

# Gamification based Skill Prediction using Blockchain Technology

A. Noble Mary Juliet, N. Suba Rani, S. Sreemathi

**Abstract:** Skill prediction is the process of withdrawing information from existing data for the purpose of determining their existing skills and future trends. Player gameplay data are collected from various sites and it is validated using blockchain technology. This ensures that the chain remains immutable, because any change in a block's data will invalidate every block that follows it. Players are then clustered using the K-means clustering algorithm, a clustering approach based on partitions is implemented. To increase the accuracy of prediction, players are classified into groups. Euclidean distance is computed to measure the distance or the (dis)similarity between each pair of players. Decision tree algorithm is used to predict player skill. The efficiency of the proposed method can be assessed using the measures such as precision, recall, F-Score, correlation of Matthews and Fallout rate. The proposed system improves the performance of the system as well as predict more accurate skill using kmeans clustering and decision tree.

**Keywords :** Skill Prediction, Cluster, K-means, Gamification, Blockchain Technology, Decision Tree.

## I. INTRODUCTION

Skills are the essential knowledge or ability to perform a job or task. There are many different kinds of skills that can help you excel in every aspect of your life whether it's education, work, or even a sport or hobby. Skills are what makes you trustworthy and confident in life, and are vital to success. It may take dedication and practice, but can learn or develop almost any skill. Skill prediction is the method of predictions using the obtained data. Predicting skill is also important when selecting potential employees. Hiring the wrong employees can cause a company to lose a lot of money [1]. As such, the company needs to know how skilled the applicant will be in the future. Take, for example, an entry-level job which requires no existing knowledge, companies cannot judge applicants based on their current knowledge, but have to predict how well they will gain the skills required to benefit the company. IBM receives more than 8,000 resumes a day. To understand the individual abilities better IBM introduced a cognify round where students had to complete various games within a specified time duration. The games were designed to test critical thinking, time and numerical skills.

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Data analytics is the method of analyzing raw data to draw conclusions about the data. There are four major types of data analytics based on the kind of analysis required and phase of workflow. Descriptive research analyzes the data and converts it into a shape that humans can easily comprehend. In mail order pharmacy, data mart is build and visualized using descriptive analysis [2]. Diagnostic research lets an researcher dive deeper into an problem at hand, so they can get to the root of a problem. Business Analytics prescriptive analytics is committed to determining the right course of action for a given situation [3]. Predictive analytics helps organizations identify patterns based on the current events [4]. Predicting the probability of an occurrence going on in the future or predicting the exact moment it will happen can be all calculated using predictive analytical models. For example predicting success of a mobile game [5], Predicting player skill.

## II. LITERATURE SURVEY

Games are a structured form of play. These could include goals, rules, art, environments, stories, challenges, characters, items, abilities, rewards, discovery and interaction by the players.

Video game includes a digital user interface as a primary element including 2D, 3D and virtual reality interfaces [6]. Video Game play improves student communication skill, employability skill, resourcefulness and adaptability skill [7]. Role playing game is a game where player can play the role of characters to develop a narrative [8].

Massively Multiplayer online game allows a large number of players to interact, cooperate and compete in a persistent virtual world [9]. Puzzles challenge mental abilities in areas such as spatial reasoning, logic and knowledge [10]. In chess player strength is determined by the quality of moves played, rather than by the results of games.

Gamification is the process of incorporating game elements into non-game application [11]. Gamification includes applying game qualities such as puzzle, play, openness, design and competitiveness to actual processes in an organizational setting in order to make repetitive tasks more enjoyable and engaging [12]. Gamification enhances the engagement of children with education content. Serious game is used to produce real world results in the fields of defence, education, scientific studies, health care, emergency management, urban planning, engineering and politics. The bigger board makes Go in Game of Go very complicated and difficult to determine. The patterns are extracted from game records and learned using K-Means.

# Gamification based Skill Prediction using Blockchain Technology

Educational game is designed for learning including elements such as memorization through repetition, experiences in a virtual world, designing things, experimentation and social interaction.

Playing computer games has both a positive and a negative impact. Video games improves laparoscopic surgical skills, attention and concentration. While gaming, the brain receives multiple stimulations, both from visual and audial, action video games make dyslexic children to read better, Therapeutic video games like Go go games for children with autism spectrum disorders improves their balance Serious games offer a variety of benefits to corporate learners of all ages, ranging from an improvement in information retention to a raise in satisfaction.

Everything in excess is bad. Anything we practice influences the brain regularly, and if we practice violent ways of thinking, feeling, and responding, then we can build on those ways [13]. Gaming use impacts the eyesight adversely and even leads in Insomnia, People who spend hours on playing violent video games can get aggressive, introvert, lose confidence in the local world.

Blockchain technology enables a decentralized system to be developed, where transactions and data are not governed by any third party entity. Any transaction that has ever been completed shall be reported in a verifiable and permanent way in a public ledger[14].

A blockchain is a growing list of records which use cryptography to connect together.

In traditional database management individuals like "administrators" hired by proprietors of servers. This centralized body that manages the database also guarantees the administrative tasks, such as daily backups etc.

On the other hand, blockchain technology is gaining further awareness of the publicly distributed ledger technology.

## III. SYSTEM ARCHITECTURE

The Player gameplay data are collected from various data providers such as Kaggle, FICS Games Database, data.world. The obtained data are then subjected to processing. The processing of data includes removal of duplication, identification and removal of unwanted and missing value. The player data are validated using blockchain. This ensures that the chain remains immutable, because any change in a block's data will invalidate every block that follows it. Gameplay datasets are collected from different data providers and validated using blockchain, the validation process includes merging of datasets and fixing mismatches in the data. Similar players are clustered based on their ratings using K-Means clustering technique. Mapping of player skill is done using decision tree. The overall process of the proposed work is shown in Fig.1

## IV. DATA PREPROCESSING

The player gameplay dataset is obtained from various data providers it contains more than 81,000 observations and as much as 20 features. Processing includes identification and removal of duplication, identification and removal of missing value and unwanted records. The gameplay dataset contains features such as Player name - Name of the player, Player Elo rating - In chess Elo rating is a method of calculating the

relative skill level of player, Date - Match conducted date, Result - Numeric value (1 - represent win, 0- represents loss, ½ represents draw), Result Winner - player who win the match, Commentaries, Moves - moves made by the player in the match, etc. The duplicate data and missing values in the dataset are identified and removed in the data preprocessing step.

## V. BLOCKCHAIN TECHNOLOGY

Whenever player rating changes, it is validated and new blocks are added to corresponding blockchain with player current data and timestamp.

Change in one block will change hash of that block. Change in block hash value denotes change in that particular block it makes blockchain secure. Each block in the blockchain consists of

- Data - Player gameplay data.
- Timestamp
- Block Hash
- Previous block hash

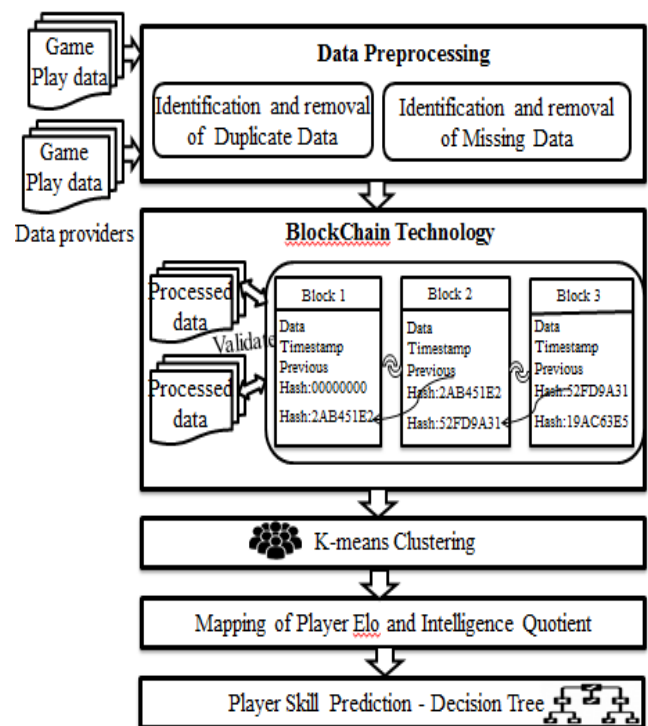


Fig.1 Architecture of the system

SHA-256 is used to calculate block hash. The Processed data are validated in blockchain.

The validation process includes merging datasets and fixing mismatches. Then blockchain is created for each players and based on player ratings, timestamp new blocks are created and are added in blockchain. Though the player data changed over time they are managed using blockchain. For clustering the similar player together the recent data are obtained through blockchain implementation and it is given as input to K-means clustering.

In Fig.2 The Block 1 is called as Genesis Block since its previous hash value is Null , block 2 contains the hash value of block 1 and block 3 contains the hash value of block 2 and this forms blockchain.

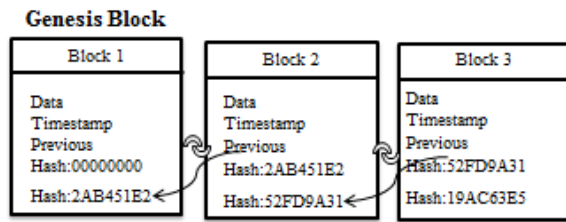


Fig.2 Architecture of the system

## VI. K-MEANS CLUSTERING

K-means partition algorithm constructs partition (cluster) of data with each group contains atleast one object and each object must belong to exactly one group.

The player gameplay data are validated using blockchain technology and output of blockchain implementation is given as input to K-means clustering algorithm.

In K-means clustering algorithm k value is predefined (K-number of clusters). Based on calculated Euclidean distance K centroids are created. The K-means clustering algorithm iterates until less variation within intracuster. Using K-means clustering player with similar ratings are clustered together.

## VII. SKILL PREDICTION

Player skills are predicted based on the gameplay data. The similarity is calculated among the players by comparing their ratings between other players in the clusters. The processed data is validated using blockchain technology and the outliers are removed using K-means clustering. The player Elo rating is converted to Intelligence Quotient using the formula  $ELO \sim (10 \times IQ) + 1000$  and player skill is predicted using decision.

Table 1: Factors for Evaluation

Factors	Description
True Positive (TP)	The count of rightly predicted skill
True Negative (TN)	The count of rightly not predicted skill
False Positive (FP)	The count of wrongly predicted skill
False Negative (FN)	The count of missed accurate and right skill

The decision tree starts with the root node, it has splitting, decision node and leaf node holds the final results. Classification rules reflect the paths from root to leaf. Tree based approaches require high precision, reliability, and interpretative ease tree predictive models.

## VIII. RESULTS AND DISCUSSION

In this section, results are discussed. One of the aims of the proposed method improves the accuracy and stability. Blockchain is implemented to merge the datasets and to perform validation of the obtained data. Similar players are

clustered using K-means clustering algorithm and it improves the accuracy of predicting player skill by removing the outliers. Decision tree empowers the accuracy, stability of prediction

### A. Data set

The data set is obtained from Kaggle, FICS (Free Internet Chess Server) Games Database, data.world. Dataset contains more than 81,000 observations and as much as 20 features. Features such as Game ID, Game start time, Game end time, Number of turns, Winner of the game, White player ID, White player rating Black player ID, Black player rating, all moves by the player in the game, etc.

### B. Evaluation Metrics

Accuracy and stability can be assessed in terms of Error rate (E). The higher the Error rate, less reliable the data classification.

Error rate (E) is calculated using the following equation,

$$\text{Error rate} = \frac{FP + FN}{TP + TN}$$

Accuracy is how close a calculated value is to the actual (true) value. The accuracy of the classification performance is calculated using the equation,

Higher accuracy and lower error rate are expected in the proposed system.

### Precision / Positive predictive value:

Precision is the fraction of relevant instances among the retrieved instances

### Recall / Sensitivity:

Recall is the proportion of specific instances that were recovered over the total number of instances in question.

$$\text{Recall} = \frac{TP}{TP + FN}$$

### F – Measure:

The f – measure is the harmonic mean of recall and precision

### Fallout Rate:

Fallout rate is calculated as the ratio of correctly predicted skill to the sum of missed and wrongly predicted skill. It is calculated as

$$\text{Fallout Rate} = \frac{FP}{FP + TN}$$

### Mean Absolute Error (MAE):

MAE is a measure of difference between two continuous variables.

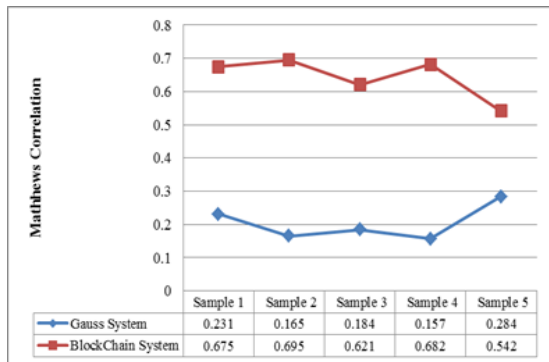
$$\text{MAE} = \frac{\sum_{i=1}^n |y_i - x_i|}{n}$$

### Matthews Correlation:

MC is a correlation coefficient between target and predictions.

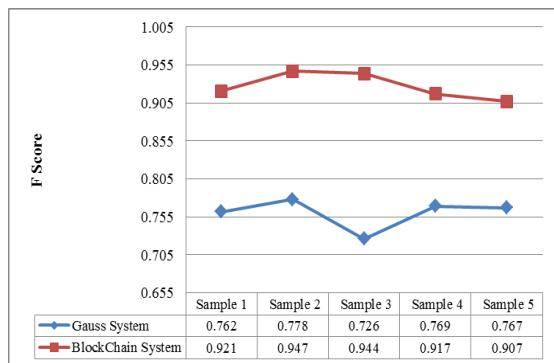
## C. Results

The experiment was conducted with 5 different samples of the player gameplay data set each containing 10 users. The samples were chosen by considering various aspects and behaviour of the player. The graph of Matthews correlation values of the proposed system is compared with existing in the Fig.3



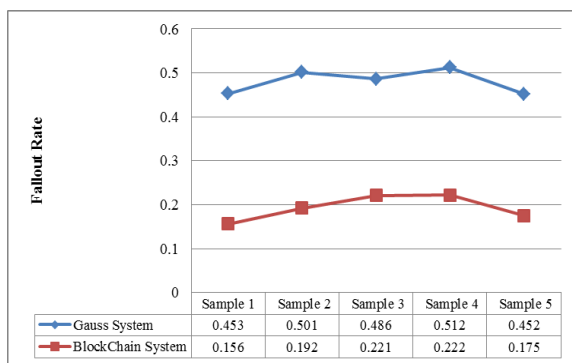
**Fig.3 Evaluated Matthews Correlation**

The f score of the proposed system has better values. It can be inferred from the Fig.4 that the Precision mean and recall mean values are higher.



**Fig.4 Evaluated Matthews Correlation**

The better reduction of fallout rate refers the better performance. Fig.5 shows the fallout rate of both the approaches. From Fig.5 it can be found that the fallout rate of the proposed approach is lower than the existing system.



**Fig.5 Evaluated Fallout Rate**

The experimental results of the Blockchain based system were compared to the newton based system based on the Gauss. The obtained results showed a better performance of the proposed method in terms of efficiency and precision.

The findings of the experiment concluded the following things

- 29% of improved in F Score
- 44% of improved in Matthews Correlation
- 17% of improved in Fallout Rate

## IX. CONCLUSION

A blockchain based skill prediction technique is used to predict the skill of the player. Player gameplay data are collected from data providers and it is validated using blockchain technology. The partition based clustering method is applied. To increase the accuracy of prediction, players are classified into groups using K-means clustering, a clustering approach based on partitions is implemented. Euclidean distance is computed to measure the distance or the (dis)similarity between each pair of players. Decision tree algorithm is used to predict player skill. This approach improves the efficiency of predicting player skill.

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