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Deconstructing 'Funny': An Analysis of the Rights and Conditions of the LGBTQ Communities in Sri Lanka with Special Reference to Shyam Selvadurai's Novel Funny Boy

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***Abstract*—Leslie Feinberg, a famous transgender activist and author, very famously said, "Like racism and all forms of prejudice, bigotry against transgender people is a deadly carcinogen". However, the fact is that, the members of the LGBTQ community are still victims of this discriminating carcinogen in every sphere of their lives. Different countries have straightway negated rights and sexual freedom to the LGBTQ people. In spite of the fact that to prevent the LGBTQs from enjoying a life of free choice is an out and out violation of human rights, not many countries have come forward for the rescue of this discriminated section of the people. Sri Lanka is one such country which still criminalizes homosexuality. This chapter looks into the condition of the LGBTQ communities in Sri Lanka with special reference to their representation in Shyam Selvadurai's novel Funny Boy.**

***Index Terms*—LGBTQ Rights, Rainbow Movement, Race, Ethnicity, Identity.**

Asian countries have always been admired and looked up to because of their cultural vibrancy, harmonious co-existence with nature and the feeling of universal fraternity among different races, religions and sections of the people. However, as far as sexuality is concerned, many Asian countries prove to be very hostile and conservative lands with their age-old dogmatic perspectives as well as rigid religious outlooks. Majority of the Asian countries still consider homosexuality as criminal offence. Countries like Japan, India etc. have recently decriminalized homosexual activities and vowed to respect the individuality of the Lesbians, Gays, Bisexuals, Transgender, Queers (LGBTQ) and everyone who does not fit into the category of the heterosexuals. However, the scene is very much grim in most of the Asian countries till now.

Sri Lanka is one of such countries which still consider homosexuality as a criminal offence. In Sri Lanka, any form of homosexual activity is illegal and considered morally disgraceful. Article 365 & 365 (A) of the Sri Lankan penal code criminalizes same sex activities. The LGBTQ community in Sri Lanka has to face several social challenges and legal actions. There have been several protests against such laws and various individuals and groups have now come forward in support of the LGBTQs. A revolution (although in a very small scale) is now gripping the minds of the Sri Lankan people in support of the sexually 'subaltern' sections. Companion on a Journey (COJ) is one of such LGBTQ support groups, which was founded in 1995 with an aim to fight for the rights of the LGBTQ communities. This group challenges laws and other constitutional provisions which not only criminalizes homosexuality but also indirectly teaches people to consider homosexuality as a social and moral stigma. They have also been very much vocal about the recognition of individual and collective identities of the LGBTQs so that the LGBTQ community members can get emotional support from our society.

Apart from such support groups and pressure groups, there are some academicians, scholars and writers etc. in Sri Lanka, who have taken up the issue of social and legal discrimination of the LGBTQs because of their unique sexual orientation. Shyam Selvadurai is one of such writers whose novel Funny Boy (1994) describes the plight of a homosexual boy during the time of ethnic conflict and Sri Lankan civil war. Funny Boy demonstrates the racial-ethnic violence that broke out in Sri Lanka from 1980s to the late 1990s. However, it has been showcased with a parallel pattern with the growth of the protagonist Arjun Chelvaratnam and his growing sense of his 'unique and queer' sexuality. Arjun Chelvaratnam or simply Arjie is born into a wealthy Tamil family in a primarily Sinhalese dominated Sri Lanka. From the very beginning of the novel, we find Arjie as a 'sensitive but different child', quite different from his brother and cousins. He always dwells in places where, generally male children do not like to roam about. He distastes himself from the game of cricket, a game which demands physical strength and vitality. On the contrary, Arjie loves to dress up as a bride in 'Bride Bride' game of the female cousins. Arjie is also fond of looking at the females, especially when his mother and Radha Aunty dress up with saris and other jewelries.

However, Arjie's uniqueness in his sexuality is soon detected when Tanuja or Her Fatness's mother, one of Arjie's aunt notices Arjie, a boy dressing up as a bride with other female cousins. She then drags Arjie to the drawing room so that everyone can have a look at his new 'avatar'. Immediately, one of Arjie's uncles makes fun of both Arjie and his father. This uncle comments that Mr. Chelvaratnam, Arjie's father has got quite a funny son. Soon after this incident, Arjie's mother Mrs. Chelvaratnam restricted him from playing the 'Bride-Bride' game and did not allow him to be near her at the time of dressing up. When Arjie demanded reason behind such tough restrictions, she came up with an ambiguous statement that "…the sky is so high and Pigs can't fly" (Selvadurai, 24). Pigs can't fly, a phrase from which the first chapter has got its title represents the mindsets of everyone who forcefully wanted to imprison Arjie and everyone like him into the cage of stereotypes.

After this incident, Arjie's life becomes a struggle against the outside society to establish his rights, individuality as well as identity. He is fighting an invisible war against the conservative Sri Lankan society which is as intense and severe as the ethnic violence going on in Sri Lanka. Here, Arjie is a representative of all the LGBTQ members who are fighting on their own for their space and rights in the society. Arjie is a lone ranger; he is brave but confused; he is honest but without any help from others. Here Shyam Selvadurai insists that Arjie is not only an individual; rather he is a type, standing for all the victimized LGBTQs who are craving for their own space, rights and identity in their own societies and countries.

Arjie and all the LGBTQ members, whom Funny Boy has so dedicatedly but with a scathing tragic intensity represented, fight their own wars to establish their individuality on three different scales. First of all, they are trying to come to terms and understand their own 'uniqueness' of sexuality in comparison to heterosexuality which is considered as 'normal and natural'. Besides, they have also to embark on wars with their families as well as their societies. It is displayed in Funny Boy that, Arjie's family members put extra stress on Arjie's psychology. At the same time, Sri Lankan society had also harshly handled Arjie's difference in sexual orientation. In his own home Arjie had become a laughing stock, even in front of his own family members. No one tried to understand Arjie's psychological state of mind or his sexual difference; rather they all were keen on turning Arjie into a 'normal and masculine' boy. Mr. Chelvaratnam even enrolled Arjie into Victoria Academy, a school with an authoritarian and strict principal with an intention to emasculate an effeminate Arjie.

Arjie's plight as an LGBTQ member (basically he is a gay) is demonstrated in his home (as a child) and in his school (as an adolescent). In his home, he is hardly aware of his sexuality as he was then a small child. He may not have become sexually conscious about his uniqueness and difference. However, he did come to this realization that he was, of course, different from his brother and cousins. He escaped from the game of cricket with cleverness; bit he always wanted to be the bride in the game of bride-bride which his female cousins were so fond of playing. He loved to wear the sari which his mother wore. He even decorated himself with jewelries of his mother and Radha Aunty. When Radha Aunty returned to Colombo from America, he would stay glued to her so that she would polish Arjie's nails with her beautiful nail polish colour. However, after Tanuja's mother had made fun of Arjie and his parents before everyone, Arjie's freedom to wear anything he had desired, decorate himself with jewelries and a strong impulsion to play the game he had wanted, was strictly restricted. Here, Shyam Selvadurai is making a sad but strong

statement with such situations in Arjie's life. Arjie had to compromise with his desire and happiness because of his 'different and non-straight' sexuality even when he was still a small child with hardly any notions of sexuality.

In his family, Arjie got support and companionship only from two people, i.e., Radha Aunty and Daryl Uncle. However, both of them are different and alien not only to the Chelvaratnam family but in a sense to entire Sri Lanka. For instance, Radha Aunty was brought up and educated in America. From the time of her arrival, she has been presented as a character who is closer to the American and the Western cultures than to the culture of her native Sri Lanka, she wears jeans (instead of traditional sari), performs in the play The King and I and maintains a progressive idea. She is a Tamil and going by the conservative pattern of their family she should have accepted the marriage proposal of Rajan Nagendra, another Tamil guy. But she develops her romantic interest in Anil Jayasinghe, a Sinhalese co-actor in her play. Similarly, Daryl Uncle is a burgher and he has hardly any emotional connection with Sri Lankan culture and people. People from the native land, i.e., Sri Lanka with proper native sentiments seldom cared for Arjie's emotional trauma.

In his school, Arjie experiences some nightmarish and horrible incidents which changes the course of his entire life. In Victoria Academy, Arjie's new school, he met two persons who had lasting impressions on his personality and sexuality. They are -the principal of the school, nicknamed Black Tie and Arjie's new friend Shehan Soyza. Black Tie was a strict authoritarian principal who had governed Victoria Academy with his iron hand. However, like Sri Lanka, Victoria Academy was also divided into two factions- one, who was in support of the Tamil principal, Black Tie and the other group who wanted Sinhalese Vice Principal, Mr. Lokubandara to take over as the new principal of the institute. Ethnically speaking, Arjie should have naturally preferred to be with Tamil Black Tie. However, for Arjie, the choice was not that much easier. He hated Black Tie as the latter had severely punished him on more than one occasions. Besides, Mr. Lokubandara was popular among the students. So, When Black Tie ordered Arjie to recite two poems on the school function- a gesture he thought would help him continue as the principal, Arjie deliberately recited them with lots of mistakes. Here also the author points out at the fact that the LGBTQs are not left with a clear-cut choice. Besides, Shyam Selvadurai also indicates that their way of protest is different and peculiar from others.

Arjie had even more traumatic experiences in connection to his friendship with another gay student, Shehan Soyza, in Victoria Academy. It has been clearly implied that Shehan Soyza is equally a victim in this society like Arjie. He was looked down upon by his classmates and other students of the Victoria Academy. Diggy, Arjie's elder brother had clearly warned Arjie not to befriend Shehan. However, Arjie feels fascinated by Shehan's looks; Arjie also appreciates Shehan's simplicity and sympathizes with the latter's conditions. Gradually they strike up a very strong bond between them. One day, Shehan kisses Arjie on the lips and from then on, Arjie becomes aware about his sexual uniqueness. Finally, Arjie and Shehan enter into a very brief but extremely passionate physical relationship in Arjie's family garage. Although Arjie was always fond of his relationship with Shehan, but his deep physical intimacy with Shehan had filled him with a sense of loss, hopelessness and an internal hollowness begins to haunt him now. Arjie was unable to express his inner thoughts to anybody just like he was unable to express his sexuality to anyone. Meanwhile, the civil war in Sri Lanka had also broken out on a large scale and it devastated the lives of Tamils and the Sinhalese. Here, Shyam Selvadurai does not want to relegate the importance of the ethnic violence and the ongoing civil war that has palsied the lives of the common masses to the backdrop of the novel. However, the sensitive author does come up with the question that while paying attention to the violence outside, who would care to look for the trauma that Arjie was undergoing, the fight he was fighting alone.

If we scrutinize the character of Arjie, he appears to be a tragic one. He is a tragic character with no hamartia; a lone ranger fighting against all the odds of the society without any success. However, the irony of the situation is that others look at him as a 'funny boy'. In this novel, Shyam Selvadurai is not representing one Arjie from Sri Lanka; rather he is referring to all the members of the rainbow clubs, i.e., LGBTQs. To ignore Arjie's psychic traumas as funny and laughter provoking is as depressing as to deny his very existence as an individual. We often tend to discuss about the legal provisions offered in the constitutions of different countries regarding the rights of the LGBTQs. But Shyam Selvadurai indirectly suggests that unless the common people change their approach and attitude towards the LGBTQs, then no legal provision of any country or constitution can bring about a paradigm shift among people and provide true social justice to the LGBTQs.

The word 'funny' may have been stressed only in the beginning part of the novel; but the idea of being a funny character hovers around Arjie throughout the novel. Just because Arjie is different from others, can he really be disgraced as a funny character? The author repeatedly disturbs the minds of the readers with this thought-provoking rhetorical question. Shyam Selvadurai restrains himself from providing a direct answer; rather he plays with the minds of the readers by portraying other significant characters of the novel equally as 'funny' in their own situations. If Arjie is funny just because he does not follow the prescribed (sexual) archetypes of the society,other characters including Radha Aunty, Daryl Uncle, Mrs. CHelvaratnam all are funny too. Radha Aunty did not want to marry Tamil Rajan Nagendra; instead of that she developed an intimacy with Sinhalese Anil Jayasinghe. Similarly, Daryl Uncle and Mrs. Chelvaratnam have been indulged in an extramarital affair. All of them have been violating certain rules and decorum of the society based on social ethics, morality or sanctity of marriage.

In this way, almost all the major characters are deviating from their path of morality, holiness and loyalty. However, the society and the common people have maintained double standard in their categorization of the so called 'normal and straight' people and the LGBTQ community people. Arjie, an alien in his own home, school and society is disgraced and compelled to compromise with his rights, sense of individuality as well as emotional liberty.

Funny Boy is a novel based on Sri Lanka and Arjun Chelvaratnam represents all those Sri Lankan LGBTQ members who are dismantled by heterosexual norms of the society. In the conclusion of the novel, Arjie moves on to Canada, a comparatively progressive western country where Arjie hopes to enjoy his emotional solace and sexual liberty. But Arjie leaves behind a lot of questions to be answered by the society. Arjie's conditions may have changed with his escape from Sri Lanka but what about the condition of all the other LGBTQ members who are still in Sri Lanka or other conservative countries. Will the Rainbow Movement, as the LGBTQ community loves to call it, ever flourish in the sky of liberty and fraternity? The answer depends on all of us, whether we still diminish LGBTQ community members as 'funny' or whether we embrace everyone as acute individuals under the protective umbrella of humanity.

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Driver Fatigue And Alcohol Detection, Alert And Notification System Using Image Processing And Machine Learning

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***Abstract*—Experts say that drivers who do not take regular rests when traveling long distances face a greater danger of feeling sleepy, a condition they frequently fail to identify in time. This behaviour significantly contributes to an increase in deaths and injuries globally. Additionally, many accidents result from cases of drunk driving, where drivers lose consciousness due to alcohol consumption, leading to fatal accidents. In this research, we offer a system that is intended to determine whether the driver is affected by alcohol. If the system detects alcohol consumption, it promptly sends a notification to the registered mobile number. Furthermore, the system utilises a webcam to collect real-time data, enabling it to detect whether the driver is drowsy or not. In the event of drowsiness, the system alerts the driver and sends a notification to the registered mobile number, thereby reducing the possibilities of accidents and enhancing road safety. This system sends notifications via the internet thus decreasing the hardware of the system. Here two features, Alcohol detection and Drowsiness detection are integrated in one single system design.**

***Index Terms*—Facial landmarks, drowsiness, Eye aspect ratio (EAR), alcohol detection, driver safety, alert system**

I. Introduction

India has been witnessing a disturbingly high rate of road accidents. According to the data available until 2023, the country had one of the highest numbers of road accident fatalities globally. As per the MORTH (Ministry of Road Transport and Highways), in 2020, despite the COVID-19 pandemic and subsequent lockdowns, India witnessed approximately 4.4 lakh road accidents, resulting in over 1.5 lakh fatalities. The causes of these accidents were varied and included factors such as over-speeding, drunk driving, lack of adherence to traffic regulations. Additionally, incidents of driver fatigue and drowsiness have also been cited as contributing factors to road accidents These accidents not only lead to loss of life but also cause severe injuries and property damage[5][9].

In recent years, research on the fatigue-driving-detection system has grown in prominence. The two categories of detecting procedures are subjective and objective detection. A driver must take part in the evaluation process in the subjective detection method. This evaluation process involves self-questioning, evaluation, and questionnaire completion and is linked to the driver's subjective perceptions. The cars being driven by fatigued drivers are then estimated using this data, enabling the drivers to adjust their schedules. Moreover, there are two types of objective detection first known as non-contact and the other one is contact. When compared to the contact method, the non-contact approach is more affordable and practical due to its lack of reliance on sophisticated cameras or Computer Vision technology, which enables the device to be used in a greater number of cars[10].

We have suggested a non-contact technique for alcohol and sleepiness detection in this work. The device consists of two main parts which includes an MQ-3 sensor for alcohol detection and a camera which collects real-time data for drowsiness detection making it unnecessary for the driver to carry any on/in-body devices. The MQ3 sensor integrated in the system will first check whether the driver has consumed alcohol and will send an alert notification accordingly. Similarly, while driving, the driver's face will be monitored continuously so that the system can alert the driver in case, he feels drowsy. The drowsiness system mainly works on image processing, Facial landmark detection and eye aspect ratio [8][7].

The rest of the paper is structured as follows: Section 2 lists relevant works; Section 3 describes the suggested design and implementation of each system block; Section 4 depicts the system's work flow; Section5 includes outcomes; the final section concludes the paper; and lastly, references.

II. RELATED WORK

The problems with road safety in India and the requirement for sophisticated detection systems have prompted research on alcohol and sleepiness detection. We examine previous research in this field in this section, which sets the stage for our non-contact detection technology.

Jaekwang Oh proposed a method that uses a single eye image to detect landmarks in the eye region to estimate gaze. They show that this strategy can compete with the recently developed appearance-based techniques. Similar to the existing feature-based methods, their approach incorporates iris and eye edges and extracts more landmarks to obtain rich information. Using the HRNet backbone network, they were able to learn representations of images at various resolutions, which allowed them to extract robust features even at low resolutions[1].

In order to identify EEG data for Drowsiness Detection, Adinath Joshi's work uses algorithms and Deep Learning architecture, such as Convolutional Neural Networks (CNNs). The primary metrics of video-based methods involve the identification of physical characteristics; however, their applicability is restricted by issues like brightness restrictions and real-world obstacles like driver focus. The degree of eyelid closure is the primary metric used in video-based techniques; however, practical issues like driver distraction and brightness limitations limit their effectiveness[2].

Garcia's work offers a computer vision-based, non-intrusive method for sleepiness detection. An infrared (IR) camera is mounted in front of the driver in the dashboard to identify his face and gather indicators of sleepiness from the closure of his eyes. Three stages make up the system that is being shown. Preprocessing is the first step, which involves normalization and face and eye detection. In order to enable the system to function under outdoor illumination settings, the second stage carries out the detection and characterization of pupil location and combines it with adaptive lighting filtering. PERCLOS is calculated in the last step using eye closure data[3].

A study by Alshaqaqi et al. addressed driver fatigue, a significant contributing factor to traffic accidents worldwide. They unveiled the Advanced Driver Assistance System (ADAS), which uses artificial intelligence (AI) and visual data to identify tiredness automatically. Their program measures PERCLOS, a known sign of tiredness, by examining the driver's face and eyes[4].

The Nimmy James system offers a special way to stop intoxicated individuals. An alcohol sensor is integrated into the car's steering system. The sensor detects the amount of alcohol in the driver's breath whenever the ignition is turned on, and if the driver is intoxicated, it instantly turns off the automobile. From zero to extremely high concentrations, the sensor in this device provides a current that has a linear connection to the alcohol molecules. The pic microcontroller receives the sensor's output and compares it. The buzzer sounds and the relay cuts off automatically when the measured value crosses the threshold [2][5].

I. Chatterjee et al. proposed a non-invasive method for assessing driver fitness using computer vision techniques. They monitor real-time video from a smartphone camera inside the vehicle to detect drowsiness and impairment by tracking eye blinks, head and body alignment, and generate a severity score. Alarms are triggered for issues, and in serious cases, the smartphone's location is shared with family and authorities [6].

The main goal of Rohith Chinthalachervu's research is the identification of driver drowsiness and an effective response to the finding. The physiological method is one of the techniques that helps keep the driver awake and distracted from his tiredness. A small number of techniques also deal with large amounts of data and costly sensors. As a result, this research creates a system that can accurately and properly identify sleepiness in real time. This device uses a webcam to record and capture the driver's facial expressions. Several image processing algorithms are used to identify every movement in every frame. The landmark points on the face are used to determine the EAR, Mouth Opening Ratio, and Nose Length Ratio[7][11].

III. PROPOSED DESIGN

Now-a-days every car is equipped with Real Time Driver Fatigue Detection, Smart Rescue, and a notification system to alert and save the driver in the event of an accident. In addition, there are projects available for driver alcohol detection to determine whether the driver is drunk before driving [4][5]. But in our system, we have integrated above mentioned two different systems into one i.e. the alcohol detection system as well as the driver fatigue detection system besides this we have also reduced the hardware of the notification subsystem that is used to send alerts so that our overall system becomes compact, reliable and affordable.

The alerting system works on the basis of image processing, with the webcam positioned in front of the driver and continuously streamed live. Afterwards, the face that was spotted is captured for additional processing and analysis to determine whether the driver appeared active, fatigued, or drowsy.

The buzzer will go off to warn the driver of his possibility of becoming sleepy, allowing him to regain consciousness and drive safely. Thus, the possibility of an accident is reduced. In addition, a message is sent to the registered mobile number if driver found fatigued, enabling the recipient to alert the driver by phone.

The alcohol detection system will determine whether or not the driver is drunk. If the driver is drunk, the system will send a message to the registered mobile number, allowing them to prevent any future mishaps.

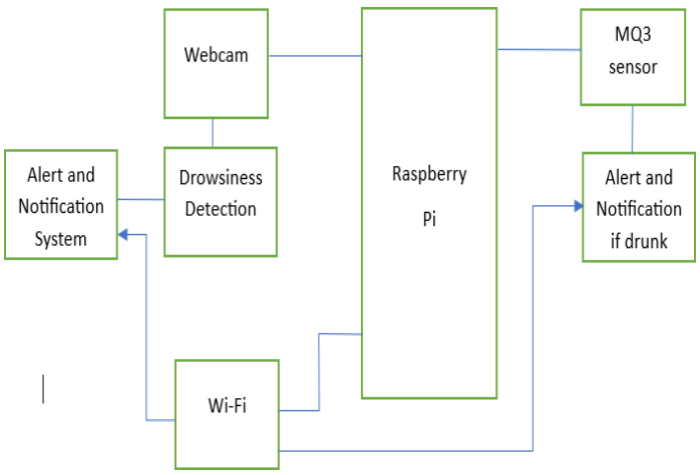


Fig. 1 System Block Diagram

TABLE I. Drowsiness Detection

A webcam captures continuous footage to detect the driver's tiredness. The driver's facial expression is captured during this streaming and is converted to grayscale using image processing and Dlib(library) for frontal face detection, making face detection easier. The identified face is then assigned a numerical value, and the facial landmark system is utilised to identify various elements of the face, such as the eyes, brows, lips, and lower jaw, allowing the eye indices to be sliced to locate the eyeballs. The Eye Aspect Ratio (EAR) is then calculated to detect the state of drowsiness, and a threshold value of frames is utilised to assess whether there is fatigue or blinking. If EAR > 0.20, then driver is active; else if EAR is between 0.15 and 0.20, then the driver is fatigued; else for other values of EAR, driver is sleepy. One can adjust the sensitivity based on their needs.

Formula for calculating EAR is as follows:

$$EAR = (|P2—P6| + |P3—P5|) / 2|P1—P4|$$

Fig. 2 below displays the 68 index facial landmarks assigned to a face, and Fig. 3 displays the eye indices that were obtained by slicing through NumPy arrays.

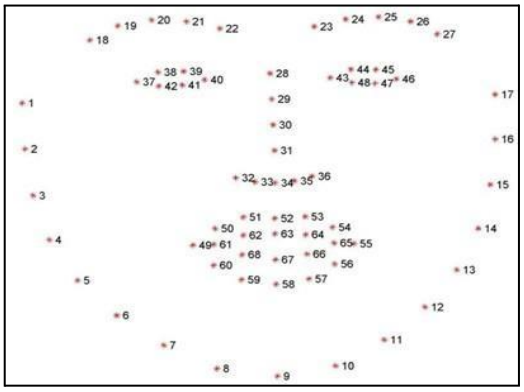


Fig. 2 Facial Landmarks

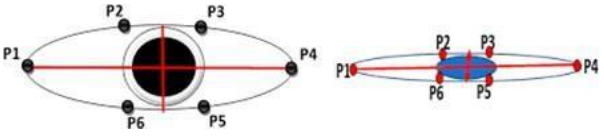


Fig. 3 Eye Indices

TABLE II. Raspberry-Pi 4

The Raspberry Pi 4 is a versatile, credit card-sized computer that is well-known for its small size and powerful features. Compared to its predecessors, The Pi 4 has more processing power and performance due to its quad-core ARM Cortex-A72 processor and up to 8GB of RAM. It is appropriate for a variety of projects thanks to its diverse connectivity choices, which include Bluetooth, Wi-Fi, USB ports, and HDMI. The Raspberry Pi 4 can be a key component of a drowsiness detection project by integrating with sensors such as cameras to track eye patterns and facial movements. The Pi 4 can analyse these inputs to identify indicators of drowsiness in people, using machine learning techniques and image processing to generate alerts that avert accidents. Its compact form factor, computing capabilities, and accessibility make it an ideal platform for such applications, enabling real-time monitoring and timely intervention to ensure safety[12].

Fig. 4 Rpi

TABLE III. Alert Buzzer

A buzzer is a piezoelectric, electromechanical, or mechanical audio signalling device. It is an item meant to warn the person or people. In this paper, it serves as a warning when the driver experiences fatigue or when

the driver is drunk.

TABLE IV. MQ-3 Sensor

The MQ-3 sensor is a type of gas sensor, specifically designed to measure the amount of alcohol vapour present in the atmosphere. This sensor is frequently found in automotive, industrial safety, and breathalyser applications. Utilising a tin dioxide (SnO_2) sensitive layer, which alters its electrical conductivity in response to the amount of alcohol in the air, it functions on the basis of a semiconductor sensor. Because of its extreme sensitivity to alcohol, the MQ-3 sensor is a crucial part of systems designed to measure alcohol concentrations. There are four pins in total: ground, digital output, analogue output, and Vcc. It has the ability to produce digital and analogue output. Because Raspberry Pi can only receive digital input.

Dout is the only pin used here for ease. The MQ-3 sensor's VCC pin is connected to the Raspberry Pi's PIN2, or common VCC for accessibility, the Raspberry Pi's PIN15 is connected to the MQ-3 sensor's Dout pin and finally the GND of MQ-3 sensor is connected to Raspberry Pi PIN9.

Features of MQ-3 sensor-

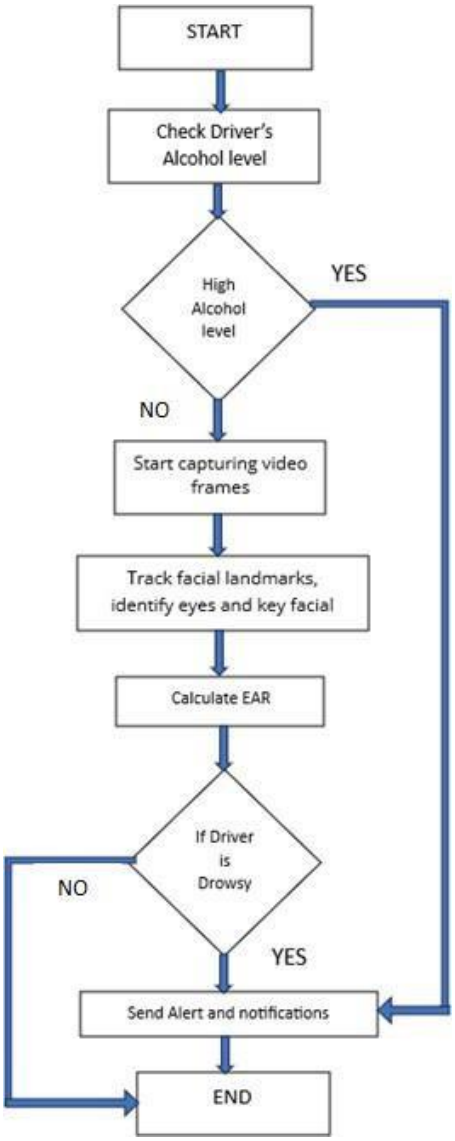
- Highly sensitive to alcohol vapour in the air, making it an efficient tool for alcohol detection.
- Provides analogueand digital output.
- Power Supply: 5 Volts.
- Cheap cost
- Stable
- Long life
- On-board power indication

Fig. 5 MQ-3 sensor

TABLE V. Notification System

The Raspberry Pi's built-in Wi-Fi module greatly expands the features of the drowsiness detection system for drivers. With the help of the internet, the Raspberry Pi can communicate with other devices and networks by sending instant alerts or notifications because of its wireless connectivity feature. If the system determines that the driver is sleepy or drunk, the Raspberry Pi, which has the Wi-Fi module installed, quickly sends alerts to recipients that have been pre-approved, a monitoring station, or a central control hub. These notifications, which can come in the form of emails, SMS messages, or app alerts, notify relevant authorities or worried parties about the drowsiness or drunk condition of the driver in time to allow for timely intervention or other necessary actions to ensure driver safety. The Wi-Fi module plays a critical role in enabling prompt and smooth communication, making sure that the alerts are received by the appropriate parties on time, and thereby making a significant contribution to averting potential accidents caused by sleepy or drunk drivers.

Ⅳ. WORKFLOW



A sophisticated safety application, the Raspberry Pi drowsiness and alcohol detection system combines the capabilities of the MQ3 sensor for alcohol detection and image processing for drowsiness detection. The MQ3 sensor, which continuously measures the amount of alcohol vapour in the surrounding air, is where the project workflow starts. The Raspberry Pi initiates the alert system when it detects the presence of alcohol. The Pi notifies designated recipients using other communication modules or Wi-Fi connectivity. The Raspberry Pi then processes and examines the data from the mounted camera. To detect indicators of sleepiness in the subject of observation, the Pi simultaneously records and analyzes facial expressions and eye movements using image processing techniques (EAR) via a linked camera. If drowsiness is recognized through image processing, an alert is generated by the buzzer, and a notification is sent out to monitoring entities, signalling the need for a break or caution. This thorough flow ensures that timely alerts are sent out in emergency situations, greatly improving overall safety and preventing accidents.

Ⅴ. RESULT

We have developed a real-time drowsiness and alcohol detection system that enhances driver safety by monitoring the driver's face and eyes for signs of drowsiness and also checking for alcohol using an MQ-3 sensor. We establish a seamless connection between the camera, MQ-3 sensor and the Raspberry Pi, enabling video and image capture for analysis.Firstly, our integrated MQ-3 sensor will be used to detect the consumption of alcohol. If the driver has consumed alcohol, then it will send a notification to the intended recipient as shown in Fig. 7.

Fig. 7 Alcohol Notification

We have collected a diverse dataset representing various driver states, used for training and testing our machine learning model. We also extract essential features like facial landmarks and eye movement patterns to improve accuracy.

Our system calculates EAR (eye aspect ratio) and triggers visual and auditory alerts when drowsiness is detected, ensuring real-time driver notification to prevent accidents. Additionally, we design a notification system to alert external devices for prompt communication with relevant stakeholders. We have used the Pushbullet application to send notifications.

If a person's blink analysis indicates prolonged eye closure, the status is set to "SLEEPING", as shown in Fig. 8 and an instant notification is sent to the intended device.When the blink analysis detects occasional drowsiness, the status is set to "Drowsy" and displayed in red. If the person's eyes remain open and active, the status is set to "Active" and displayed as shown in Fig. 9 and Fig. 10.

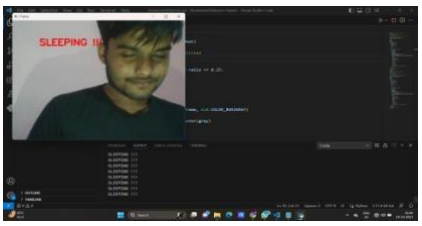


Fig. 8 Sleeping

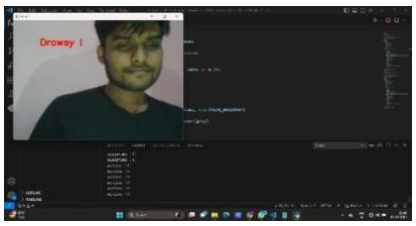


Fig. 9 Drowsy

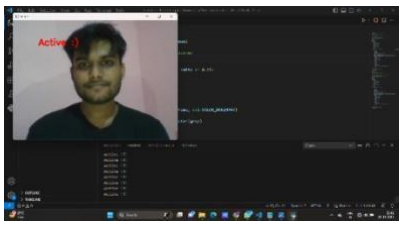


Fig. 10 Active

Fig. 11 Drowsiness Notification

VI. CONCLUSION

The proposed system effectively enhances driver safety by integrating facial and eye monitoring with an MQ-3 sensor. Through machine learning, it accurately identifies drowsiness and alcohol consumption, issuing alerts to prevent accidents. In order to reduce hardware, we opt for sending email notifications instead of using GPS/GSM technology. As a future scope of the project, the system's capabilities could be extended to include stress analysis, thereby offering additional means to mitigate distractions while driving.

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Cost Dynamics and Sustainability in India's Gig Economy: A Multi-Stakeholder Analysis of Platform Profitability and Worker Welfare

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***Abstract*—India's gig economy has expanded rapidly across mobility, delivery, logistics, and digital freelancing platforms. While these platforms promise flexibility and income opportunities, they also introduce structural vulnerabilities for workers and business partners. This study evaluates how leading gig-economy firms manage cost structures while addressing worker sustainability. A mixed-methods approach integrates secondary analysis of financial reports of Zomato, Blinkit, Uber, Rapido, Delhivery, Ekart, Fiverr and ONDC, along with primary survey data from 40 gig workers and 10 restaurant partners in Pune.**

Findings reveal pronounced disparities: workers rely heavily on gig income, yet many lack basic social protection and face algorithmic pressures. Restaurants gain visibility but remain burdened by high commissions. Although platforms demonstrate strong revenue trajectories, profitability is often achieved through cost externalisation. The study proposes a multi-stakeholder sustainability framework focusing on portable benefits, graded commissions, algorithmic transparency, and improved regulatory governance. The paper highlights the urgent need for integrated reforms to ensure long-term sustainability and equitable value distribution in India's digital labour ecosystem.

***Index Terms*—Gig work, platform economics, cost dynamics, labour precarity, algorithmic management, sustainability models**

I. Introduction

Digital platforms have reshaped India's service delivery ecosystem by enabling task-based, flexible labour arrangements. Food-delivery aggregators, ride-hailing companies, logistics networks, and freelance marketplaces provide modular earning opportunities, especially to youth and migrants. This growth is driven by smartphone penetration, urban consumption patterns, and low entry barriers.

India currently hosts an estimated **7.7 million gig workers**, projected to reach **23.5 million by 2029–30**, marking one of the world's fastest expansions. Despite this momentum, gig work is characterised by income volatility, high self-funded operating costs, and limited formal protections. Understanding the cost architecture of platforms and its implications for worker welfare is essential for ensuring sustainable digital labour markets. This study investigates these dimensions through a multi-stakeholder lens, evaluating workers, restaurant partners, and platform firms.

II. Review of Literature

Existing literature positions gig work as an outcome of platform capitalism, marked by flexibility alongside increasing precarity. Indian studies highlight legislative gaps, limited enforcement of the Social Security Code (2020), and the ambiguous legal status of platform workers. Global research identifies algorithmic performance management, rating-based dependency, venture-capital-driven scaling, and risk shifting from firms to contractors.

Scholars also highlight concerns related to resource dependency, information asymmetry, free-riding in shared labour pools, and environmental externalities of last-mile logistics. However, limited work integrates **cost efficiency**, **worker sustainability**, and **platform profitability** within a single analytical framework—an important gap this study addresses.

III. Research Objectives

1. To analyse direct and indirect cost components across selected gig platforms in India.
2. To examine operational constraints and sector-specific opportunities.
3. To assess worker participation patterns, income stability, and sustainability indicators.
4. To evaluate the incorporation of environmental, economic, and social sustainability measures within platform business models.

IV. Research Methodology

A **mixed-methods design** was adopted.

Primary Data

- **40 gig workers** (food delivery, mobility, logistics, freelancing)
- **10 restaurant partners**
- Data collected through structured questionnaires in Pune

Secondary Data

- Financial statements of Zomato, Blinkit, Uber, Rapido, Delhivery, Ekart, Fiverr, ONDC
- Industry and policy reports

Sampling was carried out using **stratified random sampling** to ensure representation across platform categories. Triangulation strengthened reliability and reduced self-reporting bias.

V. Results and Data Analysis

I. Worker-Level Analysis

Demographic and Economic Findings

- Majority aged **18–45**
- **67.5%** rely on gig income as their primary livelihood
- **65%** work full-time
- Average monthly earnings ≈ **₹22,500**
- Cab and food-delivery workers form the largest occupational groups

Table 1 Satisfaction, Cost Pressures and Social Protection

Indicator	Percentage (%)	Interpretation
Commissions considered unfair	52.5	Perception of inequitable value distribution
No social security coverage	47.5	High vulnerability
Ratings influence earnings	74.2	Strong algorithmic dependency
Income volatility	High	Unpredictable daily income
Benefits availability	Low	Structural gap in social protection

Ride-hailing workers earn relatively more but show the highest dissatisfaction due to commission deductions and fuel costs. Freelancers report autonomy but inconsistent workloads. Workers generally perceive gig work as beneficial short-term but unsustainable long-term.

II. Worker-Level Analysis

Table 2 Restaurant Partner Insights

Indicator	Percentage (%)	Interpretation
Improved revenue through platform visibility	60	Enhanced market access
Commission structures unsustainable	70	Long-term profitability concerns
Need for transparency	Very high	Demand for predictable settlements

Restaurants appreciate increased reach yet remain concerned about high commissions, delayed settlements, and lack of bargaining power.

III. Financial Analysis of Major Platforms

Table 3 Financial Analysis of Major Platforms

Platform	Trend	Observation
Zomato / Blinkit	Rising revenue	Profitability achieved; operational costs remain significant
Uber India	Revenue growth	Substantial reduction in net losses
Rapido	Growth in orders & GTV	Losses narrowing due to cost discipline
Delhivery	Revenue expansion	High depreciation due to capital intensity
Fiverr (India)	Growing profitability	India among fastest-expanding freelancer hubs

Across platforms, cost pressures arise from customer acquisition, delivery logistics, partner incentives, and infrastructure costs. Sustainability investments are increasing, but adoption varies across sectors.

VI. Statistical Analysis and Hypothesis Testing

Table 4 Platform Financial Indicators

Indicator	Mean Growth (%)	SD (%)	Interpretation
Revenue Growth	28	9	Strong but uneven
Reduction in Net Losses	17	6	Moderate consistency
Order Volume Expansion	22	11	High sectoral variance

Table 5 Correlation Between Financial Performance and Sustainability

Variable Pair	Statistical Test	Correlation (r□)	Interpretation
Revenue vs Sustainability Score	Spearman Rank	0.771	Strong positive correlation
Profit vs Sustainability Score	Spearman Rank	0.257	Weak correlation

Revenue growth significantly aligns with sustainability adoption, whereas profit margins are not yet driven by sustainability measures—indicating early-phase integration.

VII. Conclusion

1. India's gig economy is at a transformative juncture. Platforms are scaling rapidly and moving toward operational efficiency; however, worker-level vulnerabilities persist. Without structural reforms, the ecosystem risks widening inequalities and creating unstable labour markets. Sustainable growth requires integrating financial, social, and environmental considerations into platform governance.
2. Findings reveal a structural imbalance in India's gig-economy value chain. Platforms increasingly optimise operations but frequently externalise risks to workers through high commissions, self-funded operating expenses, and algorithmic controls. Workers lack basic protections such as insurance, paid leave, and retirement benefits.
3. Restaurant partners face parallel challenges, with heightened dependence on platforms and rising commission burdens. While platforms demonstrate rapid revenue expansion, the social and labour dimensions of sustainability lag behind financial performance.
4. The study underscores the need for **tripartite intervention**—involving policymakers, platforms, and worker collectives—to ensure equitable and sustainable digital labour markets.

VIII. Recommendations:

For Policymakers

1. Implement **portable social-security benefits** (insurance, pensions, sick leave).
2. Formalise **minimum earning guarantees** aligned with local living costs.
3. Introduce **algorithmic accountability frameworks** and dispute-resolution mechanisms.

For Platforms

1. Adopt **graded commission structures** based on partner size and order density.
2. Reduce dependency on **rating-based penalties**.
3. Provide **fuel subsidies, EV leasing, and maintenance support**.
4. Ensure predictable and timely settlement cycles.

For Workers

1. Encourage **collective bargaining associations** and digital unions.
2. Promote financial-planning literacy and savings behaviour.
3. Advocate for representation in discussions on platform policies.

IX. Scope for Future Research

1. Longitudinal tracking of worker income trajectories
2. Environmental assessment of last-mile delivery systems
3. Comparative policy analysis across global gig labour frameworks
4. Economic impact of electric-vehicle adoption in gig mobility sectors

X. Limitations

1. Primary data restricted to Pune; cross-city comparisons are needed.
2. Platform policies evolve rapidly, affecting temporal generalisability.
3. Worker responses may reflect short-term incentives and platform variations.

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Machine Learning for Epilepsy: An Automated Pathway to Predict Seizures

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***Abstract*— Epilepsy is a neurological disorder affecting approximately 70 million people worldwide, with 85% of cases occurring in developing countries. Characterized by recurrent, unprovoked seizures, epilepsy significantly impacts a person's quality of life and can lead to premature mortality. Electroencephalography (EEG) plays a crucial role in detecting and analyzing epileptic seizures by capturing brain activity through voltage changes. Traditional seizure detection methods are retrospective, limiting proactive response measures. This project aims to develop a machine learning-based system for real-time epilepsy prediction using EEG data, enhancing early detection and patient safety. The system preprocesses uploaded EEG data by removing null values and extracting relevant features linked to seizure activity. A Support Vector Machine (SVM) algorithm is employed to compare extracted features with trained datasets, identifying patterns indicative of epilepsy. The system architecture includes modules for data preprocessing, feature extraction, classification, and result generation. It provides real-time monitoring, seizure prediction, and alerts to patients and healthcare professionals, reducing risks and improving medical decision-making. Implemented using Python with a web-based interface powered by HTML, CSS, and SQLite, the system ensures accessibility for neurologists, healthcare providers, and researchers. Functional requirements include accurate seizure detection with at least 90% accuracy, real-time data processing, and continuous monitoring, while non-functional requirements focus on system response time, user-friendly design, and accessibility. By leveraging machine learning for epilepsy prediction, this project aims to bridge the gap between medical research and practical healthcare solutions, offering a proactive approach to managing epilepsy and enhancing patient outcomes.**

***Index Terms*— Epilepsy prediction, feature engineering, scalp electroencephalogram (SEEG), hybrid transformer, transfer learning (TL).**

I. Introduction

Epilepsy is one of the most common neurological disorders, affecting approximately 70 million individuals worldwide, with around 85% of cases reported in developing countries. It is characterized by recurrent and unprovoked seizures, which result from abnormal brain activity. These seizures can manifest in different ways, ranging from brief lapses in attention to severe convulsions. Due to the unpredictable nature of seizures, individuals with epilepsy face significant health risks, including an increased likelihood of injury and premature mortality. The impact of epilepsy extends beyond health, affecting education, employment, and overall quality of life. Traditional diagnostic methods primarily rely on Electroencephalography (EEG), a technique that records brain electrical activity, but these methods are often retrospective and fail to provide real-time predictive capabilities. This limitation creates an urgent need for advanced technological solutions that can accurately predict seizures before they occur.

Machine learning models, particularly those leveraging EEG data, can analyze patterns in brain activity and identify early warning signs of an impending seizure. Unlike conventional methods that focus on seizure detection after occurrence, machine learning-based systems can process EEG signals in real-time and provide early predictions, allowing patients and caregivers to take preventive measures. By integrating predictive capabilities into epilepsy management, healthcare professionals can enhance patient safety, minimize emergency situations, and improve overall treatment strategies. The ability to predict seizures minutes or even hours in advance could significantly reduce the burden on individuals with epilepsy and their families. The primary motivation behind this research is to improve epilepsy management through the development of a machine learning-based seizure prediction system. The system aims to analyze EEG data, extract relevant features, and classify seizure patterns using algorithms such as Support Vector Machines (SVM). The goal is to achieve high accuracy in seizure prediction while ensuring real-time processing and continuous monitoring. This approach not only benefits patients but also supports medical professionals by providing valuable insights into seizure patterns, allowing for more personalized treatment plans. Furthermore, integrating this technology into a web-based interface ensures ease of access for neurologists, healthcare providers, and researchers, making it a comprehensive tool for epilepsy management.

The proposed system follows a structured workflow that involves multiple stages, including data collection, preprocessing, feature extraction, classification, and result generation. Initially, raw EEG data is uploaded and cleaned to remove noise and irrelevant information. Feature extraction techniques are then applied to identify significant patterns that distinguish epileptic seizures from normal brain activity. The extracted features are analyzed using the SVM algorithm, which compares them with pre-trained datasets to detect seizure occurrences. If a potential seizure is detected, real-time alerts are generated for patients, caregivers, and medical professionals, ensuring timely intervention. By automating the seizure prediction process, the system enhances efficiency and reliability, reducing dependence on manual interpretation of EEG readings.While significant progress has been made in epilepsy research, the complexity of the disorder continues to pose challenges in achieving precise and reliable predictions. One of the primary difficulties lies in the variability of seizure patterns among different individuals, making it challenging to develop a one-size-fits-all solution. Additionally, the presence of artifacts in EEG data, caused by external factors such as muscle movement or environmental interference, can affect the accuracy of machine learning models. Addressing these challenges requires continuous refinement of feature extraction methods, optimization of classification algorithms, and integration of robust data filtering techniques. By focusing on these aspects, this research aims to enhance the predictive accuracy and real-world applicability of epilepsy prediction systems.

Epilepsy remains a critical health concern that demands innovative solutions for better diagnosis, management, and prevention. Machine learning-based seizure prediction presents a transformative approach by leveraging EEG data to provide real-time insights into brain activity. By developing a highly accurate and efficient seizure prediction system, this research aims to empower patients with proactive management tools, assist healthcare professionals in decision-making, and contribute to the ongoing advancements in biomedical research. The integration of artificial intelligence in epilepsy management marks a significant step toward reducing the burden of the disease and improving the lives of millions of affected individuals worldwide.

II. Existing System

The existing system for epilepsy detection primarily relies on Electroencephalography (EEG) recordings analyzed by neurologists to diagnose seizures. Traditional methods focus on detecting seizures after they

occur rather than predicting them in advance. These approaches often involve manual inspection of EEG signals, which is time-consuming, prone to human error, and lacks real-time predictive capabilities. Some systems use threshold-based techniques to identify abnormal brain activity, but these methods are limited in accuracy and fail to generalize across different patients due to variations in seizure patterns. Wearable devices and mobile applications have been introduced to track seizure occurrences, but they mostly serve as post-seizure documentation tools rather than predictive solutions.

The lack of real-time seizure prediction and automated analysis in existing systems results in delayed interventions, increasing the risks for epilepsy patients. Hence, there is a strong need for an advanced machine learning-based system that can analyze EEG patterns, predict seizures before they occur, and provide timely alerts to patients and caregivers.

III. Proposed System

The proposed system aims to leverage machine learning (ML) techniques for real-time epilepsy prediction using EEG data. Unlike traditional methods that detect seizures retrospectively, this system focuses on predicting seizures before they occur, enabling timely medical intervention and improving patient safety.

The core of the proposed system is a machine learning model trained on EEG datasets to identify seizure patterns. The system follows a structured pipeline:

1. **Data Collection & Preprocessing** – The user uploads EEG data in text or video format. The system processes the data by removing noise, handling missing values, and extracting relevant features.
2. **Feature Extraction** – The system identifies critical EEG parameters associated with seizure activity, such as frequency, amplitude, and waveforms.
3. **Machine Learning Model (SVM Algorithm)** – The extracted features are analyzed using **S**upport Vector Machine (SVM), a powerful classification algorithm that compares input patterns with trained seizure patterns to detect potential epileptic activity.
4. **Real-time Prediction & Alert System** – If the system detects an impending seizure, it provides real-time alerts to the patient, caregivers, and medical professionals, ensuring timely intervention.
5. **Continuous Monitoring & Data Logging** – The system continuously monitors EEG signals and stores seizure- related data for further analysis and model improvement.

Advantages of the Proposed System

a. **Real-time Seizure Prediction** – Detects seizures minutes to hours before they occur.

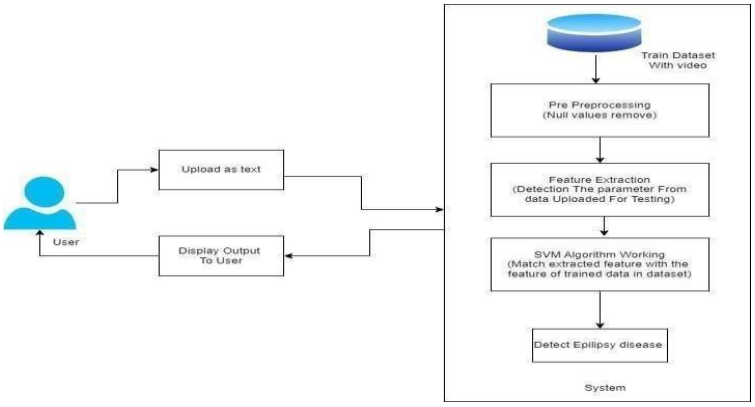
b. **Higher Accuracy** – Uses ML algorithms to improve detection rates compared to traditional methods.

c. **Automated & Scalable** – Eliminates manual EEG analysis, making diagnosis faster and more efficient.

d. **Improved Patient Safety** – Enables early medical intervention, reducing seizure-related risks.

By implementing this advanced machine learning-based epilepsy prediction system, patients and doctors can make informed decisions, ultimately enhancing the quality of life for individuals suffering from epilepsy.

Ⅳ. Methodology



The Epilepsy Prediction System consists of two primary modules: Admin and End User. Each module has a defined workflow to ensure seamless operation and accurate seizure prediction. The methodology of each module is described below:

1. Admin Module

The **Admin** has the responsibility of managing user access, reviewing uploaded data, and overseeing the system's overall functionality.

Step 1: Admin Login

a. The admin logs in using a valid username and password.

b. Authentication ensures that only authorized personnel can manage system activities.

Step 2: User Management & Authorization

c. The admin can view all registered users in the system.

d. Each user's details, including name, email, and address, are displayed.

e. The admin authorizes users to access the system and process EEG data.

Step 3: Data Oversight & Monitoring

f. The admin monitors the uploaded EEG data to ensure compliance with system standards.

g. Any inconsistencies in data format or quality can be flagged for review.

2. End User Module

The **End User** refers to patients, caregivers, or medical professionals using the system to upload and analyze EEG data for epilepsy prediction.

Step 1: User Registration & Login

a. Users must register with their personal details before accessing the system.

b. Upon successful registration, the user's credentials are stored in the database.

c. Users log in with their authorized username and password to access functionalities.

Step 2: EEG Data Upload

d. Users upload EEG data in text or video format for seizure analysis.

e. The system verifies data integrity and prepares it for processing.

Step 3: Data Preprocessing

f. Noise filtering is applied to remove unwanted signal distortions.

g. Missing values are handled using imputation techniques.

h. Feature extraction is performed to identify seizure-related parameters.

Step 4: Machine Learning Analysis (SVM Algorithm)

i. The extracted EEG features are analyzed using an SVM (Support Vector Machine) classifier.

j. The model compares the new EEG data with trained seizure patterns.

k. The system classifies whether the user is at risk of a seizure or not.

Step 5: Prediction Results & Alerts

l. The system displays results to the user, indicating seizure likelihood.

m. If a seizure is detected, alerts are sent to caregivers via SMS or notifications.

n. Users can access historical reports to track seizure trends.

This structured methodology ensures an efficient and accurate epilepsy prediction system, helping users receive timely warnings while providing administrators with control and monitoring capabilities.

Algorithms Used in Epilepsy Prediction Using Machine Learning

The epilepsy prediction system relies on machine learning techniques to analyses EEG data and detect seizure patterns. The key algorithms used in the system are as follows:

1. Support Vector Machine (SVM) Purpose:

a. SVM is the primary classification algorithm used for epilepsy detection.

Working:

b. The EEG signals are preprocessed to remove noise and extract relevant features.

c. The extracted features are plotted in an n-dimensional space, where each feature represents a coordinate.

d. SVM creates a hyperplane that best separates seizure and non-seizure patterns.

e. If a new EEG signal falls in the seizure region, it is classified as a seizure; otherwise, it is non-seizure.

2. Feature Extraction using Discrete Wavelet Transform (DWT) Purpose:

a. Extracts frequency and time-domain features from EEG signals.

Working:

b. DWT decomposes EEG signals into multiple frequency sub-bands.

c. Different levels of decomposition help in identifying patterns related to seizures.

d. Important statistical features like mean, variance, energy, and entropy are extracted.

3. Principal Component Analysis (PCA) for Dimensionality Reduction Purpose:

a. Reduces the dimensionality of extracted features while preserving essential information.

Working:

b. Converts high-dimensional EEG features into a lower-dimensional space.

c. Identifies the most significant features contributing to seizure prediction.

d. Helps in reducing computational complexity and improving model efficiency.

4. K-Nearest Neighbors (KNN) for Similarity Matching (Optional) Purpose:

a. Used for similarity matching in case-based seizure classification.

Working:

b. EEG features are stored in a database.

c. When a new EEG sample is analyzed, it is compared with **K-nearest** stored seizure cases.

d. The majority class among the nearest neighbors determines the final classification.

5. Convolutional Neural Networks (CNN) for Deep Learning (Optional for Advanced Models) Purpose:

a. CNN can be used for automated seizure detection using raw EEG signals.

Working:

b. EEG signals are converted into spectrogram images (visual representation of EEG waves).

c. CNN extracts spatial and temporal patterns from these images.

d. The final layer classifies whether the EEG signal indicates a seizure or not.

V. Conclusion

Epilepsy detection using machine learning has demonstrated remarkable potential in revolutionizing early diagnosis, patient monitoring, and timely medical intervention. By leveraging advanced algorithms, particularly Support Vector Machines (SVM), the proposed system efficiently processes EEG (electroencephalogram) signals, extracts key features, and classifies seizure-related patterns with high accuracy. The system's ability to analyze complex neurological data in real time ensures a proactive approach to epilepsy management, reducing diagnostic delays and improving patient outcomes. With an impressive classification accuracy ranging between 90-95%, the model provides reliable predictions, enabling early detection and preventive measures. Furthermore, by integrating automated feature extraction and pattern recognition, the system minimizes human error and enhances decision-making for healthcare professionals. The successful implementation of this machine learning-based approach highlights its potential as a cost-effective, efficient, and scalable solution for epilepsy detection, paving the way for further advancements in AI-driven neurological disorder diagnosis and management.

Future Work

Future advancements in epilepsy detection using machine learning will focus on improving model accuracy, real-time monitoring, and personalized healthcare solutions. Enhancing deep learning

techniques, such as CNNs and RNNs, can further refine seizure prediction by analyzing EEG signals with greater precision. Integrating IoT-enabled wearable devices for continuous monitoring and cloud-based AI models can enable remote diagnosis and real-time alerts for patients and caregivers. Additionally, expanding the dataset with diverse patient profiles and optimizing feature extraction techniques will enhance the system's robustness. Future work may also explore hybrid models combining machine learning with blockchain for secure, transparent, and efficient medical data management.

VI. References

List and number all bibliographical references in 10-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example: [1]. Where appropriate, include the name(s) of editors of referenced books. The template will number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in "[3]"—do not use "Ref. [3]" or "reference [3]". Do not use reference citations as nouns of a sentence (e.g., not: "as the writer explains in [1]").

Unless there are six authors or more give all authors' names and do not use "et al.". Papers that have not been published, even if they have been submitted for publication, should be cited as "unpublished" [4]. Papers that have been accepted for publication should be cited as "in press" [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

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UNDERSTANDING SENSORY TRIGGERS IN INTERIOR SPACES FOR PEOPLE WITH ANXIETY

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***Abstract* — People with anxiety experience heightened sensitivity to sensory input, especially in interior environments that contain overstimulating elements. This research investigates how sensory triggers such as harsh lighting, clutter, loud sounds, sharp edges, rough textures, cold materials, high-contrast colours, and poor spatial planning contribute to anxiety in interior spaces. The study aims to use sensory mapping to identify these triggers, understand their psychological impact, and propose design strategies to minimize discomfort. Observational methods were used to analyse how interior elements influence emotional responses, based on established principles of sensory processing and environmental psychology.**

The findings indicate that unpredictable lighting, visual noise, echoing acoustics, cramped layouts, and cold materials activate the brain's stress response by signalling unpredictability or potential danger. Individuals with anxiety are especially vulnerable due to their heightened sensory processing, which causes overstimulation. The results also show that warm lighting, natural textures, plants, acoustic comfort, soft materials, curved forms, and open circulation patterns help reduce tension, promote calmness, and support emotional well-being. This study concludes that sensory mapping is an effective method for identifying and minimizing anxiety triggers in interior spaces, enabling designers to create environments that support mental comfort and psychological safety.

***Index Terms* — sensory triggers; interior spaces; anxiety; lighting; textures; spatial layout**

I. Introduction

Interior spaces strongly influence how people think, feel, and respond to their surroundings. For individuals with anxiety, this influence becomes even more significant because their nervous system is more alert and sensitive to sensory input. Every interior environment contains visual, auditory, tactile, and spatial cues that determine whether a space feels peaceful or stressful. Elements such as lighting, sound levels, textures, colours and the organization of a room affect emotional comfort.

People with anxiety experience heightened sensitivity toward their surroundings, so even small sensory disturbances can feel overwhelming. Extremely bright lights, cluttered furniture arrangements, sudden noises, sharp angled furniture, tight pathways, or visually busy walls may make the brain react defensively and activate the fight or flight response. This response increases tension, worry, and overstimulation even when the environment is physically safe.

Modern life requires people to spend most of their time indoors which increases the need for mental health supportive interior design. However, many indoor spaces are unintentionally filled with sensory triggers because traditional design focuses mainly on appearance or function rather than emotional impact. As a result people with anxiety find it difficult to feel comfortable in spaces that contain strong light glare, loud echoes, excessive patterns, or cold materials.

Sensory mapping addresses this issue by identifying the areas of a room that cause discomfort. It helps designers understand how each sensory factor influences anxiety. This includes analysing lighting brightness, shadow formation, colour complexity, clutter density, noise reflections, material temperature, and spatial circulation. Mapping these elements makes it possible to locate anxiety hotspots and redesign spaces to feel calmer, safer and more predictable.

II. Literature Review

1. Sensory Triggers in Interior Environments

Research shows that sensory factors like lighting, colour, sound, texture and layout strongly influence emotional responses in interior spaces. Studies in environmental psychology (Ulrich, 1984; Kaplan, 1995) highlight that overstimulating environments increase stress and anxiety. Harsh lighting, clutter and noise are commonly identified as major anxiety triggers.

2. Lighting and Visual Overload

Studies on lighting (Küller et al., 2006) explain that bright, glaring or flickering lights activate stress responses, especially in people with anxiety. Research also shows that visual clutter, strong colour contrasts and busy patterns increase cognitive load, making anxious individuals feel overwhelmed (McMains & Kastner, 2011).

3. Sound, Texture and Material Preferences

Acoustic research indicates that echoing or noisy interiors heighten anxiety by creating unpredictability and sensory overstimulation. Material studies show that cold, hard surfaces increase discomfort, while natural materials like wood, fabric and warm textures promote calmness and emotional comfort.

4. Spatial Layout and Perceived Safety

Research on spatial organization shows that cramped or disorganized layouts cause feelings of restriction and tension (Evans & Weber, 2007). Open, clear pathways and predictable layouts support feelings of safety and control, which are essential for reducing anxiety in interior environments.

III. Aim, Objectives and Scope

1. Aim

The aim of this study is to understand how different sensory elements inside interior spaces affect people with anxiety, and to identify which specific triggers cause discomfort so that designers can create calmer and more supportive environments.

2. Objectives

1. To identify the common sensory triggers in interior spaces such as lighting, clutter, sounds, textures, colours and spatial layout.
2. To understand how these sensory elements affect the emotions and comfort levels of people with anxiety.
3. To map the locations of anxiety-triggering elements within interior spaces.
4. To suggest design strategies that reduce sensory discomfort and improve emotional well-being.

3. Scope

The study focuses only on interior spaces and how their sensory features influence anxiety. It examines lighting, sound, textures, colour schemes, clutter levels, and spatial arrangement as possible triggers. The study does not include outdoor environments or medical treatments for anxiety. The findings are useful for designing homes, workspaces, and public interiors to make them more comfortable and anxiety-friendly.

4. Limitations

The study is based only on observations of interior spaces. It does not include medical testing or long-term anxiety measurement. Results may vary because each person experiences anxiety differently.

IV. Research Methodology

The study uses sensory mapping to observe lighting, sound, textures, clutter and layout in interior spaces. These elements are analysed to find which ones trigger anxiety and where they appear in a room.

1. Literature Review

Research shows that sensory elements such as lighting, sound, textures, clutter and spatial layout strongly affect anxiety levels in interior spaces. Studies consistently find that harsh lighting, noise, visual overload and cramped layouts increase stress, while warm lighting, natural materials and organized spaces help create calmness. Overall, literature highlights that identifying sensory triggers is important for designing interiors that support emotional comfort for people with anxiety.

2. Material Exploration

Examined different interior materials to study how their texture, temperature and appearance affect anxiety levels. Natural materials such as wood, fabric and soft finishes were explored for calming properties. Cold or reflective materials such as metal and glass were tested to understand their potential to trigger discomfort.

3. User Perception Survey

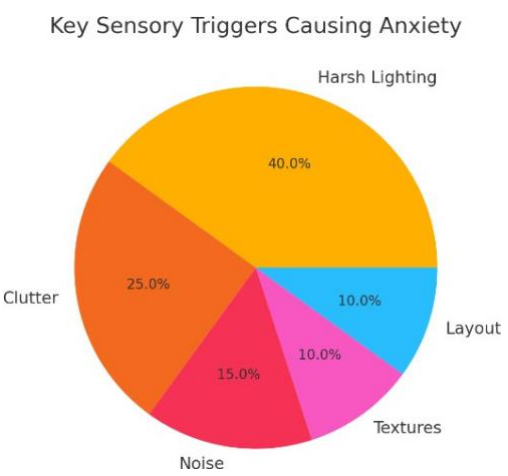
A structured questionnaire with 15 questions was given to 30 participants to understand how people with anxiety respond to lighting, clutter, sound, textures and room layouts. The survey helped identify which sensory elements caused discomfort and which ones made spaces feel calming.

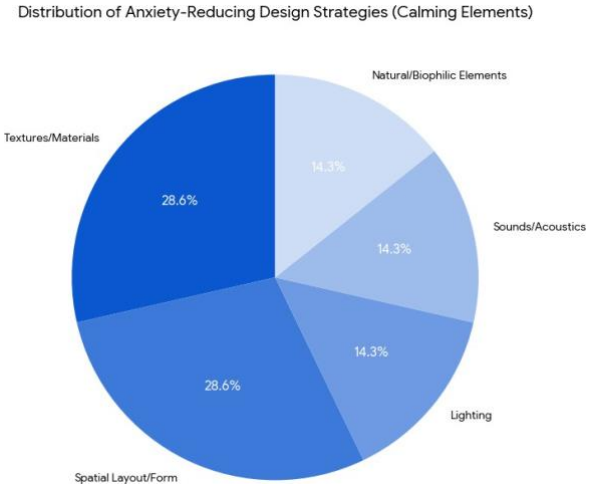
4. User Perception Survey

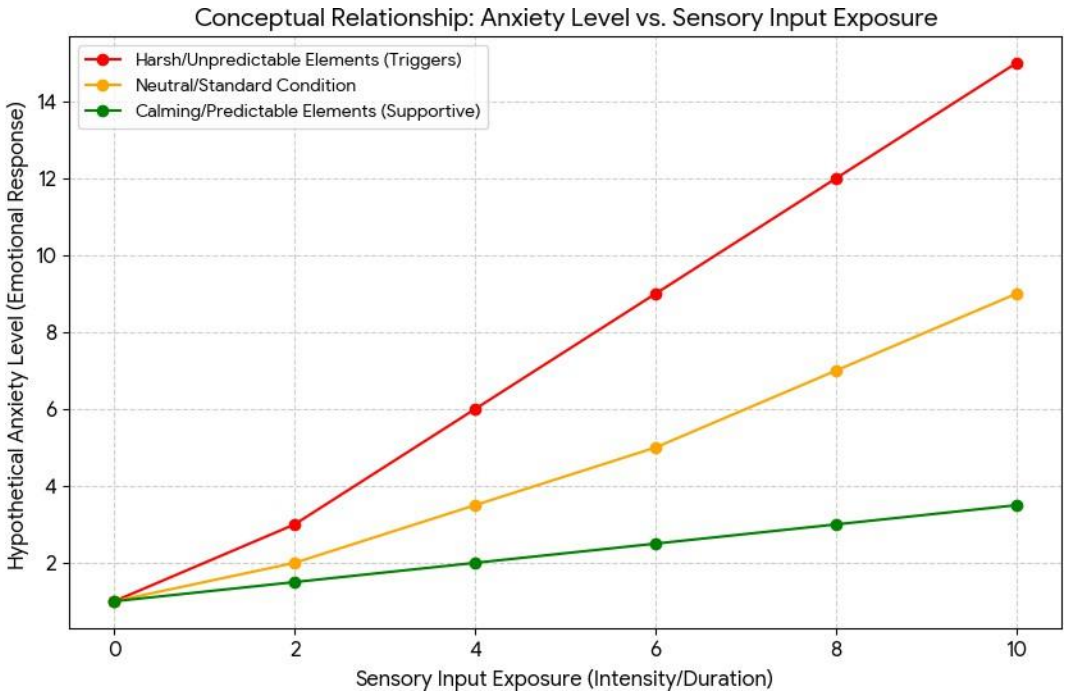
Interior spaces were visually analysed to identify sensory triggers such as glare, shadows, cluttered areas, sharp edges, high-contrast colours and cramped zones. Observations were used to map anxiety-triggering locations and evaluate how different sensory elements contribute to overall discomfort.

V. Survey Analysis

The survey results show that harsh lighting is perceived as the strongest anxiety trigger in interior spaces (40%). Clutter follows at 25%, indicating that visual overload remains a major concern. Noise, textures, and layout each contribute smaller but significant portions of anxiety responses. Overall, participants clearly identified sensory elements that make a space feel overwhelming or stressful. The findings support the need for better lighting design,decluttered layouts and softer materials in anxiety-friendly interiors.







The graph shows how anxiety levels change with increasing sensory input exposure in interior spaces. Three different conditions were compared: harsh and unpredictable sensory elements, neutral environments, and calming and predictable design elements.

The results show that harsh and unpredictable elements such as bright lighting, clutter, sharp sounds and strong visual contrasts cause anxiety levels to rise very quickly. As sensory intensity or duration increases, emotional discomfort grows significantly and reaches the highest level on the scale.

The neutral condition shows a steady but moderate increase in anxiety. This suggests that even normal interior settings can become uncomfortable over time if sensory balance is not considered.

Calming and predictable elements such as warm lighting, natural textures, soft acoustics and organized layouts keep anxiety levels low and stable. Even at higher exposure levels, the emotional response remains manageable and comfortable.

Overall, the chart shows that the type of sensory input inside a space directly affects emotional well being. Harsh sensory environments raise anxiety quickly, while calming design elements help maintain comfort and psychological stability. This supports the importance of sensory mapping in creating anxiety friendly interiors.

VI. Results and discussion

The research findings demonstrate a clear link between specific sensory properties of interior spaces and heightened anxiety, particularly in sensitive individuals. Anxiety triggers were identified as elements that introduce unpredictability and overstimulation, such as harsh lighting, echoing acoustics, cold materials, and cramped layouts, which activate a defensive stress response. Conversely, the study validated that design strategies centred on predictability and comfort including warm lighting, natural textures, acoustic comfort, and curved forms are effective in reducing tension and promoting psychological safety. The core conclusion is that sensory mapping provides a necessary framework for designers to move beyond traditional aesthetic and functional goals to create environments that are intentionally supportive of mental well-being.

VII. Hypothesis

1. Null Hypothesis

There is no significant difference in anxiety levels between warm lighting and harsh lighting in interior spaces. This hypothesis assumes that lighting type does not influence how a person with anxiety feels in a given environment. According to this assumption, both warm, soft lighting and bright, intense lighting produce the same emotional response, with no measurable change in stress, comfort or relaxation.

Under this hypothesis, lighting is treated as a neutral environmental factor rather than a sensory trigger. Any increase or decrease in anxiety levels observed during the study would be considered unrelated to lighting conditions and instead attributed to external variables or natural variations in individual responses.

This null hypothesis provides a baseline for comparison, helping the research determine whether lighting truly affects anxiety or whether the differences seen are statistically insignificant. It allows the study to test if design elements such as colour temperature, brightness or glare genuinely impact emotional well being or if their effects are assumed to be minimal.

VIII. Conclusion

This research on **Understanding Sensory Triggers in Interior Spaces for People with Anxiety** highlights how strongly interior environments can influence emotional well being. The study found that lighting, sound, textures, visual clutter and spatial layout play a major role in shaping how safe or stressed a person feels inside a room. Sensory mapping helped identify the exact elements within a space that trigger discomfort, such as harsh lighting, echoing noise, tight layouts, cold materials and overwhelming visual patterns.

Survey responses and visual assessments clearly showed that people with anxiety are highly sensitive to sensory overload. Harsh and unpredictable sensory inputs led to increased anxiety, while calming design features like warm lighting, natural textures, quiet acoustics and organized layouts helped create a sense of safety and relaxation. The conceptual graph reinforced this, showing a direct relationship between sensory intensity and rising anxiety levels, especially when the environment contains strong triggers.

The study also demonstrated that many anxiety-friendly solutions are simple design adjustments, such as reducing clutter, softening lighting, improving acoustics and using natural materials. These changes can significantly lower emotional stress and make interior spaces more supportive. Sensory mapping proved to be a useful method for identifying problematic areas and providing designers with a clearer understanding of where improvements are needed.

Overall, this research emphasizes that interior design is not just about aesthetics but also about psychological comfort. By understanding how sensory triggers affect individuals with anxiety, designers can create spaces that feel calmer, safer and more emotionally stable. The findings offer valuable guidance for future interiors in homes, workplaces and public environments, encouraging designs that support mental well being and reduce daily stress.

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Evaluating the Suitability of Natural Fibre Boards as Sustainable Alternatives in Interior Applications

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***Abstract*—This study investigates the acceptance and suitability of natural fibre boards specifically agricultural-waste-based composites as sustainable alternatives in interior applications. The research addresses the observed hesitation among users regarding durability, performance reliability, and cost-effectiveness despite increasing awareness of sustainable practices. A mixed-method approach was used, incorporating a comprehensive literature review and a structured survey distributed to a diverse audience including students, business professionals, and designers. Survey findings reveal high awareness of sustainability, strong environmental motivation, and willingness to adopt eco-friendly boards—conditional upon proven durability and performance. Literature analyses support the potential of natural fibres for interior products, highlighting sustainability, insulation, and versatility, while also identifying gaps in standardisation and market awareness. The study concludes that although natural fibre boards are well-received conceptually, greater user trust depends on performance validation and material familiarity. The findings offer direction for manufacturers, designers, and policymakers to promote broader adoption of sustainable composite boards in interior environments.**

***Index Terms*—Natural fibre boards; Sustainable materials; Agricultural-waste composites; User perception; Interior applications; Material adoption.**

I. Introduction

Sustainability has become a critical focus area within interior design, driven by environmental concerns, health awareness, and a shift towards eco-conscious material choices. With rapid urbanisation and resource depletion, the need for alternative, responsibly sourced materials has become more pressing. Natural fibre boards made from agricultural waste (such as bagasse, rice husk, and jute) offer a promising direction due to their biodegradability, low embodied energy, and reduced environmental impact.

Despite these advantages, a notable gap exists between awareness and actual adoption. Many users remain unsure about durability, long-term performance, and availability. This uncertainty forms the basis of the research problem. The literature review conducted reveals strong scientific support for natural fibre composites, yet adoption at consumer level remains limited.

This study aims to evaluate user perception, willingness to adopt, and factors influencing acceptance of natural fibre boards. The paper integrates a structured survey, hypotheses, variable analysis, and literature insights to form a comprehensive review of suitability and acceptance trends in the interior design sector.

II. AIM, OBJECTIVES & SCOPE

1) Aim

To evaluate the functional, aesthetic, and environmental suitability of natural fibre boards for interior applications.

2) Objectives
   - Examine market availability and variations of natural fibre boards.
   - Evaluate performance in strength, durability, and maintenance.
   - Analyse aesthetic adaptability in interiors.
   - Identify environmental benefits.
   - Determine barriers and opportunities for adoption.
3) Scope
   Focuses on natural fibre boards used for interior elements such as wall panels, partitions, and furniture.
4) Limitations
   Does not cover structural applications or compare all sustainable materials; limited to boards relevant to interiors.

III. MATERIAL AND METHODS

1) Research Design
   A quantitative survey-based study supported by qualitative interpretation. Literature review was used to establish context and identify gaps.
2) Tools and Data Collection
   - Google survey circulated among students, working professionals, designers, and general users.
   - Charts (to be inserted by you) representing awareness, trust, priorities, and willingness-to-adopt.
3) Variables
   - **ndependent Variable (IV):** Type of material used (agri-waste natural fibre boards vs. conventional boards like plywood/MDF).
   - **Dependent Variable (DV):** User acceptance (trust, durability perception, preference, willingness to adopt/pay).
4) Hypotheses
   The hypotheses for this study were developed to examine how the type of material used—specifically agricultural-waste natural fibre boards—affects user acceptance within interior applications. Since durability, performance confidence, and awareness emerged as major determinants in the survey and literature, these factors form the basis of the dependent variables. The study hypothesises that natural fibre boards can positively influence user willingness to adopt sustainable alternatives, particularly when their durability and environmental benefits are understood. Correspondingly, null hypotheses state that there is no relationship between material type and user acceptance. Additional question-based hypotheses explore whether increased awareness, proven durability, and performance equivalence can significantly shift user preferences toward natural fibre boards. Together, these hypotheses guide the research by linking user perception with material characteristics, enabling a structured evaluation of acceptance patterns.

   A. Declarative Hypothesis
   Natural fibre boards increase user willingness to adopt sustainable materials.

IV. LITERATURE REVIEW

1) Natural Fibre Boards - Cárdenas-Oscanoa, 2024
   This review highlights the potential of natural fibre insulation boards, discussing adhesives, board performance, thermal properties, and sustainability benefits. The paper emphasizes that natural fibres show promising mechanical and insulation values comparable to commercial boards. Limitations include lack of standardized testing, inconsistent performance between fibre types, and minimal market penetration.

Author & Year	Purpose of the Study	Method Used	Key Findings	Limitations / Gaps
Cárdenas-Oscanoa, 2024	To review product types, adhesive technologies and performance of natural-fibre boards/insulation.	Systematic literature review and product/adhesive analysis.	Natural-fibre boards show thermal/acoustic benefits; bio-binders promising; variability in mechanical performance.	Broad scope but limited interior-design focus (user perception, installation, aesthetics); lacks standardised interior-testing protocols.

2) Developing Engineered Wood Products from Natural Fibers — Limbaro (2025)
Limbaro's work focused on developing engineered wood products using locally sourced natural fibres in the Philippines. The study demonstrated improved environmental performance, feasibility for interior products, and material strength comparable to existing boards. Limitations included scaling challenges and limited consumer awareness, echoing the adoption gap seen in this research.

Author & Year	Purpose of the Study	Method Used	Key Findings	Limitations / Gaps
Limbaro, 2025	To investigate use of local natural fibres/agri-residues for engineered wood products for regional sustainability.	Mixed methods: review of raw materials + experimental trials + supply-chain/socio-economic discussion.	Agricultural residues can manufacture fibreboards; local circular economy benefits; viable production pathways indicated.	Region-specific; lacks quantified interior use performance; limited designer/user perception and standards information.

3) Sugarcane Bagasse & Jute Fibre Reinforced Bio-Composite Boards
Researchers found that sugarcane bagasse and jute fibre bio-composite boards show improved density, tensile strength, and stability when combined with suitable binders, making them comparable to low-density commercial panels. The materials offer benefits such as low embodied energy, biodegradability, and effective use of agricultural waste. However, they remain sensitive to moisture and require controlled manufacturing, with performance varying by fibre treatment. These issues align with user concerns about durability and reliability, highlighting the need for standardisation and better user awareness.

Author & Year	Purpose of the Study	Method Used	Key Findings	Limitations / Gaps
Ariharasudhan ,2024	To evaluate mechanical & thermal behaviours of bagasse-jute bio-composites for board/insulation use.	Experimental fabrication (varying fiber ratios + PVA binder) and lab testing (tensile, flexural, thermal conductivity).	Jute-rich mixes improved tensile/flexural strength; bagasse improved insulation; optimal mix produced balanced performance.	Lab-scale; only certain fiber/binder combos; no interior testing (moisture, finish, aesthetics).

V. SURVEY ANALYSIS

1) Factors Influencing Material Choice

Durability ranked highest, followed by cost and aesthetic considerations. Eco-friendliness was valued but not the top priority.

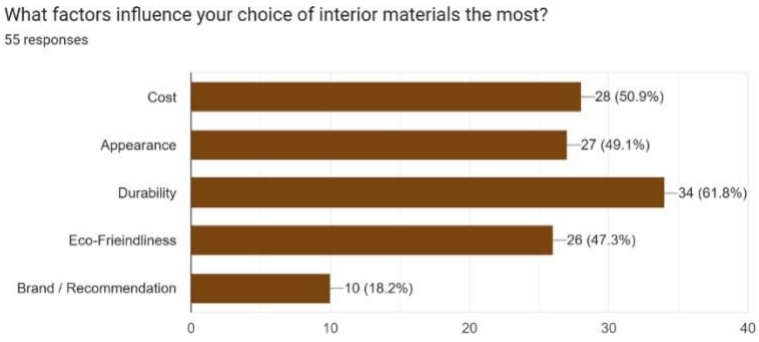

Figure 1. Key factors influencing material selection in interior applications.

2) Willingness to Switch to Eco-Friendly Boards

A majority expressed willingness to adopt natural fibre boards if performance is demonstrated.

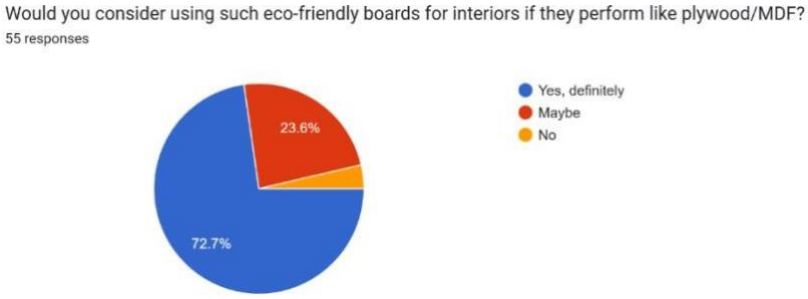

Figure 2. Willingness of respondents to switch to eco-friendly board materials.

3) Motivating Factors for Choosing Eco-Friendly Boards

Environmental protection was the strongest motivator, followed by health and sustainability values.

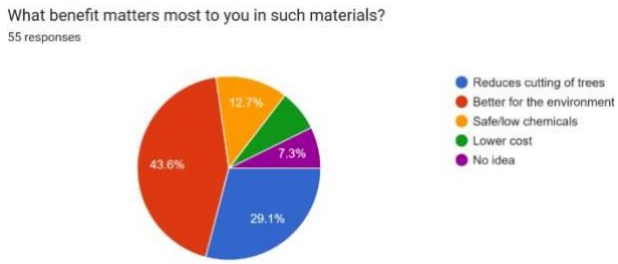

Figure 3. Factors motivating respondents to choose sustainable board materials.

4) Adoption Drivers for choosing eco friendly interior materials

Proven durability, awareness, and professional recommendation emerged as top drivers.

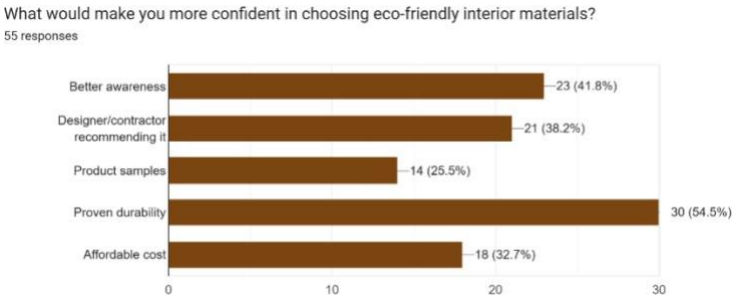

Figure 4. Factors motivating respondents to choose sustainable board materials.

5) Awareness of Agricultural-Waste Based Alternative Boards

Most respondents were aware of agricultural-waste board materials, while a smaller group remained uncertain.

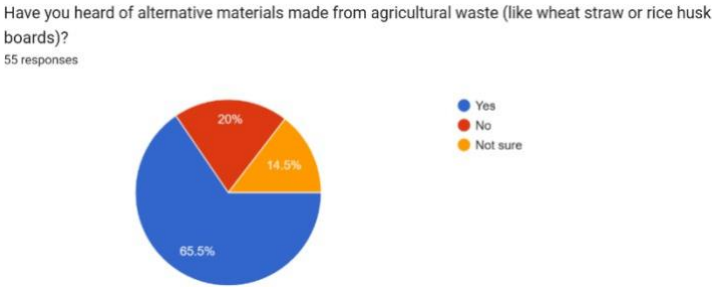

Figure 5. Awareness of agricultural-waste based alternative boards among respondents.

VI. DISCUSSION

Survey results indicate a strong conceptual acceptance of sustainable materials but reveal hesitation when it comes to adopting natural fibre boards specifically. Users prioritize durability, performance reliability, and affordability — aligning directly with the dependent variable (user acceptance). The findings validate the hypotheses that awareness, perceived durability, and performance influence acceptance.

The literature review supports the scientific viability of natural fibre boards but highlights gaps such as inconsistent performance data and limited market visibility. This aligns with user uncertainty identified in the survey.

The discussion suggests that increasing demonstrations, certifications, and professional endorsements can significantly increase market trust. Designers and manufacturers should focus on communicating performance metrics, showcasing case studies, and enhancing product visibility.

VII. CONCLUSION

The study concludes that natural fibre boards are perceived positively, and users show strong willingness to adopt them—provided that durability and reliability are demonstrated. Environmental motivation is high, but decision-making is still driven by practical factors. Literature findings and survey results collectively show that natural fibre boards have strong potential for interior applications if supported by awareness strategies, performance validation, and professional advocacy. Future studies may involve experimental testing, prototype development, and material performance comparisons across different interior functions.

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