Colour Creation Muse (CCM): Focusing on Primary Colours for An Imagination Based Creativity Generation

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***Abstract*—Colour Creation Muse delves into the extraordinary power of prime colours: red, blue, and yellow, and their role in sparking human creativity via imagination. This innovative computational tool harnesses the innate associations and sentiments evoked by these foundational hues to inspire diverse artistic and cognitive outputs. Drawing from the intersections of art, design, psychology, and computing, this research elucidates the historical significance, emotional resonance, and psychological impacts of the prime colours. The Colour Creation Muse (CCM) system adeptly taps into this rich tapestry of meanings, offering users a palette to ignite their creativity. Through CCM, applications in art, design, education, and psychology are enhanced, offering a fresh perspective on colour-driven imagination. Incorporating intuitive selection tools such as hue variation sliders and real-time feedback, the CCM engages users in a dialogue with colour that is both emotionally resonant and psychologically insightful. This paper unveils the multifunctional capacity of the CCM through dynamic case studies, showcasing its ability to craft not only visually compelling designs but also to imbue them with a narrative depth that resonates across various industries. The efficacy of CCM in generating culturally coherent and context-rich outputs is demonstrated, highlighting its role in branding, advertising, and product design. This research concludes by recognising the CCM's groundbreaking contribution to the creative fields, where it stands not just as a tool for colour selection but as a comprehensive decision-making instrument poised to revolutionise consumer engagement and perception.**

Keywords—Colour, imagination, creativity generation, RGB, Emotion

I. Introduction

The intrinsic language of colour orchestrates a profound dialogue between visual stimuli and psychological responses, an interplay pivotal to the realm of human expression and creativity. Throughout history, fields ranging from art to psychology and from design to artificial intelligence have sought to decode the mysteries of colour [1]. Red, blue, and yellow as the primary colours stand prominently at the forefront of this exploration, often dubbed as the prime colours of creativity. In the digital realm, although slightly altered to RGB, their essence remains pivotal for visual rendering and innovative digital tools [2]. In the domain of creativity, the CCM system emerges as an advanced computational interface, engineered to harness the dynamic qualities of these primary hues to catalyse and enhance artistic and cognitive outputs. Grounded in interdisciplinary research, this study delineates the historical significance and the psychological impact of prime colours, exploring their unique capacities to evoke sentiment and stimulate the imagination. The discourse traverses through the intersections of art history, design principles, psychological theories, and computational methodologies, converging upon the CCM system as a testament to the symbiotic relationship between colour theory and technological advancement.

Prime colours hold a revered status, with each colour encapsulating a distinct psychological and cultural narrative. Red, often associated with ardour and urgency [3]; blue, evocative of serenity and depth [4]; and yellow, symbolic of vitality and cheer, serve as the cornerstones of creative inspiration [5]. The CCM system, rooted in this historical and psychological context, is conceived to leverage these colour associations, providing a digital milieu where prime colours are not static but are engaged in a dynamic interplay, thus fostering an environment conducive to innovative creation.

In applications extending from education to design, and encompassing the vast field of psychological study, the CCM system presents a useful paradigm for colour engagement. This system challenges and augments traditional methodologies by introducing a colour-infused approach to stimulate intellectual processes and enhance pedagogical practices. Through a series of illustrative case studies, this research illustrates the efficacy of CCM in devising distinctive colour schemes, elucidating how these generated palettes underpin and influence the ensuing artistic designs and narratives.

II. Related Work

The intricate relationship between colour and human cognition has long been a subject of fascination, spanning fields such as art, design, psychology, and more recently, artificial intelligence. The hues that paint our world not only affect our emotions but also play a pivotal role in fueling creativity and imagination. A seminal work in understanding the depth of our relationship with colour is William James's "The Principles of Psychology", published in 1890. James put forth the idea that colour perception is intensely personal, varying among individuals, across cultures, and in different contexts [6]. He further emphasised that colours aren't just visual stimuli; they carry with them a wave of emotions, capable of setting moods and evoking diverse sentiments. Building on James's foundation, modern studies have delved deeper into how colours influence our emotional and cognitive landscapes. Such works have also explored the role of colour in sparking creativity. For instance, an intriguing study found that exposure to the colour red not only heightened physiological responses but also fostered quicker and more innovative solutions during visual recognition tasks [8]. This indicates a direct link between specific colours and enhanced creative thinking. Another piece of research showcased the impact of colour on perceptions of value, where items set

against a black background were viewed as more luxurious compared to those on a white one [9].

The realm of artificial intelligence, coupled with the explosion in digital artistry, has further intensified the nexus between colour and creativity. Platforms like DeepDream, utilising neural networks, churn out mesmerising visuals, often evoking deep creative interpretations [10]. Similarly, ColourNet's advanced deep-learning approach crafts not just images but stories, by overlaying pictures with colour harmonies that resonate emotionally [11]. The synergy of colour and AI doesn't stop there. With the emergence of specialised tools that harness the power of colours, industries such as fashion and interior design are experiencing a renaissance in creative outputs. These advancements underscore the endless possibilities that lie at the intersection of colour, creativity, and computational power.

III. Red, Blue, and Yellow in the CCM

Red, blue, and yellow have traditionally been revered as primary colours, forming the bedrock from which a spectrum of other hues emerges. Within the CCM system, these hues are treated as more than mere pigments; they are essential elements that engage with the users' senses and intellect, creating a complex web of meaning that is critical to the creative process.

A. Red in the CCM

1) The Vibrancy of Red in Emotional and Cultural Contexts: Red seizes the gaze with its vibrancy, spanning a spectrum from the fervour of romance to the sharp focus required in critical situations, shaping stories from tender affections to imperative alerts [4][9]. This colour's impact transcends societal meanings, eliciting instinctive reactions that underscore a fundamental connection to its dynamic essence [2]. Additionally, red has a significant influence on action and perception. Renowned for its ability to enhance focus, red is indispensable for precision-requiring activities, while its boldness can also serve as a warning, guiding actions where meticulous care is crucial [3][13]. The symbolism of red morphs across different cultures—it can denote affluence and festivities in Eastern contexts or represent commemoration and bravery across diverse societies, demonstrating its universal adaptability and resonance [17][18][19][20].

2) Historical Significance and Modern Implications of Red: Traditionally a symbol of status and power, red has been a colour of choice for monarchs and ceremonial events, reflecting its enduring stature and ceremonial value [21]. In arenas of rivalry and challenge, the intensity of red is leveraged to convey boldness and assertiveness, affecting decision-making and competitive dynamics [8][12]. In the realm of commerce, red's allure is pivotal, known for stirring excitement and appetite, thereby influencing consumer behaviour and branding strategies [15].

3) Practical Applications: Red's vibrant appeal is widely recognised in the design industry for its innate ability to draw focus, making it the colour of choice for emphasising important features and characters, such as in narratives or digital interfaces where key elements are marked for prominence. The iconic imagery of the fearsome red dragon or the striking cloak of Little Red Riding Hood in folklore speaks to red's profound narrative power and its deep-rooted impact on storytelling and symbolism. This spectrum of symbolism, from intense strength to deep affection, provides a rich canvas for creative expression across various mediums.

B. Blue in the CCM

1) Emotional Influence and Cultural Associations: Blue, known for its soothing essence, is often linked to creativity and reflection, inspiring artistic expression and thoughtful design within the CCM framework. Its association with stability and trust positions it as a cornerstone for brand identities that embody reliability [21][22]. As a hue that sparks innovation, blue is selected for its potential to unlock new ideas and inspire visionary thinking [27]. Across cultures, blue's significance is as diverse as it is profound—from celestial connections in ancient civilisations to its representation of wisdom and loyalty in modern contexts, making it a versatile and deeply resonant colour in the global creative palette [23][24][25].

2) Historical Context: Historically, blue has symbolised serenity and depth, with ancient cultures linking it to celestial entities and attributing it qualities of wisdom and sanctity [26]. The rarity of blue pigments like ultramarine made it a treasured colour in historical art, often reserved for the depiction of significant and divine subjects during eras like the Renaissance [23][27]. In the commercial realm, blue's ability to convey trustworthiness and competence has been crucial in influencing consumer behaviour, making it a strategic choice in branding and marketing [11].

3) Practical Applications: Blue's calming hues have long been cherished in the arts for their ability to add depth and evoke contemplation, as seen in masterpieces like Van Gogh's "Starry Night" and Hokusai's "The Great Wave" [29]. This colour extends beyond visual arts, enriching narratives in literature and interactive media with themes of adventure and mystique. It is blue's inherent ability to inspire a sense of discovery and introspection that makes it a pivotal element in creative expressions, often used to craft experiences that transport audiences to the tranquil vastness of imaginative and reflective spaces [27].

C. Yellow in the CCM

1) Emotional and Cultural Associations: Yellow is celebrated for its bright and energising presence within the CCM, often linked to creativity and positive energy, encouraging designs that are lively and cheerful [30]. It's associated with mental alertness and is believed to stimulate the cognitive processes necessary for innovative thinking [31]. In nature, yellow connects with the sun and the earth, bringing forth designs that reflect ecological and natural motifs [32]. Culturally, yellow's significance is rich and varied: it's a colour of spiritual importance in Hindu traditions, a symbol of wealth and status in African societies, and a marker of imperial power in historical China. This multifaceted colour continues to inspire a breadth of creative applications, celebrated for its ability to evoke prosperity, happiness, and inspiration across cultures.

2) Historical Context: In history, yellow has carried weighty significance, often entwined with the sacred and the sovereign [23]. It has represented divine authority and regal

stature, underpinning its enduring relevance across ages. Mirroring the golden tones of ripe fields, yellow also symbolised wealth, fertility, and the rich bounty of the land in agricultural communities [22].

3) Practical Applications: Yellow, evocative of harvest gold, is frequently used to signify plenty, growth, and wealth, a tradition rooted in agricultural customs [22]. Its vibrant palette paints a picture of joyful vistas and abundant landscapes, from sunny coastlines to fields of grain. Emblems such as the sunflower embody the joy, camaraderie, and festivity that yellow inspires, highlighting its role as a muse for a wide range of creative and symbolic expressions.

Table 1 presents an organised summary of the properties of the primary colours red, blue, and yellow across different dimensions: emotional associations, cultural symbolism, practical applications, and miscellaneous references and symbols commonly associated with each colour.

TABLE I. RGB COLOUR'S PROPERTIES

Colour	**Properties**			
	Emotional associations	***Cultural symbolism***	***Practical (Application)***	***others***
Red	Love, Passion, Anger, Excitement, Danger, Warmth, Romantic attraction, Aggression, Enthusiasm, Energy	Luck (in China), Mourning (in South Africa), Revolution, Wedding (in China), Faith, Beauty, Courage, Sacrifice	Traffic lights (signalling "stop" or "caution"), Sales, Attention-grabbing, Red health bars in games, Warning signals	Red Roses, Red Dragon, Little Red Riding Hood, Red Apple, Red light district
Blue	Calm, Stability, Sadness, Melancholy, Serenity, Wisdom, Introspection	Loyalty, Divinity, Purity, Professionalism, Dependability	Sky and ocean depictions, Representation of depth and vastness in art and design	Dreamscapes, Fantasy worlds, Exploration of the human psyche, "The Great Wave off Kanagawa", "Starry Night"
Yellow	Happiness, Optimism, Caution, Anxiety, Hope, Comfort, Vitality, Upliftment, Alertness	Wealth, Power, Regality, Harvest, Abundance, Prosperity (often linked to the sun or gold)	Traffic lights (signalling "caution"), Cautionary signs, Portraying light and energy in visual art	Sun-drenched beaches, Golden wheat fields, Sunflower, Autumn foliage, Celebratory events

IV. CCM'S ROLE IN CATALYSING CREATIVITY

The CCM system stands at the confluence of colour theory and creative ideation, serving as an inventive mediator that transmutes primary colours into wellsprings of originality. It is a pivotal instrument in creative endeavours, offering a conduit from nascent ideas to comprehensive creations that are visually striking and conceptually rich.

- Fostering creative exploration: The CCM system, through its dynamic colour selection and association features, encourages users to explore beyond conventional colour usage, prompting the discovery of new creative territories. By integrating colour psychology, the system aids users in crafting designs that not only catch the eye but also engage emotions, weaving a deeper narrative into the visual experience.
- Enhancing design with depth and contexts: The CCM's extensive repository of colour implications, encompassing both cultural and historical dimensions, equips users with a vast array of semantic threads to enrich their creative output. It adeptly places colour choices in a broader narrative context, enabling the generation of designs that are not only aesthetically pleasing but also culturally attuned and historically grounded
- Optimising the creative workflow: The CCM system's user-friendly interface simplifies the complex process of colour selection, presenting real-time feedback that visualises the potential impact of each choice. Such efficiency not only conserves creative energy but also refines the decision-making process, granting users the liberty to seamlessly experiment with various colour combinations and their intrinsic narratives.
- Enabling cross-disciplinary creativity: The CCM's applications transcend visual arts, permeating sectors such as marketing, product innovation, and interface design, which testifies to its adaptability as a creative utility. By harmonising the language of colour, the CCM cultivates a collaborative ethos among diverse creative fields, encouraging the intermingling of concepts and the emergence of groundbreaking creative artefacts.

In essence, the CCM system transcends its function as a mere colour selector to become a profound enabler of creativity, emotional articulation, and cultural literacy. Integrating the CCM into any creative process augurs the metamorphosis of elementary colour selections into compelling stories and experiences that captivate, resonate, and leave a lasting impact.

V. IMPLEMENTATION OF CCM SYSTEM

The implementation details provided for the CCM system highlight a user-centric approach, blending the science of colour theory with user interaction to produce tailored creative outcomes. Here is an elaboration of the described functionalities and their potential impact on the user experience and creative process:

A. Input Layer

The input layer is crucial in collecting user preferences, which is the starting point for the CCM system to generate creative suggestions. The detailed description of the Colour selection input is as follows:

1) Colour selection input:

a) User interface design

- Colour selection sliders: Users can select primary colours (red, yellow, blue) through colour sliders. Beneath each primary colour slider, there will be sub-

sliders for different shades, such as light blue, navy blue, sky blue, etc.

- Colour Preview: As users select colours through the sliders, a real-time preview window will display the chosen colour.
- Psychological Tags: Beside each colour or shade, a set of tags will describe the psychological meanings commonly associated with them (e.g., the navy might be associated with "professionalism," "stability")

b) Colour choice mechanisms:

- Individual Colour Choice: Upon selecting a single Colour, the system provides a default tonal range for the user to choose from. For instance, after choosing blue, the user can select different shades of blue via the slider.
- Dual Colour Choice: When two Colours are selected, the system internally generates and presents a preview of the secondary Colours that might result from the mix. The system also displays psychological tags associated with these secondary Colours.

c) Colour depth selection and feedback: Users can dynamically modify the foundational colour and immediately observe the changes in the resultant image. The system provides instant feedback, educating users on how variations in colour intensity influence psychological interpretations in an accessible manner

2) Attributes input:

a) Stylistic attributes: Users can choose from a variety of attributes such as 'serious', 'lively', 'elegant', 'playful', and so on. These attributes guide the CCM in honing the colour selection toward a desired stylistic direction.

b) Optional Attributes Selection: The CCM system also caters to users who wish to explore unguided creative outputs. By opting not to select any attribute, users can leverage the system's capability to generate spontaneous results, potentially leading to unexpected and innovative creative concepts.

3) Domain input: This input is critical in contextualising the creative output within a relevant field of application. It ensures that the resulting creative work is not only aesthetically aligned with the user's vision but also applicable within a practical domain.

a) Selection of domain: Users are presented with various domains such as 'fashion design', 'product design', and 'advertising design'. The chosen domain influences the thematic and functional aspects of the output, steering the creative process towards industry-specific conventions and innovations.

b) Influence on database selection: The selection of a domain plays a pivotal role in filtering the system's database, aligning the output with domain-relevant images, motifs, and design principles. It ensures that the output is not only visually and emotionally compelling but also practically relevant and industry-aligned.

In summary, the Input Layer of the CCM is a testament to the system's user-centric design. It emphasises the importance of user preference and intention in driving the creative process, underpinned by a sophisticated system architecture that translates these inputs into tangible creative outcomes. As shown in Figure 1, the user interface of the CCM is crafted for straightforward navigation, enabling users to effortlessly choose. This design not only enhances the user experience but also impacts the intricacy and richness of the ensuing creative product.

B. System Output

1) Single colour output (Physical imagination): When a user selects a single primary colour, the system activates its "physical imagination" rule. This process involves interpreting the colour's broader symbolism and associations. For instance: The system references the colour's cultural significance, such as red's association with luck in Chinese culture or mourning in South African culture. It assesses the colour's psychological impact, like blue's calming effect or yellow's energising influence. The historical context is considered, where a colour like green might be linked to a specific art movement such as the Renaissance or a period like the Victorian era.

2) Combined colour output (Expanding imagination): When users of the CCM system choose to combine two primary colours, they engage in a creative process that goes far beyond the simple creation of secondary hues. The system's interpretation of these colour fusions brings forth a spectrum of possibilities that harnesses both chemical and physical imagination to produce a range of outputs that are unexpected and evocative:

a) Physical imagination - Real-world association: Incorporating physical imagination into combined colours, the CCM system also contemplates the practical and direct associations that colours possess. Red and yellow might trigger the system to conceptualise outputs that tap into their prevalence in signals and warnings, such as the alertness demanded by traffic lights. This could result in designs that play on the interactivity and immediate impact of these colours, such as emergency services interfaces or dynamic public signage.

b) Chemical imagination - Beyond colour blending: Chemical imagination is the system's ability to infuse the output with a deeper understanding of the emotional and cultural resonance of combined colours. For instance, when red and yellow merge to become orange, the system recognises orange as a symbol of vitality, enthusiasm, and creativity. The resulting images might feature scenes like a golden-hour landscape, capturing the warmth and end-of-day reflection, or a bustling autumn festival, full of movement and energy. This approach elevates the output from mere colour representation to a storytelling vehicle, where each image is infused with a narrative.

By considering cultural significance and psychological impact, the system ensures that each single colour output carries a depth of meaning and association. This leads to designs that are not only visually appealing but also deeply resonant with cultural and psychological undertones.

C. Image Generation Process

This process is a complicated fusion of user inputs and a richly curated database that enables the creation of visually and conceptually aligned outputs. A detailed exposition of the image generation process will be introduced:

1) Data-driven selection: The CCM system uses a data-driven approach to sift through a richly compiled database to find images that align with the user's chosen parameters.

a) Emotional Tone: The database categorises images according to the emotions they evoke, aligned with psychological colour theory. For instance, red may be indexed with images that evoke passion or urgency, while blue could be associated with serenity or trust.

b) Cultural Context: Cultural influences are deeply embedded in the colour significance of images. The system recognises the diverse interpretations of colours in different cultures—red might signify prosperity in some cultures, while it could represent mourning in others.

c) Historical Significance: Colour-linked historical connotations are considered, making the outputs more layered and meaningful by connecting them to their historical significance.

The algorithm's ability to cross-reference colours with emotional, cultural, and historical data points ensures that the outputs are not only relevant but also richly layered with meaning.

2) Physical vs. Chemical Imagination: The image generation process within the CCM system is an intricate dance between physical and chemical imagination, whether it is dealing with a single colour or a combination thereof.

a) Physical imagination – Transformation and synthesis: Physical imagination anchors the CCM system's output to the tangible aspects of the world around us. It calls upon a deep reservoir of real-life imagery and contexts, crafting outputs that resonate with the physical manifestations of the selected colour. Whether the user inputs a solitary hue or a pair, the system responds by invoking the most emblematic and widespread symbols of that colour.

b) Chemical imagination - Context and realism: Chemical imagination, particularly when engaging with combined colours, is about the transformation and synthesis of concepts, emotions, and cultural narratives. This transformative approach is rooted in the theoretical framework that views colour combinations as catalysts for a creative reaction, producing outcomes that are nuanced and rich in meaning.

The image generation process in the CCM system is therefore a delicate balance between the 'physical' aspects of colour, which are grounded in reality, and the 'chemical' aspects, which delve into the theoretical and emotional connotations of colour. This dual approach allows the CCM to produce images that not only visually communicate a chosen palette but do so with a depth of understanding and contextual awareness that can enhance the storytelling and emotional impact of the creative work.

D. Algorithmic Mapping

At the heart of the CCM system's image generation is an algorithmic structure that intricately maps input colours to their cultural, psychological, and historical connotations. The process begins with the system analysing the selected primary or combined colours against an extensive database that tags images not only with colour metadata but also with cultural and emotional descriptors. This complex mapping utilises a multi-layered approach:

1) Colour analysis: The algorithm categorises the input by discerning whether a single colour or a combination of colours is presented, to determine a precise colour match within the database. For a single colour, the search is straightforward, looking for images with a dominant presence of the colour. For dual colours, it evaluates how the two colours interact, their potential blend, and their separate impacts. This ensures that the generated images reflect the user's selected palette accurately and aesthetically.

2) Culture mapping: The algorithm leverages a comprehensive cultural matrix that maps individual Colours to their varied interpretations across global cultures. For example, while white is often associated with purity and peace in some cultures, it might be linked to mourning and remembrance in others. This cultural matrix is an integral part of the algorithm, enabling it to identify and present images that are culturally resonant based on the input Colours. When dealing with a combination of Colours, the algorithm intricately analyses how the distinct cultural significances of each Colour might blend or juxtapose, thus creating a visual narrative that is culturally coherent and meaningful. The key technical points include:

a) Combined colour synthesis: For combined colours, the algorithm performs a synthesis process where it not only merges the individual colours but also their cultural significance. The algorithm uses a set of rules and machine learning models to predict how cultural meanings combine or contrast, which is akin to mixing colours in a palette to see what new hue emerges.

b) Cultural relevance scoring: Each potential image is assigned a cultural relevance score based on how well its elements match with the derived cultural significances. This scoring adopts a machine learning method where models are trained on large datasets to recognise cultural elements in images.

c) Image selection and ranking: The algorithm selects images with the highest cultural relevance scores from the database. It also ranks the images based on additional criteria such as aesthetic appeal or user engagement metrics to refine the output.

3) Psychology mapping: Using principles from colour psychology, the algorithm aligns colours with their associated emotions and psychological impacts. It makes the outputs look right and feel right, invoking the intended emotional response. The primary technical points like*:*

a) Psychological profile creation: The algorithm needs a database or a knowledge base that contains profiles linking colours to specific psychological effects. This knowledge base is created by analysing research from colour psychology, which includes empirical studies and theoretical work that correlates certain colours with emotions and moods.

b) Colour emotion mapping: Each colour is mapped to a spectrum of emotional responses. For example, blue is often associated with calmness, while red can evoke feelings of excitement or urgency. This mapping can be nuanced to include variations in hue, saturation, and brightness, as these can alter the psychological impact of colour.

c) Emotional analysis and prediction: Using the colour-emotion profiles, the algorithm predicts the emotional

impact of the selected colours. In the case of combined colours, it assesses how the emotional responses to individual colours might interact or blend.

d) Image emotional scoring: Potential images in the database are scored based on the emotional responses they are likely to evoke. This scoring system would use the psychological profiles as a reference to match images with the predicted emotional impact of the colour.

e) Image filtering and selection: The images are filtered through the scoring system, selecting those that have a high likelihood of evoking the desired emotional response. This selection process involves machine learning algorithms trained to recognise and score emotional content within images.

4) History mapping: The historical mapping feature of the algorithm functions as a temporal compass, guiding the system's selection process by aligning Colours with their historical narratives. This facet is implemented through the following steps:

a) Historical database query: The system queries a historical database that catalogues the use and significance of Colours throughout history. For example, it might identify the Colour purple with royalty and wealth in ancient Rome due to its rarity and the expense of producing the dye.

b) Temporal association: Each Colour is associated with specific periods or historical events. For example, olive green may evoke military uniforms and thus be associated with wartime periods, or the vibrant psychedelic Colours of the 1960s might bring to mind the counterculture movement.

c) Contextual relevance analysis: The algorithm analyses the context in which Colours were used historically. It understands that certain Colours can signify different movements or eras, such as the use of pastel shades in the Rococo period or the sombre Colours of the Industrial Revolution.

d) Combined historical significance: When dealing with dual-colour inputs, the system looks for historical intersections where both Colours played a role. For example, the combination of red and gold could evoke imagery from the Renaissance, where these Colours were often used in opulent artworks.

e) Narrative synthesis: The system synthesises a cohesive historical narrative by considering the individual and combined significance of the Colours. This process ensures that the resultant images reflect a story or theme that resonates with the historical importance of the Colours.

f) Output selection and customisation: Finally, based on the historical analysis, the system selects or generates images that visually represent the historical themes. The outputs are tailored to showcase the Colours in a manner that is historically informed, possibly adjusting elements like texture, patterns, or accompanying imagery to suit the historical context

E. Algorithm: Colour Creation Muse System

```
procedure INITIALISE DATABASE
Load database with images, motifs, etc.
Initialise userPre as an empty structure
end procedure

procedure COLLECT INPUT PREFERENCES
userPre.priColours← GetUserColourSelection()
userPre.shades ← GetUserShadeSelection()
userPre.psyTags ← GetPsychologicalTags()
userPre.stylisticAttributes ← GetStylisticAttributes()
userPre.domain ← GetDomainSelection()
end procedure

procedure GENERATE CREATIVE SUGGESTIONS (userPre)
if the userPre.domain is not empty then
 Database ←FilterDatabaseByDomain(user pre.domain)
end if
 Initialise suggestions as an empty list
for each colour in userPre.priColours do
suggestions.append (GenerateSuggestionBasedOnColour(colour))
end for
return suggestions
end procedure

procedure FILTER DATABASE BY DOMAIN(domain)
 // Filter logic to be implemented
end procedure

procedure GENERATE SUGGESTION BASED ON COLOUR(colour)
culturalSignificance ← GetCulturalSignificance(colour)
psychologicalImpact ← GetPsychologicalImpact(colour)
historicalContext ← GetHistoricalContext(colour)
return CombineAllAspects (culturalSignificance, psychologicalImpact, historicalContext)
end procedure

procedure COMBINE ALL ASPECTS (cultural, psychological, historical)
 // Logic to synthesise suggestion
return synthesisedSuggestion
end procedure

procedure MAIN
CCM_Database ← LoadDatabase()
COLLECT INPUT PREFERENCES()
```

38: CreativeSuggestions ← GENERATE CREATIVE SUGGESTIONS(userPre)

39: DisplayCreativeSuggestions(CreativeSuggestions)

40: end procedure

This algorithm was designed to generate creative colour suggestions based on user preferences. Here's a step-by-step explanation for it:

- *Initialisation of the Database (Lines 1-4):* The system starts by loading a pre-existing database that contains images, motifs, and other relevant data. It also initialises a structure to hold user preferences.
- *Collecting User Preferences (Lines 5-11):* This procedure gathers input from the user regarding their colour preferences, desired shades, psychological tags (which might reflect the emotional or psychological effects the user wants to achieve), stylistic attributes (such as modern, vintage, etc.), and the domain of interest (which could be fashion, interior design, etc.).
- *Generating Creative Suggestions (Lines 12-21):* With the user's preferences collected, the system proceeds to generate creative suggestions. If a domain is specified, the database is filtered accordingly to ensure that suggestions are relevant to that domain. For each primary colour selected by the user, the system generates suggestions. These suggestions are accumulated in a list and returned.
- *Filter Database by Domain (Lines 22-24):* This procedure is a placeholder for the logic required to filter the database based on the domain specified by the user. The details of this logic are not provided in the pseudocode.
- *Generate Suggestion Based on Colour (Lines 25-30):* For a given colour, this function retrieves its cultural significance, psychological impact, and historical context. These three aspects are then combined to form a single creative suggestion related to that colour.
- *Combine All Aspects (Lines 31-34):* This function synthesises the cultural, psychological, and historical aspects of colour into a cohesive suggestion. The actual logic for this synthesis is not detailed in the pseudocode.
- *Main Procedure (Lines 35-40):* This is the main execution flow of the system. It begins by loading the database and collecting user preferences. Then, it generates creative suggestions based on these preferences. Lastly, the suggestions are displayed to the user, likely through a user interface.

VI. Using the Template Case Studies and Discussion

A. Case Study

1) The perspective of marketing and branding: A marketing team is tasked with developing a branding strategy for a new line of wellness beverages. Using the CCM, they select a palette that conveys health and vitality. Green is chosen for its association with nature and growth, and yellow for its brightness and energy. The CCM's cultural matrix indicates that in their target market, these Colours also represent balance and happiness, reinforcing the brand message. The team then adjusts the shades to match the historical context of traditional healing practices, highlighting the product's natural ingredients. The CCM suggests a rich, earthy green and a warm, golden yellow, reminiscent of ancient herbal remedies. The final branding uses these colours to create a sense of authenticity and trustworthiness, resonating with consumers seeking a holistic approach to health.

2) The perspective of user interface design: A UI designer is creating an app for a meditation service. They want the Colour scheme to evoke tranquillity and focus. The CCM is used to select a primary colour of deep blue for its calming effects and an accent of soft pink for its soothing quality. In the cultural context function of the CCM, deep blue is linked to depth and stability in Western cultures, while soft pink has a calming effect in many Eastern cultures, fitting the app's global market. The historical mapping of CCM indicates that such a colour combination is for papers with more than six authors: add author names horizontally, moving to a third row if needed for more than 8 authors.

B. Discussion

In both case studies, the CCM is pivotal not only in choosing visually appealing colours but also in ensuring these choices resonate on deeper cultural, psychological, and historical levels. This results in a more profound connection with the target audience and lends an additional layer of storytelling to the branding and design efforts. Such a thoughtful approach to colour can significantly enhance brand perception and user engagement, as it appeals to the subconscious emotions and cultural nuances of the audience. For marketers and designers, the CCM becomes an indispensable tool, transforming the subjective process of colour selection into a strategic and data-driven decision-making process. It ensures that every hue serves a purpose and aligns with the overarching narrative the brand or product aims to tell.

In all, the CCM system goes beyond aesthetics by embedding cultural intelligence and emotional sensitivity into visual design, providing a competitive edge in creating meaningful and resonant user experiences.

VII. Conclusions

In conclusion, the Colour Creation Muse (CCM) system exemplifies the harmonious integration of technology, creativity, and cultural sensitivity. It transcends the mere selection of Colours to encompass emotional, cultural, and historical contexts, ensuring that outputs are not just visually appealing but also resonate on a deeper level with the intended audience. Through the CCM system's advanced algorithms and user-centric design, designers can navigate complex colour relationships and their implications with ease. The system offers an intuitive interface for selecting primary and secondary Colours, adjusting their depth, and instantly seeing the emotional and psychological impact of these choices. By incorporating cultural matrices and historical data, the CCM system ensures that designs honour and reflect the richness of cultural diversities. As illustrated in the case study, a simple Colour choice like deep blue can transform into a culturally resonant and lively image for an advertising campaign, tapping into the Native American cultural context and infusing it with a modern aesthetic. The potential applications of the

CCM system are vast, spanning advertising, product design, digital media, and education. It provides a powerful tool for professionals and creatives to craft messages that are not only seen but felt, bridging gaps between cultures and eras, and telling stories that might otherwise remain untold.

As we continue to explore the intersections of technology and creativity, the CCM system stands as a beacon of potential, pushing the boundaries of what can be achieved in the realm of design. It encourages a thoughtful approach to creativity, urging users to consider the full spectrum of a Colour's power—its ability to soothe or excite, to call forth memories, and to cross-cultural divides. In doing so, the CCM system is not just a tool for creating images; it's a catalyst for innovation, empathy, and connection in an increasingly visual world.

REFERENCES

[1] F. M. Adams and C. E. Osgood, "A cross-cultural study of the affective meanings of colour," J. Cross-Cultural Psychol, vol. 4, no. 2, pp. 135–156, 1973.

[2] R. Sacchi, et al., "Colour variation in the polymorphic common wall lizard (Podarcis muralis): An analysis using the RGB colour system," Zoologischer Anzeiger - J. Comparative Zool, vol. 252, no. 4, pp. 431–439, 2013.

[3] A. J. Elliot and D. Niesta, "Romantic red: Red enhances men's attraction to women," J. f Personality Social Psychology, vol. 95, no. 5, pp. 1150–1164, 2008.

[4] R. Mehta and R. J. Zhu, "Blue or red? Exploring the effect of colour on cognitive task performances," Journal of Science, vol. 323, no. 5918, pp. 1226–1229, 2009.

[5] A. K. Fetterman, M. D. Robinson, and B. P. Meier, "Anger as 'seeing red': Evidence for a perceptual association," J. Cognition Emotion, vol. 26, no. 8, pp. 1445–1458, 2012.

[6] W. James, The Principles Of Psychology Volume II, 1890.

[7] O. Genschow, L. Reutner, and M. Wänke, "The colour red reduces snack food and soft drink intake," J. Appetite, vol. 58, no. 2, pp. 699–702, 2012.

[8] A. J. Elliot, M. A. Maier, A. C. Moller, R. Friedman, and J. Meinhardt, "Colour and psychological functioning: the effect of red on performance attainment," J. Exp. Psychol.: Gen., vol. 136, no. 1, pp. 250–258, 2007.

[9] L. I. Labrecque and G. R. Milne, "Exciting red and competent blue: The importance of colour in marketing," J. Acad. Market. Sci., vol. 40, no. 5, pp. 711–727, 2012.

[10] A. Mordvintsev, C. Olah, and M. Tyka, "DeepDream—A neural network model for visualizing and understanding convolutional networks," arXiv preprint arXiv:1506.06579, 2015.

[11] S. Gowda and C. Yuan, "ColourNet: Investigating the Importance of Colour Spaces for Image Classification," J. Advances in Intelligent Systems and Computing, vol. 868, pp. 349–360, 2019.

[12] R. A. Hill and R. A. Barton, "Red enhances human performance in contests," J. Nature, vol. 435, no. 7040, pp. 293, 2005.

[13] A. C. Moller, A. J. Elliot, and M. A. Maier, "Basic hue-meaning associations," Emotion, vol. 9, no. 6, pp. 898–902, 2009.

[14] S. Lichtenfeld, A. J. Elliot, M. A. Maier, and R. Pekrun, "Fertile yellow: Yellow facilitates creative performance," J. Personality Soc. Psychol, Bull, vol. 38, no. 6, pp. 784–797, 2012.

[15] N. Kaya and H. H. Epps, "Relationship between colour and emotion: A study of college students," J. College Student J., vol. 38, no. 3, pp. 396–405, 2004J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, pp.68–73, 1892.

[16] F. Bast, "Reading Red: The Troping of Trauma in Toni Morrison's Beloved," J. Callaloo, vol. 34, no. 4, pp. 1069–1086, 2011.

[17] W. Eberhard, Dictionary of Chinese Symbols: Hidden Symbols in Chinese Life and Thought, Routledge, 2006.

[18] A. Archer and S. Stent, "Red socks and purple rain: the political uses of colour in late apartheid South Africa," J. Visual Commun, vol. 10, no. 2, pp. 115–128, 2011.

[19] M. Torgovnick, Primitive Passions: Men, Women, and the Quest for Ecstasy, University of Chicago Press, 1998.

[20] J. L. Papajcik, "The rhetoric of American beauty: A value analysis," Ph.D. dissertation, Univ. of Akron, Akron, OH, 2006.

[21] E. Phipps, Cochineal Red: The Art History of a Colour, Metropolitan Museum of Art, 2010.

[22] H. Cerrato, "The meaning of colours," The Graphic Designer, 2012.

[23] J. Gage, Colour and Culture: Practice and Meaning from Antiquity to Abstraction, Univ of California Press, 1999.

[24] S. Sharif and S. Mahmood, "Iconographical Approach in the Art of Hinduism: A Study of Pranāmī Temple at Malkā Hāns," J. Al-Qamar, pp. 119–138, 2020.

[25] T. Dignam, "Cultural Perception of Colour in Film," Ph.D. dissertation, BA thesis, Dublino, IADT, 2021.

[26] R. Clark, The sacred tradition in ancient Egypt: the esoteric wisdom revealed, Llewellyn Worldwide, 2000.

[27] M. Pastoureau, Blue: The History of a Colour, Princeton University Press, 2023.

[28] B. Fagan, Beyond the blue horizon: how the earliest mariners unlocked the secrets of the oceans, Bloomsbury Publishing USA, 2012.

[29] J. K. Yonemura, "The Influence of Ukiyo-e on Impressionism and Post-impressionism," J. M.S. thesis, California State Univ., Dominguez Hills, CA, 1996.

[30] E. E. Matthews and P. F. Cook, "Relationships among optimism, well‐being, self‐transcendence, coping, and social support in women during treatment for breast cancer," Psycho‐Oncology: J. Psychological, Social Behavioral Dimensions Cancer, vol. 18, no. 7, pp. 716–726, 2009.

[31] B. G. Dearing and S. Singg, "Photosensitive Assessment: A Study of Colour Preference, Depression and Temperament," Subtle Energies Energy Med. J. Archives, vol. 7, no. 2, 1996.

[32] S. Kakar, The Colours of Violence: Cultural Identities, Religion, and Conflict, University of Chicago Press, 1996.