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Predicting Performance of Online Education Students Using IOT and Boosting Algorithmic Framework

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ABSTRACT- There are many problems and algorithms that allow machines or systems to take decisions for trainers of online education industry. These machine models enhance user participation in many ways. Many studies/research have been conducted in online education industry to solve many problems related to student's orientations and performance using various IoT and AI related algorithm specially boosting algorithm. The main focal area of this paper is to foresee, final performance of online education learners specially university/institute offering online education in India using some IoT and AI techniques specially Boosting Algorithm towards maximum utility of trainers.

KEYWORDS- AI; Algorithm; Data Science, ML, Online Education Industry, Data Analysis, Boosting Algorithm, Data Mining, Support Vector Machine (SVM), Artificial Neural Network (ANN), Technology-Enhanced Learning (TEL), GBM Technology enhance learning(TEL).

I. INTRODUCTION

Trainer education and involvement in good quality education, also because of the nature of its role like educational guidance, educational monitoring, facilitate learners' maturity and setting professionals goals therefore teachers/faculty are the important part of the online education and learning system. Tarik et al. [1] [2] states that Algorithms behind artificial intelligence allow machines to make judgements in place of people. Guilherme [5] defines modern age aspect as our main belief in technology in all aspects of life, not least in education. The Internet of Things as a growing and fast technology has recently attracted attention from around the world as stated by Moutaib, M. et al. [22].

Even with appropriate trainer orientation, decision-making and choice are tough, to minimize issues, the selection of course should be comparable to the student's selection. Good collaboration and learner involvement are essential for the successful learning process to have a greater impact. To improve engagement and understand the context of online education learners, the technologies like Internet of Things and AI can be leveraged. Also, the primary emphasis is a crucial element of the evaluation of educational outcomes for learners. Most of the e-learning environment research is restricted to improving instructional strategies. A relatively little amount of This paper's goal is to propose a framework that will identify each learner's distinct learning skills using IoT devices and AI using the Boosting algorithm. Based on it, assessments predictions will be made, and learners will be evaluated using ¬-those criteria.

A platform for online education that integrates IoT and AI-based algorithms to collect information on human behavior, the surroundings, and the physical world. The platform might be modified to add features like context awareness using this data and an AI system. Trainers can conduct clever solutions that meet the needs of their students using cognitive modules.

The entire research work is divided into five different module, In next section, literature review work was carried out to find the research gap and most of the research work was done on predicting student performance but not on trainers' utility by using Boosting algorithm. In section 3 proposed methodology was suggested to develop an effective framework for trainers utility and section 4 refers to the conclusion of the paper.

II. LITERATURE REVIEW

Numerous research endeavors have been conducted in the fields of Data Mining and Artificial Intelligence/machine learning to enhance the academic lifeline for students' success. Kirsal Ever et al. [7] [13] have proposed machine learning techniques that were used in place of humans to solve real-life problems by utilizing their extensive abilities for classification, optimization, and prediction.

Chung, J. Y., & Lee, S. [4] use random forests algorithm to predict students at the risk of dropping out. Latrellis et al. (2021) discussed two AI algorithm to anticipate learners' performance.

E. Fernandes, M. Holanda, M. Victorino, V. Borges, R. Carvalho, and G. van Erven[24][9] studied a correlational & precautional study using DM algorithms to measure ,working of students using Gradient Boosting Machine (GBM) algorithm, on attributes like grades, absences etc Tomasevic, N. et al. [10] made a comparison among various ML techniques to test the performance of scholastics academic achievement in a course.

Uskov, V. L. et al. [11] created a project that tests eight machine-learning techniques. To predict student academic achievement. B Sekeroglu et al. [25] considered various datamarts using five ML algorithms for the prediction and classification aspect of students. Saa, A. A. et al. [12][14]

used DTs, naive Bayes, and artificial neural networks(ANN) methods.

According to a study conducted by Sekeroglu et al.[25], using ML methods to forecast and categorize student achievement, the familial and community surroundings can significantly affect their performance.

Data mining algorithms, DTs, naive Bayes classifiers (NBC), and artificial neural networks (ANN), Saa, A. A. et al. [12] used to study those factors that affect student performance, like grades, result, online participation, demographic and social information.

The study conducted by Ricci, F. et al. [15] investigated recommender systems' importance in TEL. To solve the problem of class uneven attributes. Thai-Nghe, N. et al. [16], November) design a model to forecast student learning, using data mining algorithms such as Bayesian Networks (BN), DT, and Support Vector Machines.

For improving prediction output Thai-Nghe, N. et al. [17] developed a model of recommendation system techniques (RST) methods, such as logistic regression by applying scholastic and relevant information.

Romero, C. et al. [18] also contrasted data mining techniques to rank learners. Moreover, Bekele, R., & Menzel, W. [19] employed data mining methods to forecast students' conduct of work; this exhibits the usage of the Bayesian approach in educational institutes. Nghe et al. & Joseph, S. I. T[6] compared the efficacy of the DT and BN algorithms for projecting students' academic success using data mining approaches. In their proposal for a system of reconditions for online and blended courses, Chavarriaga et al. [23] acknowledged that social and skills insight are reliable sources of insightful suggestions for students looking to improve their learning abilities.

Ahajjam, T. et al. [20] offered six experiments using the ML techniques of classification and regression. The IoT and AI (Boosting Algorithm) used in this research illustrated and used to forecast students' performance in this paper.

III. PROPOSED METHODOLOGY

This paper's methodology combines a quantitative and qualitative approach. The data sets will be gathered using a variety of IoT devices or sensors, and for accuracy and completeness, each piece of data will be time-stamped. Programming languages like R, Python, and others will be utilised to analyse the data collected to create the report and drive the algorithm. The primary design of the research is to employ the AI Boosting algorithm to increase the learning algorithm's accuracy. The following data types should be gathered: heart rate, brain waves, temperature, perspiration, eye movement, etc. We anticipate a connection to exist between various IoT device data kinds and learner comprehension. If the analysis does not find the data types to be suitable, they can be altered at any moment in accordance with the requirements.

The major concern related to data set collection is the time- in general questionnaire data collected at the end of the session but this is not useful and not accurate because learners may not be able to answer accurately, therefore data will be collected in time slice or in between the lecture to understand the better understanding of the learners.

The proposed system will be developed using object programming language and analysis engine. The architecture has four modules.

- IoT devices used to capture data and data concentration center.
- Questionnaire used to collect data from learners.
- Data analysis (Boosting AI based algorithm)
- Data visualization tools used for presenting the data.

The application will use several algorithms to provide the trainers with various reports. To comprehend the hidden agenda or pattern from the learning system that can improve the trainers' accuracy and decision-making about the students, data analysis and data visualization are applied. To increase the system's accuracy in this case, we apply the Boosting method.

If we want to maximize his decision-making power of trainers related to learners, then we need to create a computer program that will accurately predicts performance of the learners based on usual information or on collected different data set by the sensors. To create such a program, the highly skillful strategy needs to form on some set of rules related to the learners. Additionally, by repeatedly asking expert opinion on different collections of sets, the learners can extract many patterns used in decision making.

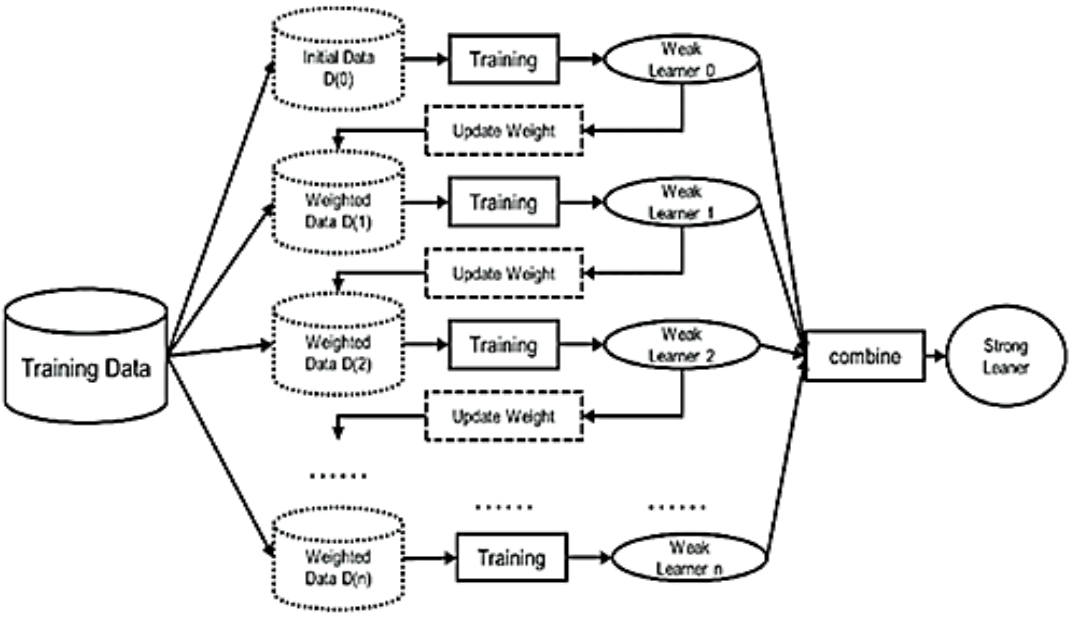

Figure 1: Framework for AdaBoost Algorithm

Algorithm 1 An algorithm Used for AdaBoost Model

Input: Training Data from instance space where $D_t(i)$ denotes the weight distribution on training set i on round t and provided $(x_1, y_1), \ldots, (x_n, y_n) where x_i \in X, y_i \in Y = \{-1, +1\}$

Output: Profiling the students on basis of various parameters

1: Set $D_1(i) = \frac{1}{m}$ For t= 1,...,T

2: Train weak learners using distribution D_i

3: Get weak hypothesis $h_i : X \longrightarrow -1, +1$ with error

4: $\epsilon_t = Pr_{i \sim D_t}[h_t(x_i) \neq y_i]$

5: Choose $\alpha_t = \frac{1}{2} ln(\frac{1-\epsilon_t}{\epsilon_t})$

6: $UpdateD_{t+1}(i) = \frac{D_t(i)}{Z_t} * \begin{cases} e^{-a_t} & \text{if } h_t(x_i) = y_i \\ e^{a_t} & \text{if } h_t(x_i) \neq y_i \end{cases}$

7: $D_{t+1}(i) = \frac{D_t(i) e^{-\alpha_t y_t h_t(x_i)}}{Z_t}$

8: Output the final hypothesis:

$H(x) = sign\left(\sum_{t=1}^{T} \alpha_t h_t(x)\right)$

Figure 2: Framework for AdaBoost Algorithm

In order to use these rules to maximum advantage, there are two problems faced by the computer programmer: one the report generation for better prediction and second how the different data set are correlated to single data set for accurate prediction. Boosting refers to abnormal and operative method for mixing unreliable and faulty criteria to get an extremely accurate forecast.

Using an ensemble approach called "boosting," weak classifiers are combined to try to produce stronger classifiers. The boosting algorithm's main aim is to train a series of weak models and increase prediction power, each of which makes up for the shortcomings of its predecessors, in contrast to many machine learning models that concentrate on high-quality prediction performed using a single model. Boosting gives machine learning models, the ability to increase their prediction accuracy.

Ada boosting, also known as adaptive boosting, is an algorithm that uses a decision tree model with an adept value of 1. Ada boosting is nothing more than a forest of treeless stumps. AdaBoost works by giving cases that are challenging to categorize more weight and instances that are already handled well less weight. With the purpose of solving classification and regression issues, the AdaBoost algorithm was created.

A. AdaBoost Algorithm

Boosting is a strategy for combining a number of poor classifiers into a single high-performance prediction rule. AdaBoost is a boosting algorithm that corrects the mistakes of its prototype. The weight of the underfit training instances of the previous model is increased. With each new predictor, the emphasis is therefore placed more on the complex examples than the others. The flowchart of AdaBoost algorithm is shown in Figure 1.

The Algorithm used for AdaBoost Model is shown in below in Figure 2. Suppose we are given training data $\{(x_i, y_i)\}_{i=1}^{N}$ where $x_i \in R^K$ and $y_i \in \{-1, +1\}$. And suppose we are given number of weak classifier , denoted by $f_m(x) \in -1,1$ and 0-1 loss function I defined as:

$$I(f_m(x), y) = \begin{cases} 0 \; iff \; f_m(x_i) \in y_i \\ 1 \; iff \; f_m(x_i) \notin y_i \end{cases}$$

The pseudocode for AdaBoost Algorithm is defined as follows in Figure 3. After learning, the final classifier is based on a linear combination of the weak classifier:

$$g(x) = sign\left(\sum_{m=1}^{M} \alpha_m f_m(x)\right)$$

Algorithm 2 Psedocode for AdaBoost Algorithm

for i from 1 to N **do**

$w_i^{(1)} = 1$

end for

for m = 1 to M **do**

Fit weak classifier m to minimize the objective function:

$\epsilon_m = \frac{\sum_{i=1}^{N} I(f_m(x_i) \neq y_i)}{\sum_i w_i^{(m)}}$

where $I(f_m(x_i) \neq y_i = 1$ if $f_m(x_i) \neq y_i = 1)$ and 0 otherwise

$\alpha_m = ln \frac{1-\epsilon_m}{\epsilon_m}$

for all i **do**

$w_i^{(m+1)} = w_i^{(m)} e^{\alpha_m I(f_m(x_i) \neq y_i)}$

end for

end for

Figure 3: Pseudocode for AdaBoost Algorithm

B. Framework

The first part of this framework was data collection and design a big data warehouse from different sources by using different IoT devices followed by data cleaning and data transformation as shown in Figure 4. Then entire data is divided into different data set like D1...Dn after each dataset is trained and evaluated by using different AI and ML techniques followed by Boosting algorithm which improves the prediction power of trainer I education system.

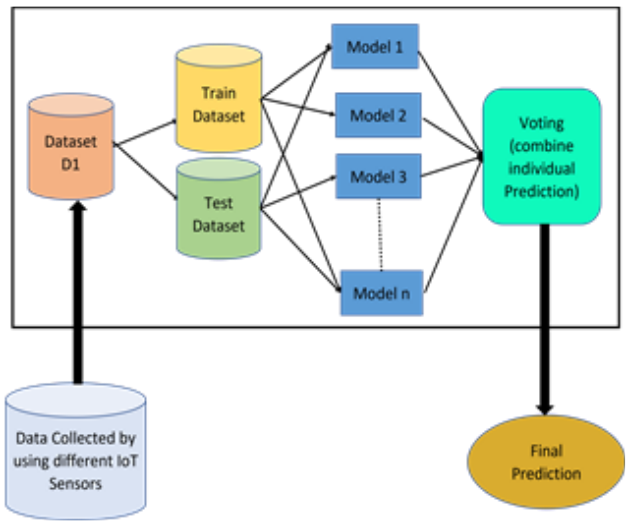

Figure 4: IOT and AI model using Boosting Algorithm

IV. CONCLUSION AND FUTURE SCOPE

The outcome of this research, the authors develop a student outline model by operating boosting algorithms covering the major objective of predicting students' overall performance & description. Here a new model is proposed in which a Ada boosting algorithm is used by updating of weak classifiers continuously & instantly. Student profiling will be done by capturing data related to learning, behavior, social & personality identity by using various IoT Sensors.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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