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Stage, Studio and Screen: Reimagining Dance Online

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ABSTRACT

Dance is a field of study expressed through a series of improvised or choreographed movements and steps that involve arms, legs, and torsos extending across physical space. When these activities shift online, the challenges for performance and teaching are more novel than those found in verbal or text-based communication. This paper discusses preliminary results from a qualitative study conducted to understand how performers and students adapted to online spaces when in-person events were not available. We examine how performers reconstructed the stage and overcame obstacles to building rapport with audiences. We also investigate how students assembled makeshift dance studios in the home and challenges they faced when trying to make sense of choreographed instructions. Preliminary analysis shows that existing technologies lack support for performing and learning dance online, and we conclude with suggestions for how more sophisticated systems might be designed to support embodied knowledge production and transfer.

CCS CONCEPTS

• **Human-centered computing** → **Ethnographic studies**; • **Applied computing** → **Performing arts**.

KEYWORDS

embodied interaction, remote collaboration, dance performance, dance and technology

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1 INTRODUCTION

Dance requires synchronization of bodily movements through space including arms, legs, and torsos, in addition to synchronization with the music [1]. In a dance performance, artists engage their audience through the medium of the stage which serves as a space with backdrops, props and lighting, and where performers enact choreographies of various dance forms. Whereas, in a dance class, students interact with teachers, and other students, in the dance studio which is usually a large room with ceiling to wall mirrors, flooring to ease impact, and a sound system to play music and serves as a space where dance is taught and practiced.

When these two physical spaces, the stage and the studio, are compressed onto computer screens, performers and students need to adapt to the constraints of being framed within the space of a visual display monitor. We investigate how these physical spaces were reconfigured to accommodate the constraints of limited screen real estate. Specifically, how a physical art form of bodily movement, imposing stages, and spacious studios were presented and managed through computer-mediated communication systems. In this preliminary study, we examine how the change in space configuration, moving from a real to a virtual space influenced interactions between performer-audience and teacher-student. In particular, we were interested in understanding how embodied interaction is reconceptualized in a virtual environment for both professional and amateur dancers as they navigate through confined screen spaces to express and learn movements that are meant to be performed and watched in large physical spaces.

To achieve this, we interviewed Indian classical dance performers and students, in addition to conducting a participant-observation study of an online dance class when dance events were shifted online during the most recent pandemic lockdowns in India that ended in Spring 2022. Preliminary research spanned from July 2021, when India was still in full lockdown, to April 2022, when restrictions to physical events had ended. The aim of the interviews was to understand participants' experiences of performing and learning an embodied art form online. The paper is structured as follows: section two presents a brief review of research in embodied interaction online and dance more specifically. Section three describes the methods used in the study. In section four we present preliminary findings. Finally, section five concludes with a discussion of how more sophisticated systems might be designed to support embodied knowledge production and transfer.

2 LITERATURE REVIEW

The body is a communicative instrument where movements are used to convey ideas and express emotion [2]. In virtual settings, it is much more challenging to convey bodily interaction and social presence especially when engaging in group activities that require some degree of attention [3]. As [4] notes, to design technologies well "requires an understanding of the physicality of its contexts of use, including the physicality of its users." In addition, it has been argued for many years that HCI research should reposition itself away from traditional modes of interaction that focus on verbal, text-based, keyboard and mouse driven conversational interaction to embodied interaction where the context of human physicality and physical objects supplement cognitive approaches [5]. Virtual reality systems are designed to support multimodal activities such

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as head and hand movements [6, 7] and video capture systems process full body motion [8–10]. While these and other prototypes continue to be evaluated for how they incorporate gesture and head movements [11, 12], support for full body interaction remains elusive.

While even though more promising systems are in the pipeline, today we still find video conferencing tools are being used to engage in different types of remote collaboration and embodied interaction. There is a significant corpus of seminal research [13–23] that remains essential for conceptualizing and understanding the diverse settings in which systems are used and how they could be improved. These early investigations laid the foundation for the field of Computer Supported Collaborative Work (CSCW) with a focus on support for distributed work.

One of the key limitations found in screen-based tools is that they inhibit remote collaboration because it occurs within the frame of a device's screen which limits the potential for viewing and physical movements [16, 20]. While other research describes challenges around establishing co-attention and co-orientation, referring to the ability for multiple people to focus on a common point [24]. The authors note that this challenge is especially prevalent when multiple people collaborate with each other using shared objects. Other limitations include the inability to see where the attention of remote collaborators is focused [25]. To address these, [26] developed a framework for tangible interaction that incorporates four areas to examine in design; tangible manipulation, spatial interaction, embodied facilitation, and expressive representation. Each of these dimensions can be used as a guide to help designers incorporate embodied interaction by considering both physical and social factors.

2.1 Online Interaction in Dance

A review of dance related research in HCI [27] shows that prototypes are mostly developed with an aim at solving technical challenges with a focus on engaging with professional, elite dancers and ensembles [28, 29]. Movement-based research can be categorized into three stages within the creative process; creation (choreography and stage), performance (interactivity and improvisation), and analysis (modelling and annotating) [27]. For instance, [30] describes a prototype that maps body motion using sensors, video, and motion capture data with the eventual aim to produce computer-augmented dance. Other research investigates the perception of movement using a modified Kinect system to analyze qualitative parameters such as flowing, energy, and flexibility [31]. While [32] summarize nine frameworks created to support movement-based interaction design, the authors also present their own toolkit and prototype that focuses on support for three viewing perspectives; the mover, observer and machine. In [33], the authors investigate live performance of improvised dance in collaboration with computer programmers who do live coding to generate sounds based upon dancers' movements. Finally, in education, coursework has been developed in collaboration with professional dancers that includes movement exercises, choreographing, coding and theoretical material [28, 34].

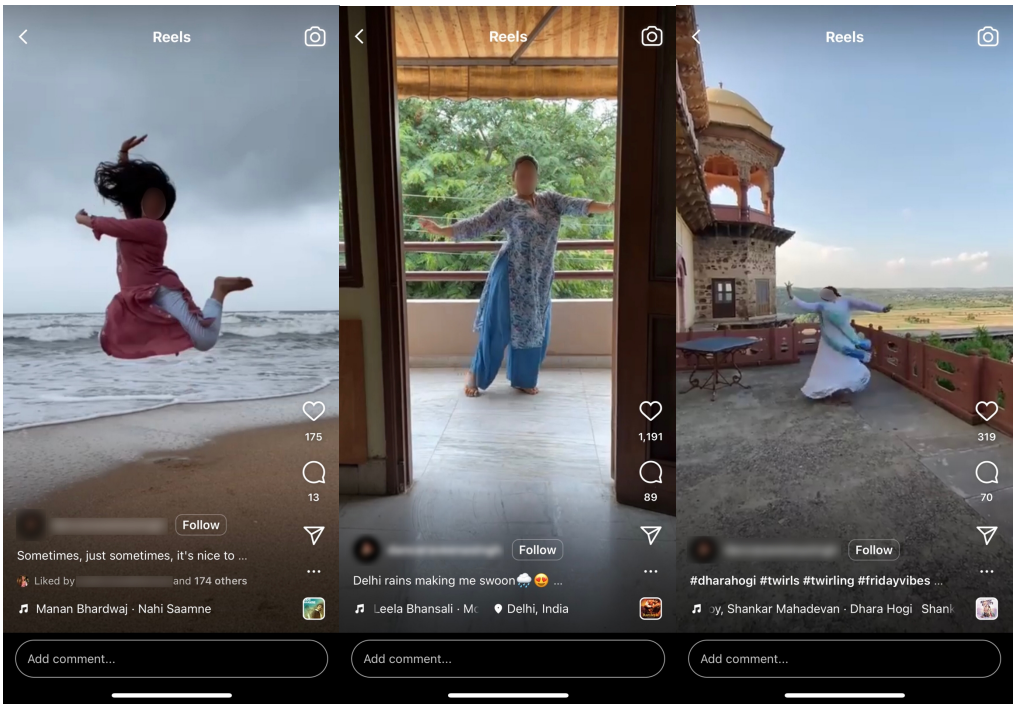
These studies offer significant contributions in movement-based research that extends our understanding of embodied interaction. However, they mostly focus on solving technical challenges and engage with professional dancers and elite ensembles. In contrast, our study focuses on understanding how non-expert, ordinary users rely upon off-the-shelf video technologies to support dance performance and learning. Our aim is to examine how interactions are transformed in online settings using systems that are available for widespread use. For instance, how the performer and audience build rapport online, an important element of dance performance in physical spaces. This is typically done when the performer on stage responds to the audience through movements or verbalizations; and the audience responds to the performer through applause and cheers. This interactional turn-taking creates a sense of liveliness and co-participation [35] and allows both to make sense of how well a performance is going [36]. In addition we examine how students develop workarounds when learning dance choreographies at home. In this way, our research provides a lens into how non-elite dancers navigate their use of technology in support of dance practice.

3 METHOD AND APPROACH

To understand how technology transforms dance performances and classes with non-expert users we conducted a preliminary study. After obtaining approval from our Institutional Review Board, participants were recruited using snowball sampling [37], first by approaching personal contacts, who in turn, recommended other participants from their personal contacts. For the preliminary study, eight interviews were conducted online between September 2021 and April 2022. We interviewed four Indian Classical dance performers located in Delhi and Kolkata. In addition to these, we also conducted a preliminary review of the performers' social media channels to understand how they used them to present their work and engage with audiences. We also interviewed four dance students located in Delhi who were learning various dance forms such as Bharatanatyam, Jazz, and BollyHop (combination of Bollywood and Hip Hop). In addition to these, one researcher conducted a brief participant observation study attending six online BollyHop classes.

The interviews and participant observation sessions were conducted in English and online using Zoom (both interviews and classes), with each lasting approximately 30-45 minutes. Interviews were audio-recorded and later transcribed and analyzed using inductive coding to identify themes [38]. The coding process continued until no new codes emerged. During the participant observation sessions, dance classes were screen recorded and patterns of interaction were identified and analyzed [39]. Specifically, using breakdown analysis [40] to identify when and how misunderstandings occurred during the classes.

The aim of the interviews and participant observation focused on two main topics: first, understanding how adjustments were made by performers and students to adapt to online platforms; and second, the challenges and opportunities they faced when interacting through computing technologies. In the next section, we present our preliminary findings.



(a) (b) (c)

Figure 1: Participants' new performance spaces (a) on a beach, (b) in a balcony (c) at a fort.

4 PRELIMINARY INSIGHTS

This section presents preliminary findings from the study. Section 4.1 discusses the adjustments made by performers and the challenges and opportunities they faced while interacting with audiences during online dance performances. Section 4.2 discusses the adjustments made by students and the challenges and opportunities they experienced during online dance classes.

4.1 Screen as a Reconstructed Stage

In this section we present, first, insights into how dance performers managed the virtual stage and second, novel ways of building rapport between the performer and the audience.

4.1.1 Performers Managing Virtual Space. On a virtual stage, performers were required to manage the space in a way that would foreground their performance. Many performers took advantage of the portability of their laptop computers to conduct performances in unconventional spaces.

> "It's no longer just a stage with a black backdrop. It's the garden, it's the road, it's the terrace, everywhere. Any space that is interesting has lent itself to performance too. For example, the garden has two rose bushes here, and one mango tree here. So I can have the mango tree at [one] moment and I can go near the rose bush here [at another]."

This new found flexibility became a blueprint for what one participant described as "site-specific choreographies" where performances could serendipitously emerge by using objects available in that space as part of the dance (Fig.1).

In Figure 1 we see how the mobile capabilities of the laptop facilitated novel performance spaces making it possible for dancers to create new meanings out of their art form.

Performers also discussed how their cameras had come to represent the audience which prompted ideas for new ways to perform, as well as view, dance.

> "The change that I have made is angles, for example, this particular movement will look much better from a top angle. So, let me keep the camera on top and take this movement from the top. Let me take this movement as a closeup, or on a gimbal shot where the camera moves at me. So what I do has not changed but what the camera picks up is what I work with."

In this quote the performer describes how interactions with the camera are managed through different viewing angles, giving her, and her audience, viewpoints into dance sequences that they would not have otherwise experienced in a physical stage-based performance. In these ways, the virtual stage empowered performers, giving them the ability to reconceptualize the audience's view of a performance.

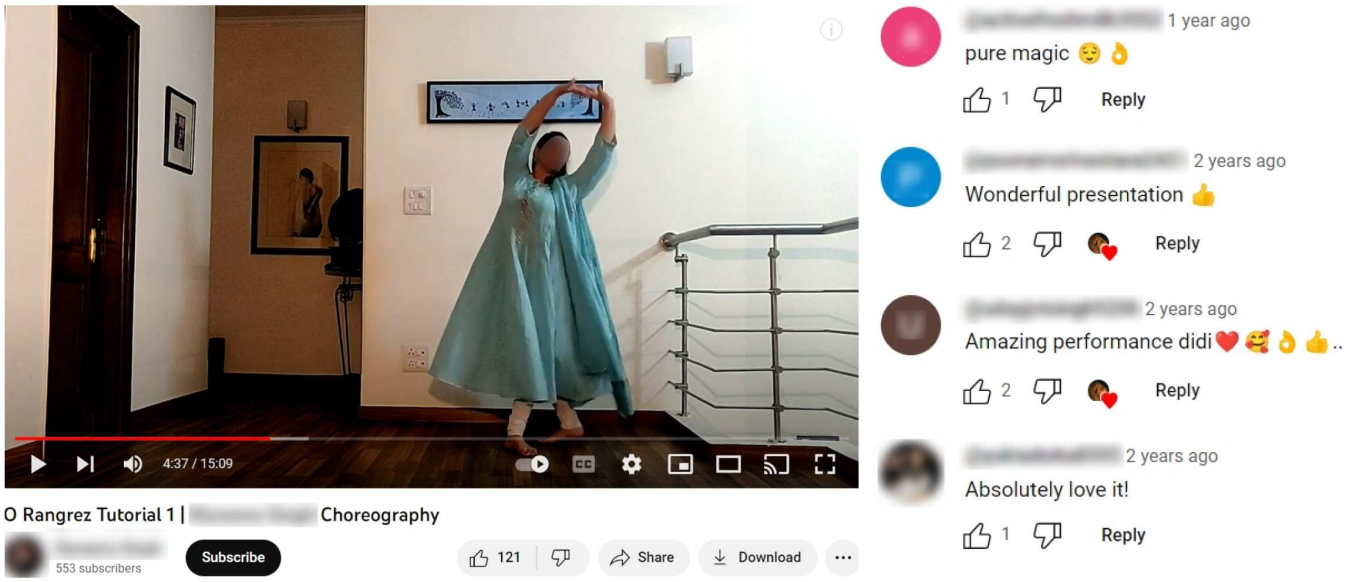


Figure 2: Participants' a) Dance tutorials on Youtube, (b) Building rapport on social media

4.1.2 Building Rapport. In order to build rapport between performer and audience, there has to be some form of communication between the two. In physical stage-based performance, this is displayed when the audience responds to the performer's activities.

> "When I have an audience full of people, there is a very palpable energy, whether I can see them or not. There is a lot of real-time response. So as I'm dancing, I can sense the audience's engagement. It doesn't have to be verbal."

This response motivates the performer, and the audience, as they collectively experience the mutual unfolding of a performance in the presence of each other. However, in an online performance, the screen separates the two, diminishing co-presence.

Some performers reported that the audience would add comments to the Zoom chat box while the performance was taking place. Although, they told us that they could not see these and still felt isolated from the audience. At this point in its development, the technology available to ordinary people simply cannot replace the rapport developed in a physical space. However, a workaround was found and rapport fostered asynchronously through social media.

> "If I've missed clapping, what I've gotten instead is hundreds of comments, instant emojis like clap, heart, wow, lovely. So that has brought the dancer closer to the audience. Because I am able to look at all the comments, reply, and put a face to them."

In this quote the performer describes how the audience builds rapport with her through comments and likes. However, the interaction remained limited to appreciative statements and emoticons as shown in Fig.2 (b).

While social media platforms provided audiences an avenue to respond to a dance performance, it also meant that performers created shorter choreographies and tutorials of up to 5-15 minutes as shown in Fig.2 (a), unlike live performances which may last for 1-2 hours.

Overall, we found that although there were no shared physical spaces, it nevertheless became a catalyst for novel adaptations for presenting, and participating in, Indian dance culture. For instance, performers had more control over viewing perspectives; controlling the position of their cameras and making decisions about what to show an audience. Performers also realized that the mobility of laptops and technical equipment removed the limitations of the physical stage as they started to use the spaces around them to create unconventional backdrops (from beaches to balconies) to perform choreographies. They also began using social media platforms to engage in new kinds of rapport building with audiences through emoticons displaying hearts, claps, and smiles; as well as comments of adoration and appreciation.

4.2 Screen as a Reconstructed Studio

Using a combination of interview and participant observation data, this section discusses how dance students met the challenges and opportunities they experienced when participating in online dance classes.

4.2.1 Visibility in a Makeshift Dance Studio. For students a room in their house became a makeshift dance studio that enabled them to continue their dance studies. Participants said that the home environment was not conducive to dancing and that small rooms restricted their movements. One student said that her neighbors complained about the stomping from her beating feet on her floor and into their ceiling. Moreover, home studios often led to distractions during classes when family members entered the room. However, most families supported students and contributed to creating an environment for dance classes to occur.

Figure 3: Breakdown in understanding: students doing a step in different directions.

However, even if there was enough space in a room for a student to do theatrical dance moves, the camera restricted their movements because they needed to maintain a position that would make them visible to the instructor and other students. Nevertheless, students developed workarounds to the fixed angle camera in their computers by adjusting it to either the head, legs, or torso, depending upon the sequence of dance moves they were learning. Although, dance sequences requiring extreme degrees of movement (such as from standing to going to the floor), meant that most students would not be visible on the screen (Fig.4). Camera positioning constraints also prevented students from seeing other students and the instructor when they were performing a sequence of steps at the same time together as a group. Dance students often rely on watching others to correct their posture and to check the correct sequence of steps.

Visibility in the computer screen became an important element for students to consider where they constantly needed to make compromises that were often unsuccessful, when trying to display their full bodies into a webcam and when trying to see the bodies of other dancers. Even though students spent time planning the set-up of their makeshift dance studios, negotiating visibility was a constant challenge.

4.2.2 Maintaining Mutual Understanding. Learning new steps was one of the most difficult things to achieve online. This was primarily due to participants having different Zoom mirror images settings selected. For example, if the teacher raised his left hand, it would be visible on the right side of the screen, therefore some students would lift their right hand (Fig.3).

Here we see how Zoom displays each student's view differently; some right, and some left handed. To resolve this, before teaching any step, the instructor would start by orienting the students to his right or left by raising his hand and announcing "this step starts on the right-hand side". As students became more aware of the visual inconsistencies some adjusted easily; for others it was more difficult. However, this also highlights a lack of technical knowledge that is very common amongst non-expert users. If all participants had calibrated to the same mirroring settings the issue may have been resolved. Nevertheless, challenges persisted as students inevitably followed different musicalities and rhythms due to bandwidth lags, and the small square boxes that displayed other students and the instructor made visibility difficult when standing at a distance.

Overall, students said that the home environment was less conducive to learning because rooms in houses could not accommodate moving freely. They were also preoccupied with the potential of unwanted interruptions. In addition, students were constantly negotiating between keeping themselves in the camera view, and freely engaging in the sequences of steps they were learning. Regardless of the conveniences of learning from the comfort of one's own home, engaging with the dance content, instructor, and fellow students was cumbersome.

5 DISCUSSION AND FURTHER WORK

In this paper, we discussed the unique challenges and opportunities dance performers and students face when managing their interactions online. On the one hand, for performers, online spaces opened up possibilities as they reconceptualized the stage beyond a stationary architecturally designed platform; taking their choreographies to beaches, balconies, and historical sites. Moreover, performers gained a new type of control over their performances when making decisions about camera angles that determined the focus of the audience's gaze. They also used social media platforms to extend their reach and build rapport between themselves and the audience.

On the other hand, for dance students, online learning presented more challenges than opportunities including; space constraints in makeshift studios, and negotiating laptop camera views to make their bodies visible on small screens. Additionally, there were misunderstandings between students and instructors when learning steps that require three-dimensional points of view that were further confused due to inconsistent mirror display settings across the group. Workarounds to these challenges were found such as; announcing the directional orientation of steps (left or right), and indicating confirmation of understanding through thumbs up gestures.

The two most widely used video technologies used by non-experts are Zoom and Google Meet (while MS Teams is considered an enterprise tool). When remote collaboration is initiated it will most likely be done using one of these two platforms. For this study, Zoom was used, however Google Meet has essentially the same functionality. Over the course of this preliminary study, we found

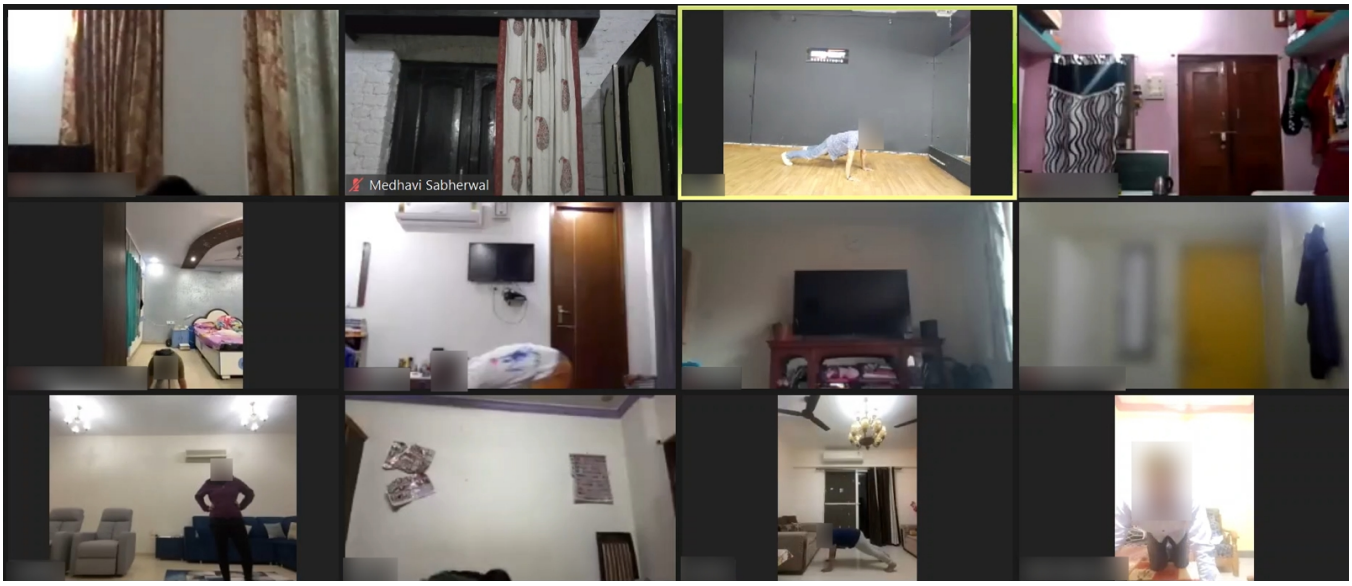


Figure 4: Challenges to visibility of both teacher and student.

that support for embodied interaction remains problematic in technology that is readily available to non-technical-expert users. This lack of support for movement-based, in contrast to verbal and text-based communication may not be surprising considering that systems have historically been designed with a focus on conversational communication [4]. However, with the imminent ubiquity of VR systems [5–11] that incorporate full body participation, exploring these discrepancies offers novel avenues of investigation for HCI researchers. For example, enhancing learning in online environments could include interfaces that facilitate full body demonstrations of movement, facial expression, and even allow for physical corrections to posture and movement using sensors [41]. We argue that more empirical research be conducted that examines the challenges and opportunities of video-mediated support for embodied interaction in dance that could be generalized to different use case contexts (e.g. the performing arts, sports, remote equipment repair, etc).

Conveying embodied movements through computer-mediated screens is challenging [42]. In our future work, a series of co-design workshops will be conducted with dance performers, audience members, instructors, and students to imagine new forms of hybrid (virtual-physical) embodiment. The aim will be to ideate and prototype a system specifically designed to support embodied dance practices in both performance and instructional contexts. Unconstrained by the limits of current technological capabilities we will employ speculative design practices to imagine novel hardware, software, and interfaces that might unlock the potential future of technologically-mediated dance performance, teaching, and learning.

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