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**AUTOMATIC DETECTION OF EMOTIONS IN VEHICLE DRIVERS
BASED ON ANALYSIS OF BIOMEDICAL DATA TO IMPROVE THE
PERFORMANCE**

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ABSTRACT

Everybody on onboard your character vehicle will enjoy each feature. To achieve so, a machine should firstly assess that patient's psychological or stress state, something it should perform by studying the patient's bio-information. Professionals propose a way for inferring moods from a woman's EEG, beating, or heart rate (beat percentage or maximum pulse speed)

through study, as well as recommending colors and music in the inside automobile consumer experiences dependent on the child's psychological state. The approach is designed to determine the 4 emotional factors (stability, quiet, tension, and excitement) by implying or defining emotional condition depending on EEG findings. The SVM algorithm is used for detect physiological materials so depending stress degree by combining mental cycles information through either customizable managerial system, beating, and cardiac rhythm measurements. By using SVM approach that detect your EEG, pulse rhythm, and pulse catalogued upon biological subjective factors, the maximal result of 86.1 % was reached, whereas 80 % of data were learnt suitably as a percentage for refresher materials. Although anticipated, a sporangial categorization procedure relies based on the suspense indicators proffered in this paper will indeed aid in the study of the residing reason functionality (HCI) as it enters its 4th Technological Transformation by labelling feelings colors and nostalgic sound commensurate to for every patient's feeling.

Keywords: Automatic Detection, Emotions, Vehicle Drivers, Analysis Of Biomedical Data

INTRODUCTION:-

Due to its growth in its 4th technological transformation period, a unique futuristic innovation known as emotionally artificial intelligence (Intelligence) has developed in past decades. Due to such the confluence between computer or communications technologies (ICT) with cognition sciences domains, Intelligence emotive computer technologies, that could understand and evaluate individual feelings, is progressing fast [1, 2]. As a result, person computing interaction (HCI) technologies are growing more significant, and research on machine responses relying on emotional inferences and customer purpose, instead then computing responses generated via explicit client interactions, are growing more

common [3]. Its brain computing interfacing (BCI) technique, specifically, analyses, orders, or regulates temporal level electroencephalogram (EEG) information recorded on a person's head. Using Cbi technologies, much research has been done to offer communication among people and machines by merging the patient's emotional data with environmental data [4, 5]. Emotion is a mental capacity and a response to outside perceptual input in animals. People respond psychologically to a variety of societal and historical variables and experience a range of feelings as a result. Emotional detection software is a method of collecting knowledge from the customer's facial emotions and bodily motions depending upon emotional

facts to make smart judgments that may allow optimal response [6]. With a result, technology is critical to quantify consumers' mental strain levels employing EEG and experiment in words of quantifiable mathematical numbers in regards to mental condition, as well as attempts to alleviate these stressors by identifying the resulting bodily alterations. Colors and melody may have important parts in comprehending or interpreting individual feelings since things are produced within a small amount of space and stay for a lengthy period in recollection. A method presented in this work identifies the patient's emotions by understanding and organizing the responses that emerge in response to the patient's psychological situation, or then classifies the biometrics emotive data based on that tension score. With a result, technology is critical to quantify consumers' mental strain levels employing EEG and experiment in words of quantifiable mathematical numbers in regards to mental condition, as well as attempts to alleviate these stressors by identifying the resulting bodily alterations. Colors and melody may have important parts in comprehending or interpreting individual feelings since things are produced within a small amount of space and stay for a lengthy period in recollection. A method presented in

this work identifies the patient's emotions by understanding and organizing the responses that emerge in response to the patient's psychological situation, or then classifies the biometrics emotive data based on that tension score. Moreover, the device is built to create individual packages of heart rates or arterial tension (heart rate and maximal arterial stress) values and transmit them to a database. As a result, after obtaining the fingerprints, the physiological emotional data is classified using a supporting vectors network (SVM) method based on the tension score. Different training methods are used in judgment devices in particular [7].

Literature survey:-

Behavioral psychology studies people or creature cognition functions like vision, communication, memory, and feelings. Methods for integrating such mental functions to the production of robotics, electrical devices, structures, and other objects are explored in the field [8, 9]. Research in its identification, interpretation, or analysis for many sorts of information created through physiological activity has lately gained traction as cognition sciences as gained traction.

Emotionally intelligent computing allows computers to recognize people's feelings and emotions and to perform actions

that are suitable to the circumstances. This entails autonomous systems that can perform suitable actions based on previous knowledge or the current psychological state. Recently, as wearable computing technology thoughts and moods were outward expressions on alterations in a person's emotional situations. People's mental moods and feelings were studied and employed as diagnostic information in health diagnostic testing in years previous. These are, nevertheless, being employed in several sectors, including structures with psychotherapy artwork with automated illumination that mirrors moods, automobiles that avoid drowsiness, and machines who comprehend and react to emotional moods. Extremely smart computing technologies which can comprehend cognitive processes, sentiments, or reactions are being studied by scientists. Technology has progressed to the point that it can better precisely assess vital signs including electroencephalograms (EEG), electrography (EMG), heartbeat (ECG), and lightning body reaction (GSR) and create good identification findings for people' cognitive, emotional, and physical state [10, 11].

In general, peripheral neural systems nor parasympathetic neural systems responses, including ECG, EEG, body heat

(SKT), or GSR, may be used to identify human moods. Our research in brain signal emotional identification technologies has been split into two categories: statistics approaches and computer-training techniques. Numerous latest tracks are evaluated using regulation methods, and affective characteristics that reflect feelings are extracted. Next, with every mood, cutoff levels that correlate with regulations are defined, and feelings are identified using those criteria. Neuronal networks (NN), supporting vectors computer (SVM), k-nearest friend (k - nearest neighbors), inter autoencoder (MLP), Geometric mixed modeling (GMM), determination trees (DT), and Invasion by foreign networking (BN) are examples of computer learning-based emotional identification algorithms [12–14]. Brain signal intelligence necessitates the collection of a significant quantity of characteristic information as well as the requisite retraining for emotional detection. As a result, the quantity that characteristic material gathered and associated dependability have a substantial impact on the identification game's eventual effectiveness. All emotional detection algorithms which have been researched thus far, meanwhile, had utilized information from manufactured and overblown feelings.

There is one key issue that affects the effectiveness of emotional detection algorithms with true settings since it becomes simple to fraudulently obtain training information that contains feelings. As a result, accurate biometrics information gathering is deemed required in bio signal-based mood detection. Nevertheless, during biosignal collecting, a patient's affective experiences can readily shift depending upon its surroundings or any patient's psychiatric status, making it challenging to accurately detect a patient's feelings solely on a particular available in stock. As a result, instead of relying just on single available update stock to identify emotions, scientists are looking at approaches that combine multiple vital signs or incorporate other emotive assessment markers like speech and face movements. One of the more intensively researched topics in biology is the emotional detection of high technologies on nervous system signals. Brain messages, among others cerebellum messages, indicate the health of the main neurological systems. Emotions are believed to have linked with α and β oscillations that arise as a result of both conditions of cerebral activation. Alpha oscillations are associated with a calm or calm condition, and they rise in response to good feelings Alpha oscillations, on the

contrary side, rise with unpleasant affective situations [14]. Autonomic nerve systems responses, in contrast to mind signals, happen whenever orders from your mind were obtained, but they signal physiological alterations whenever a human is shocked or confronted with risk. Such responses include a fast pulse, stiffened face features, perspiration inside both hands and front of the head, and variations in overall warmth and heat in specific bodily regions. Because parasympathetic neural systems are in charge of such physiological alterations, affective moods can be deduced through biomedical messages via identifying parasympathetic nerve network responses. ECG, EMG, GSR, or SKT were biosignals that may be monitored in response to sympathetic nerve systems responses. Hearts rhythm variation (HRV) or hearts speed (HR) have been employed in research to detect moods. A lower pulse beat suggests that you are calm, whereas a higher pulse beat shows that you are stressed, frustrated, or dissatisfied. As a result, your pulse rate is frequently implemented to evaluate information. Measuring the HRV using the pulse and identifying characteristics can be used to classify moods. Nevertheless, identifying feelings solely based on the pulse is challenging [15]. A majority of all

investigations into emotional identification using EMG have focused upon the detection of feelings from the activity of face musculature. The EMG of a mouth may be utilized to assess elevated strain and detect moods, as well as to monitor the activity of cheek musculature. Its EMG rises in a strained condition and drops in a calm one. Its precise amounts of muscular strain, on the other hand, fluctuate depending on which portion of one muscular is being evaluated. As a result, accurate detection is required for this frequency. Dermal conductance rises if perspiration was prevalent in your dermal, it's what GSR alludes to. It may be employed to determine if you're stimulated or stressed. With excitement and unpleasant feelings, the GSR intensity rises. With acute stimulus, the response time (delay) is short. With rapid and intense stimulus, the response susceptibility (slope) is high. In this result, GSR may be a useful tool for assessing unpleasant feelings. SKT is a heat indicator of specific bodily sections, as opposed to bodily temperatures. This isn't a typical basic biosignal indication, but it may be utilized to track variations in mental states over time. Outside ecological elements have a big impact upon that.

Biosignals had previously been employed to determine anxiety levels in people in research. To assess anxiety rates,

many researchers used training assessments to construct test settings and subsequently detected high levels. Those prior research, on the other hand, were hampered in this reality because they focused on a probability mood classification and could not explore combos of characteristics that are ideal for tension reduction through feelings. According to indicated in **Table 1**, past research addressing for detection various stressful levels employing biosignals were encapsulated throughout this section with its objective, biosignals exploited, and analytic methodologies. Past research has used a variety of biosignals, including HR, GSR, ECG, EMG, and alpha tides, to identify stressful levels. The pulse information has been employed best to determine tension out of all of them. Pulse variation was useful when conjunction alongside another information since it may happen in several circumstances apart from strain [16].

Design:-

The EEG, heartbeat, and hypertension statistics have been acquired from these same detectors, and this same pulsation percentage as well as body fluids stress (heartbeat tension and ventricle venous force) information have been generated throughout solitary information container individually and forwarded to the dataset throughout

order to deduce and identify the emotions of an individual preview on the patient's strain. Utilizing the collected EEG, heartbeat, or cardiac values from a flexible controller, an SVM engine was exploited to identify physiological mood signals per the tension scale. These same song parts supplied "Galaxy note Concept" to music have been gathered, classified, or been using, or this same fingerprint expression detail was classified into a bright value equal relating to the feeling relying on 20 image expression concepts picked via HP's "this same Significance of Shades," and the music parts supplied "Galaxy note Theory" to art are bean also produced, classified, and was using [13]. The method presented in this study, which conducts emotive categorization and suggestion depending on biomechanics and tension indices, is shown in **Figure 1**.

Utilizing Eps recordings, this research created a fuzz algorithm to interpret biological mood signals relative to a patient's anxiety level. All 4 forms of stressful emotional data conveyed by the fuzz management method are steady, calm, strained, and enthusiastic. The patient's EEG

was measured using a BIOPAC MP 150, and the assessment followed the 10–20 Global Method of Electrodes are placed. Just the Eps were sampled at 256 Hz whenever the experiment is carried out.

With hardware, information has gone via a 60 Hz notch filter. A spectral range of 0.5–50 Hz was used to alter the collected information. The information for 60 seconds, which is regarded as the steady research portion for EEG research, was exploited to examine the EEG information, eliminating each 30 second component of the beginning and finish. To evaluate the EEG information, these exist in the temporal domains, they were firstly transformed towards the frequencies realm by employing rapid Harmonic transformation, as indicated in Equations (1).

$$G(e_m) = \sum_{i=0}^{M-1} g_i f^{-i2\pi im/M} \quad (1)$$

This information was transformed to these spectrum domains using the Fourier technique to obtain an actual magnitude by every band.

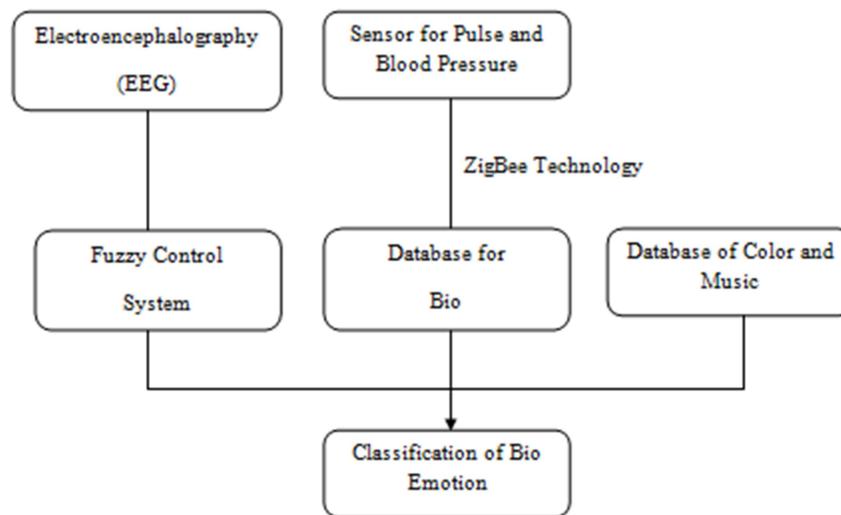


Figure 1: Diagram of the system's setup

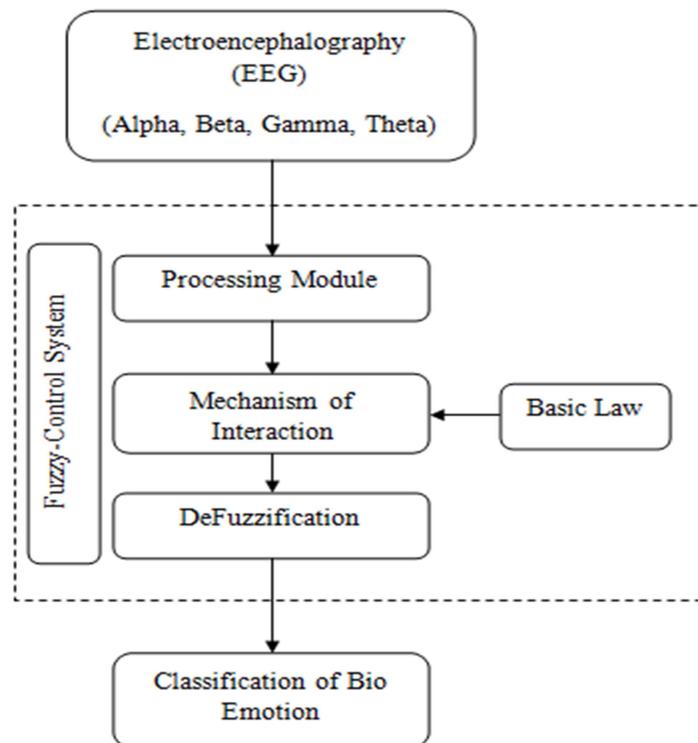


Figure 2: The bio emotion classification-based fuzzy control system uses EEG data

In addition, as comparisons or research, the spectrogram analyses approach was employed [13]. For several fields, particularly biosignals, the energy spectral assessment approach is frequently employed.

It may be split into each and 2 based on the expressing technique. A frequencies domains for 0 and positive is shown on 1 panel, while a frequencies domain of negatives, 0, and good is shown on the other. To use each

power spectrum analysis approach, this study determined the real numbers of spectra for the band's frequency of, and. Eq. shows the Harmonic affine transformation (2)

$$g_i = \frac{1}{M} \sum_{i=0}^{M-1} g_m f^{-i2\pi im/M} \quad (2)$$

Equations (2) were generated by getting the relative numbers on either end subsequently cubed and combined. Its plaza root equals a data which were exposed when a Harmonic transformation gets proven must be identical with that total of squares of the original data. The complete strength rating was calculated as its combination of all

Harmonic transforms and a summation of squares of the source. To put it another way, it means that the overall energy number is the same in either frequencies or chronological domain. This one is referred to as the Perceval hypothesis [11].

This work employed yet another dynamic spectrogram to recover the real numbers of a spectrum of angle θ (4–8 Hz), alpha (8–14 Hz), beta (14–30 Hz), and gamma (30–50 Hz) regions, and employed them as an intake variable of the fuzz control scheme to identify the mood.

Table 1: Using EEG data to create a fuzzy condition

| θ | α | β | γ | <i>Emotion</i> |
|----------|----------|---------|----------|----------------|
| High | Low | Low | Low | Impulse |
| Low | High | Low | Low | Tranquillity |
| Low | Low | High | Low | Anxiety |
| Low | Low | Low | High | Curiosity |

Nonetheless, since all EEG, heartbeat, or hypertension statistics during using this work are quadratic information architectures, using the SVM method was employed to tackle that quadratic discriminating issue of multilayered classifier architecture. The SVM method aims to increase the distance among the nearest observed results (effective access) in 2 classes to create a classification border. Additionally, even when straight separating is difficult, categorization is aided by employing quadratic support vectors or a

core function, and because a result, it is employed in a variety of fields, including medicine, picture and phrase identification, and so forth. Many conventional patterns identification algorithms use the hazard reduction strategy to improve the effective quality of training information. The SVM technique, for example, is built on a structure hazard technique to reduce the likelihood of erroneous categorization of information with a defined but uncertain likelihood distribution [15].

EVALUATION AND RESULTS:-

The tests in this work were carried out utilizing EEG, heart rate, and hypertension as inputs variables for evaluating physiological mood variables under the stress index. **Table 4** classifies the 4 phases (stable, calm, strain, and excitation) using the stress index as know perfectly for physiological emotional data. An SVM method was employed to create and assess the categorization of emotional states in this work. The SVM technique is a categorization method that finds the discriminate border with the greatest separation possible among it and every category.

The zonal basic functional kernels are employed as a kernel of an SVM method for our research; its diameter of kernels was coded as one while its SVM individual's margins were incremented. An efficiency results for classification accordingly on 4 categories of biometric mood information using the SVM algorithm is shown in **Figure 3**. The greatest performance of 86.1 percent is achieved when 80 percent of the data was acquired corresponding with the proportions of training data. Table 2-4 also displays the mistake matrices after 80 percent of the information has been learned. 90.4 percent of people being classified as steady, 83.4

percent as calm, 84.5 percent as strained, and 85.7 percent as enthusiastic.

Additionally, 10-fold crossed verification was used to test the monitoring efficiency of a suggested approach that suggests color or songs based on physiological mood input and tension indices, reducing the influence of learning material and assuring dependability. -e10-fold crossing verification separates the input across 10 identical portions, ninth of which are used for learning, and that other portion is used for testing. The 10-fold crossing validating method involves repeating the learning and assessment ten times at least to assess overall results, with one proportional portion of the information employed for the assessment being modified each round. **Figure 4** depicts a 10-fold cross-validation example. All information collected was split between evaluations or verification data in this investigation using a 7:3 ratio. This technique was also improved by employing the end up leaving strategy.

Inside the verification information collected from this effectiveness review, **Table 5** indicates mean reliability of 86.4 percent. As a result, the suggestion game's efficiency is excellent.

Figure 5 depicts the outcome of developing an interface for the suggested technology that

suggests color and songs based on physiological mood data and tension levels. As per biomotion statistics or tension score, the emotions color, or sentiment music are divided under the relevant categories.

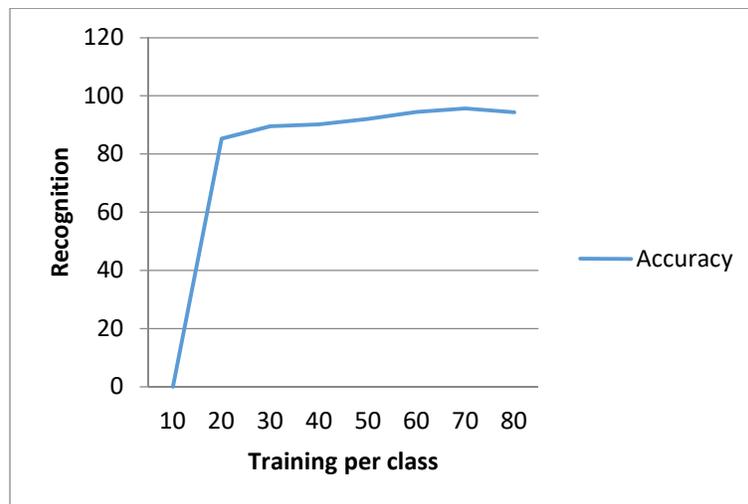


Figure 3: Bio - Emotion categorization (Accuracy)

Table 2: According to the stress index, the appropriate emotional colors and matching emotional music.

| Stages | Bio Emotion Information | Emotion colors | Emotion Music |
|--------|-------------------------|----------------|---------------|
| I | Impulse | Brown | The lullabies |
| II | Tranquillity | Red | The Spring |
| III | Anxiety | Blue | The Ave Maria |
| IV | Curiosity | Green | The Dream |

Table 3: Bio-emotions are classified using the stress index

| Stages | Bio Emotion Information | ElectroEncephaloGraphy In Hertz | Pulse T/Mins | BP SD | |
|--------|-------------------------|---------------------------------|--------------|-----------|-----------|
| I | Impulse | θ | 65-75 | 85 | 110 |
| II | Tranquillity | α | 75-85 | 85-90 | 125 |
| III | Anxiety | β | 85-95 | 95-98 | 145 |
| IV | Curiosity | γ | 70-90 | Above 100 | Above 150 |

Table 4: The Matrix of Perplexity

| Type | | True Condition | | | |
|---------|--------------|----------------|--------------|---------|-----------|
| | | Impulse | Tranquillity | Anxiety | Curiosity |
| Process | Impulse | 85.5 | 12.5 | 0 | 0 |
| | Tranquillity | 105 | 95.3 | 4.5 | 0.7 |
| | Anxiety | 0 | 6.8 | 85.4 | 12.7 |
| | Curiosity | 0 | 0 | 15.2 | 86.8 |

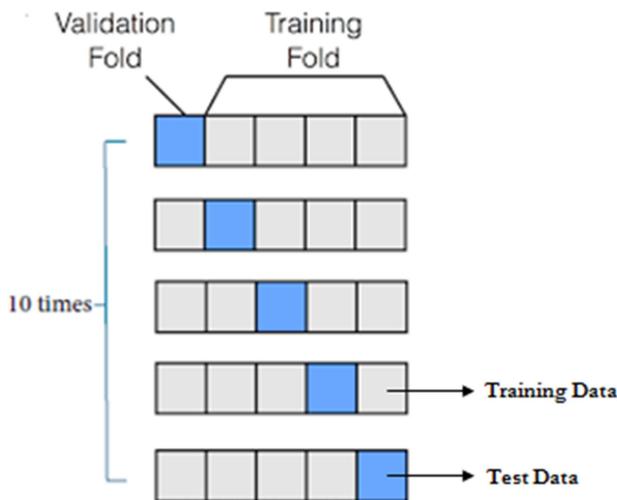


Figure 4: The Validation of A 10-Fold Cross

Table 5: The verification of data performance evaluation

| Fold Number | Unit of Accuracy in Percentage |
|-------------|--------------------------------|
| 1 | 85.6 |
| 2 | 88.8 |
| 3 | 84.3 |
| 4 | 83.4 |
| 5 | 82.4 |

| Colors | Emotion |
|--------|----------------------------------|
| Red | Passionate, Aggressive, Strength |
| Orange | Playful, Energetic, Fun |
| Yellow | Happy, Friendly |
| Green | Natural, Stable |
| Blue | Serene, Trustworthy, Inviting |
| Purple | Spiritual, Mysterious, Romantic |
| Pink | Feminine, Young, Innocent |
| Black | Powerful, Sophisticated, Edgy |
| White | Clean, Virtuous, Purity |
| Gray | Neutral, Formal, Gloomy |

Figure 5: As per biological emotional statistics & tension level, a matching emotions colors or corresponding emotion songs suggestion method

CONCLUSION:-

Using physiological data, this research attempted to identify and suggest emotional color or emotional songs that corresponded to the patient's mood. Consequently, the emotional color and

emotional songs were identified corresponding that present physiological emotional knowledge or tension indices for a client using true emotional assessment following monitoring their EEG, heartbeat, or hypertension measurements (i.e.,

biometrics data). A fuzz management method was created to divide the EEG signals into 4 categories of biometrics emotional signals (stable, calm, stress, and excitation), and the heart rhythm and arterial by readings were individually constructed in individual packages and delivered to the repository. Its maximum result of 86.1 percent is achieved after 80 percent of all variables are learned corresponding with its proportion in a trained sample by applying the SVM method to identify the EEG, heart rates, or vital sign statistics depending on biometrics mood variables. Furthermore, the findings of errors matrices categorization are 90.4 percent for steady, 83.4 percent for calm, 84.5 percent for strained, and 85.7 percent for stimulated, indicating great effectiveness. Moreover, a 10-fold pass verification was used to assess this same traceability achievement of the scheme that suggests feelings shades and feelings songs based on biometric motion data and strain indicator, and a natural ability percentage of 86.4 percent was found, indicating that the suggestion game's achievement was good. This research suggested a biometrics emotional data categorization method that uses a tension indicator that can automatically identify the emotional color and emotional audio depending on the patient's state. As a result,

it is intended to add to research on human-computer interaction in this fourth economic revolutions period. Feelings would be identified in upcoming research depending on contextual and contextual variables, as much as the patient's physiological data. Moreover, in addition to the EEG, heartbeat, or hypertension employed throughout the present research, the overall reliability and effectiveness of a suggested method will be improved by adding different forms of biometrics data as metrics for detecting biometrics feelings.

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