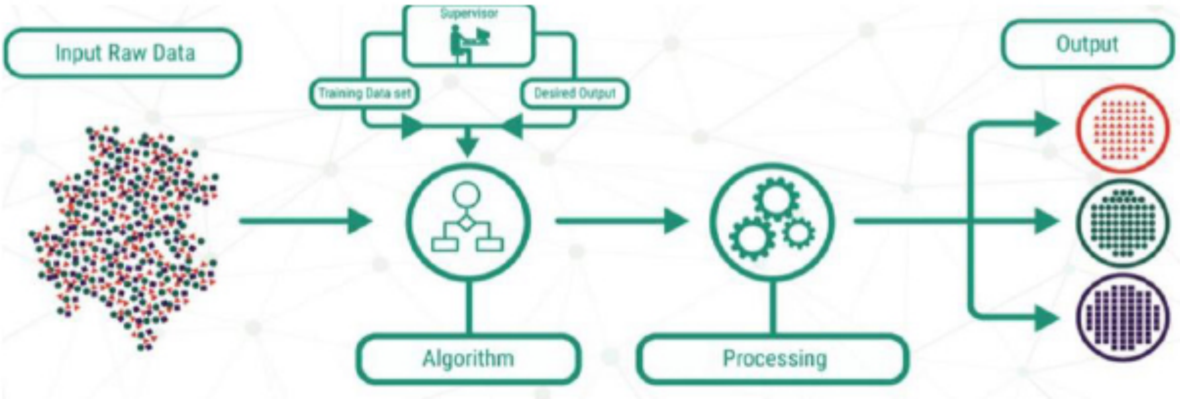

Fig. (8))

Supervised Learning [12].

Regression: The regression type is supervised learning techniques whose output variables are continuous and can be assigned any real value. Examples are weight, size, amount, *etc*.

Classification: This is supervised learning in which the output vectors are usually discrete or non-continuous, such as gender (male or female) or color (black, white, red, *etc*.).

Unsupervised Learning

Unlabeled data characterize unsupervised learning. It involves the grouping of data variables with similar characteristics or attributes. In other words, it does not have supervisors or training data (see Fig. **9**).

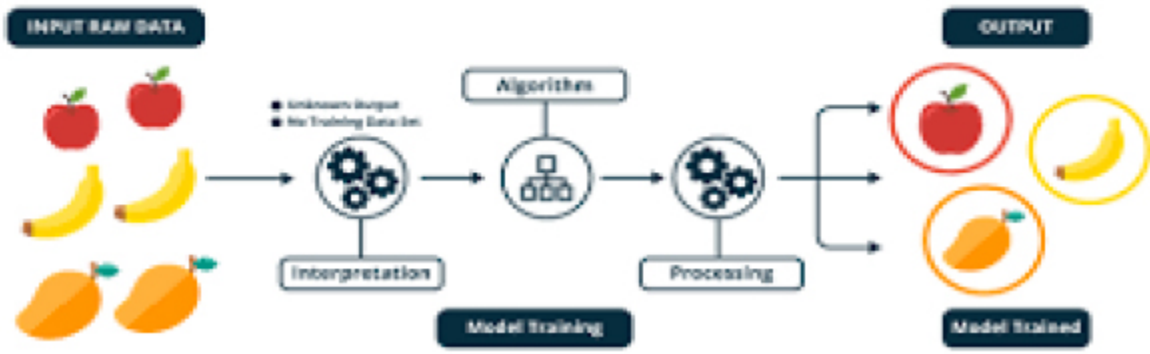

Fig. (9))

Unsupervised.Learning [13].

Semi-supervised Learning

Unlike supervised learning, where all the input variables are well labeled, only a few large data sets are labeled in semi-supervised learning. The unlabeled datasets are then classified into the labeled groups, *i.e.*, the labeled sets are used as a guide for the unlabeled data, as shown in Fig. (**10**).

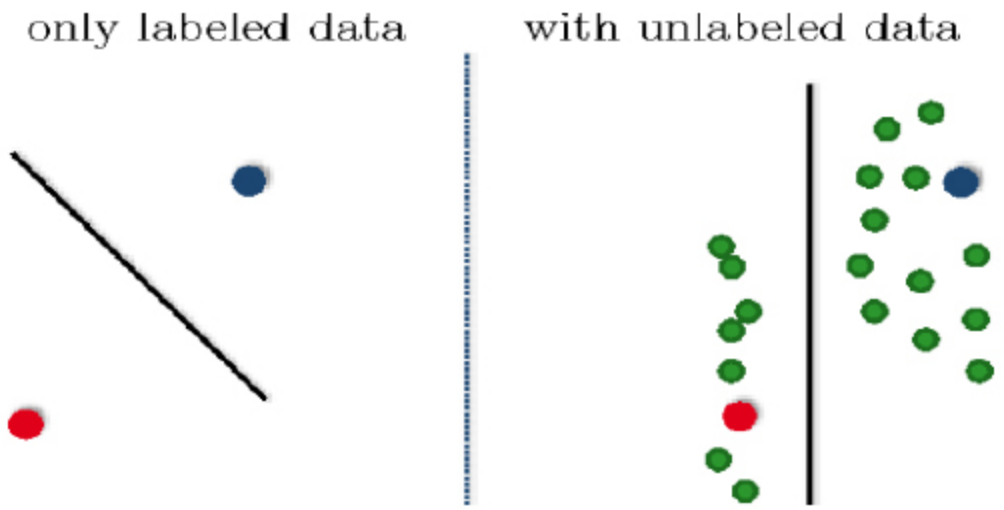

Fig. (10))

Semi-Supervised Learning [7].

Reinforcement Learning

This is a machine learning technique whereby the output vector is solely dependent on the input, and the next input vector depends on the output of the previous information. As shown in Fig. (**11**), this chain continues until the processing is stopped. A typical example is a game of chess.

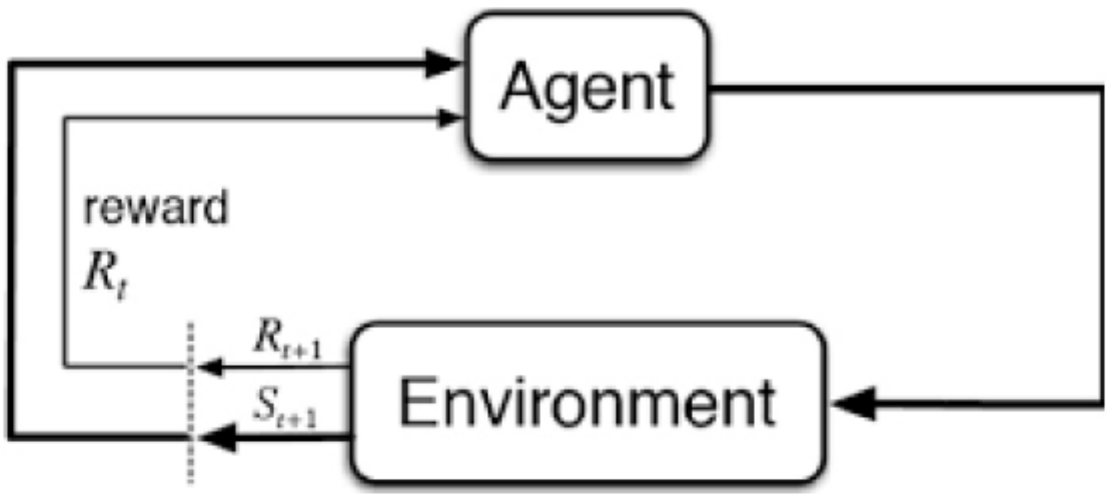

Fig. (11))

Reinforcement Learning [14].

OVERVIEW OF HUMAN-COMPUTER INTERACTION (HCI)

Due to the ubiquitous nature of electronic processing devices (such as PDAs, laptops, mobile phones, *etc*.), a larger percentage of data repositories have been digitized. This implies that data warehouses are now in electronic devices such as flash drives, hard disks, compact disks, *etc*. As a result, humans have channeled many efforts towards easy visualization and efficient usage of such data. The quality of algorithms (software) used for mining data and machine learning is usually rated based on the user's experiences, expectations, and how good the software is. Hence, a lot of attention needs to be paid while developing an interface for these algorithms as they will form the basis of interaction between humans and computers.

Human-Computer Interaction (HCI) is a multi-disciplinary field consisting of ergonomics, psychology, design, engineering, which deals with the design and development of intuitive and highly efficient systems that humans can access and manipulate digitized data with the least possible disruptions [15]. It requires designing, implementing, and evaluating various ways computing devices can interact with and be used by humans. These interactions between humans and computers are carried out to guarantee easy and stress-free data exchange between digital data sources and humans, thereby boosting the efficiency of Human-Computer-related tasks. Often, people confuse interaction for an interface. Interaction is an abstractive model through which humans communicate with computing systems to carry out a given job. Simultaneously, the interface refers to the technical method (either software or hardware) of realizing an interaction model (see Fig. **11**). Therefore, the alphabet 'I' in HCI covers both abstractive model and technical methodology (*i.e.*, both interaction and interface) [16].

In other words, HCI is a vast field that embodies human factors, the experience of users, design of interactive systems, design of a cognitive task, an interface between humans and machines, architectures of information, design of user's interface, design of software products, collaborative works that are supported by computer [17]. The concept of Interaction and Interface is explained in Fig. (**12**).

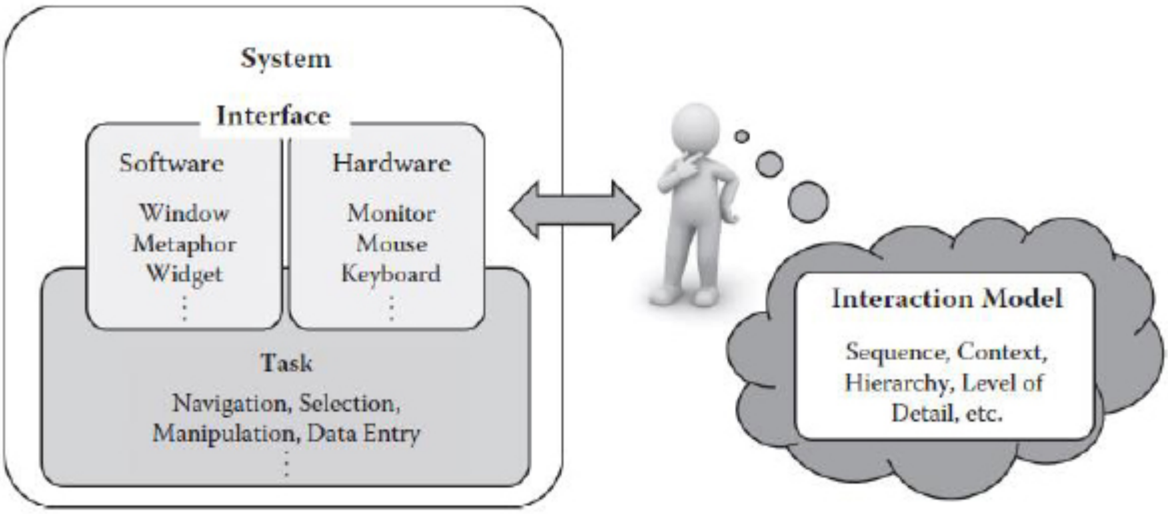

Fig. (12))

Concept of Interaction and Interface [16].

BASIC PRINCIPLES OF HCI

Knowing the Users

One of the most important details that require attention while designing an interactive interface is the end-users of the device. This involves modeling using a user-centered design approach. In 1971, Hansen coined the phrase 'know thy user,' which captures the overall concept of a user-centered design [16]. This HCI principle emphasizes the creation of interaction and interface that must handle the needs and technical capabilities of various users. The group of users can be categorized based on many factors like level of education, age, computing experience, skills, *etc.* [18]. Hence, elements that represent the target users should be collated and analyzed. These factors will help in modeling an interaction and deciding an interface that is most suitable to the physical and mental health of the target users.

Due to technological improvement, the quest for universal usability has become rampant. The term universal usability refers to an interface that captures what is suitable for a wide range of users rather than for a specific set of users. This involves the integration of several interfaces into a single interface. An example is a multilingual interface where different users select their preferred language of operation. An interface equipped for universal usability can allow several categories of users, such as physically challenged users, novice, experts, *etc.*, to perform the same task without having a different output.

Understanding the Task

A task is an operation to be carried out on an interactive device by humans. In designing the HCI system, it is essential to take into consideration the job to be accomplished. Understanding the task involves defining a clear purpose and determining the strategy to relate the method of execution to the users. This can be achieved by modeling the structure of the subtasks and the sequence at an abstract level. The content and functionality of the interaction should be well depicted.

Reduction in Memory Load

In designing an interaction and interface system, redundant information should be avoided to make memory usage as minimal as possible. It is well known that the speed of task completion can be associated with light memory load. The system structure should be organized so that the user's interface and guides to task completion are precise and short. Also, the capacity of information or data required by the processing memory to deliver a suitable outcome should be streamlined without affecting the intuitive nature of the interaction between humans and computers. In other words, interfaces like descriptive menus, option boxes, tips, voice prompt, *etc.*, that aids easy and enjoyable human-computer interaction should be concise.

APPLICATIONS OF AI, ML, AND DATA MINING

The various types of databases that are available and the kinds of information or knowledge that can be mined from them have been established in the previous section. On the other hand, Artificial Intelligence through machine learning requires a lot of training using an extensive database and suitable algorithms. The communication, understanding, and interaction gap between humans and machines can be bridged by infusing knowledge discovery from a database into machine learning to produce an intelligent machine. Machines will understand the various types of data generated from human activities and then analyze them to extract unknown or hidden trends and patterns. The machines will then use the extracted knowledge to provide descriptive or predictive solutions to challenges encountered (or likely to be discovered) by humans in their day-to-day activities. Some of the improvements that can be made in various sectors by applying artificial intelligence, machine learning, and data mining are described briefly below:

Agriculture and Food Industry

Machine learning and data mining can drastically boost food crops and reduce the number of wastes that have become a bone of contention in some parts of the world. The previous data that has been generated from past agricultural activities, such as soil requirements, planting, and harvesting dates, maintenance activities, the ratio of quantity planted to that harvested, preservation methods, *etc*. can be collected and labeled to form a sizeable heterogeneous data warehouse, which can further be used to train a machine. The intelligent machine trained on these databases will perform many activities such as knowing when, where, how, and what type of crops to plant, carrying out maintenance activities on the farm, and predicting what to expect during harvest season. The easy accessibility of this is of great importance to the farmer to plan for storage capabilities and exploit or create market opportunities. Furthermore, time-series and geographical data generated from sales of products and different market locations can be used to estimate or predict the type of foodstuff in high demand concerning a particular site. Hence, all efforts or attention can thus be channeled to the production of those foods as they tend to move fast and return high income and reduce waste that may result in planting (in excess) crops in low demand in a particular region.

Transportation Sector

Self-driving cars are significant inventions in the transportation industry that artificial intelligence, in conjunction with data mining, seeks to perfect. Self-driving cars have been in existence for a while, but many accidents have been associated with this invention due to a lack of expected intelligence. A self-driving vehicle can be improved drastically by providing standard and well-detailed geographical databases and historical traffic data. For example, considering a self-driving car traveling to a fixed destination, since there are usually more than one routes that can lead to a desired human destination, the automated vehicles may choose the longest path or even select the shortest route but encounter unexpected heavy traffic. But a machine capable of learning and mining from a past database can efficiently use the knowledge obtained to examine various scenarios, make assertions or predictions on the different routes and possible challenges that may be encountered, and then decide on the best course to follow a successful journey. Also, considering self-driving cars for commercial purposes like taxis, an intelligent machine can predict costs of its maintenance, such as fueling, rate of parts breakdown and repair costs, *etc*. and then use information obtained from these data to indicate or suggest a profitable price at which customers can be charged for the various journey.

Security and Defense

Terrorism and counterterrorism are some of the most difficult challenges faced in various parts of the world. A lot of lives, both civilians and defense militants, are lost annually due to terrorism. This has made countering terrorists one of the major bones of contention for most regions. Mining statistical data such as time of the attack, duration of the episode, location, the magnitude of damage caused (*e.g.*, death, property destruction), *etc*., obtained from historical acts of violence can result in unknown discoveries. Moving further by training war machines to develop intelligent machines may bring an abrupt end to terrorism. Intelligent war machines can uncover terrorists' trends, such as specific time of the attack, pattern of movement, weapon capacity, *etc*. If these kinds of knowledge can be acquired, war machines can plan and predict the best possible ways and weapons to neutralize the enemies. A unique and powerful strength of terrorists is the inability of defense militants to predict or pinpoint the exact time of the attack. Through AI, ML, and data mining, this factor can be quashed. The power of anticipation (in terms of time, location, and weapons) will drastically reduce or eradicate terrorism.

Processing and Manufacturing Industries

Processing and manufacturing industries are significant ways of bolstering the economy of a country. The capacity of goods manufactured and services rendered locally and internationally plays a substantial role in a country's economy. The recent advent of industry 4.0, which involves incorporating digitalization, information, and communication technology (such as IoT) into the traditional industrialization methods, has provided an easy avenue through which artificial intelligence and data mining can be infused into industrial activities. One significant advantage of industry 4.0 is the ease of collection and availability of massive industrial data. It has been established that a big relatable database is the most important driving factor for artificial intelligence. Most manufacturing industries employ a network of partly or fully automated machines to carry out their activities. After these machines are explicitly programmed, they carry out their tasks fixedly and repetitively with a lack of sensitivity to individual errors. For example, liquid mixers in beverage plants usually programmed to mix various liquids in ratios (volume concerning time) cannot ascertain if the resulting mixture meets the required quality. This is generally done by humans (quality assurance). Hence, using industry 4.0 to make machines with artificial intelligence will improve every aspect of the manufacturing industries ranging from production time, manufacturing costs, produced quantity, *etc*.

In a bid to uncover new knowledge and information, the concept of data mining has evolved over the years. Similar to the extraction of valuable materials from rocks in a process called gold mining, data mining involves the processes and techniques employed in discovering and decoding information in the form of patterns, associations, anomalies, *etc*., which has been deeply embedded in large volumes of data. Data mining, being an iterative process, involves various steps that need to be diligently carried out in other to uncover or extract a new and unknown set of information from the database. Although there are no restrictions to the kind of databases from which data could be mined, the type of processing algorithm would differ due to the varying structure of the different data repositories. These algorithms and techniques differ based on the nature of the database from which data is to be mined, and they include classification by decision tree, Artificial Neural Networks (ANN), and Clustering (K-Nearest Neighbour, KNN). These techniques are presented in order of complexity and efficiency. With the introduction of machine learning and artificial intelligence, it has become very common to employ computers to assist and enhance the data mining processes. Artificial intelligence involves the design of computer-like systems to carry out tasks that depend on the intelligence of humans. This enables machines to respond and carry out some activities just like a human would. These activities include voice and pattern recognition, language translation, visual perception, and decision making. Machine learning further enhances the concept of artificial intelligence by equipping these machines with the ability to study and understand their immediate environment, thereby improving their knowledge base and experience in decision making. The various machine learning techniques help the machine to collect and analyze data, acquire new knowledge from the analyzed data, study and understand new patterns and apply the knowledge in solving problems at later times. With these advancements in technology, the concept of human-computer interactions has been greatly optimized as machines can now extract data, analyze, understand and learn from these patterns without any human helping them while they enhance their decision-making capabilities from this knowledge. The targeted application of AI, machine learning, and data mining can help improve the interaction between humans and computers in the various sectors in which there arises the need for this kind of interaction. Also, problems can be solved more accurately and in lesser time.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

REFERENCES

[1] Ramageri B.. Data Mining Techniques and Applications.Indian Journal of Computer Science and Engineering200014301305

[2] Chen M.S., Han J., Yu P.S.. Data mining: An overview from a database perspective.IEEE Trans. Knowl. Data Eng. 1996886688310.1109/69.553155

[3] Paulson S.. “A Survey on Data Mining Techniques in Agriculture”, vol. 3, no. 30. International Journal of Engineering Research & Technology (IJERT), pp. 1-30, 2015..

[4] Zaki M., Wong L.. Data Mining Techniques.Department of Computer Science, Rensselaer Polytechnic Institute TroyNew York, USA2003

[5] Nestor P.. Stack Exchange[Online]. Available:2012https://stats.stackexchange.com/questions /20053/how-to-aggregate-deal-with-time-series-data- in-multiple-markets [Accessed 27 August 2020]..

[6] Mohammed M., Khan M., Bashier E.. Machine Learning Algorithms, and Applications.CRC Press201610.1201 /9781315371658

[7] Rao J., Ramesh M.. A Review on Data Mining and Big Data, Machine Learning Techniques.International Journal of Recent Technology and Engineering (IJRTE)201976S2914916

[8] Anand N., Uma G.. Improving Academic Performance Of Students By Applying Data Mining Technique.Chennai European Journal Of Scientific Research2009344526534

[9] Singh G., Mishra A., Sagar D.. An Overview Of Artificial Intelligence.Sbit Journal of Sciences And Technology20132114

[10] Habeeb A.. “Introduction to Artificial Intelligence”, Available: http://dx.doi.org/10.13140/RG.2.2.25350.88645/1 (Unpublished Paper)..

[11] Shalev-Shwartz S., Ben-David S.. Understanding Machine Learning: From Theory to AlgorithmsNew YorkCambridge University Press201410.1017/CBO9781107298019

[12] Sun Y., Peng M., Zhou Y., Huang Y., Mao S. “Application of Machine Learning in Wireless Networks,” Key Techniques and Open Issues.https://arxiv.org/abs/1809.08707

[13] Jiang C., Zhang H., Ren Y., Han Z., Chen K., Hanzo L.. Machine Learning Paradigms for Next-Generation Wireless Networks.IEEE Wirel. Commun.2017249810510.1109/MWC.2016.1500356WC

[14] Amiri R., Mehrpouyan H., Fridman L., Malli R.K., Nallanathan A., Matolak D.A.. Machine Learning Approach for Power Allocation in HetNets Considering QoSIEEE International Conference on Communications2018, 17.10.1109/ICC. 2018.8422864

[15] Sosa C., Peixoto A., Cinto T.T.. “An Expert System to Support the Design of Human-Computer Interface,” in Expert Systems for Human, Materials and Automation.Piracicaba, BrazilIntechOpen201193108

[16] Kim G. Human-Computer Interaction Fundamentals and Practice.New YorkCRC Press2015

[17] Culén A.L., Følstad A.. Innovation in HCI: what can we learn from design thinking8th Nordic Conference on Human-Computer Interaction2014, 849852.10.1145/2639189.2654845

[18] Dix A., Finlay J., Abowd G., Beale R.. Human-Computer InteractionNew JerseyPearson Prentice2004