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Customized Curriculum and Learning Approach Recommendation Techniques in Application of Virtual Reality in Medical Education

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Abstract: Virtual Reality (VR) has made considerable gains in the consumer and professional markets. As VR has progressed as a technology, its overall usefulness for educational purposes has grown. On the other hand, the educational field struggles to keep up with the latest innovations, changing affordances, and pedagogical applications due to the rapid evolution of technology. Therefore, many have elaborated on the potential of virtual reality (VR) in learning. This research proposes a novel techniques customized curriculum for medical students and recommendations for their learning process based on deep learning techniques. Here the data has been collected based on the pre-historic performance of the student and their current requirement and these data have been created as a dataset. Then this has been processed for analysis based on CAD system integrated with deep learning techniques for creating a customized curriculum. Initially this data has been processed and analysed to remove missing and invalid data. Then these data were classified for creation of the curriculum using a gradient decision tree integrated with naïve Bayes. From this, the customized curriculum has been generated. Based on this customized curriculum, the learning approach recommendation has been carried out using the fuzzy rules integrated knowledge-based recommendation system. The experimental results of the proposed technique have been carried out with an accuracy of 98%, specificity of 82%, F-1 score of 79%, information overload of 75%, and precision of 81%.

Keywords: Content-based Multimedia Retrieval, Hypermedia systems, Web-based services, Semantic Web, Multimedia
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1 Introduction

Phrase education broadly refers to promoting learning, knowledge acquisition, skill acquisition, or acquisition of good ideals. The fundamental goal of education is to educate students for life, work and citizenship by instilling the information and abilities that society requires [Paszkiewicz, 2020]. During the educational process, the educator's job is to increase graduates' qualifications and abilities. Exercises, laboratory, and internships are typically divided into 2 parts: theoretical and practical. Theoretical courses involve the transfer of knowledge in lectures to a large group, which may include debates. Students' requirements and labour market pushed adjustments in the educational system over time [Chen, 2020]. Based on Confucius' insight, the practical aspect has been prioritized: "Tell me and I forget, show me and I remember, let me participate and I understand." Because of technical intricacies, the requirement of abstract thinking as well as fact that the concepts are not palpable, many students have difficulty grasping concerns, particularly in scientific classes [Abich, 2021]. Fundamental flaws prevent future development and research of more complex challenges. Modern technologies, such as online courses, different computer-based platforms [Singh, 2020], and others, are currently being used as solutions, allowing students to repeat same material multiple times, make mistakes as well as learn from them. Numerous examples of outstanding educational gear as well as software show that the edutech industry can enhance learning results for vast majority of pupils. More educational institutions worldwide are beginning to implement sophisticated new technological tools to assist them in fulfilling the needs of a varied student body. Digital instructional information is displacing traditional books. Classic copybooks are supplanted by notebooks, tablets, and mobile phones with dedicated applications. Education is given to every student's academic skills, preferences and goals through distance and personalized learning [Tabatabai, 2020].

The first notion of "Virtual World" was revealed in a 2017 interview with Jaron Lanier titled "A Portrait of the Young Visionary." Based on his words, the virtual world is offered as a technique for synthesizing a shared reality. Our ties with the physical world are recreated in a new way. This only affects how we interpret truth through our senses. Following that, Loomis distinguishes between the actual and phenomenal worlds, saying that the phenomenal world is responsible for the mediation with the physical world. Our senses are the ones that create it.

On the other hand, VR aims to encourage users to immerse themselves in a "reality" so that they can act naturally and complete tasks. Users assume that the virtual environment in which they are immersed adheres to the same standards as the actual world. Virtual world developers use a variety of strategies and approaches to building compelling virtual worlds [Burghardt, 2020].

1.1 Use of VR in education

CAI (Computer-assisted instruction) or CBT (computer-based training) is a natural extension of VR in education. Since the early 1950s, computers have been employed as teaching tools. Serious study began in the early 1960s. Since debut of microcomputer in 1977, computers, particularly microcomputers or PCs, have been a growing as well as recognized delivery tool for numerous education. VR is utilized on any computer. Pantelidis (1991-2009) mentions approximately 800 printed resources on VR in education as well as training in her vast bibliography, which dates back to 1989 and includes articles and reports. The list is far from thorough. Since the first sophisticated VR headsets in 2013, the technology has gone through a period of rapid advancement in the VR field. Since then, new headsets have become available every year until writing this article, adding new levels of immersion, removing barriers to entrance, or just lowering the price dramatically compared to earlier devices. According to educators, each breakthrough has taken virtual reality closer to being a feasible tool for use in schools worldwide. However, due to this rapid progress, academic research on their use in classrooms from just five years ago may no longer be relevant to the current state of technology [Hamilton, 2021].

2 Literature Review

The development of technologies with similarities to virtual reality can be traced back to the 19th century. During this historical period, the idea of a stereoscope was first conceived of and developed. The research conducted by Sir Charles Wheatstone shown that the human brain is capable of combining two images, one for each eye, to create a single image that gives the impression of having a sense of depth and space. The virtual reality (VR) technology that is available today has various uses, and new ones are being developed every year. It is reasonable to suppose that this technology will find applications in all spheres of human endeavour. One of them, which has recently shown the greatest rate of expansion, is generally acknowledged forms of entertainment. This is due to the fact that the frameworks used to produce modern games are also used to construct a virtual environment specifically designed for virtual reality (VR). As a result, virtual reality (VR) entertainment is at the top of its games, and the solutions developed specifically for this industry are getting better and more appealing to the customer. However, the costs associated with the purchase of both high-quality goggles and a powerful computer that would meet the requirements of graphics generation within VR are a significant factor that limits the complete dissemination of this form of entertainment (at a level similar to traditional consoles). This is a factor that limits the complete dissemination of this form of entertainment (at a level similar to traditional consoles). The "Virtual Reality Education Xpansion" (VREX) project is an interesting endeavour in the field of education [Cotet et al. 2020]. The platform is hosted in the cloud and is primarily utilised in China. Its purpose is to enhance users' understanding of several scientific fields, including biology, astronomy, medicine, engineering, and others. In this regard, another great example is provided by the surgery training course that can be accessed through this platform. A tool called "Anatomy Builder VR," which was developed by researchers at Texas A&M University [Mian et al. 2020], provides access to a similarly applicable field of study. Students are able to execute predesigned scenarios while also gaining an understanding of the anatomy of the limbs of various animals. Another illustration of this can be seen in a programme that was developed at the University of North Carolina at Chapel Hill. Using a three-dimensional representation of the human body, the programme enables medical professionals to accurately plan the distribution of radiation beams that are utilised in the treatment of cancer [Salah, 2020]. In addition, because of the massive amounts of data that are generated today as well as the capability of 3D visualisation, virtual reality technology can be utilised by both medical professionals and students for organ exploration [Guo et al. 2020]. The field of rehabilitation presents a significant opportunity for the application of this technology. Therefore, virtual reality can provide appropriate simulated environments in which cognitive, emotional, and motor disorders can be assessed and treated. Exploring typically inaccessible items, learning about complex processes, comprehending difficult-to-observe phenomena, and performing inspection and test procedures that are risky to undertake in real-world situations are some of the primary advantages of using VR in education. A virtual tour of the "Virtual Energy Center" at Louisiana State University (LA, USA), in particular of "The Solar Technology Applied Research and Testing (START) Laboratory," to which access is restricted, is one example of one of these potential solutions [Aylward, 2021]. Another potential application for virtual reality (VR) is the teaching of molecular mechanisms in chemical engineering classes, for instance, by allowing students to visualise chemical compounds [Won and Kim, 2021]. An excellent illustration of an instructional virtual reality game is the title GridlockED. It was developed by [Sdravopoulou et al. 2021] as a cooperative learning game for teaching medical students how to handle patients and do triage. Playing contemporary educational games necessitates the utilisation of cutting-edge visual technology [Korzeniowski, 2018], such as stereoscopic 3D or a head-mounted virtual reality (VR) environment. Rich learning experiences can be provided to users by employing these strategies, which utilise a spatial depth on the screen. When a player wears glasses that are capable of rendering 3D images, the virtual world around them takes on a more three-dimensional appearance, giving the impression that objects in the game are physically closer to them. The findings of this study were published in [Cassidy, 2020]. Virtual reality (VR) was defined by [Almousa, 2021] as a computer-simulated world in which the player interacts with a 3D environment using a customised head-mounted display that presents visual effects to eyes. This definition relates to the topic of 3D technology. In contrast to 3D, in which the user is the only spectator, virtual reality (VR) enables the user to become an active participant in the story, thereby delivering an untethered and immersive experience [Vaitkevičius, 2019]. A video game that is played in virtual reality (VR) is, as a consequence, more realistic than a game that is played in three dimensions (3D). Because of this, virtual reality (VR) methods are utilised to enhance 3D modelling, which ultimately leads to improved communication in educational as well as occupational settings [Dan, 2021]. In a survey of 237 gamers, [Fairén et al. 2020] discovered that those who utilised virtual reality had much higher levels of interest and cognitive stress than those who only used 3D. Researchers have recently questioned the implications that using 3D and VR technologies have on issues such as social isolation, discomfort, eye fatigue, and headaches when these methods are used for extended periods of time [Ramirez and Bueno, 2020].

3 System model

This section discusses the proposed virtual reality integrated with artificial intelligence system based medical student's curriculum customization and learning approach recommendation based on their curriculum. Here, the data was collected based on the past performance of the medical student along with their curriculum requirements and the dataset was created. Then the data has been processed by CAD system-based deep learning classification for creating a customized curriculum using a decision tree integrated with naïve Bayes with a learning approach recommendation system using fuzzy rules integrated knowledge-based recommendation system. The overall proposed architecture is shown in Figure 1.

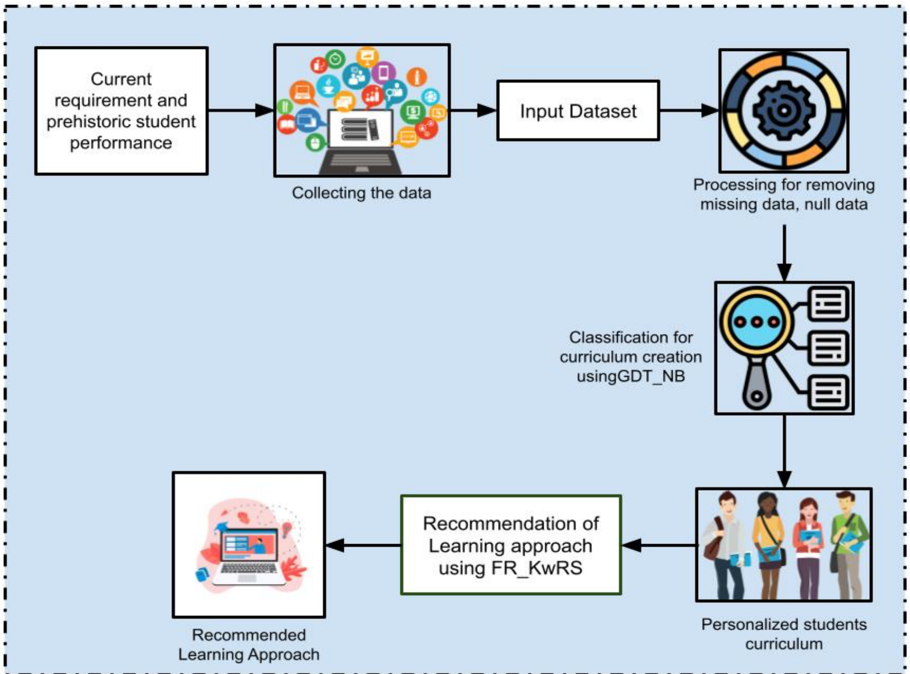


Figure 1: Overall proposed architecture

3.1 Analysis of Data

The importance of data analysis cannot be overstated in regard to this research. Not only will a substantial amount of data need to be processed, but the type of data that will be incorporated into the study will also require data analysis. Big data is the type of technology that is most suited to meet the requirements of this project. The purpose of this was to analyse data from a variety of repositories, and this successfully accomplished that goal. The information that students produce as a result of their participation in activities and their interactions with the learning management system (LMS) is recorded and stored in a database that is well organised. However, if these data are the only ones taken into consideration, the study does not provide enough granularity. In addition, the results are broken down into categories based on the ratings that were given to each individual activity. This does not imply that accurate data on the development of each individual student is being collected in any way, shape, or form. This does not imply that reliable data on the progress of each individual student is being obtained at any point in time.

3.2 Hadoop Operation

MapReduce directs the computing process to the location where the data to be processed is stored in a cluster. When a MapReduce method is started, tasks are distributed among the cluster's servers as well as Hadoop handles data transmission and reception between nodes. To reduce network traffic, computing occurs at nodes that contain data on premises. The inputs as well as outputs of jobs are often stored in a file, which is where the storage as well as compute nodes are located. When the application logic cannot be deconstructed into a single MapReduce run, numerous phases are chained together, resulting in one phase being used as input for mappers in the following step. This feature allows each fragment's tasks to be done on node where it is stored, decreasing data access time as well as transportation between cluster nodes.

3.3 Classification for creation of a customized curriculum using decision tree integrated with naïve bayes

The CART (Classification and Regression Trees) is a decision tree classifier applied to determine the classified output with high accuracy. CART is a binary recursive partitioning technique utilized to target and forecast both continuous and nominal features. No binning is required or advised because the data is handled raw. The data is separated into two children starting at the root node, and each of the children is split into a child nodes. Without applying a stopping rule, trees are expanded to their maximum size; in essence, the tree-growing process comes to a halt when no more splits are feasible due to a shortage of data. As illustrated in Figure 2, the maximally large tree is then pruned back to the root using a novel technique of cost-complexity pruning. CART method is designed to generate a series of nested trimmed trees, each of which is a contender for being best tree.

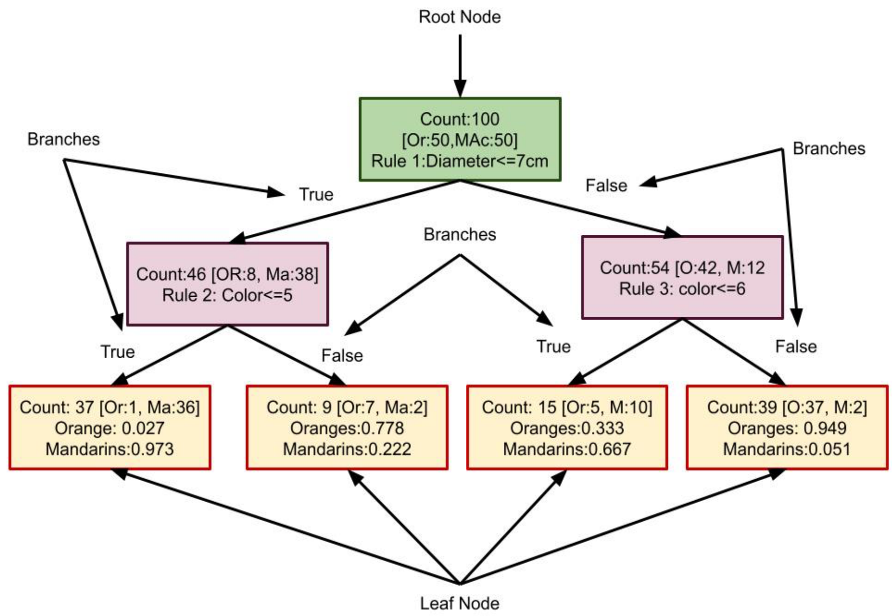


Figure 2: CART based decision tree architecture

Tree-growing algorithm:

Input: D is a data partition that consists of a set of training tuples and their corresponding class labels.

Output: A decision tree.

1. BEGIN: Distribute all training data to the root node.
2. Define root node as a terminal node
3. SPLIT:
4. New_splits=0
5. FOR every terminal node in the tree:
6. If the sample size of the terminal node is insufficient, or if all instances in the node belong to the same target class, go to GETNEXT.
7. Determine the characteristic that best divides the node into two child nodes using an authorised splitting rule.
8. GETNEXT:
9. New_splits+1
10. NEXT
11. Pruning algorithm:
12. DEFINE: r(t)= training data misclassification rate in node
13. t p(t)= fraction of the training data in node
14. t R(t)= r(t)*p(t)
15. t_left=left child of node t
16. t_right=right child of node t
17. |T| = number of terminal nodes in tree T
18. BEGIN:Tmax=largest tree grown
19. Current_Tree=Tmax

20. For all parents t of two terminal nodes
21. Remove all splits for which R(t)=R(t_left) + R(t_right)
22. Current_tree=Tmax after pruning
23. Remove node(s) t for which R(t)-R(t_left) - R(t_right) is minimum
24. PRUNE: If |Current_tree|=1 then goto DONE
25. For all parents t of 2 terminal nodes

A top-down induction algorithm is the decision tree algorithm. This algorithm aims to create a tree with as many homogeneous leaves as possible. The main goal of this method is to keep dividing nonhomogeneous leaves into leaves that are as homogeneous as feasible. The set of candidate attributes is called an attribute list. Attribute selection method is a mechanism for determining the "optimal" splitting criterion for dividing data tuples into separate classes. Converting a decision tree to rules has several advantages. First, pruning decisions are made easier with the help of a decision tree. Because each rule's context is simpler to see. Converting to rules also eliminates the distinction between attribute tests performed near the tree's root and those performed near the leaves. People can read and grasp these regulations more easily. The following are the basic rules for using a decision tree. As a result, every path from the root to the leaf of the decision tree is made up of attribute checks, culminating in a leaf that describes the class.

If-then rules can be created based on the multiple pathways from the root to the leaf nodes. Frequently, rules can be combined to create a smaller set of rules.

1. If result = “distinction %” then credit rating = excellent
2. If stream = “arts” and result = “70 %” then credit rating = average.
3. It may be possible to simplify the rules once they have been generated.
4. It is impossible to simplify rules with only one antecedent. As a result, only those with two or more antecedents are considered.
5. Remove any extraneous rule antecedents that have no bearing on the rule's conclusion. Several rules that lead to the same class may be mixed in some instances.

Decision rule directs the feature vectors to the node's left child node, while other vectors are directed to the node's right child node. Because each leaf has a label t, an example x is given a label t (l(x)). State that a new iteration has started every timeline 3 is implemented. Read a predetermined number of samples if there are too many; otherwise, utilize the entire data set. In each cycle, a new level of nodes is added to tree. In line 5, we utilize a stopping criterion to determine if a leaf v should be split or labelled. Stopping criteria could include a limit on the number of samples that reach a node or impurity of nodes. The impurity of a node is a function G that quantifies label homogeneity in samples arriving to the node. The tree construction process is depicted in the algorithm below.

Decision tree algorithm:

Input Training set $\{(x_1, y_1, \ldots., (x_n, y_n)\}$

Start T to be a single unlabeled node.

```
Navigate the data samples to their corresponding leaves.
for all unlabelled leaves v in T do
        While there are unlabelled leaves in T do
           If
               Label v with the most frequent label among samples reaching v
         end if
         Select candidate splits for v and evaluates D for each of them.
          Split v with the highest evaluated D among all possible candidate splits.
 end for
Decision Tree One Node per Iteration
Input Primary training data set values as {(x1, y1). . . (xn, yn)}
        Start T to be a single node.
        for all unlabelled leaves v in T do
           while there are unlabelled leaves in T do
             if v satisfies stopping criterion or there are no samples reaching v then
               else
                  Split an unlabelled leaf v so that nvD is the highest of all unlabelled
leaves as well as candidate splits, where nv is the number of samples reaching v.
                 Select candidate splits for v as well as evaluate D for each of them.
                     Label v with most frequent label among samples reaching v
           End while
```

Probabilistic Naïve Bayes classification algorithm based on statistical inference is adopted. This classification procedure will output the posterior probability of a test instances belonging to each of the potential classes. Posterior probability relates to observing certain characteristics of test instances. These training records in standard database terms are referred to as attributes or fields. With this model, a decision theory to find the class membership for every new instance is deployed. Bayes classifier relies on the independence of training set data or features. The architecture of naïve Bayes classification is shown in Figure 3.

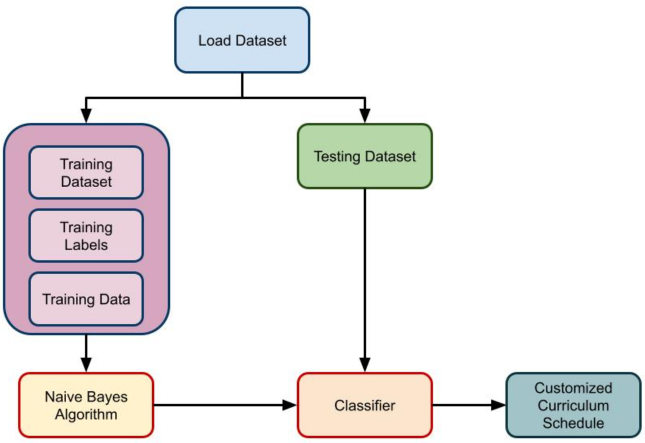


Figure 3: Architecture of naïve Bayes classification

3.3.1 Bayes theory

Subjective Bayesian inductive theory relies heavily on Bayesian theory. Under incomplete knowledge, Bayesian decision-making is estimating the subjective probabilities of certain unknown states, then using Bayesian formula to adjust the occurrence probability, and finally utilizing the expected values as well as the modified probabilities to make the best options. Ω is a complete set, C1, C2, ⋯, Cn ∈ Ω, Ci indicates ith category, P(Ci) > 0, i = 1, 2, ⋯, n. Any 2 sorts are incompatible with each other

$\overset{n}{\underset{i=1}{n}} C_i = \Omega$.. For any set x, if P(X) > 0, so by eq. (1)

$$P(C_i \mid \mathrm{X}) = \frac{P(\mathrm{X}|C_i)P(C_i)}{\sum_{i=1}^{n} P(\mathrm{X}|C_i)P(C_i)} \quad (1)$$

3.3.2 Naive Bayesian classification

The maximum likelihood estimation concept is used in naive Bayes classification to categorise the data into the most likely category, as shown in Eq. (2):

$$P(C_i \mid \mathrm{X}) = \mathrm{Max}\,\{P(C_1 \mid \mathrm{X}), P(C_2 \mid \mathrm{X}), \cdots P(C_n \mid \mathrm{X})\} \quad (2)$$

Assume that the sample X = (A1, A2, ⋯, Ak) is an attribute vector, with Aj being the jth attribute, which may contain some values xj.

The attributes in a Naive Bayes classification are assumed to be independent of one another, therefore by Eq (3)

$$P(\mathrm{X} \mid C_i) = \prod_{j=1}^{k} P(A_j = \mathrm{x_j} \mid C_i) \quad (3)$$

Replacing formula (3) into formula (1) by eq. (4):

$$P(C_i \mid \mathrm{X}) = \frac{P(A_j = x_j \mid C = C_i)}{P(X)}$$

$$P(C_i \mid X) = \prod_{j=1}^{k} P(A_j = x_j \mid C = C_i) \quad (4)$$

$$P(C_i) = \frac{N(C_i)}{N(D)} \quad (5)$$

$$P(C_i) = \frac{N(C_i)}{N(D)} P(A_j = x_j \mid C = C_i) = \frac{N(C=C_i, A_j=x_j)}{N(C_i)} \quad (6)$$

Substituting formula (5) and formula (6), then by eq. (7),

$$P(C_i \mid \mathrm{X}) = \alpha \prod_{j=1}^{k} \frac{N(C=C_i, A_j=x_j)}{N(C_i)} \cdot \frac{N(C_i)}{N(D)} \quad (7)$$

3.3.3 Feature-weighted naive Bayes classification technique

It is commonly assumed that an attribute feature is more frequently and higher its weight in the model. As a result, the feature's weight coefficient is set to eq (8)

$$w_j = \frac{N(A_j=x_j)}{N(D)} \quad (8)$$

When the property Aj is xj, wj denotes the proportion of the total number of samples in the total number of samples. Eq. (9) can be made better to

$$P(C_i \mid X) = \alpha \prod_{j=1}^{k} w_j \frac{N(C = C_i, A_j = x_j)}{N(C_i)} \cdot \frac{N(C_i)}{N(D)}$$

$$\alpha \prod_{j=1}^{k} \frac{N(C=C_i, A_j=x_j)}{N(C_i)} \cdot \frac{N(C_i)}{N(D)} \quad (9)$$

3.3.4 Laplace calibration

When the number of training samples is little as well as the number of attributes is big, the training examples are insufficient to cover all attributes, hence number of Aj=xj samples may be 0 and entire category conditional probability P(Ci| X) is 0. It is impossible to acquire an appropriate classification if this occurs frequently. As a result, merely using the proportion to evaluate category conditional probability is quite risky. The problem can be solved by using Laplacian calibration, which solves the problem of the category conditional probability being 0. At the same time, this minor variation does not affect the sample's classification.
Certain way is to make the following changes to formula (10):

$$P(A_j = x_j \mid C = C_i) = \frac{N(C = C_i, A_j = x_j) + 1}{N(C_i) + q_j}$$

$$w_j = \frac{N(A_j = x_j) + 1}{N(D) + q_j} \qquad (10)$$

qj relates the number of possible values of attribute Aj.
By replacing formula (10, (9), we can get by eq. (12)

$$P(C_i \mid X) = \alpha \frac{N(C_i)}{N(D)} \prod_{j=1}^{k} \frac{N(A_j = x_j) + 1}{N(D) + q_j} \cdot \frac{N(C = C_i, A_j = x_j) + 1}{N(C_i) + q_j} \quad i = 1,2 \ldots \ldots n \qquad (12)$$

Learning approach, fuzzy rules integrated knowledge recommendation method:
In fuzzy methods, the rules base is a set of fuzzy rules $R^{(k)}$, for $k = 1, \ldots, N$, of form $R^{(k)}$: IF x_1 is A_1^k AND x_2 is A_2^k AND...AND x_n is A_n^k THEN y_1 is B_1^k AND y_2 is B_2^k AND...AND y_m is B_m^k where N is number of fuzzy rules, $A_i^k -$ fuzzy sets by eq. (13)

$$A_i^k \subseteq \mathbf{X}_i \subset \mathbf{R}, i = 1, \ldots, n \qquad (13)$$

B_j^k - fuzzy sets such as by eq. (14)

$$B_j^k \subseteq \mathbf{Y}_j \subset \mathbf{R}, j = 1, \ldots, m \qquad (14)$$

$x_1, x_2, \ldots, x_n$ - input variables of linguistic method, from eq. (15)

$$[x_1, x_2, \ldots, x_n]^T = \mathbf{x} \in \mathbf{X}_1 \times \mathbf{X}_2 \times \ldots \times \mathbf{X}_n, \qquad (15)$$

$y_1, y_2, \ldots, y_m$ - output variables of linguistic method, from eq. (16)

$$[y_1, y_2, \ldots, y_m]^T = \mathbf{y} \in \mathbf{Y}_1 \times \mathbf{Y}_2 \times \ldots \times \mathbf{Y}_m \qquad (16)$$

Symbols $\mathbf{X}_i, i = 1, \ldots, n$ and $\mathbf{Y}_j, j = 1, \ldots, m$, represents spaces of input and output variables. Using the "or" logical operator, we presume that certain rules $R^{(k)}, k = 1, \ldots, N$, are related to one another. Furthermore, consider that fuzzy output sets are singletons in this research. The paper will use a small Mendel-Wang approach to produce fuzzy rules.

Formal and informal learners' knowledge bases are represented in the dataset created here. This component's output is preprocessed data obtained from the following sources:
Social Learners Network - wikis, forums, blogs @ MEC LMS;
MEC Moodle Database - former student competence qualifications;
Other institutes LMS Servers. i.e., the other three institutes in Oman.
All of the above can be combined into a hybrid filtering strategy using well-defined educational metadata sources as well as filtering decisions influenced by educational factors. Finally, additional filtering is done on this matrix based on the educational "footprint" that these three data sources' learners have.

This component's data preprocessing activities include data filtering, session identification by year and semester, student profile, transaction identification, path completion, data transformation and enrichment, and data integration, and reduction to create a direct learning experience. The component seeking student data reflects different qualities of students, such as building a student profile, which is utilized to produce an implicit learning experience utilizing data mining association rules. The development of student needs cannot be justified just on the basis of precise values; rather, a multicriteria analysis method must be used. The following three phases can be used to define student preferences and learning behaviour:
1. Clicks: The material shortlisting is defined by this activity.
2. Selection: This action is defined as selecting a material and adding it to the cart.
3. Learning: Utilizing or reading material is this action.
the 3 behaviours listed above are utilized to determine learners' relative preferences LPij for each data source's information. Formula used is by eq. (17):

$$P(C_i \mid X) = \alpha \prod a_{j=1}^{k} w_j \frac{N(C=C_i, A_j=x_j)}{N(C_i)} \cdot \frac{N(C_i)}{N(D)} P\left(A_j = x_j \mid C = C_i\right) = \frac{N(C=C_i, A_j=x_j)+1}{N(C_i)+q_j} = \alpha \prod a_{j=1}^{k} \frac{N(A_j=x_j)}{N(D)} \cdot \frac{N(C=C_i, A_j=x_j)}{N(C_i)} \cdot \frac{N(C_i)}{N(D)} w_j = \frac{N(A_j=x_j)+1}{N(D)+q_j} P(C_i \mid X) = \alpha \frac{N(C_i)}{N(D)} \prod a_{j=1}^{k} \frac{N(A_j=x_j)+1}{N(D)+q_j} \cdot \frac{N(C=C_i, A_j=x_j)+1}{N(C_i)+q_j} i = 1,2,\cdots,n \frac{LP_y^c - \mathrm{Min}_{1\le j\le|M|}(LP_y^c)}{\mathrm{Max}_{1\le j\le|M|}(LP_y^c) - \mathrm{Min}_{1\le j\le|M|}\left(LP_{yj}^c\right)} + LP_{ij} = \frac{LP_{yj}^c - \mathrm{Min}_{1\le j\le|M|}\left(LP_{ij}^c\right)}{\mathrm{Max}_{1\le j\le|M|}\left(LP_{yj}^c\right) - \mathrm{Min}_{1\le j\le|M|}\left(LP_{yj}^c\right)} \frac{LP_{ij}^x - \mathrm{Min}_{1\le j\le|M|}\left(LP_{ij}^s\right)}{\mathrm{Max}_{1\le j\le|M|}\left(LP_{ij}^s\right) - \mathrm{Min}_{1\le j\le|M|}\left(LP_{ij}^x\right)} + \frac{LP_{ij}^l - \mathrm{Min}_{1\mathrm{sjs}|M|}\left(LP_{ij}^l\right)}{\mathrm{Max}_{1\le j\le|M|}\left(LP_{ij}^l\right) - \mathrm{Min}_{1\le j\le|M|}\left(LP_{ij}^l\right)} \tag{17}$$

$LP_y{}^{\epsilon}, LP_y{}'$ and $LP_y{}'$ signify number of references to the material made by learner I for material j through clicks, selection, and learning actions, respectively, from eq (18).

$$\mathrm{Max}_{1\leqslant,s|M|}\left(LP_g^c\right), \mathrm{Max}_{1\leqslant j\le|M|}\left(LP_y^x\right) \tag{18}$$

$\mathrm{Max}_{1\le j\le|M|}\left(LP_{ij}^l\right)$and $\mathrm{Max}_{1\le j\le|M|}\left(LP_{ij}^l\right)$ indicates maximum number of clicks selection as well as learnings for a learner i for M material. The goal is to model a student’s data seeking behavior to design a personalized data retrieval method that would improve students' learning experiences, and such a PRS must include the following elements. The database of students' profiles contains logs as well as records of learning styles, access to learning materials, and other information on the student's speciality. Using these information and logs, the student's preferences with classmates will be determined.

4 Performance analysis

The post-pandemic world demands novel methods to fulfil people’s requirements. This research considers this factor and attempts to develop an online education approach. Use of technology to enhance education as well as evaluate student performance is the starting point. It is worth noting that the current situation has led to online, virtual or hybrid educational methods being expected as a response. This research is being used to improve the architecture as well as the infrastructure of universities that took part in study. This is considered a benefit because having the best infrastructure in place allows you to focus your efforts on machine learning model creation. If any architecture layer has to be upgraded, it can be done so without incurring additional technical, human, or financial expenditures.

Machine learning uses students' performance in every activity to make actionable recommendations. As a result, the decision is made based on the student's greatest results in every activity. For instance, there are instances where activities, such as fast evaluations using true and false items, do not correspond to the needs of a certain set of pupils. The method recognises these individuals and suggests alternative activities to the course creator. The development of ML is considered crucial in this regard. A large range of activities has been designed for this learning, which ML offers to the student based on their needs.

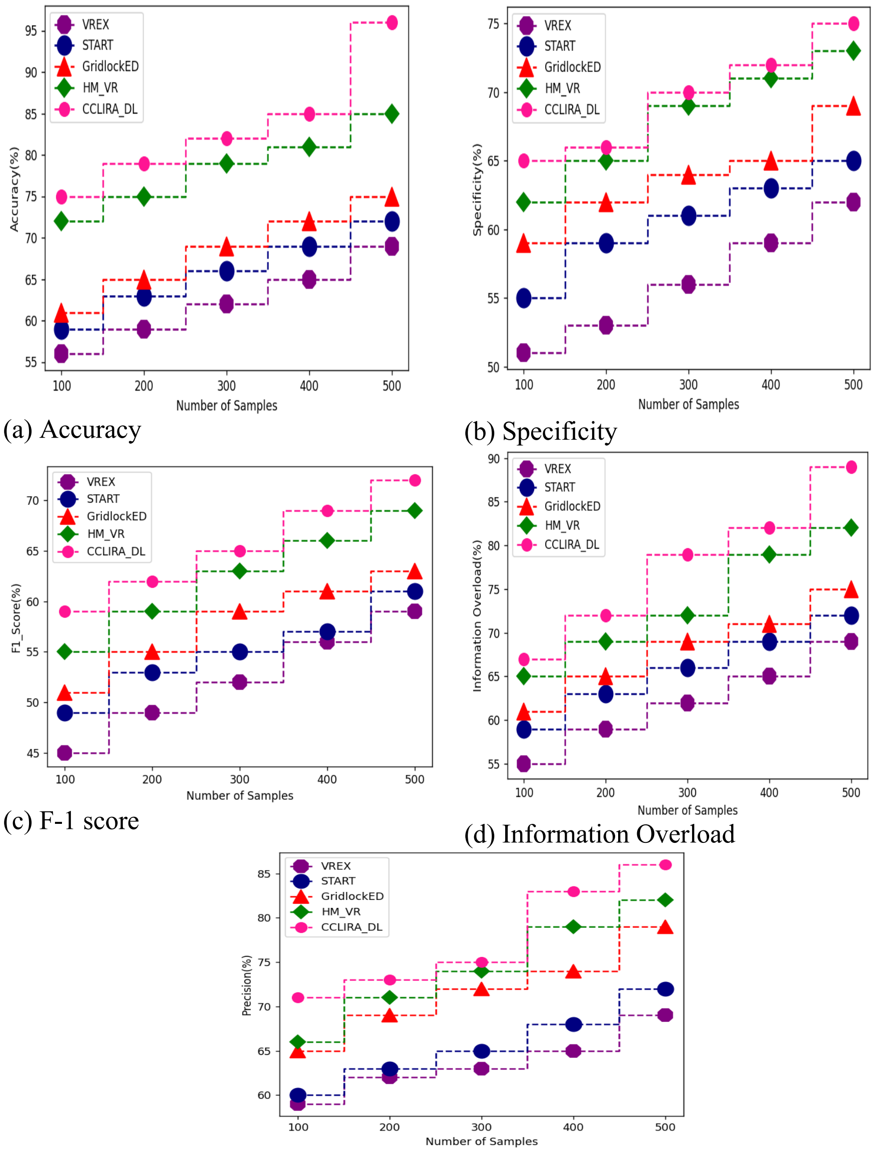
4.1 Dataset Description

Kaggle: The dataset was obtained from the Kaggle.com website. There are 395 student records in this collection, each with 30 attributes and domain values. The dataset was split into 2 parts: training (75 percent) and testing (25 percent).

Open University Dataset: It was obtained via Kaggle and used in both tests. This dataset contains 32,593 student records from 15 various countries. Student-selected courses, demographic data, and student interactions with e-learning environments are also included in the data. The dataset was cleaned and features that were desired were extracted. Dealing with missing values as well as conveying arithmetic values to phrases is part of dataset cleaning for classification analysis. The demographic (D), engagement (E), and performance (P) input elements of the dataset are goal variables, with students' performance assessed as pass or fail.

Techniques	Accuracy (%)	Specificity (%)	F1_Score (%)	Information Overload (%)	Precision (%)
VREX	69	62	59	69	69
START	70	65	61	72	72
GridlockED	73	69	63	75	79
HM_VR	75	73	69	82	82
CCLIRA_DL	95	75	72	89	86

Table 1: Comparative analysis for Kaggle Dataset



(a) Accuracy

(b) Specificity

(c) F-1 score

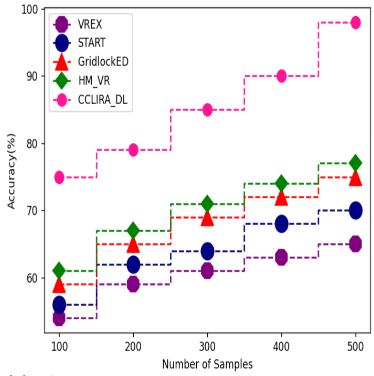
(d) Information Overload

(e) Precision

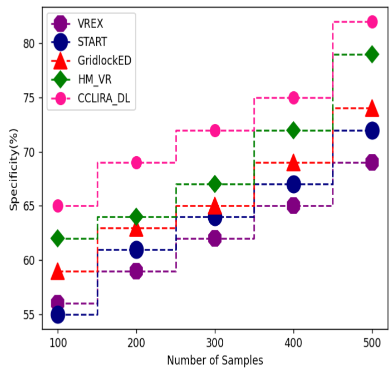
Figure 4: Comparative analysis of proposed and existing techniques in terms of accuracy, specificity, F-1 score, information overload, and precision for Kaggle dataset

Techniques	Accuracy (%)	Specificity (%)	F1_Score (%)	Information Overload (%)	Precision (%)
VREX	65	69	55	59	65
START	70	72	66	63	70
GridlockED	75	74	72	69	73
HM_VR	77	79	74	72	76
CCLIRA_DL	98	82	79	75	81

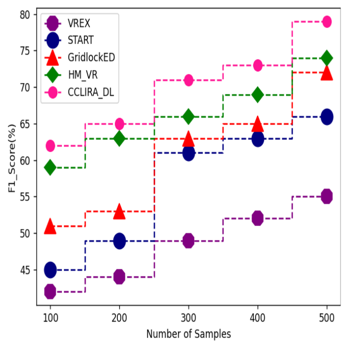
Table 2: Comparative analysis for Open University Dataset



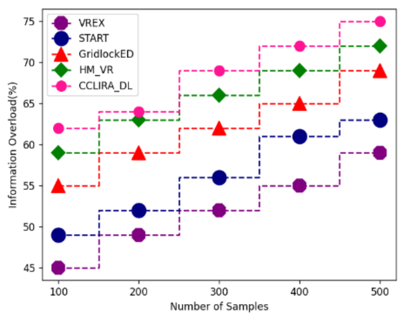
(a) Accuracy



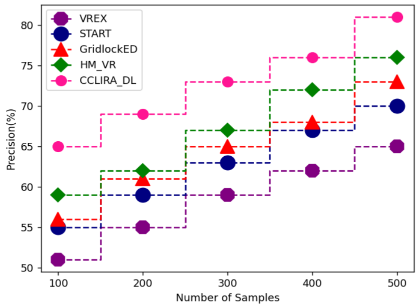
(b) Specificity



(c) F1_Score



(d) Information Overload



(e) Precision

Figure 5: Comparative analysis of proposed and existing techniques in terms of accuracy, specificity, F-1 score, information overload, and precision for Open University dataset

The above Tables 1 and 2 and Figures 4 and 5 show a comparative analysis in terms of accuracy, specificity, F-1 score, information overload, and precision for various datasets like Kaggle and Open University dataset. Here the analysis has been carried out between the existing and the proposed techniques. For the Kaggle dataset, the proposed technique obtained an accuracy of 95%, specificity of 75%, F-1 score of 72%, information overload of 89%, and precision of 86% compared with the existing technique. Then the proposed technique obtained an accuracy of 98%, specificity of 82%, F-1 score of 79%, information overload of 75%, and precision of 81% for Open University dataset. From the above analysis, the proposed technique obtained optimal results in personalizing students' curriculum and their learning approach.

5 Conclusion

This research proposed a novel virtual reality augmented technique in education. Here, the aim is to propose a virtual reality integrated with artificial intelligence system based medical students' curriculum customization and learning approach recommendation based on their curriculum. Here, the data has been collected based on the past performance of the medical students along with their curriculum requirements. Then the dataset has been processed for CAD system-based deep learning classification for creating a customized curriculum. It uses a decision tree integrated with naïve Bayes with learning approach recommendation system using fuzzy rules integrated knowledge-based recommendation system. The experimental results obtained by the proposed technique have an accuracy of 98%, specificity of 82%, F-1 score of 79%, information overload of 75%, and precision of 81%.

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