# Game-Stress-Tracker: EEG-Based Smart Advisor Bot for Stress Detection During Playing BGMI Game

**Sima Das, Sayantan Malick, Sovan Sundar Dey, Amin Sarkar, Fardin Hossain, and Abdus Samad**

**Abstract** In today's fast-moving world, different ages peoples are suffering from mental stress, among them video games are the most popular activity to reduce psychological stress; but some games reduce stress and some games induce stress. In this paper our proposed system will detect the stress level of a game during playing. Chronic stress consequences in cancer, cardiovascular disease, depression, and diabetes consequently are unfavorable to physiological fitness and mental health. Battle Ground Mobile India is a popular game and it is an edition of PUBG. Kraft released the BGMI game on July 2, 2021, which supports android devices. This game is based on the multiplayer battle royal game which is available online. This game is very popular among teenagers but the game has some limitations also. Limitations of BGMI games are as follows: not hearing anyone while playing the game, eyes being affected, stress on the brain, disbursing money, addiction to the game, and bad effects on education. So, in this paper, we are discussing how the BGMI game affects the human brain. We used electroencephalography to collect brain signals, and alpha ($\alpha$) range brain signals filtered by the band pass filtering method. After that feature extraction is done by the principal component analysis method. Classification is done by a support vector machine and classified by the following categories: normal or stressed, stressed further divided into medium and high-level stress. The proposed system was validated using accuracy, f1 score, and precision with values of 89.53, 89.51, and 89.52%. The proposed system will be notifying the guardian using Telegram Bot about the current stress of their child, based on that result, the guardian can avoid or allow their child to play games. So, the system will help to reduce the stress of children as well as their guardians.

**Keywords** Electroencephalography · Principal component analysis · Support vector machine · Physio care · Stress detection · Brain computer interaction · Bot

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## 1 Introduction

In this era, video games are the most popular activity among more than 2 billion people [1]. Sometimes playing violent video games causes aggression and stress [2]. Chronic stress is potentially health-threatening [3, 4]. An EEG is one of the major diagnostic assessments for epilepsy. An EEG also can play an important role in diagnosing different brain disorders [5]. In the present world stress is a common factor for a child to old-aged people. Like all habituated game BGMI additionally have a few barriers: it's addictive, so could probably waste a variety of a while just by using gambling it, the competitiveness of the sport would possibly have an impact on your highbrow fitness as you could lose someday, wastage of money, it is the mode of amusement and you need to no longer play an excessive amount of as it has a bad effect on thoughts and eyes. So, these are disadvantages of gambling BGMI but all of these are based upon your ways to play the game and the manner intensely, approximately triumphing in it.

The current work focused on analyzing the stress by comparison of training and testing of EEG-based game datasets. The dataset is collected from electroencephalography which is connected to the subject's scalp while they are playing a BGMI game. The raw EEG dataset needs to be cleaned, for that purpose alpha ($\alpha$) range filtering is used. Features are selected by principal component analysis; classification is done by using a Support vector machine and classified as stress or normal load. Telegram bot used to send messages to the user and their parent's mobile about the mental condition of the user. The rest of the chapter is as follows, Sect. 2 for the literature survey, Sect. 3 for the proposed work, Sect. 4 for experimental results of the current system, and the last conclusion and future works are discussed.

## 2 Literature Survey

The article was designed by Lee et al. [6], to study intellectual and physical strong sports in virtual reality via brainwave detection. To mitigate strain, it's critical to relax the mind by way of enough sleep. Professionals furthermore perceive that relaxation is vital to enhance the mind's reminiscence, cheering the concentration to accomplish time to arrange the length over an intellectual composer. It is a digital authenticity content that may construct a sensible atmosphere, and it recommends satisfied material which could verify the method of resting over mild actions and elements that support relaxation as a technique of brain wellbeing.

Shirke et al. [7] are introduced to the stress of varied depth while performing each day's duties. Excessive strain may be injurious to humanoid fitness. Hence, stress analysis is crucial in avoiding harmful lengthy-period consequences. In this examination, they examine the probability of EEG intended for the size of severe intellectual pressure. As well as up-strain evaluation by 4 samples on strain-caused themes is performed. The tests have been performed with an EEG sensor, Thing

Speak, and an application program on mobile. Challenge is needed to perform a cell sport that encourages strain for the game developments. As soon as the severe stage of pressure is perceived, the character becomes informed through the cell utility to produce a peaceful song and remaining eyes. Inclusive, the test was resolved by decreased strain ranges of the problem subsequently remaining eyes accompanied by track and unaccompanied by track.

In our previous work, Das et al. [8] are designing this paper to measure cognitive load and the analytical burden is considered for young people whilst sporting a one android game involving easy complicated brain action. The recording of human brain action given analytical burden during the data achievement method; EEG is using. EEG is human brain signals acquired through this electric field generate invariants owing to neuronal firings also acquired through the sensor placed by the skull in one manner. Then acquired human brain signals are processed via different steps with the maximum target of assorting through analytical burden; one subject separated the three groups: lower, medium, and high.

Dharmapuri et al. [9], are developed AI-based chatbot to detect mental stress for preventing suicidal tendencies and help to psychiatric treatment.

## 3 Proposed Work

In this era, most teenagers or young people are interested in playing mobile or computer games which affect their brain and affect stress. In this section, we will propose a method that will be helpful to detect stress during playing BGMI games. Figure 1 shows that EEG is used to collect data, an $\alpha$-range filter is used for cleaning data, the principal component analysis is used to select features, and the support vector machine is used for classification as normal or stressed. As the result is stressed then it will be further categorized as medium or high-level stress using the color bar, brain map, and SVM, the collected result is sent to the user as well as parents' mobile to alert them.

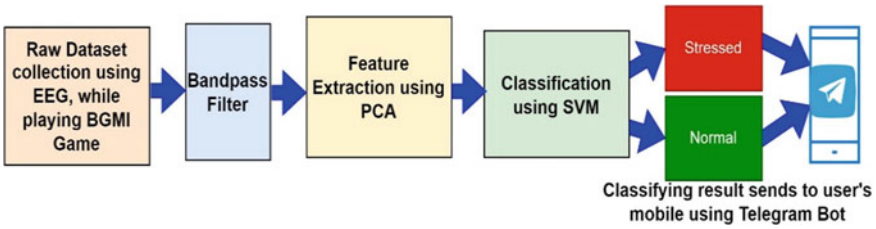



**Fig. 1** Proposed work for "game-stress-tracker"

### 3.1 Dataset Collection

The current work has been applied to 20 numbers of subjects with their consent whose age is above 18. For the EEG test, a small metal disc is used, which consists of electrodes with thin wire pasted onto the brain scalp. The electrodes perceive small electrical signals controlled by the movement of brain cells. O1, O2, T3, T4, FP1, FP2, A1, A2, FZ, CZ, and PZ electrodes are positioned on the scalp of the participant which measures voltage and sends a numeric value via the Brain Tech Traveler system.

### 3.2 Filtering

In this paper, we used an 8–12 Hz bandpass filter which means the lowest frequency of the filter is 8 and the highest is 12 Hz, which is the range of the alpha bandpass filter. In Eq. (1), $F$ is the band pass filter, $F(H)$ means the highest frequency, and $F(L)$ is the lowest frequency band pass allowed for the proposed system.

$$(F)^2 = F(H) \times F(L) \tag{1}$$

### 3.3 Feature Extraction

The data collected while testing is usually in a large data set. Reduce the large data sets into smaller ones that still contain large data, using this method feature extraction, and selection are done. Here features are O1, O2, T3, T4, FP1, FP2, A1, A2, FZ, CZ, and PZ. In Eq. (2–4), X is the after-filtering dataset, C is used for covariance matrix, $\Lambda$ for eigenvalue, and an eigenvector is E.

$$X = \text{[After Filtering\_EEG Dataset]} \tag{2}$$

$$C = X^{\mathrm{T}} X \tag{3}$$

$$\Lambda E = C E \tag{4}$$

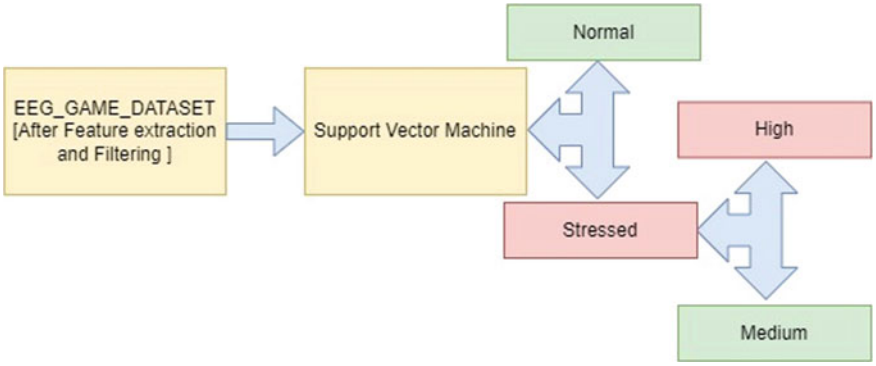



**Fig. 2** Classification using support vector machine

### *3.4 Classification*

Classification is done by using a support vector machine and is primarily classified as normal or stressed. After primary classification, stress is further classified as medium stress or high stress by comparing a color map with a brain map. The red color indicates high stress and the blue color indicates medium stress. In Eqs. 5 and 6, $\Lambda E$ is the after-feature extraction dataset, $W$ is the weightage value, and $P$ is the threshold value. If the $\Lambda E.\ W$ is greater than the threshold value than positive means normal, otherwise stressed, stressed datasets are further categorized as high and medium as shown in Fig. 2.

$$\Lambda E.\, W > P \tag{5}$$

$$\Lambda E.\, W < P \tag{6}$$

### *3.5 Game Rating Calculation*

In this paper, the rating of the game is calculated by classifying stress levels during playing games. The total number of data collected during playing games of each level and each person within several days. After collecting data, stress is detected as medium and high stress by using color maps. In this paper, we assume that 1 is the lowest and 5 is the highest rating of the game. In this system, 2 were used for medium weightage value, and 5 were used for highest weightage value for stress detection which is shown in Eq. 7.

| FP1-A1 | FP2-A2 | O1-A1 | O2-A2 | T3-A1 | T4-A2 | FZ-A1 | FZ-A2 | CZ-A1 | CZ-A2 | PZ-A1 | PZ-A2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13.5 | 15.6 | 7.8 | 8.1 | 2.6 | 3.5 | 4 | 5.1 | 6 | 7.3 | 0.3 | 1.3 |
| 23.5 | 32.6 | 18.1 | 17.6 | 14.3 | 10 | 15.1 | 17 | 15.6 | 13.8 | 15.3 | 13.9 |
| 32.3 | 41.3 | 36.1 | 25.6 | 18.9 | 14 | 17.3 | 20 | 23 | 23.2 | 18.9 | 16 |

**Fig. 3** Dataset collection using EEG

$$\text{Game Stress Rating} = \left( \frac{2 \times \text{medium\_ stress}}{\text{medium\_ stress} + \text{high\_ stress}} + \frac{5 \times \text{high\_ stress}}{\text{medium\_ stress} + \text{high\_ stress}} \right) \tag{7}$$

## 4 Result

The current work has been applied to 20 numbers of subjects with their consent whose age is above 18. The proposed system was validated using accuracy, f1 score, and precision with values 89.53, 89.51, and 89.52% which are shown in Fig. 5, and was initiated and improved upon existing ones. The system analyses stress levels to be useful for psychologists and mental healthcare and sends the report using the Telegram bot.

### *4.1 EEG Placement and Dataset Collection*

The standard 10–20 systems are used to collect data. In the current work, we used O1 and O2 in the Occipital lobe used to see the game, T3 and T4 in the temporal lobe used for try to temporal solution of the game, FP1, and FP2 in the prefrontal lobe used for trying to fetch the solution, and A1 and A2 for ground and reference, FZ, CZ, PZ are common reference electrodes as shown in Figs. 3 and 4.

### *4.2 Brain Map and Telegram Bot*

The brain activity is captured by EEG and generated brain map and also detect stress level by using a color map. In this proposed system we used the Occipital, Prefrontal, and Temporal lobe for stress detection. As shown in Table 1, the Brain map was generated with blue and red colors by using Loreta. Blue color indicates that they have low to medium stress and red indicates that high-level stress occurs

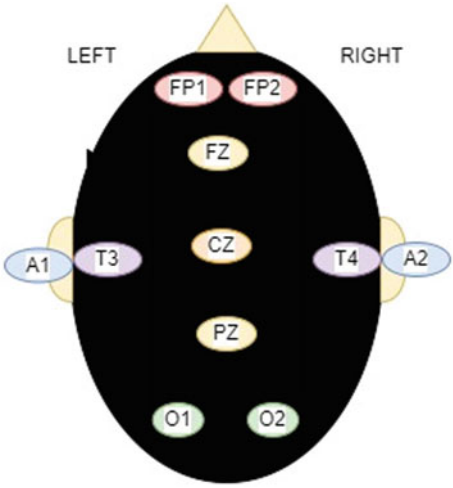



**Fig. 4** 10–20 system of electrode

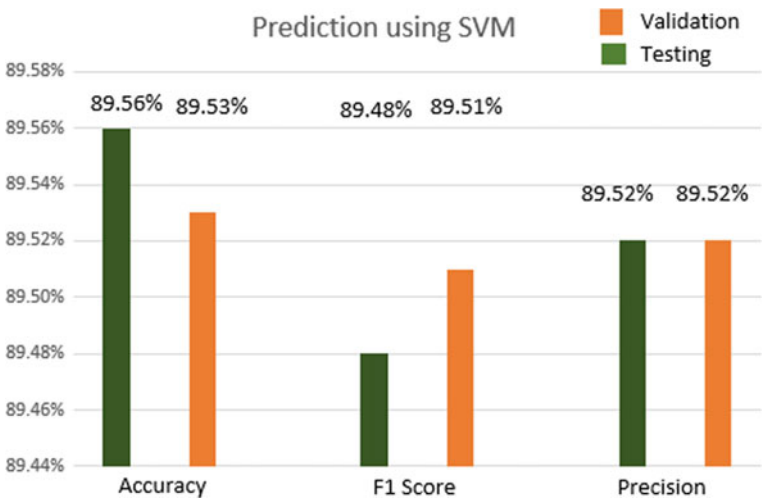
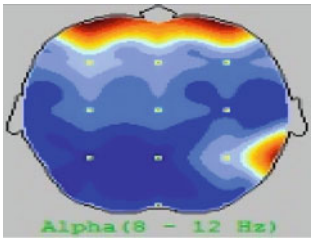



**Fig. 5** Stress detection using a support vector machine placement using EEG

during playing the BGMI game. After calculating the stress level results are sent to the user's mobile by using Telegram Bot.

**Table 1** Identification of Brain Activation while Playing BGMI Game

| Brain map | Screen shot of telegram bot |
|---|---|
|   |   |

## 5 Conclusion and Future Work

BGMI, is an imitation of the world's most popular game, and is now ubiquitous. Some games are very aggressive, the human brain is under a lot of pressure while playing the game, addicted to the game has a bad impact on the human mind. Electroencephalography is used to collect the brain signal, α range bandpass filtering is used to filter, and the principal control analysis method has been used to extract the features. Support vector machines have been used to classify brain signals as normal or stressed. If stresses are found then they will be further categorized as medium and high stress by comparing color bars with generated brain maps. In this paper, we used different classification techniques like back propagation neural network, k-nearest neighbor, linear discriminant analysis, and quadratic discriminant techniques, but the support vector machine gives 89% and above accuracy which indicates that it is the best technique for the proposed system.

In the future, we will use this current method with different types of machine learning and deep learning techniques for better result. The future method will be used at different ages and applied to different kinds of games.

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