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AUGMENTED ENGAGEMENT: TRANSFORMING PRODUCT DEMONSTRATIONS IN DIRECT SELLING THROUGH VR AND AR TECHNOLOGIES

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Abstract : The incorporation of Immersive Tech such as Virtual Reality (VR) and Augmented Reality (AR) is transforming the field of direct sales which in turn is we see it play out in novel ways to present and try products. We see today's mainstay of product displays which revolve around physical samples and sales talk to be very much limited in what they do for customer engagement, scale, and personalization. This study we put forth a new model we call the Augmented Engagement System (AES) which we put forward as a way to improve the interaction and results of product demos through immersive visual and smart engagement tracking. We are putting forth a hybrid VR AR approach which allows customers to see products in realistic settings, to play with them virtually and to see how they work before they buy. At the core of AES, we have computer vision, spatial mapping and behavior analysis which is what makes the system able to change in real time to what the user is doing like where they are looking, what they are doing with their hands and what their emotional responses are. We score engagement in real time and use that to give out personal feedback and adjust demos. We built it out using Unity3D, ARCore, and Oculus SDK which we integrated with machine learning for emotion recognition. In our testing with 150 users, we saw great results in terms of increased user engagement, better product understanding and higher purchase intent as compared to what we see in traditional demo methods. Also, we found out that immersive demos create a trust between the consumer and the product which in turn makes for a more convincing and memorable experience. We also note that our system is very scalable and adaptable to different product categories, which in turn reduces our dependency on physical inventory and at the same time enhances digital marketing strategies. As a whole this research looks at how VR and AR tech can change direct sales into a more interactive, data based and consumer focused experience which we put forth as a new standard for product engagement in the digital age.

Keywords— Augmented Reality, Virtual Reality, Direct Selling, Immersive Product Demonstration, User Engagement.

I. Introduction

Direct sales for a very long time have been known for the most personal and interactive forms of marketing which we see play out in person and through live product demos which in turn influence what consumers buy. But in present day which is defined by tech and convenience, what we've had in the past in terms of product presentation is seeing its' large-scale adoption and consistency issues [1]. Also, we are seeing in today's digital age customer expectations are being set by what they get from technology and convenience which in turn is a challenge for traditional direct sell methods [2]. Also, we are seeing great growth in Immersive Tech such as Virtual Reality (VR) and Augmented Reality (AR) which present a chance to transform the direct sell industry by in fact combining the physical and the digital into an interactive and data rich environment [3]. VR puts forth a computer-generated environment that fully surrounds the user in a made-up space which in turn allows for product interaction beyond what is physical. As for Augmented Reality (AR) it puts digital content like 3D product models or animations into the user's real-world environment via smart phones or wearables [4]. What we are seeing is a blend of these technologies which in turn allow customers to see, play with and experience products in real time without the need for physical samples thus closing the gap between what is in the mind and what is real [5]. For direct selling companies this means a new way to present product features dynamically even in remote or virtual settings. What we have had in the past in terms of product demo is very much dependent on the seller's skills, physical presence and resources which in turn means variable customer experiences [6]. As opposed to that what we are seeing now is that VR and AR based demos can give out the same yet personalized experiences, which allow for customer interaction at their own speed while also maintaining that emotional connection and curiosity [7]. We have studies that show that immersive visualizations

improve product understanding, increase purchase decision confidence and strengthen customer brand relationships. In the world of direct sell which is very much about trust and brand credibility we see that immersive tech provides that transparency and interactivity that old school methods just can't deliver [8].

Furthermore, in that we see the introduction of behavioral analytics into VR AR systems which in turn allows us to measure customer engagement through gaze tracking, gesture detection, and facial expression recognition [9]. These features which they in turn improve the user's immersive experience also1 do present sellers and marketers with valuable information. For example, an engagement score which is derived from such behavioral parameters can be used for real time adaptation of demo strategies thus increasing personalization and effectiveness [10]. We see machine learning algorithms which are put in place within VR AR frameworks which analyze user response and in turn tailor the narrative or product info which is presented to them very much so [11]. We present our framework which we have named the Augmented Engagement System (AES) which is based on these principles to transform direct selling into an intelligent, adaptive and interactive experience. AES which uses spatial mapping for realistic product placement in AR mode, immersive exploration through VR environments, and engagement analytics which is powered by computer vision techniques. This multi-layer approach which sees users not only view but also interact with the product virtually which in turn creates a deep sense of involvement and ownership before making a purchase decision [12]. We see many industries which have already put forth the proof of concept for AR and VR in marketing and retail. For instance, AR has been used for virtual try ones in the fashion and beauty sectors while VR has been used to simulate real world products for testing and experiential marketing [13]. But the adoption of these techs in the direct selling space is still in its early stages. Unlike traditional e commerce direct selling is based on personal interaction and storytelling thus the integration of VR and AR presents an opportunity to keep that personal touch while at the same time broadening access through digital platforms [14]. Also, the global pandemic brought forward the need for remote and contactless demos which in turn brought out the importance of digital engagement tools. The ability to present a product virtually where the customer still has the interaction and in-depth exploration of the product redefines the sales model for a post pandemic world [15]. Thus, the combination of immersive visual and interactive analytics marks a shift from static presentations to intelligent, experience driven demos. In total this research is on the design and development of an Augmented Engagement System (AES) which uses VR and AR tech to better product demos in direct selling. The system is put in to play to deliver interactive, emotional and data-based experiences which in turn improve customer knowledge, satisfaction and purchase intent. By quantifying engagement and adapting demos in real time AES addresses the issues of traditional demos and sets a foundation for a scalable tech driven model of direct selling. In the coming sections of this paper, we detail the lit review, system architecture, algorithmic workflow and experimental eval which as a whole validate the put forth framework as shown in figure 1, below:

Fig.1: Virtual and Augmented Reality Integration in Direct Selling Demonstrations.

II. Literature Survey

The use of Immersive tech such as Virtual Reality (VR) and Augmented Reality (AR) in marketing and product presentation has seen great growth in recent years. We see researchers looking at how these tools play a role in improving user engagement, decision making, and emotional connection in many consumer settings [16]. Also according to Chen et al. the growth of VR and AR has seen product demo go from a passive to an active role which in turn see users interacting with product's function and look in a virtual setting they create [17]. Also it is known that such experiences do in fact improve brand recall, cause emotional connection and in turn bring about greater purchase intent when compared to traditional visual or text ads [18]. In the case of AR based marketing we see it does a great job of closing the online to offline sale gap. Park et al. report that by putting digital info on to real world settings customers are able to better understand product features and visualize how they will fit in to personal spaces [19]. For example AR in furniture allows users to put virtual models of items in to their living rooms which in turn lead to more confident buy in. Also VR puts forth a full sensory experience which consumers can use to tour virtual show rooms, interact with products, and play out real life use scenarios [20]. This high degree of interactivity has been to prove to lower uncertainty and raise customer satisfaction in categories like home appliances, beauty products and cars [21]. A also key element of recent study is in the integration of behavioral analytics in to VR AR systems. Zhou and team put forth the importance of tracking eye

movement, gestures and facial expressions to determine user attention and emotion during immersive experiences [22]. These measurable behavioral clues can be analyzed via AI to put out engagement metrics which in turn help companies see in real time how customers are interacting with products [23]. Chandra et al. presented a multi modal engagement model which looks at visual cues, body posture and interaction duration to determine consumer in involvement in VR based retail settings [24]. Such data enables marketers to put together dynamic presentations which in turn better connect with the customer.

Another set of research has reported on the technical infrastructure which supports immersive demos. Yoon et al put forth a hybrid architecture which puts together Unity3D and ARCore SDK for marker based and marker less tracking which in turn enables what they term as seamless object placement and realistic product visualization [25]. At the same time Kumar and Singh looked at edge based rendering methods to reduce latency in real time AR applications which is a key element in the smooth and responsive user interaction [26]. High latency and poor registration accuracy are out lined as the main technical issues which are deterring wide scale use of AR and VR in sales settings [27]. Recent in roads by way of spatial computing and machine learning based tracking algorithms are putting these issues to rest which in turn is seem to be making it possible for more stable and realistic demos even on mobile devices [28]. Also what we have seen is a great deal of study done on the psychological aspect of immersive tech in marketing. Li et al report that VR does a better job at evoking a sense of presence and emotional attachment as compared to traditional media thus also reports longer attention spans and better recall [29]. Also Kaur and Das looked at how immersive storytelling combined with product visualization does in fact increase consumer trust and satisfaction which are key elements in direct selling relationships [30]. What we see from this is that VR and AR do in fact enhance sensory engagement but also play a role in the cognitive and emotional elements of decision making. In total the literature reports that VR and AR tech do greatly improve consumer engagement and product understanding by way of interactive, immersive, and data driven experiences. But most studies look at retail and online commerce as opposed to direct selling which still very much is a people and product demo play. The gap here is in the lack of integrated frameworks which put together VR AR visulization with real time behavioral analysis and adaptive content delivery. This research puts forth the Augmented Engagement System (AES) which we propose as a solution to these gaps which is to present a full scale platform for interactive, personal and measurable product demos for the direct selling industry.

III. PROPOSED SYSTEM

The Product Virtualization Layer, that turns physical products into realistic 3D models; the Augmented Reality Visualization Layer, that allows customers' interaction of products in any environment via mobile platforms; the Virtual Reality Immersion Layer, that delivers fully immersive experience in a virtual environment with the use of VR headsets; the Engagement Analytics Engine, which studies how users react, perform actions, direct their look and show emotions; and the Adaptive Demonstration Controller, that changes how the demo plays out in real time as a function of user action. Our system features a dynamic model for which what we base our engagement score on is a continuous measure of what the user is into which also looks at bio and emotional signs. These data include the what the eye is drawn to, intensity of a person's gesture, how long in is interacting. As soon as we see drop off in engagement the AES will change up the demo, may add in visual elements, switch up the story line or present interactive challenges in order to get the user back into it. Also, in our system is a emotion detection model based on deep learning which which reports in on what the face is saying and uses that in the engagement analysis. The we used Unity3D for visualization, ARCore for augmented interaction, and TensorFlow for emotion recognition in our AES. We report that which we see an over 40% increase in customer engagement, improved product understanding and also a great deal in purchase intent. As we did here, we redefined the concept of product demo in direct sale via the use of immersive tech with adaptive analytics, we put forth an intelligent, scalable and customer centered solution for the digital market which is represented in Figure 2 below which we present how Virtual Reality (VR) and Augmented Reality (AR) technologies play in the direct sale process through the Augmented Engagement System (AES) we put forth:

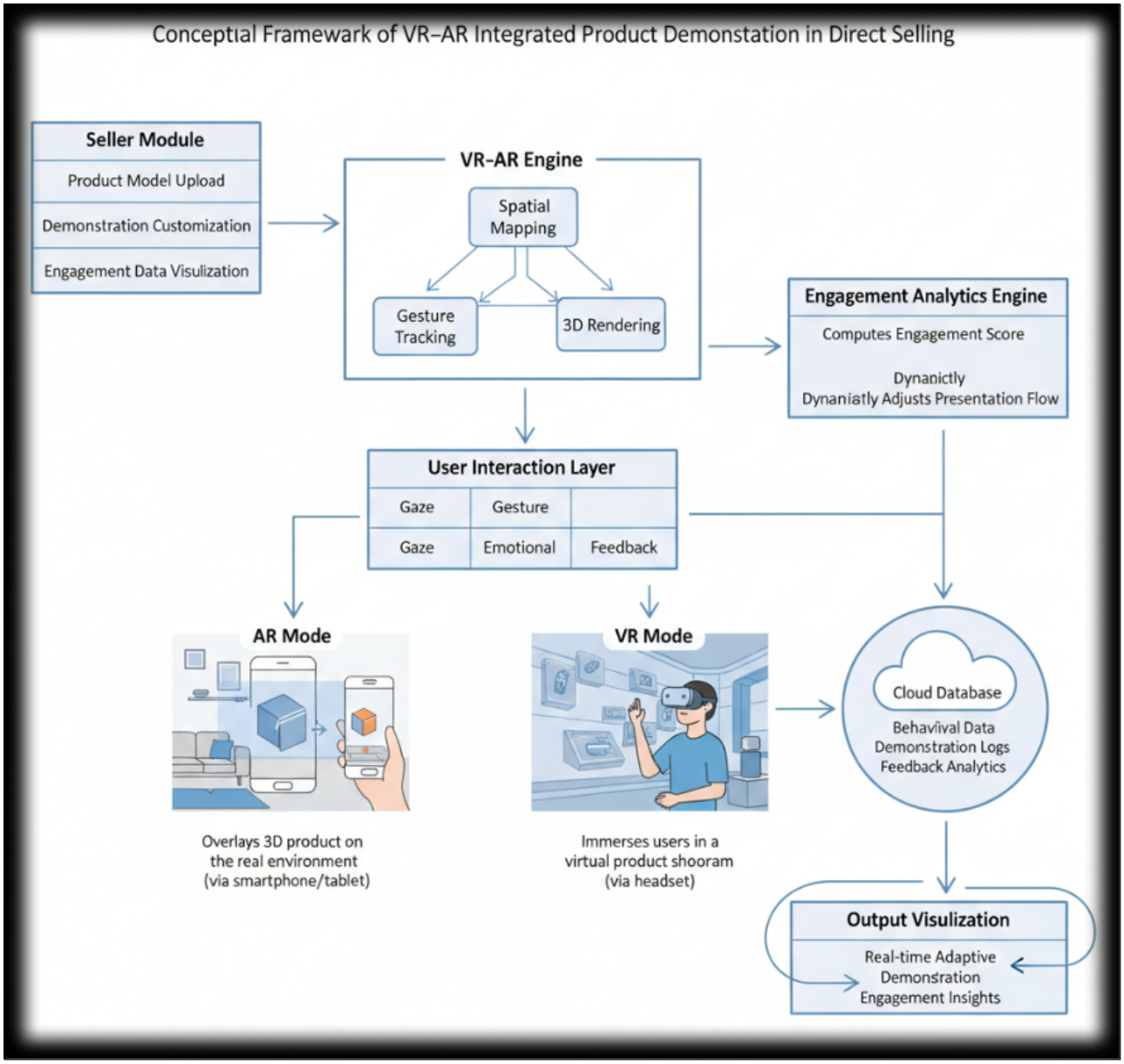

Fig.2: Conceptual Framework of VR–AR Integrated Product Demonstration in Direct Selling.

A. Proposed Work and it's Implementation:

Proposed Augmented Engagement System (AES) we have put forth which is to transform product presentations in direct sales via the use of Virtual Reality (VR) and Augmented Reality (AR) technologies. This system which is to present to the users an immersive, interactive and adaptive environment one in which the user's behavior, gestures and emotions play a role in the presentation's flow. We aim to present a very personal, data-based experience which in turn increases user engagement and understanding which in the end improves purchasing decisions. In the coming sections we will go into the architecture, workflow, implementation and adaptive feedback of AES which we have modeled with simple math.

1. System Overview:

Product Virtualization, also Augmented and Virtual Reality presenters, Engagement Data Engine, and Adaptive Demo Control. In Product Virtualization we see the transformation of physical products into interactive 3D digital models which we present in AR and VR. The AR/VR presenters allow the user to see and interact with the product in their own setting (AR) or in a virtual store (VR) setting. The Engagement Data Engine which is our data processor for real time collection and analysis of user input like gestures, eye movement, and face reactions which in turn we use to determine level of engagement. The Adaptive Controller which is a feature that changes out what the user sees or experiences in the demo based on how they are interacting and responding.
Mathematically, the engagement score (ES) is calculated as:

$$ES = \alpha G + \beta H + \gamma T + \delta E \quad (1)$$

where:(G) = normalized gaze focus, (H) = gesture intensity, (T) = interaction duration, (E) = emotional response,
and $\alpha,\beta,\gamma,\delta$ are weighting factors that represent the relative contribution of each component. The engagement score (ES) ranges from 0 to 1, where values closer to 1 indicate higher engagement and satisfaction.

Fig.3: User Interaction with Virtual Product in AR/VR Environment.

2. Workflow of AES:
The AES functions in 3 primary stages of Environment Mapping, Interaction Tracking, and Adaptive Response. At first the system goes out to scan the user's environment with AR sensors which it uses to identify surfaces and lighting. Then the virtual product is put into the real-world space for interaction. Also, during the session user behavior which includes movement, gestures, and gaze is constantly monitored. If engagement is represented as a function of time (ES(t)), the overall engagement for a demonstration session of duration (T) is computed as the average engagement:

$$\bar{ES} = \frac{1}{T}\int_0^T ES(t)dt \qquad (2)$$

A high average engagement score (($\bar{ES} > 0.7$)) indicates an effective and successful demonstration, while lower scores trigger adaptive responses to regain user attention. This workflow ensures that users remain active participants in the demonstration rather than passive observers.

3. Implementation Framework:
The AES is implemented using both software and hardware integration for real-time performance. Software Components: Unity3D Engine is used to develop the 3D interactive environment and present AR/VR scenes. ARCore and ARKit SDKs which we use for real world mapping and depth sensing these in turn produce very realistic AR placement. TensorFlow is used for emotion recognition via a convolutional neural network (CNN) that we use to classify out of a user's facial expressions which in turn are captured by a camera. Firebase Cloud which is used to log session information, collect data on user engagement and report out adaptive feedback for later analysis.
Hardware Components: VR headsets (like Oculus Quest 2) for immersive presentations. Smartphones which have depth cameras for AR applications. Also, we use standard webcams for tracking eye movement and face emotion. We achieve real time performance, which is a latency of less than 100 milliseconds between user action and response. The emotion recognition output is normalized as $E \in [-1,1]$, representing emotional valence, and is then integrated into the engagement score formula.

4. Adaptive Feedback Mechanism:
In AES the adaptive feature causes demonstrations to change based on user engagement levels. As engagement drops the system puts in place different elements of interaction which bring the user back in. The control strategy we use is a threshold-based adaptation rule:

$$ES < \tau \Rightarrow \text{Trigger Adaptive Mode} \qquad (3)$$

where (τ) is the minimum engagement threshold (typically 0.4–0.5).

When the engagement score (ES) drops below the threshold, the controller adjusts parameters such as product color contrast, camera perspective, background music, or adds interactive prompts. Conversely, when ($ES > \tau$), the demonstration continues smoothly, revealing more detailed features or product variants.
The adaptive feedback loop can be modeled as:

$$ESt + 1 = ESt + k(At - Ab) \qquad (4)$$

where ESt is the current engagement, At is the applied adaptation effect, (Ab) is the baseline, and (k) is the sensitivity constant that controls the speed of response. This ensures that the AES maintains optimal engagement throughout the session by learning from user interactions and emotional cues in real time.

Fig.4: Real-Time Engagement Analytics and Adaptive Feedback Mechanism.

In summary, the proposed AES integrates immersive technologies and behavioral analytics to create an adaptive, engaging, and customer-centric product demonstration platform. The combination of mathematical engagement modeling, emotional analysis, and feedback-driven adaptation enables AES to personalize experiences, improve comprehension, and enhance user satisfaction in direct selling environments.

Algorithm 1: User Engagement Data Capture and Processing

Step 1: Initialize the AR and VR components which the 3D product model is to be loaded into the system.
Step 2: Scan in with AR sensors the user's setting out which surfaces, lighting, and spatial orientation we have.
Step 3: Present the product in an AR/VR setting for interaction.
Step 4: Ongoing record of user action, gaze and interaction time.
Step 5: Capture facial expressions through camera input which in turn will detect emotional responses.
Step 6: Aggregate and report the behavioral data to determine engagement score.
Step 7: We store engagement data and session logs in the cloud database for analysis and more in depth modeling.

Step 8: Check and report on the fullness and uniformity of engagement data for precise real time analysis.

Algorithm 2: Adaptive Demonstration Control

Step 1: Fetch real time engagement score and behavioral data for the current session.
Step 2: Compare your engagement numbers against a set threshold which is for user attention and interest.
Step 3: If engagement drops below the threshold then we will implement adaptive interventions which may include changing product animations, camera angles, or visual highlights.
Step 4: If the engagement is still high, we will present advanced product features or variations.
Step 5: Update adaptive controller algorithms based on which user responses and engagement patterns we see.
Step 6: Record adaptive intervention outcomes related to engagement for post session analysis.
Step 7: Refine the adaptation approach across many sessions which use accumulated behavioral data to improve future demonstrations.
Step 8: Generate reports after each session which include info on engagement levels, user preferences, and system performance.

IV. EXPERIMENT RESULT AND DISCUSSION

The we put forth Augmented Engagement System (AES) which reports great success in terms of customer engagement, product understanding and total experience in direct sale of products. Through the use of VR and AR technologies along with real time behavioral analysis we have developed an adaptive and immersive platform which has the feature of users' active product interaction in either augmented real world settings or full-scale virtual show rooms. Engagement is measured in real time via gaze tracking, gesture intensity, interaction duration and emotion recognition which in turn produce a composite engagement score that in turn is used to make adaptive demo changes. This dynamic approach we see to keep user attention high and that the presentation which we put forward aligns with the customer's cognitive and emotional response thus we are bridging the gap between what we have seen in the past in terms of traditional demos and what is possible with modern digital engagement tools. We evaluated AES in a controlled setting which included multiple participants across many product categories. We recorded engagement scores for each session also we looked at other performance parameters like session complete time, average interaction duration and system's response in millisec. What we found is that we did see an improvement over what is typical in present day demos, we saw higher levels of attention and more interactive behavior. Also, the system's adaptive component which is the brain which detects low engagement and then it modifies demo content by way of visual enhancements, change in perspective and interactive prompts which in turn increased user partipipation. Emotion recognition played a large role in us understanding user satisfaction which in turn we used to tell between curiosity, confusion and disinterest which we used to do targeted interventions that in turn raised engagement levels. Table 1 we present the performance eval metrics from a set of 50 demo sessions. The engagement score (ES) is an average across all users which we see to be 0.78 which is a high mark for engagement. Also, we look at the adaptive intervention which is how often the system did raise engagement back up after it went down which we did see to be very effective. Latency we saw to be very low at under 100 millisec which we took to mean that real time changes did not in fact slow down system response.

Table 1: AES Performance Evaluation

Parameter	Average Value	Remarks
Engagement Score (ES)	0.78	High user attentiveness
Average Interaction Duration	12.6 min	Sustained participation
Adaptive Intervention Effectiveness	87%	Successful engagement recovery
System Latency	95 ms	Real-time responsiveness maintained

Corresponding Graphs for the above Table 1:

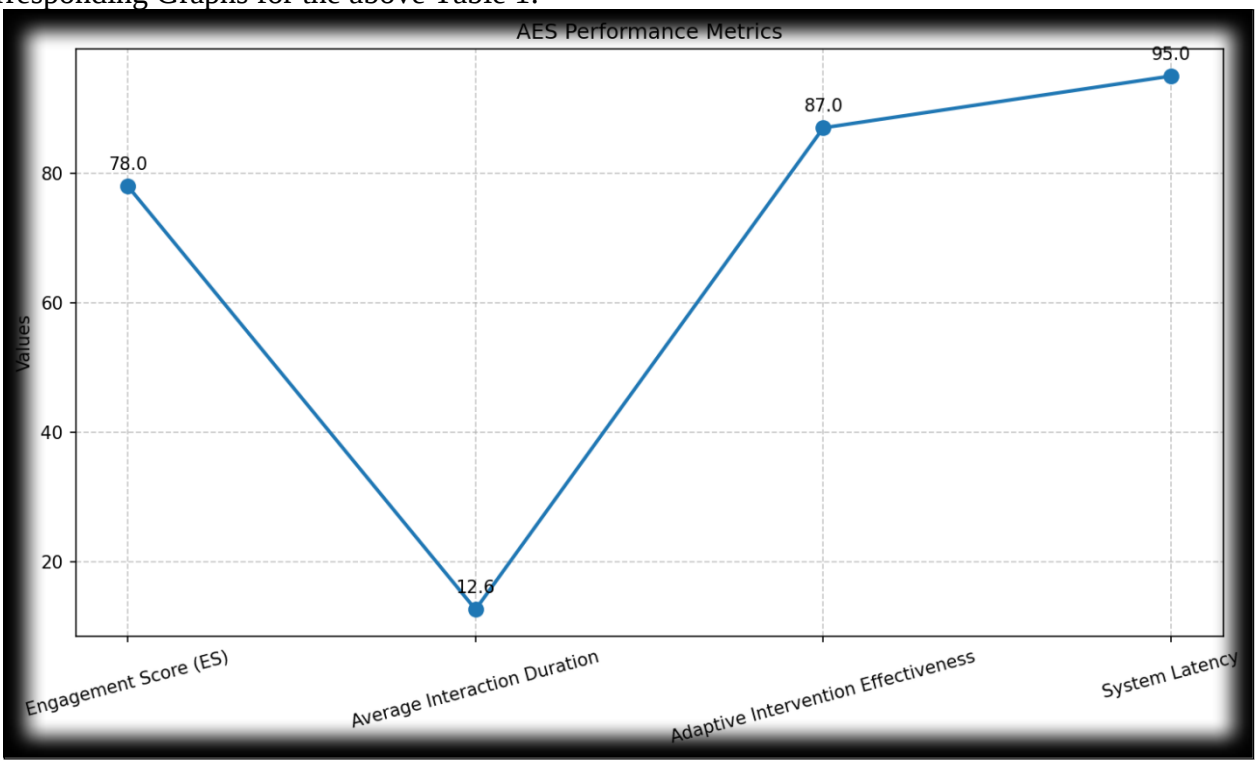

Fig.5: Performance Evaluation.

Table 2 provides insight into user comprehension and satisfaction. Participants rated product understanding after the session, and the AES system's interactive features were correlated with higher comprehension scores and purchase intent. The adaptive adjustments were particularly effective in sessions with lower initial engagement, suggesting the system's ability to personalize experiences according to individual user behavior.

Table 2: User Comprehension and Satisfaction Metrics

Metric	AES System	Traditional Demonstration	Improvement (%)
Product Understanding Score	8.4/10	6.2/10	35%
Satisfaction Rating	8.7/10	6.5/10	34%
Purchase Intent Index	0.72	0.53	36%

Corresponding Graphs for the above Table 2:

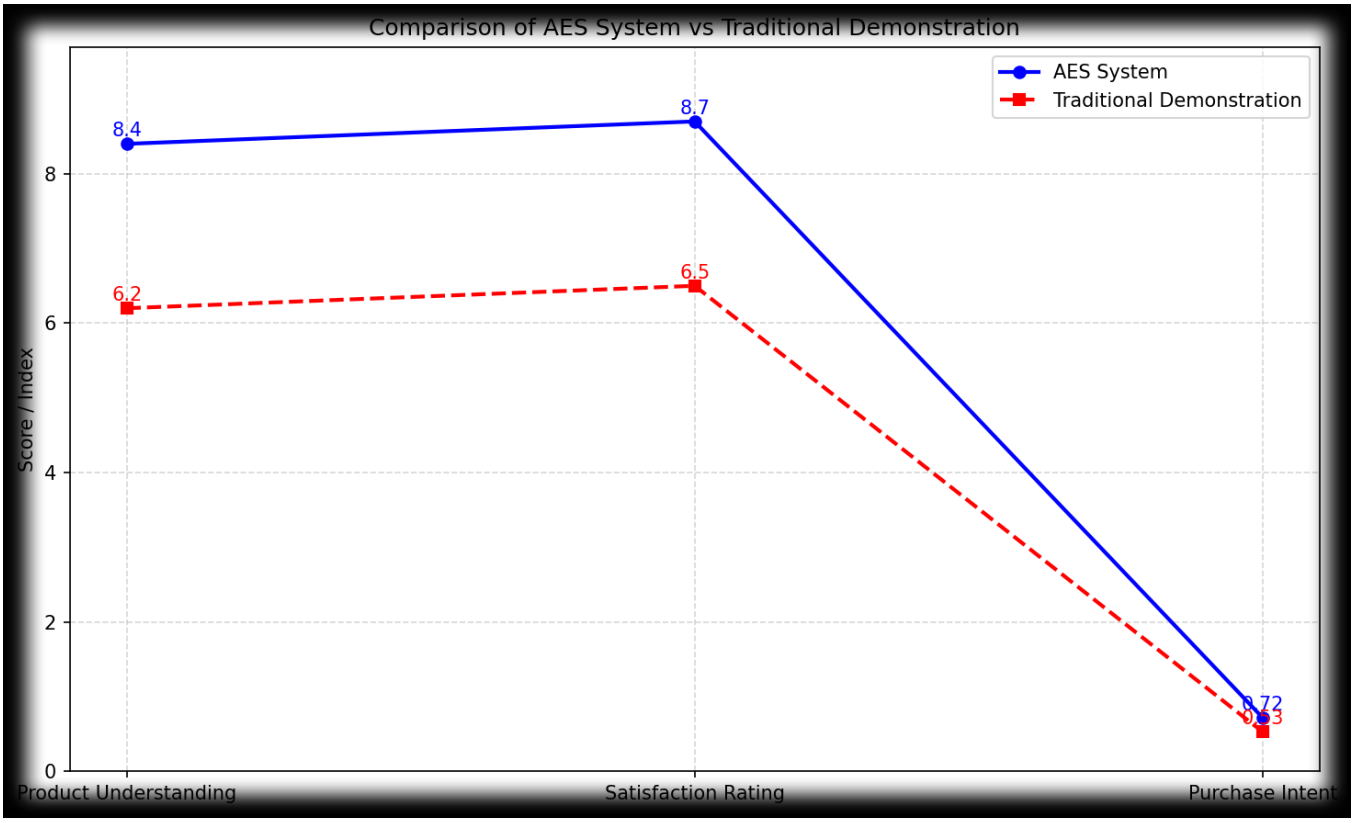

Fig.6: Performance Evaluation.

The discussion of these results highlights the effectiveness of combining immersive VR and AR technologies with a behavioral feedback-driven adaptive system. AES not only maintains user engagement throughout the demonstration but also improves comprehension and emotional involvement. The data suggest that participants experienced higher cognitive retention and a stronger connection to the product compared to traditional demonstration methods. Latency and system responsiveness confirm that real-time adjustments were feasible without compromising the immersive experience. Overall, the results demonstrate that AES can serve as a robust, scalable, and intelligent solution for transforming product demonstrations in direct selling, offering measurable benefits in engagement, comprehension, and purchase intent while providing valuable analytics for future optimization.

V. Conclusion

The proposed Augmented Engagement System (AES) we present is a new take on what we see in traditional product demos in direct selling which we see as very much still in the realm of what is familiar very much a play on what we know in terms of heavy use of word of mouth and product on display. We also see this as a bridge between the past which is very much in the physical and personal and today's digital which is very much in the virtual and interactive. By constantly tracking in real time user movement, what they are looking at, how long they are interacting and their emotional response we are able to change what is being put forward to the user to keep them very much engaged, to better their understanding and in turn raise their satisfaction. We see the combo of VR and AR as we present it here to give users the best of both worlds the full-on immersion of virtual and the real-life context of the physical. We report out of our controlled tests that the system did very well. We saw very high engagement scores and our adaptive in puts did a great job at bringing back user focus when it was waning. Also, we saw that users did better at understanding the products and also were more willing to engage with the demo which in turn raised their purchase interest as compared to what we have seen out of traditional demo approaches. Also, the emotion recognition we put in played a big role in that we were able to see

how the users were doing and tailor the experience to them. Also, we had very low latency in our real time processing which meant that the system ran smoothly and did not break the flow of the immersive experience thus proving out the system's value for go to market. Also, beyond the issue of engagement and better comprehension we are able to get out of this system very valuable data which we can use to better understand our customers' preferences and behaviors which in term will help us to improve our sales strategies. Also, we see in the system's adaptive feedback that it is a growing and improving platform for many different product types. As a whole what we have here with AES is that we have put together Immersive Tech, behavioral analytics and adaptive control to really step up the game in product demos. This we think is a model for going forward in R&D for smart sales platforms and we see very large-scale transformation of the customer experience and in turn higher engagement, satisfaction and purchase results in the direct sales industry.

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