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Impact of Social Games in Aggregating Relationships in Social Capital through Online Social Media Network

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<i>Article History</i>	<i>Abstract</i>
<p>Received: 23 July 2023 Revised: 18 August 2023 Accepted: 26 September 2023</p>	<p>In recent days, social network sites connect people and help them maintain social ties through aggregating and accumulating social capital. This trait is important for organisation and individual success. The literature in the field indicates that there is a wide gap in automating the prediction of aggregation of social capital through online social games in social media networks. The analysis of the impact of social games in facilitating Social Capital (SC) is very vital. The existing mathematical and statistical modelling techniques fail to recognise the inherent and latent associations among the exploratory variables. Hence, this work proposes an ensemble machine learning model that learns the inherent features from the questionnaire collected from online gamers on three genres, namely media technology availability, multimedia communication channels and degree of social connectedness. The base learners explore the data domain in different ways to extract the features. The efficacy of the model's prediction is done by analysing the accuracy, F1 score, precision and recall. The results indicate that the model can effectively classify the instances, whether they positively or negatively contribute to the aggregation of SC. As a future extension of the research, the model can be made to learn more extensive attributes.</p>
<p>CC License CC-BY-NC-SA 4.0</p>	<p>Keywords: <i>Social Capital, Ensemble Model, Social Media Networks, Random Forest, Social Media Games, SVM</i></p>

1. Introduction

Developing social relations and interpersonal skills is now gaining more popularity, even among Multinational companies, to achieve the notion of sustainability in all aspects of management [1]. The term Social Capital (SC) is not new, and it has a long history of lineage, as humans tend to associate themselves with others with whom they share some common grounds. SC is a product of positive human interaction of any form [2]. More precisely, SC can be defined as a set of shared values that makes individuals operate as a group to achieve a shared and common purpose [3]. The outcomes of SC may either be tangible or intangible. It sometimes comprises innovative ideas, favours, and useful information, with futuristic opportunities. This trait cannot be held by an individual. It is perceived as the capacity among the individual's Social Network Connections (SNC) [4]. These connections can be explored to best describe the success of the organisation in terms of networking and personal relationships within or outside the organisation. This relationship is a means of building friendship, trust, and respect and developing harmony among the employees, thus creating a positive work culture.

SC can be inferred as the capability to procure resources, information or favours through personal connections. The fundamental idea behind this is to describe the harmony between the members who are connected [5]. From the perspective of business, social capital effectively contributes to the success of a company by creating a sense of shared values without compromising mutual respect [6]. Figure 1 shows the factors that influence the SC in any connections, while Figure 2 shows the types of SC.

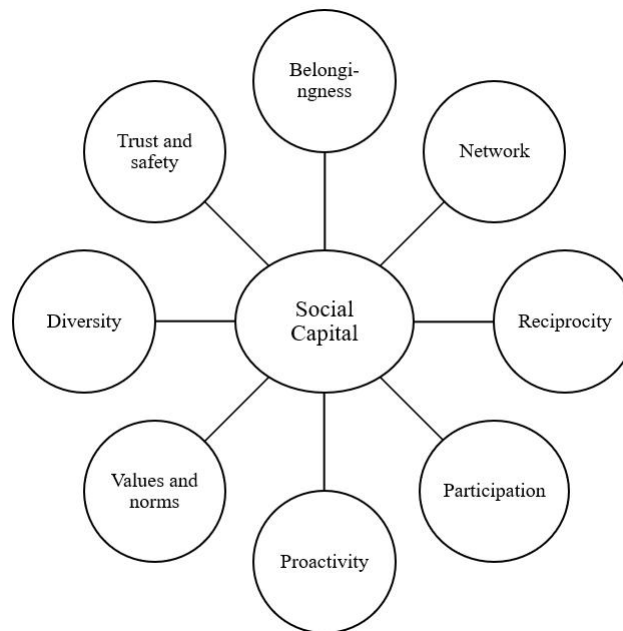


Figure 1. Factors Influencing Social Capital

SC can be classified into three types, namely bonding, bridging and linking.

- i) Bonding is the SC formed among the group with common goals and interests.
- ii) Bridging focus on creating SC across the groups. In a successful bridging, the individuals within two groups find their shared interests and goals to operate together to attain them.
- iii) Linking creates ties among different groups, including different socioeconomic communities. Linking eventually increases the chances of enhancing social mobility.

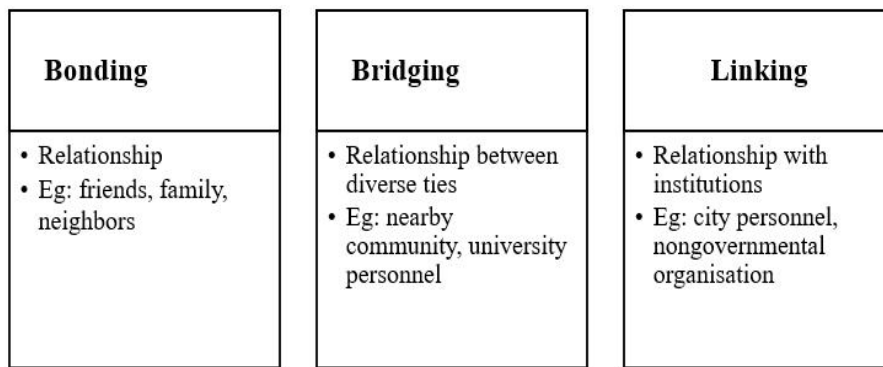


Figure 2. Various Types of SC

Figure 3 shows the relationship between trust, social media and equality, considered as building blocks of SC.

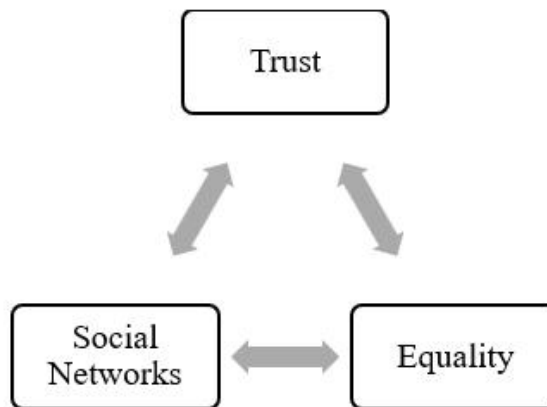


Figure 3. Building Blocks of SC

Social networks like Airbnb, Uber, and eBay employ SC to make selections based on previous reviews [7]. The companies or organisations that own these websites make use of these reviews as a part of improving their quality. Social Networking Sites (SNS) like Meta can improve bonding by analysing the personal interests of the individuals [8]. Nevertheless, social media is a primary source of building SC for firm owners who showcase their goods, products as well and services through online mode. Immersive gaming environments such as Massively Multiplayer Online Role-Playing Games (MMORPGs) permit people from various socioeconomic groups and versatile demographics to collaborate in online worlds [9]. These individuals will eventually develop relationships and strong associations.

The creation of Social Network (SN) and the development of SC have attracted the interests of many [10], [11]. As online games are increasing, they imbibe communication activities among the players who are held accountable for the activities of other players [12]. The behaviours will facilitate communication and conversation to cooperate in helping others while engaging in group activities to accomplish the goals [13]. Now, it has become an effective means of social interaction and self-expression. These games, when properly played, can take up an important role in developing, nurturing and predicting a user's psychosocial characteristics [14], [15]. Figure 4 shows the opinions of online gamers on their view of playing online social games. Adolescent children may experience changes on three levels, namely physical, emotional and cognitive. These changes determine their social relationship in the future as their social activities increase [16]. Acquiring SC through proper interactions is viewed as the key element that impacts the adaptive behaviour of children during their adolescence [17]. Figure 5 shows the interaction of social media and its various contents accessed by the people.

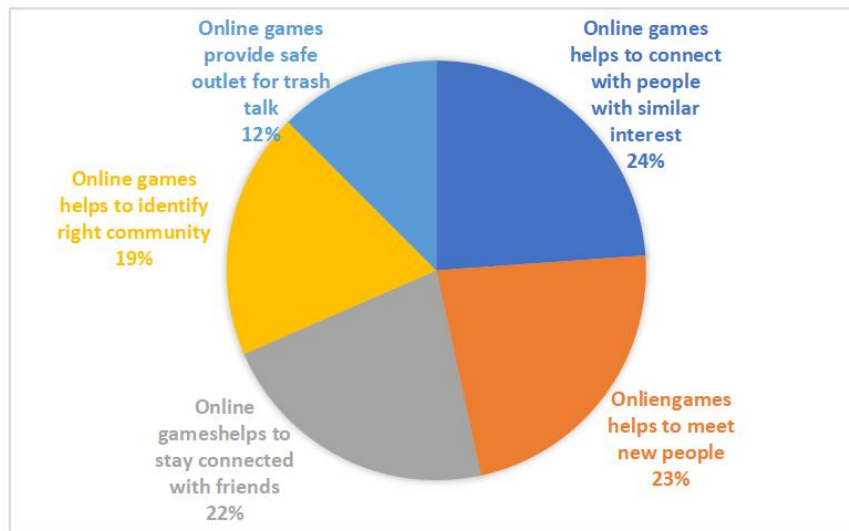


Figure 4. Opinions About Online Games

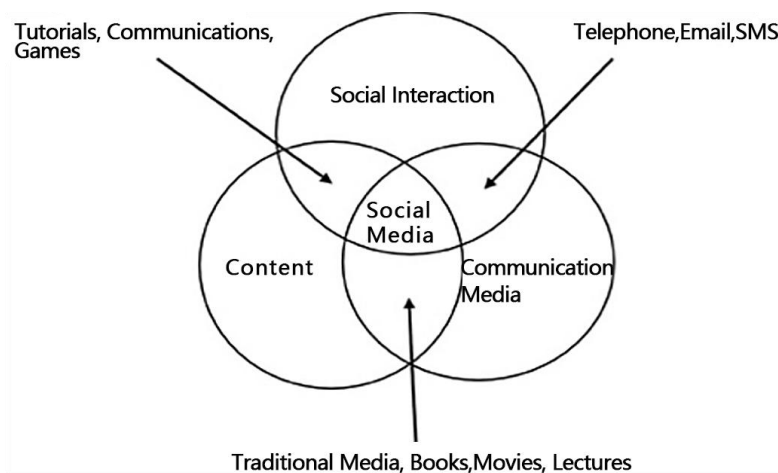


Figure 5. Online Social Media Content on SC

1.1 Online Gaming Communities

The developments and introduction of new online games have paved the way for adolescent people to get connected to people all over the world. These permit the players to go deep into the gaming environment and develop an avatar to interact with a virtual world and with other avatars. Few games are used as a part of treatment for Attention Deficit Hyperactivity Disorder (ADHD) children [18]. The key advantages of these games are achieved when the players try to achieve the common shared goal by operating together.

Also, this gaming community gives a chance for the players to meet anyone in the world who plays the same game. They have also been an outlet for creativity and even literacy. The fans participate in Fanfiction stories that are created by themselves. These so-created fictitious biographies based on the characters in the characters of the game can be the content of short novels. The game itself demands the players to virtually create their looks, character, etc., to know their way of interaction. These communities impart belongingness and also develop leadership by helping them to organise their group, take the initiative and aid them to achieve greater success. Smaller gaming communities foster a feeling of trust among the players, which may lead to the disclosure of personal information. Trust is also enhanced through in-game cohesive play. They also develop emotional bonds between their teammates who are in high-stress situations [19]. The gaming communities have become a place where meaningful social interaction occurs, which is the main motivation behind multiplayer games. The three genres of data considered in this work include:

1. Media technology availability refers to the potential of the medium used by players to carry out actions with technical support, such as the potential characteristics and capabilities of the medium. For example, Facebook technologies such as liking, commenting and reposting provide us with the technical support to communicate with others.

2. multimedia communication channels refer to the ability of gamers to communicate with each other across multiple media platforms, apps and other channels (e.g. Facebook, Instagram, WhatsApp) at the same time.

3. The degree of social connectedness refers to the closeness of the player's communication with social connections.

This study analyses these meaningful collaborations and social interactions in aggregating the SC. This explores the possibility of the presence of a virtual gaming network that creates greater SC. Also, the disadvantages of constant interaction with the virtual world have some ill effects both on their emotions and health. This study investigates the impact of SC on adolescents by examining the psychosocial variables. This also examines how the subjects are related or connected with each other to utilise their SC to effectively manage the psychological status by analysing the empirical data.

2. Related Works

This section briefs a few significant works in analysing social games in accumulating relationships through SC from online SMN. From the literature, it can be witnessed that there is a gap in coherence among theoretical aspects of SC and its main components. Also, there is no definite operational description of the primary elements for evaluating or assessing the SC [20].

Social information seeking is the browsing information of individuals known to the users offline [21]. This disclosure of this information has a very positive effect on the SC. The heterogeneous information like hometown, biography, place, etc., presents missing SC cues and strives to establish the missing common ground. Also, profile-related information on social media sites is strongly correlated with Facebook friends [22]. These signal others about their specific personal interests affiliated with some institution, organisations or social connections to establish a connection with Facebook friends, transforming latent ties [23]. The disclosure of personal attributes, qualities and information is constrained by the privacy attitudes of Social Network Sites (SNS) [24].

The monolithic activity in SM impacts users in multiple ways based on the type of activities, communication, broadcasts and passive consumption of news [25]. The longitudinal surveys were done on 415 Facebook users, which showed that messages are closely associated with increasing the SC. A detailed comparative analysis of SC based on the environmental aspects of Ho Chi Minh and Bangkok was studied [26]. The effect of empirical as well as theoretical triangulation was studied to get more insight into SC and the ways gender impacts trust. A detailed work that analyses three major classes of SC, namely trust, cooperation, and network, was done using the game theory [27]. A few important implications were drawn from this research on the definition of these terms.

United States has been recently witnessing a decline in the SC among internet users. The research was done by modelling an SC with explicit links to all the ideologies of SC, along with multiple indicators gathered over a period of 20 years [28]. The results were not consistent, and hence, the decline in SC of the US was not agreeable. Homero Gil de Zúñiga gave a new dimension to the accumulation of SC in SM from the conceptual and empirical perspective [29]. The study was made based on the two-wave panel data set of the US to investigate the variation in two modes of SC, namely online and offline. Results indicate that the SC in SM is totally different from face-to-face social capital. Building SC based on the usage of ICT tools is a new trend of research that focuses on the accumulation, escalation and effective utilisation of offline as well as online resources for improving the SC [30]. These trends indicate the narrowing gap among these modes of accumulation of SC as the Information and Communication Tool (ICT) platforms increased the specificity.

A comprehensive review of the online SN and accumulation of SC on 54 articles were done [31]. An elaborative 13-category framework was provided as a roadmap for future researchers. The results portrayed that SC is nurtured through the SN sites. Two types of hypotheses based on augmentation as well as displacement acted as two mediators to analyse the association between SM and mental health among the population in New Zealand [32]. The analysis was made based on networking, accumulation of offline SC, internet addiction, depression and anxiety. The results indicate that SM in networking increased anxiety as well as depression both offline and online.

A study on the consumers' perceptions of SC in luxury Social Media (SM) communities on about 353 luxury brands was done [33]. Reciprocity and shared vision displayed a positive relationship with brand passion. The mechanisms of SC on the consumer-brand community have to be understood by the brand owners. Using SM to express opinions and trusted information involving the participation of citizens in civic affairs is done [34]. The findings indicate that the usage of SM and SC fosters civic activities. The influence of SM in imparting heterogeneity and improvement of bridging as well as bonding in SC is studied [35]. The results showed that usage of SM is closely associated with communication among college students with improvement in bridging as well as bonding SC.

The survey shows that many researchers investigate the effect of accumulation of SC in various SM platforms. However, not many works focussing on the interaction of online game players in building the SC were done. Hence, this study attempts to analyse the impact of online SM games in the accumulation of SC among the players using the Machine Learning (ML) model.

3. Methodology

The popularity and success of ML models are not restricted to any field of interest [26]. As SM is the most widespread as well as rapid voluminous data-generating application, it poses the challenge of processing massive data. Hence, ML models are a natural choice for learning these data, which learn the activities of the users/ game players to predict the accumulation of SC in the gaming platforms. The research methodology used in the work is based on the survey that was conducted among online gamers. The questionnaires were based on their anxiety level, social media interaction and satisfaction in life. The data gathered was then learned by the proposed ensemble ML model to predict whether the gamer is contributing positively or negatively to the accumulation of SC in the context of online gaming platforms.

Figure 6 shows the proposed ensemble model for predicting the aggregation of SC among the gamers. In ensemble modelling, multiple diverse models are integrated to predict a common outcome. The integration can happen either by using homogeneous or heterogeneous models or even by splitting by deploying different training data sets. The model then aggregates the prediction results of each of the base models and outputs it as a final prediction. The primary motivation for deploying ensemble models in problems such as SC prediction among gamers is to mitigate the impact of the generalisation error, a common prediction error. Diverse and independent models eventually lower the prediction error.

The data is collected through the comprehensive questionnaire, which analyses different aspects of SC development in online gamers. Then, data is subjected to k-fold cross-validation to increase the robustness of the data. The classification happens by including the most influential features collected from the data. Four different ML base learners are used to explore the data, and aggregation of the predictions from individual base learners is done by stacking the Random Forest (RF) algorithm. Each of the base learners used in the work is unique in its own right. Support Vector Machine (SVM) works well linearly separable data at the same time. Random Forest, which is used both as a base learner as well as stacking algorithm, ensembles and aggregates the predictions of the individual learners.

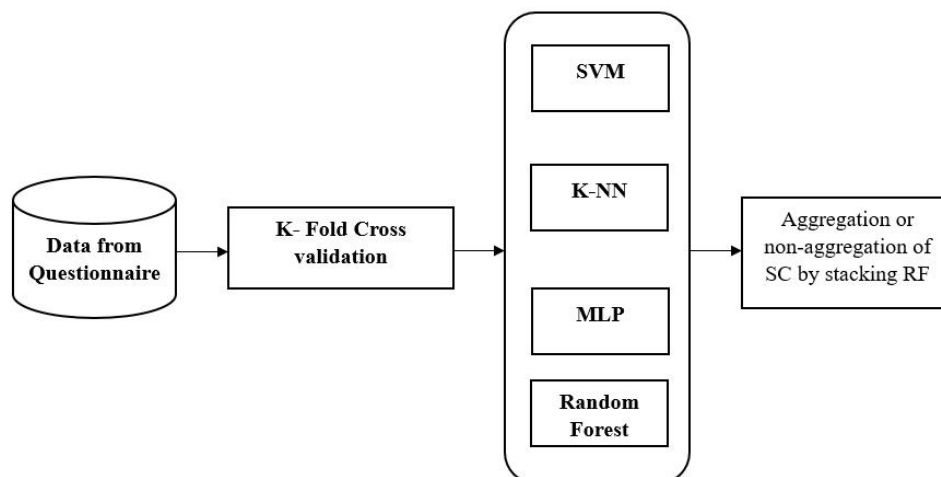


Figure 6. Ensemble Model for Predicting the Accumulation of SC

Multi-Layer Perceptron (MLP) is a rudimentary model for all deep learning architectures. The algorithms used in this ensemble are supervised learners. K-Nearest Neighbor (KNN) is an unsupervised learning algorithm that captures innate patterns by exploring the data. RF is an ensemble of homogeneous decision trees.

3.1 SVM

SVM supports the labelling of the class by a one-to-rest approach. Each time, the base learner predicts the belonging or membership of the instance to a specific class. An imaginary hyperplane delineates a specific class from the rest of the data points [37]. This is very efficient for small sample-learning models as it adheres to the structural risk mitigation strategy for prediction. The model adopts non-linearity by adopting kernel tricks. Figure 7 shows the working principle of SVM.

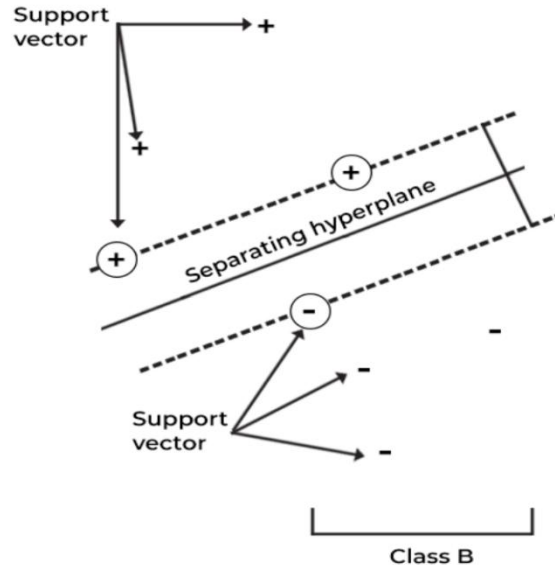


Figure 7. Support Vector Machines that Draws Imaginary Hyperplane on Data Instances

3.2 Random Forst (RF)

RF is a homogenous ensemble-based learner which uses decision trees as predictors of class labels. The class label is predicted by Equation 1.

$$Y = \begin{cases} 1, p > 0.5 \\ 0, \text{else} \end{cases} \quad (1)$$

p is the mean probability that individual base learning decision trees belong to a particular class, which is computed using the majority voting technique in case of classification or using a method of averaging for regression. RF can quickly construct and train the individual base learners, making it more suitable for handling large volumes of data. The attribute selection in the decision tree is done in a random fashion, which eventually avoids overfitting. Figure 8 shows the ensembling of RF from individual decision trees.

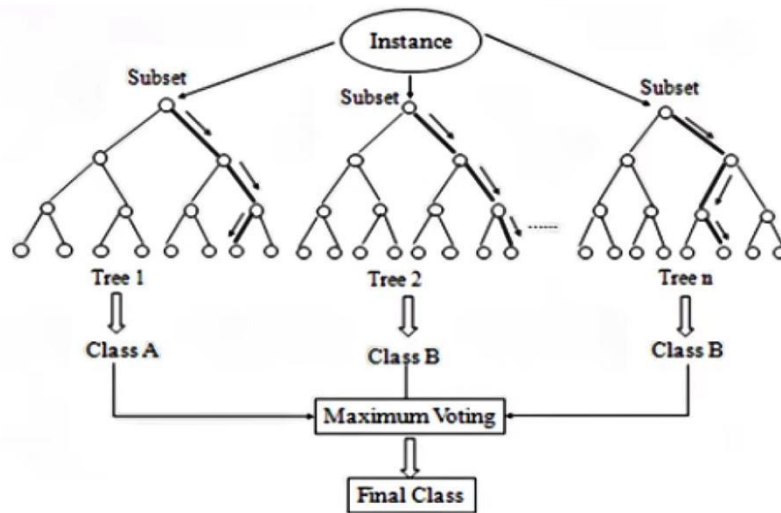


Figure 8. Development of RF from Individual Decision Tree

3.3 Multi-Layer Perceptron (MLP)

This is a simple and rudimentary neural network with only three layers, namely: input, hidden and output layer. The architecture of MLP is shown in Figure 9. The weights are modified through the backpropagation model. The model deployed for this work comprises 6 hidden layers that are trained for 600 iterations. The Adam optimiser is deployed at the output layer as the activation function, and the hidden layers use ReLu, which works according to Equation 2.

$$Y = \max(0, x) \quad (2)$$

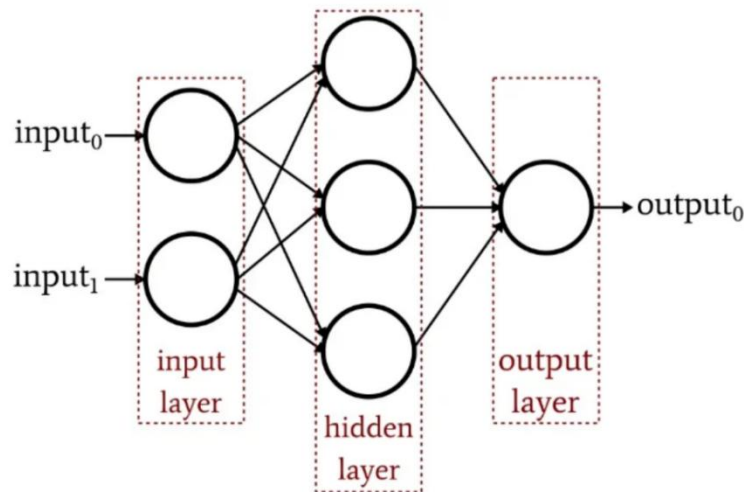


Figure 9. Basic Architecture of MLP

3.4 - Nearest Neighbors (K-NN)

This unsupervised strategy classifies the data by investigating the similarities and dissimilarities among them. This is lazy learning, a non-parametric model that labels the data into n classes which is the K value. Figure 10 shows the classification of KNN.

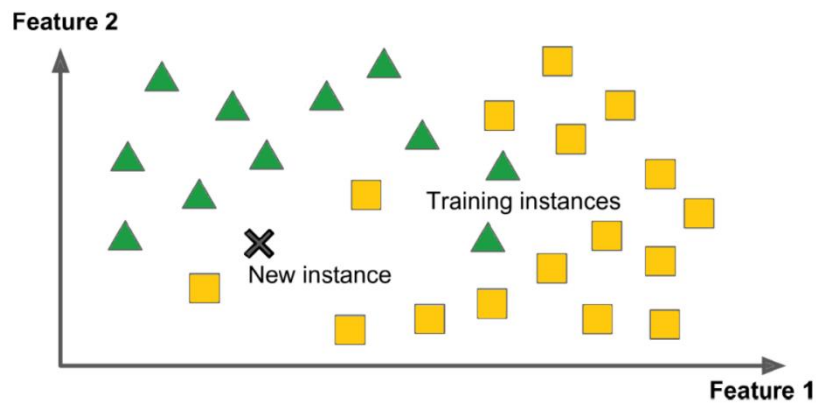


Figure 10. Classification of Instances in KNN

4. Results and Discussion

The work focuses on accumulating the SC among online gamers by examining their psychological as well as other demographics about the gamer. The survey method is used for learning the characteristics, which comprises elaborative questionnaires that are categorised under three heads, as mentioned in Table 1.

Table 1. Questionnaire Used in the Study

Category	Question	Answer options
Availability of Media Technology (AMT)	For the past 2 weeks, how often have you been bothered by the below-mentioned issues? <ul style="list-style-type: none"> • Nervous • Uncontrolled worrying. • Worrying about the variety of matters • Facing trouble in relaxing. • Restless • Annoyed • Scared 	<ul style="list-style-type: none"> • Not at all • Several days • Over half the days • Nearly every day
Connectivity to Multimedia communication channels (CMC)	Use a 1-7 scale to indicate your degree of agreement. <ul style="list-style-type: none"> • My life is close to ideal. • Excellent life conditions. • Satisfied with life. • I am prosperous 	<ul style="list-style-type: none"> • Strongly disagree • Disagree • Slightly disagree • Neither agree or disagree • Slightly agree • Agree • Strongly agree
Degree of Social Connectedness (SC)	<ul style="list-style-type: none"> • Scared of authoritative people • Bushing in the presence of others • Social events scare me. • I do not talk to new people • Not able to accept criticism. • Fear of embarrassment • Sweating in the presence of new people • Avoiding speeches • Heart palpitations 	<ul style="list-style-type: none"> • Not At All • A Little Bit • Slightly Disagree • Neither Agree or Disagree • Slightly Agree

This table focuses on the mental ability of the gamers. Apart from these questionnaires, the dataset also contains general demographics and other information like age group, gender, etc. The descriptive analysis of the data based on the playing style, which shows the connectedness among others, is shown in Table 2. This table focuses on how well the individual players interact with others

and form social connections among them. Apart from this, mental well-being is also monitored by measuring the satisfaction level in their life, which is a great human value.

Table 2. Connectedness between the Gamers

Playing Style	Number of Respondents	Average Playing Hours	Average Satisfaction of Life
Multiplayer games with acquaintance with teammates	258	28.9	7.43
Multiplayer games with real friends	283	24.67	7.44
Multiplayer games with strangers	436	27.54	7.11
Single-player	94	22.53	7.05

The three scores, as mentioned in Table 2, are the primary attributes or features which are learned by the proposed ensemble model. The responses to the questionnaire can be grouped into the following categories: gender, geographical location, cultural background, gaming platform and specific games. Each of them has its own strengths and weaknesses and cannot be generalised. The data indicates that League Of Legends is not listed among the top 10 popular games. Also, the game styles on the smartphone or tablet have varied effects on social balance and mental health. It can be observed that the distribution of the number of hours spent in gaming per week is in Gaussian form, and this is unbiased and is shown in Figure 11. The data labels are hardcoded in the dataset based on the above findings.

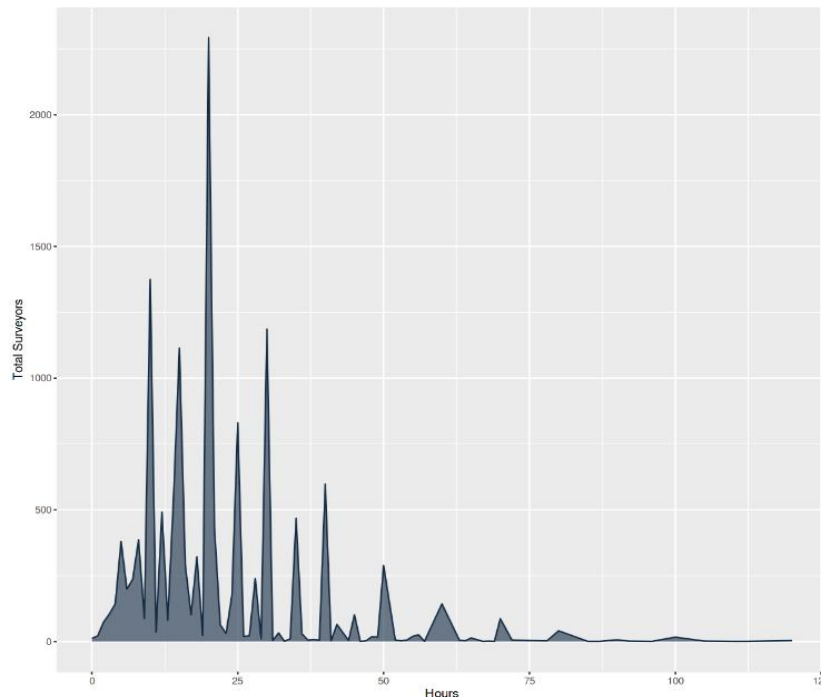


Figure 11. Gaussian Distribution of the Number of Hours of Data

A few important research insights and correlations can be made as answers after analysing the data. Gamers with weak AMT scores are less likely to get socially connected and, hence, do not contribute to the accumulation of SC. Also, these people have lower life satisfaction levels. Also, the vice versa is also true. People with higher satisfaction in life exhibit more social connectedness and hence can be attributed to having less SC.

Table 3. Mean of the Responses of the Three Categories.

Reason For Playing	Number Of Respondents	Anxiety Measure	Life Satisfaction	Social Connectedness
Relaxation	619	6.31	18.9	20.5
Winning	1963	6.1	18.333	22.01
Improvement	4672	5.25	19.6	19.49
Fun	5060	4.6	20.67	19.13

This dataset is processed by the proposed ensemble model, and predictions are made. The efficacy of the model in predicting the accumulation and non-accumulation of the SC of the gamers is shown in Figure 12. This also displays the comparison between the other state of art algorithms. The computation of the performance metrics is listed below:

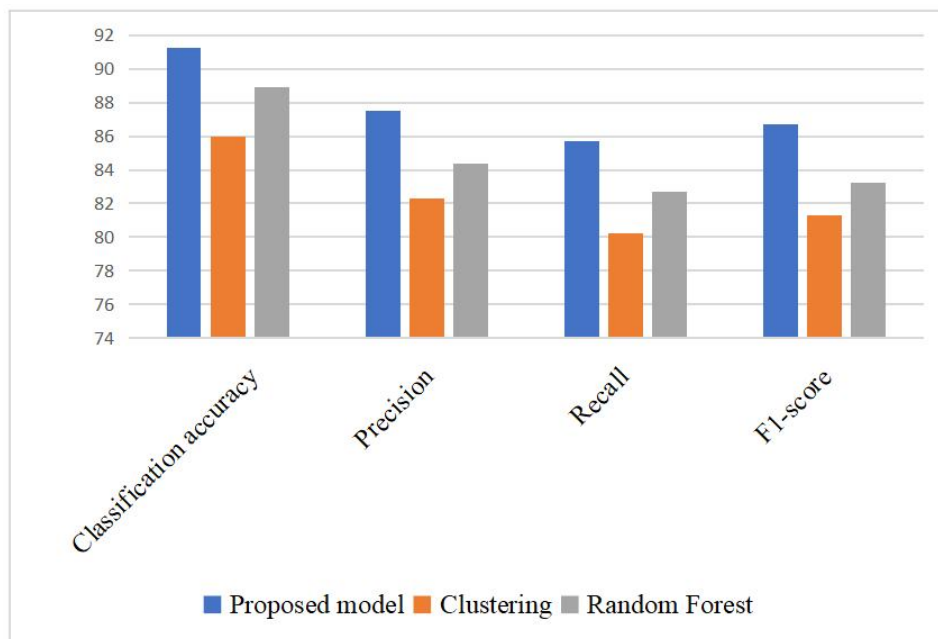


Figure 12. Efficacy of the Model in Comparison with Other ML Algorithms

Classification accuracy is the proportion of right predictions by the model and is mentioned in Equation 3.

$$\text{Accuracy} = \frac{\text{Count of samples classified in proper class}}{\text{Total classifications}} \quad (3)$$

Precision indicates the fraction of actual positives to the samples that are predicted as positives and is computed using Equation 4.

$$\text{Precision} = \frac{\text{Count of positive samples}}{\text{Total classifications classified as positive class}} \quad (4)$$

Recall is ratio positive samples and the instances correctly classified. This is found using Equation 5.

$$\text{Recall} = \frac{\text{Count of instances rightly classified as positive}}{\text{total number of classified instances correctly classified}} \quad (5)$$

F1-Score indicates the geometric mean of precision and recall and is determined based on Equation 6.

$$F1 - Score = \frac{2 * Precision * Recall}{Precision + Recall} \quad (6)$$

The results of the comparative analysis show that the existing individual-based learning models exhibit low values in all the classification metrics. This is an indication that the individual learners are not able to explore and learn from their search spaces. The proposed model is an integration of various algorithms. Hence, each of them operates on the data in a unique way so that the features are overseen.

5. Conclusion and Future Works

Man is a social animal who tends to live in colonies and communities. The rampant technological development has made humans get connected in various online platforms like social media networks, gaming, etc. There has been a debate that online games are exploiting gamers by increasing their anxiety and stress levels. Despite this fact, online multiplayer games are a primary means for accumulating the SC on some common grounds. The literature indicates there is a wide gap in a systematic analysis of the accumulation of SC. Hence, this work proposes an ensemble ML model that learns the social activities of online gamers through a questionnaire which is categorised into three domains. The model's efficacy is validated on the standard classification metrics, namely accuracy, F1 score, precision and recall. The results indicate that the proposed model exhibits better classification efficacy in determining whether the sample instances contribute towards the accumulation or aggregation of SC or not. In the near future, the model can be trained to explore a wide range of data with a variety of attributes.

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