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Player Behavior Prediction for In-Game Purchases Using Machine Learning

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ABSTRACT

Nowadays, the gaming industries collects the large amount of players data during the gameplay. This project mostly focuses on the prediction of player behavior for in-game purchases using the Machine Learning. By monitoring and observing the player activities such as his play time, game progress and previous purchase history, the system can predict the player whether he is gonna make it in-game purchases. This project can analyze the player behavior based on his in-game purchases and how active and how much time he is spending in the game. Machine learning algorithms like Random Forest algorithm, Support Vector Machine, Gradient Boosting and Long Short-Term Memory networks. These algorithms make sure the prediction is very accurate and helps developers to understand the player preferences and improve in the game purchases. In this project, the machine learning models identify the players movements in the game such as how much time he is spending in the game, how active he is in the game, what his movements are during the game. By analyzing these details, it predicts the behaviour of the player and predicts how likely he is gonna do the in-game purchases. These predictions are mainly done by using the machine learning models.

KEYWORDS: Random Forest Algorithm, Support Vector Machine (SVM), Gradient Boosting, Long Short-Term Memory (LSTM), Machine learning, Purchase, Player behaviour, Prediction.

INTRODUCTION

Nowadays, the gaming industries are using machine learning algorithms to analyze the behavior of the online player. This explains the system that uses the computer vision and deep learning and machine learning to understand the basketball videos. It removes the unnecessary things in the background by identifying the basketball court and lines. A deep learning model called LSTM is used to identify and predict the player movements like shooting, passing and jumping. It focuses on the movement patterns. It shows the good accuracy in predicting the player behavior. Mobile Ad Hoc Networks (MONETs) are very highly dynamic networks that are vulnerable to the various security threats in the gameplay. One of the most serious threats is the multi-collusion attacks, where multiple unknown nodes cooperate to disrupt the network operations. This project focuses on detecting and analyzing these attacks using game theory. This model helps in understanding the attacker behavior and decision-making patterns. It gives strategies to the both attackers and defenders. Massively Multiplayer Online Role-Playing Games contains large number of players interaction and behavioral data.This makes understanding and predicting player behavior very crucial and complex. By this we can't easily improve the game design,

player retention and overall user experience.

It explores through the modern machine learning and deep learning algorithms to overcome the difficulty. To analyze and evaluate the team performance in the dynamic environment of soccer, this project focuses on using the Machine Learning techniques. First it studies the data such as player movements, passes, shots and actions to understand the team strategies. It understand the different patterns that cause the team success during the game. By analyzing the players social activity and interaction patterns within the game, this project focuses on predicting the churn among game users. It uses these graphs to represent the relationships and behavioral changes among the players. The key factors are social interaction, activity frequency and engagement levels. Neural Networks are used to identify the patterns of the data. Using predictive analyses this project predicts the in-game transactions by analyzing player behavior. It converts the players data into the tokenized histories to get the correct patterns. It improves the accuracy of prediction by learning the past behaviors and transactions.This project mainly focuses on the prediction of the player behaviour on how much time he is spending in the game, how often he plays the game, how his actions are making, how often he purchases. The machine learning models analyze these data and predict the player behaviour. This project focuses on predicting the players that when they are likely to be able to make in the in-game purchases in free online games. It uses the survival analysis techniques to collect the player behaviour data.

The goal is to help the developers to monetize the strategies by understanding the player purchase history. This work focuses on a churn prediction using RFM-UR features. Machine learning models analyze player activity patterns to identify that users are going to quit or not. Early detection allows game companies to take action to retain users. This approach helps maintain an active player base. The goal of this project is to measure and predict player engagement in online games. It analyzes data such as session length, frequency of play, and in-game interactions. Machine learning techniques are applied to find patterns in player behaviour. The results help developers understand what makes the players interested. This leads to better game design and improve the user satisfaction. This project aims to predict the skill level of players in MOBA games. It uses in-game statistics like kills, assists, match outcomes and movement patterns. Machine learning use the data to classify the players into different skill levels. This project explores how social connections affect player retention in mobile games. It studies player interaction such as friendships, team play, and communication. This helps developers use social features to improve retention.

This project improves churn prediction by using multiple machine learning models. Instead of relying on a single model, it uses a stacked algorithms to improve the accuracy of the prediction. This helps game developers to identify the risks and reduce the churn. This project examines the privacy and security challenges in social computing platforms. It studies how user data is collected, shared and protected online. The research highlights risks such as data misuse and lack of trust. It also discusses methods to improve security and user confidence. This project focuses on profiling the players using data collected from multiple resources. Multi-task learning is used to predict different player characteristics at the same time. This project aims to predict the churn in the game Destiny. It uses hidden Markov models to track changes in player behaviour time. Early churn prediction allows developers to take preventive actions. This project studies how player behaviour reflects skills engagement and decision-making in competitive online games. This project uses big data techniques to predict churn in large scale online games. It analyzes multiple data like gameplay activity, spending behaviour and session patterns.

LITERATURE REVIEW

[1]The author W. Yang et al. worked on the project "Purchase Prediction in free online games via survival analysis", with the help of Random Forest algorithms, and Cox proportional hazards regression algorithms. This project mainly focuses on predicting when and which players will start to make purchases in the free online games. This project give the very promising results and contains the 96% of the accuracy rate. [2] The authors, T. Manju Usha Sree, P. Sasikumar, S. Ayesha, M. S. Amzad Basha and M. Martha Sucharitha, worked on the project "Predicting Player Engagement in Online Gaming: A Machine Learning Approach", with the help of algorithms like Logistic regression, Random Forest, Support Vector Machine, Decision Tree and Gradient Boosting. It focuses on analyzing the player behaviour data from online games like the players time session, In-game actions and movements and progression. It has accuracy of 92% depending on the datasets. [3] A. Perišić and M. Pahor, worked on the project, " RFM-LIR Feature Framework for Churn Prediction in the Mobile Games Market," with the help of the algorithms like Random Forest and XGBoost. The project developed the RFM-LIR feature to improve the churn prediction for the online games by integrating the Recency, Frequency, and Monetary features. The accuracy of the project is 90%.

[4]The authors, V. Pepatang and V. Kotrajaras, worked on the project, "Machine Learning Model for Skill Level Prediction in Multiplayer Online Battle Arena," with the help of algorithms like Logistic Regression, Decision Tree, Random Forest, Support Vector Machine. The authors focused on predicting the skill level in online gaming using data like kills, deaths, assists, win rate and player behaviour. The accuracy rate of this project is 90%. [5]The authors, Óskarsdóttir, M., Gísladóttir, K.E., Stefánsson, R. *et al.* worked on the project, "Social networks for enhanced player churn prediction in mobile free-to-play games", with the help of the algorithms like Decision Tree, Random Forest and KNN. It studied that how social network information can improve the models that predict the player behaviour in the online free games. The accuracy of the project is 82%. [6]The authors, Guo, R., Xiong, W., Zhang, Y. *et al. worked on the project, "*Enhancing game customer churn prediction with a stacked ensemble learning model", with the help of algorithms like Decision Trees, Random Forests, KNN, and XGBoost. The authors focused on predicting the customer churn in online games by analyzing the player behaviour , his movements, transaction history. The accuracy of the project is 88%.

[7]The authors, Z. H. Borbora and J. Srivastava, worked on the project, "User Behavior Modelling Approach for Churn Prediction in Online Games", by using algorithms like Logistic regression, Decision tree, Random forest and support vector machine. The authors focused on analyzing player activity data from online games to understand patterns. They used metrics like session duration, login frequency, in-game purchases and purchase history. The accuracy of the project is 88%. [8] The authors, K. J. Shim and J. Srivasthav, worked on the project, "Sequence Alignment Based Analysis of Player Behavior in Massively Multiplayer online Role playing games", by using the algorithms like Sequence alignment algorithms. The authors analyzed player behavior in MMORPGs by modeling player action sequences. The goal was to identify similarities and classify player types. The accuracy of the project is 85%. [9]The authors, S. Zhao, R. Wu, J. Tao, M. Qu, H. Li and C. Fan, "Multi-source Data Multi-Task Learning for Profiling Players in Online Games", with the help of algorithms like LSTM, CNN and GCN. The authors developed a method called MSDMT to profile online players by predicting player churn and player behavior simultaneously. The accuracy rate of this project is 95%.

[10]The authors, M. Tamassia, W. Raffe, R. Sifa, A. Drachen, F. Zambetta and M. Hitchens, "Predicting Player churn in destiny: A Hidden markov models approach to predicting player departure in a major

online game", with the help of algorithms like Hidden markov models(HMM) and Viterbi algorithm. The authors studied player behavior in online game Destiny by analyzing how players move through hidden engagement. The accuracy of this project is 85%. [11]The authors, A. Dehpanah, M. F. Ghori, J. Gemmel and Mobasher, worked on the project, "Player modeling using behavioral signals in competitive online games", with the help of algorithms like Random Forest, Support Vector Machine, Logistic regression and KNN. The authors worked on modeling player behavior in competitive online games by analyzing in game behavioral signals such as movement patterns, actions and performance. The accuracy rate of this project is 75%. [12]The authors, A. F. del Rio, P. Pei Chen and A. Perianez, worked on the project, "Profiling players with Engagement Predictions", with the help of algorithms like Random Forest, Support Vector Machine, and logistic regression. The authors focused on profiling players by analyzing gameplay behavior such as session time, frequency, progression rate, and in-game actions. The accuracy rate of this project is 90%.

[13]The authors, J. Tao et al. worked on the project, "Explainable AI for cheating detection and churn prediction in online games", with the help of algorithms like Random Forest, XGBoost, and support Vector Machine. The authors focused on detecting cheating behavior and predicting player churn in online games using explainable AI techniques. The accuracy rate of this project is 92%. [14]The authors, P. Bertens, A. Guitart and A. Perianez, worked on the project, "Games and Big data: A scalable multi-dimensional churn prediction model", with the help of algorithms like Survival ensemble models. The authors developed a scalable churn prediction model for mobile games that uses big player behavior data to predict when a player stop playing and how long they play before churning. [15]The authors, J. L. Heish and C. T. Sun, worked on the project, "Building a player strategy model by analyzing replays of real-time strategy games", with the help of algorithms like Decision trees/Random Forest, Support Vector Machine and LSTM models. The author focused on analyzing replay data from real time strategy games to understand player decisions and behavior. The accuracy of this project is 85%.

PROPOSED METHODOLOGY

This project mainly focuses on predicting the player behaviour by using the machine learning models. It understands how players behave inside the game and using that behaviour to predict whether they are likely to make in game purchases. The process begins by collecting data such as how much time they spend in the game, frequency of logins, interaction with in-game items, purchases history. After collecting data the project will be trained with that collected data. In this project we use algorithms like Random Forest algorithm, Support Vector Machine(SVM), Gradient Boosting, and LSTM networks. BY using these algorithms it predicts the player behaviour whether he is gonna make it in purchases or not. There are several key steps in the proposed methodology for predicting player behavior in in-game purchases using the Machine Learning. These are divided into several steps like data handling, modeling and evaluation.

1. Data Collection:

It is the gathering of the relevant data about the player interactions and purchases in the game. The data includes player sessions, the levels he completed, the time he spent, and his achievements in the game and the players login frequency, his playtime and the players social interaction. The data also includes the players personal information like his age group, his location or address, platform and device. The source of the data is observing his frequency of purchasing, type and amount of time in in-game purchases. For this, we have to use game analytic tools or database exports.

2. Processing the Data:

The processing of the data means the cleaning of the data that we have collected. The missing points, duplicate ones and inconsistent data points are to be cleaned or removed or modified. In this process convert the categorical variables into the numerical representations.

3. Model selection and Training:

In this section we need to choose the best machine learning model suitable for the prediction of the players purchase behavior. The models are like Logistic Regression, Decision Tree or Random Forest, Gradient Boosting and Neural networks. In these compare each and select the best performing model. Then train that model with the dataset and check the performance like accuracy, precision and validate it.

4. Model Evaluation:

In this section we have to test the model with the dataset to test the prediction accuracy. And then validate the performing model with the real world applicability by by the comparison of the predictions to the actual player purchase behavior.

5. Deployment:

Then finally integrate this model into the game analytics system. Then it will be ready to predict the in-game purchases at the regular intervals. Use these predictions for the marketing and promotions and personalized offers and increase the player number and the engagement and revenue.

SYSTEM ARCHITECTURE

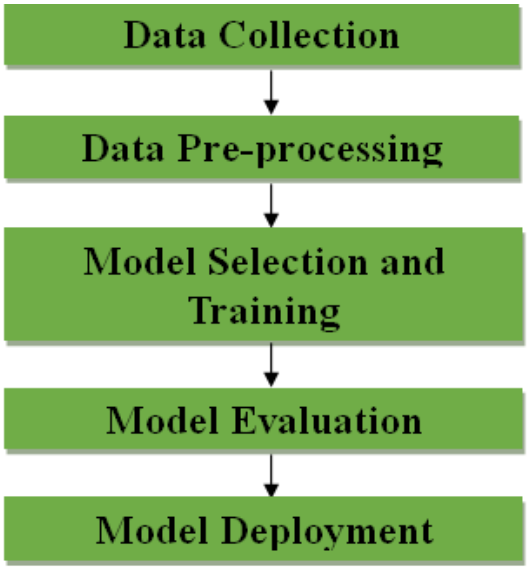

FIG 1.SYSTEM ARCHITECTURE

In this figure, it explains the development and the runtime of the project. In this first the game model collects the data of the player. On the basis of that data, it calculates the performance of the player and it processes the Feature selection based on the Sensor data collection and through the feature set it processes the feature calculation. After the data is collected the model will be trained according to that and makes the model inference. After the model is trained it validates the player details and predicts the player behaviour in in-game purchases.

RESULT & DISCUSSIONS

Using the gameplay and the historical data, the proposed machine learning model will accurately predict the players purchasing behavior. It analyzes and identifies the key factors like the players spending time in the game, his playing session frequency ad the past purchasing history which plays as key factors in in-game buying decisions. The results show the improved prediction accuracy and compared to the traditional rule-based methods. It will enable the game developers to target the buyers and give in-game offers and increase the overall income by maintaining the players attached. This project predicts the best results with the best accuracy to analyze the player behaviour prediction in in-game purchases. These predictions are occurred by using the machine learning models and deep learning models.

PERFORMANCE MATRIX

Model	Accuracy (%)	Precision (%)	Recall (%)
Logistic Regression	82.5	80.2	78.9
Decision Tree	85.3	83.7	81.5
Random Forest	91.2	89.8	88.6
Support Vector Machine	88.6	87.1	85.4
Gradient Boosting	92.8	91.5	90.2
LSTM Network	94.1	92.9	91.7

TABLE 1.PERFORMANCE MATRIX

GRAPHS

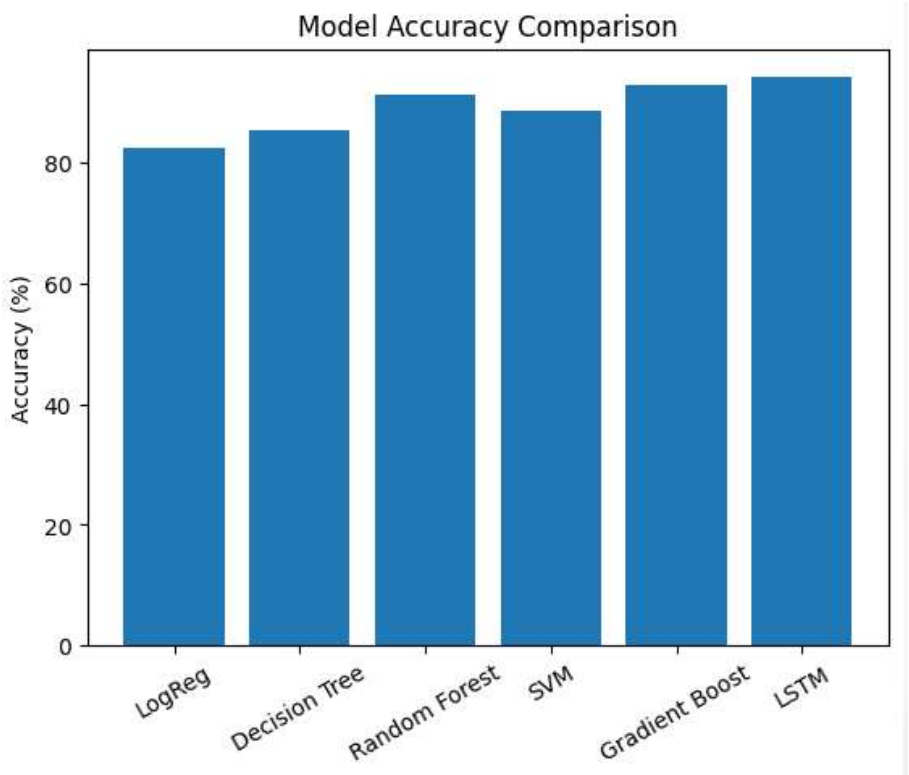

FIG 2.BAR GRAPH

CONFUSION MATRIX

FIG 3.CONFUSION MATRIX

SCREENSHOTS

FIG 4.HOME PAGE

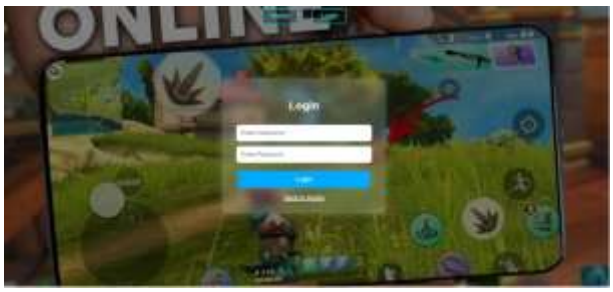

FIG 5.LOGIN PAGE

FIG 6.DASHBOARD

FIG 7.PREDICTION PAGE

FIG 8.RESULT

CONCLUSION&FUTURE WORK

This project demonstrates that the machine learning models and techniques can accurately predict the player behavior in the in-game purchases. It analyzes the online players activity, their gaming patterns, and purchase history and identifies that which players are likely to make in in-game purchases. The game developers will take the results and improve the game by monetizing strategies. They enhance the player engagement. Finally, this project will provide the absolute predictions and solutions for understanding and predicting the player purchasing behavior. In the future, this project can be improved by using the advanced machine learning and the deep learning models and techniques to evaluate and predict the player behavior and purchasing patterns. Additional data such as social interactions, emotional responses and cross-game behavior can be included to improve the accuracy.

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