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Multi-Color Brush

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ABSTRACT

This work presents a novel technique and physically-motivated model for controlling the allocation, switching, and changing of one or more attributes of a drawing (colors, opacity, size) on the fly using a single brush.This technique makes working with colors and design strokes easy and effective for painters/designers/artists by minimizing the number of clicks they do when shuffling between two (or more) color on a touch device.

This work allows a painter to load acolor (say Red) on one side and another color (sayYellow) on another portion of the brush and there is some overlap and mixing involved. The painter can now tilt/rotate or perform any other defined movement on the brush to control the color that should be applied.Multi-finger touch gesture has beendeveloped to prototype the concept. In addition to colors, this work is extendible to control and switch other parameterslike opacity andsize of the brush by using the same technique of controlling, allocating, switching, and changing properties with the tilt/rotation/angular movement of the brushon the fly.

Keywords
Touch Gesture, Digital Artwork,and ColorsSelection

1. INTRODCUTION

Creative artists, painters are getting attracted towards software drawing applications, leveraging technology to create, produce, and spread their artworks to larger audiences. This was earlier not possible because the drawings were limited to physical paper/charts/canvas. Multiple applications are being made and offered to these creative people to perform free-flow hand drawings on these applications' canvas. Some of the applications on iDevices, Android phones, and touch tablets are Adobe Photoshop Touch [1], Adobe Ideas [2], Autodesk Sketchbook Express [3], and Paper by 53 [4].

This work becomes more significant when artists/painters are doing free-flow hand drawings/strokes on touch devices. An artist shuffles between multiple colors or different brush size in their artwork.

Drawing on touch devices using stylus or fingers gives a real-life like drawing simulation and feeling to the artists thatwas earlier not possible due to the limitation of mouse movements and keyboard controls.

Traditional brushes are available with drawing applications, which show variances in terms of different shapes (circle, rectangle, and so on) or sizes (such asline size, line width, and so on), but none gives a capability to an application user to control, change, or switch to a different color on the fly using the same brush.

2. PROBLEMSTATEMENT

Applications [1] [2] [3] [4]are providing their best touch-enabled features for managing colors in a drawing, yetone of the pain points associated with drawings on software/touch applications are the constant interrupts happening while drawing, resulting into (although necessary) multiple intermediate clicks and hand/finger/stylus/pen movement in a direction (or sequence) thatis not in line with the drawing pattern.

Some of the examples of interrupts that break continuity in a free-flow drawing are:

– If apainter decides to use a slightly lighter shade of acolor (or a different coloraltogether) with respect to the color that is currently being used.
– If apainter decides to use a slightly darker shade of acolor (or a different coloraltogether) with respect to the color that is currently being used.
– If apainter decides to use a different color with respect to the color that is currently being used.
– If a painter decides to use a color blending of his choice with minimum clicks thatcan be done instantly on the fly.
– In many a cases, a painter knows three or four core colors that he will use in his drawing but selecting them on and off turns into an interrupt and brings discontinuity in his free-flow drawing.

The color shuffling, selection and blending operationsarenecessary for a painter, but doing multiple clicks for selecting them on and off breaks the continuity of free-flow drawing.

To add efficiency to free-flow drawing, a solution is needed where multiple necessary/required shades of colors can be attached to the currently-being-used (and ready-for-use) on-screen brush itself. It will be very useful and effective for a painter to keep drawing and apply those variable shades of color (or a different color) without leaving the drawing, or without invoking the color palette and putting effort in selecting the required color shade or a different color.

Our work solves the above discussed use case to a significant extent by providing a dynamic control and switching of colors on the fly as per painter's choice with a simple angular movement (gesture) of fingers on the touch device.

3. SOLUTIONANDIMPLEMENTATION

This work, whichisa computer-implemented method (inspired from a physically motivated model) for use in devices,comprises:

- An on-screenbrush for painter/application user for coloring/drawing strokes.
- A color database.
- Initializing the on-screen brush with two or more color values(through hex values or RGB value) of painter's choice.
- An area on color selection applet listingtwo or more selected color organized in any order.
- A color allotment logic that associates two or more color(s) to the drawing brush.
- Color allotment logic comprises of a multi-angle coordinates (we took three angle coordinates as implementation technique) driven byAngular Indexing Scale (AIS) and Pressure Indexing Scale (PIS) algorithm toallow allocation of specific intensity of colors to brush during initialization phase and to control switching/blending later. AIS is capable of recognizing tilt/rotate/wheel-like movement/angular movement of the stylus/brush strokes.
- Anangular/tilt/wheel-likerotation sensing, pressure sensing on the device in connection with touch pad trajectory (capable of sensing the input pressure value of any external pressure of object on the device screen through pen, stylus, or finger) or/and capable of sensing angular/tilt/rotate/wheel-like movement of object (drawing brush) on the touch device screen.
- Swiping/moving/tilt/rotation/wheel-like movementof brush strokes as and when user does and detecting its movement with corresponding angle or pressure values on the device screen
- Binding and saving different color values(values in terms of hex values or RGB or any other relevant units) of the said color with specific angular coordinates of the brush.
- Bordering positions where angles are such that multiple colors come into play then they could mix together in different ways (including appearing side by side or streaked together) with respect to variable pressure triggeredbythe painter.
- Pressure variances are used for blending different colors at borders (i.e. where two colors are overlapping each other) or to increase the intensity of a color.
- Option to redo the color allotment incase a user wants a different color selection.
- Editing the name of the brush and saving brush's name to device's and application memory.
- Repeatingthe above method to include more brushes if painter is interested in.
- Adding/listing the newly-created brush amongst application's list of available brushes.
- Applying the said brush in free-flow drawing strokes with suggested changes in colors as per pressure change or/and tilt/rotation of brush strokes, movement on the application canvas on the said device.

The Brush can also be configured to control or switch properties like Opacity, Size of brush, and so on, on the fly. The above logic is applicable to controlling and switching these parameters too. The artist can thus create various profiles of brushes for controlling or switching colors, opacity, or size and can use them by simply doing a tilt/rotation/wheel-like movement of brush/styles while doing strokes/free-flow drawings.

How it works

A new gesture algorithm and corresponding applets are devised and designed that enables an artist to attach multiple colors to a single brush.

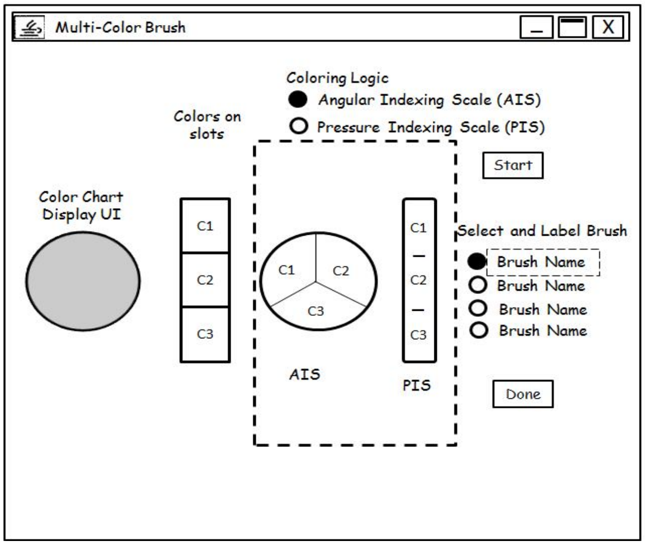


Figure 1: New Brush Movement User Interface

Applet shown above in figure 1, is the newly designed user interface carrying following components

a) Color chart displays user interface showing a list of all available colors with the application.
b) A panel of multiple slots where colors are assigned to each respective slot.
c) A color allotment logic that maps to Tilt/Rotate/Angular movement of the drawing brush.
d) A color intensity control logic that maps to the applied pressure of the drawing brush.
e) "Start" and "Done" buttons to control allocation of color parameters on the brush.
f) One or more brushes to use in the drawing.

Figure 2 shown below providesa detailed description of each legend in the newly designed user interface for color allotment to a brush selected by the painter.

The difference legends shown above are as follows:

1. Multi-color brush applet – The newly designed multi-color brush applet launch icon is integrated with the core application (say Adobe Illustrator, Sketchbook, or any other drawingtouch apps). Once the applet icon is invoked, the multi-color brush applet gets invoked for further actions by the painter.

2. Database of all available colors, stored and integrated within the applicationpackage.
3. Color Chart Display user interface for showing various available colors in the application. One or more pointers (needle pointers) are provided in the chart display UI(like Adobe Kuler color selection chart) that allow a painter to select any three (or more) colors of his choice. Three different colors here are represented by C1, C2, and C3, respectively. Note that we took presence of three needles for selecting three colors in this example.

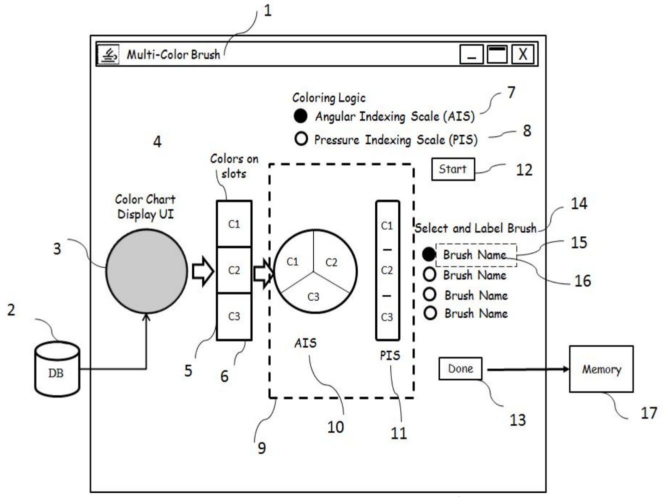


Figure 2: Detailed components identification

4. Equivalent Color mapping slots are provided next.Each color chart needle is mapped to a respective slot. As soon as the painter selects multiple colors in the color chart display user interface, these slots get filled/assigned with respective colors.
5. Shows color slots.
6. Shows total of three slots. This is programmable values; it can be any number (2 or more) depending on application designer.
7. Angular Indexing Scale: AIS is a set ofcolors mapping scales that this technique offers to the painter. Each slot is mapped to a definite angle range values associated with it. Color that fits into the respective slot will be mapped to that specific angle range values. For example, in the above figure, three different colors assigned to three angular coordinates are C1, C2, and C3, and each slot is mapped to angular ranges values, like C1 is mapped to 0degrees to 30 degrees, C2 is mapped to 31degrees to 60degrees, and C3 is mapped to 61degrees to 90 degrees.
8. Pressure Indexing Scale, aka PIS, is a blending mapping scale. A User is asked to select/pick a brush and swipe it over the trajectory with pressure variances at each marked entry on the trajectory. Each pressure variance position of the brush at respective mark on the trajectory will be allocated mapped intensity values to the recorded pressure value of the brush.
9. Grouping of AIS and PIS available to the painter. Painter can select for associating multiple colors as well as blending variations with the brush.
10. AIS will be enabled for tracking angular values allotments to selected colors. AIS trajectory will be enabled when a painter selects AIS option as part of the 7th point.
11. PIS trajectory will be enabled for tracking brush pressure sensitive movement on the trajectory and further assigning intensity blending valuesto each pressure variance. PIS trajectory will be enabled when a painter selects PIS option as part of the 8th point.
12. The Start button, which when pressed enables a Painter to measurebrush swipe/movement/tilt/rotationon the AIS/PIS selected trajectory.
13. The Done button, which when pressed enables aPainter to stop recording brush swipe/movement/tilt/rotation on the AIS/PIS selected trajectory.
14. The Select and Label brush allows user to pick the under color mapping brush and rename that to any preferred label of painter’s choice (for example, if a painter allocates three different shades of Red to the brush, he might want to label the brush as “shades of Red” brush). Traditionally, brushes were not assigned any label. This work allows assigning colors and a relevant name (or label) to the said brush. One or more brushes are made available in the applet for assigning different colors to different brushes.
15. Denotes brush entry, which users can click and a new label can be assigned.
16. Denotes the text name, which brush is going to be labeled with.
17. Application communicates with memory for saving and retrievingprocessed data allocations.
18. Users can further use brush allocations to control switching of other parameters like Opacity, Size, and so on.

Figure 3 shows an exemplary art work demonstrating a painter selecting AIS method for allocating colors to various angular positions of the drawing brushallotted.

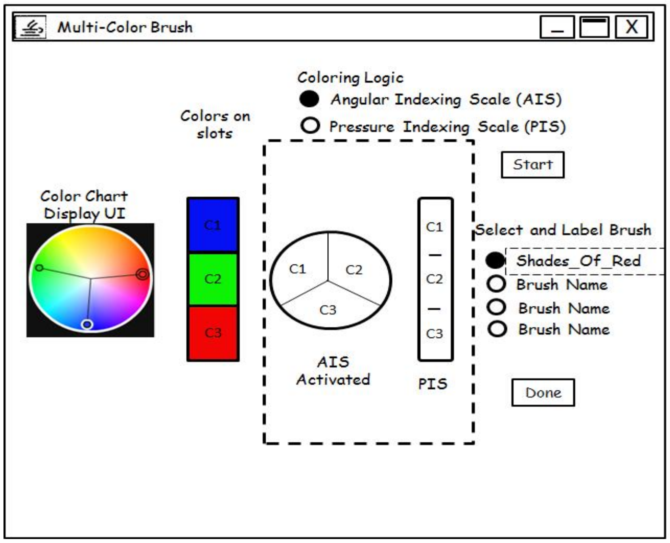
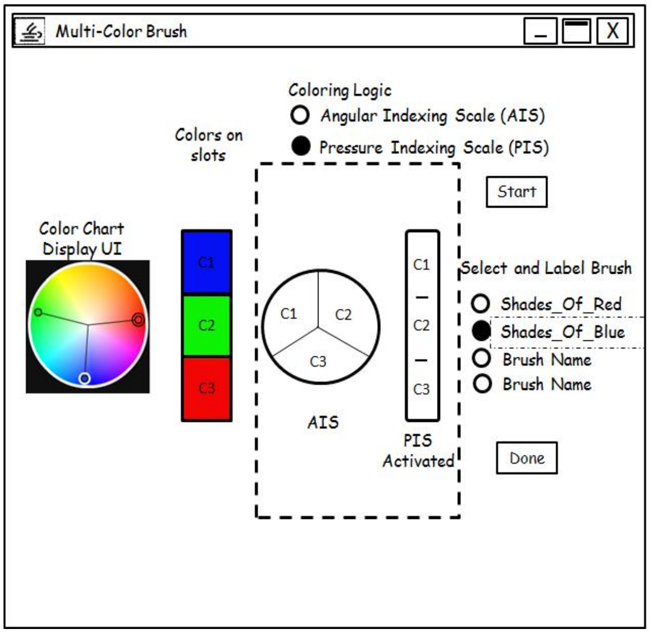


Figure 3: AIS Selection

Exemplary art work demonstrating activated color panel chart with three needles pointing to different color shades. Based on the position of thethree needles in the color chart, the corresponding color slot panel is filled with respective colors in slots 1, 2, and 3.Multi-color brush applet shows "AIS activated" and further user labels the selected brush to his choice of labeling text as"Shades_Of_Red". Asmultiple brushes are supported, assigning a relevant name with respect to assigned colors will help painters in remembering the colors thatare attached to various brushes.

Another simpler method to initialize color is to give a listing of available colors (say C1, C2, C3) to the user and let the user place his finger/brush directly to C1, C2, C3 in a particular sequence. How angles are then mapped to each of these blocks are listed, is explained later in the paper.

Figure 4 showan exemplary art work demonstrating a painter selecting PIS method for allocating blending intensity color values to various pressure variance instances of the drawing brush. Painter further selects naming the second brush as "Shades_Of_Blue" in order to label the brush with a relevant remembrance of colors assignment with the drawing brush.



○ Angular Indexing Scale (AIS)
● Pressure Indexing Scale (PIS)

○ Shades_Of_Red
● Shades_Of_Blue
○ Brush Name
○ Brush Name

Figure 4: PIS Selection

Figure 5shows the end to end workflow chart showing various modules and components in different color assignments to the drawing brush. Detailed explanation is followed after the figure.

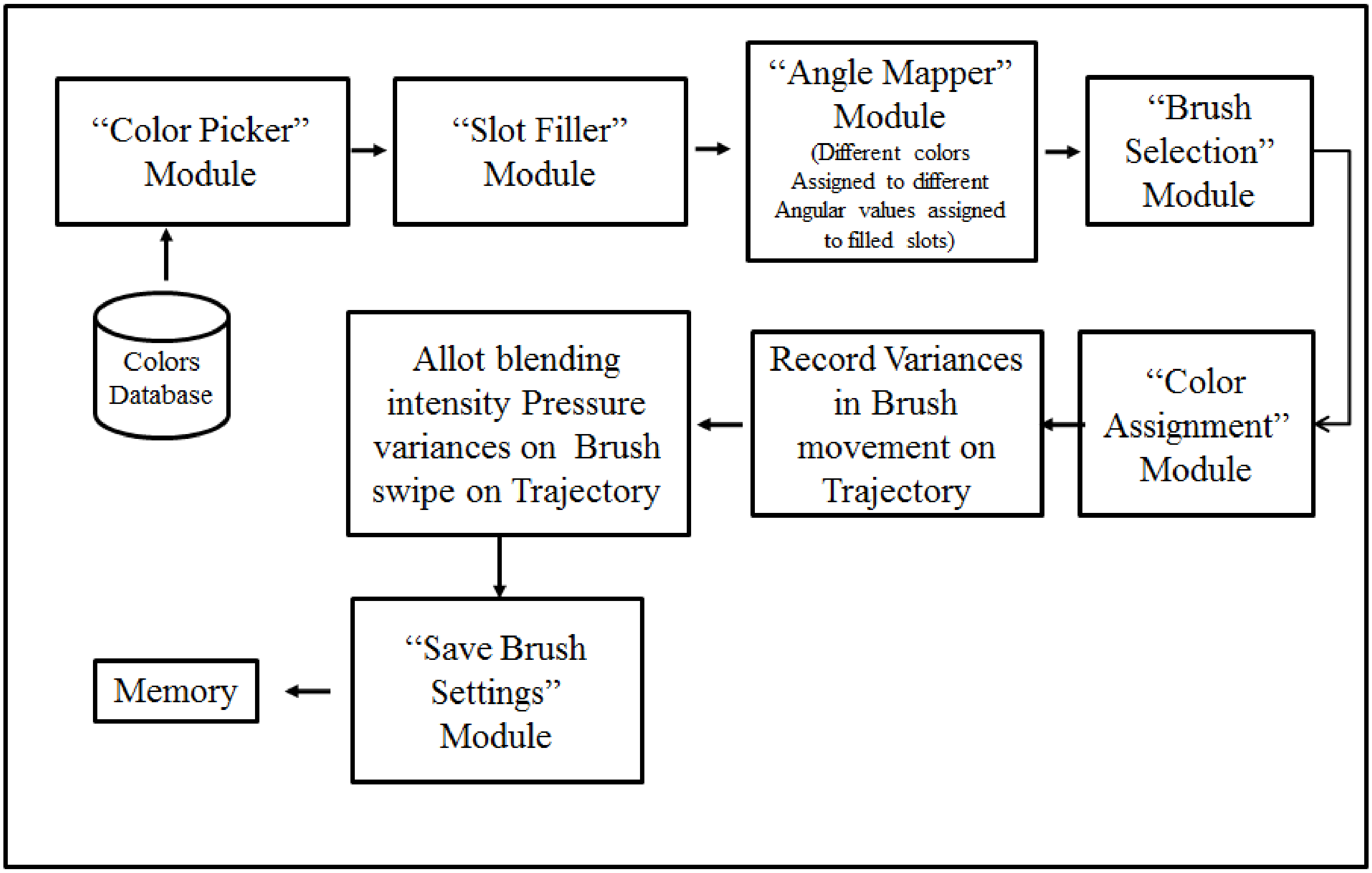

"Color Picker" Module
"Slot Filler" Module
"Angle Mapper" Module (Different colors Assigned to different Angular values assigned to filled slots)
"Brush Selection" Module
Colors Database
Allot blending intensity Pressure variances on Brush swipe on Trajectory
Record Variances in Brush movement on Trajectory
"Color Assignment" Module
Memory
"Save Brush Settings" Module

Figure 5: Modules workflow.

The Color Picker module fetches all available colors from the color database, integrated within the application, provides and maps data to the Color slots available in the application. Each slot assigned to a single color entry. Angle mapper module further allocates a specific color to different angular ranges with respect to the tilt/rotate/wheel-like angled movements or to pressure variance values on the trajectory. Brush is then selected by a painter and he further clicks the Start button to swipe the brush on the trajectory (depending on the selection made out of AIS or PIS), respective AIS or PIS trajectory will be activated. Color assignment module helps assigning the respective color to the brush angle. Brush settings are then saved, and if user is interested, he can also label the brush with a relevant label/title for ease of remembrance. All allocated data gets saved in devices and application memory.

Figure 6 shows how user-specified collection of color shades are assigned to brush as per their angular variances ranges allotted to them. Exact HEX values (color values can be represented in terms of RGB values or CMYK values) thatare selected by a user from the color display chart UI are shown here. Each of the selected color value gets mapped to the color allocation slot.

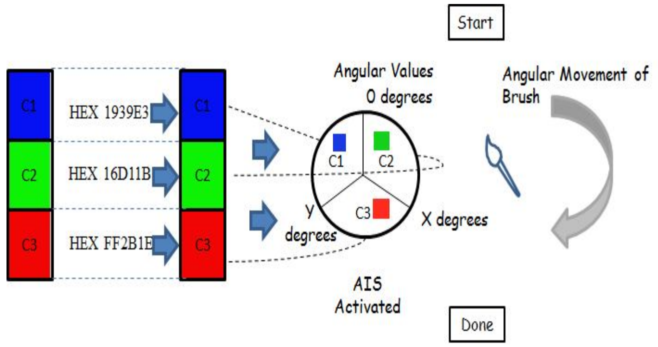
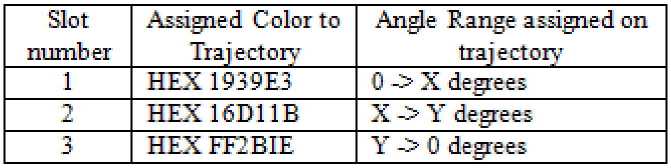


Figure 6: AIS Color allocations with multiple angle ranges

Table 1 shows a mapping between slot numbers, assigned colors and the respective angular ranges allotted.

Table 1: Slots, Angles and Color mapping



Slot number	Assigned Color to Trajectory	Angle Range assigned on trajectory
1	HEX 1939E3	0 -> X degrees
2	HEX 16D11B	X -> Y degrees
3	HEX FF2BIE	Y -> 0 degrees

Table 2 shows on AIS selection, trajectory is shown running with three divisions (as per count of colors slots), where each slots running with a different angle/tilt/rotate values/range is associated to them.

Table 2: Angle mapping with Colors

Brush angular assigned on slots	Color Assigned to brush
Any angle between 0 and X degrees	HEX 1939E3
Any angle between X and Y degrees	HEX 16D11B
Any angle greater than Y	HEX FF2BIE

Another simpler method to assign color is to enable users to place a finger or brush directly on the color blocks listed on the screen. Each color slot is mapped to a particular angular range. As soon as the finger/brush is touched on the color, the respective angle is assigned to the brush.

For example, the first color (say Blue) is assigned an angular range of 0 degree to 30 degree; the second color (say Green) is assigned an angular range of 31 degrees to 60 degrees, and so on. In that case, if a user taps his finger (or places brush) on a specific color slot, the corresponding angular range gets associated with the brush.

Respective colors are invoked when an artist finally does an angular inclination movement of the brush or his fingers on the touch device, which means when the brush or user's fingers is at 0 degree angle, theBlue color with HEX value 1939E3 is assigned, and as brush moves on the screen at different angles, it finally ends up at a certain angle and the color HEX FF2B1Egetsassigned.

Figure 7 shows PIS(Pressure Indexing Scaling) invocation case, how user-specified intensity allocationsof blending intensities are assigned to brush as per their pressure variances when recorded during their movement on the trajectory.

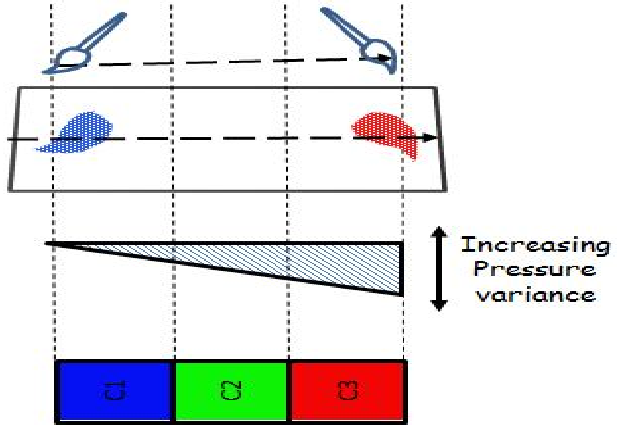


Figure 7: PIS invocation and color mapping

Exact HEX values (color values can be represented in terms of RGB values or CMYK values) which are selected by a user from the color display chart user interface are shown here. Each of selected color value then gets mapped to the color allocation slot (shown here in number form from C1 to C3). Figure 8 and Table 3 shows on PIS selection, trajectory is shown running with 3 divisions (as per count of colors slots), each slot running with a different pressure values/range associated to them.

Table 3: Color shades, slots and pressure intensity mapping

Slot number	Assigned Color to Trajectory	Pressure Range assigned on trajectory
1	HEX 1939E3	1 unit
2	HEX 16D11B	X -> Y units
3	HEX FF2BIE	Z -> A units

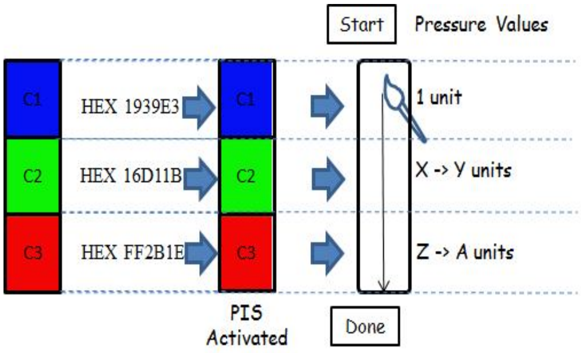


Figure 8: Color mapping with Pressure intensity

Figure 8 shows the brush movement on trajectory and allocation of specific colors at specific pressure values. Minimum unit of blending variation with respect to pressure intensity resides with application designer while developing the application.

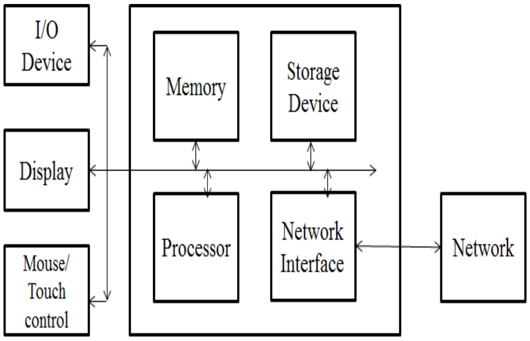


Figure 9: Hardware Interfaces

Figure 9 shows the hardware component that plays an active role in bringing the concept in reality. The various components included are: Input and Output device, Touch device display, Mouse/Stylus/Finger touch controls, Device Memory, Device Processors, Device Storage, and Network interface.

4. SUMMARY

'Multi-color' gesture is generated by a unique and on-demand combination of: first finger (A), in touch with touch device display screen, positioned statically at certain coordinates on the screen, along with a second finger (B), moving on the touch device performing an angular movement, where the combination of both fingers at that moment, invokes respective color as per the angular movement of the finger. Once invoked, the artist can do free-flow color selection using his fingers.A UI is also built that shows the current color and the corresponding angular valuefor facilitating the painter to know. Figure 10 shows the end to end workflow.

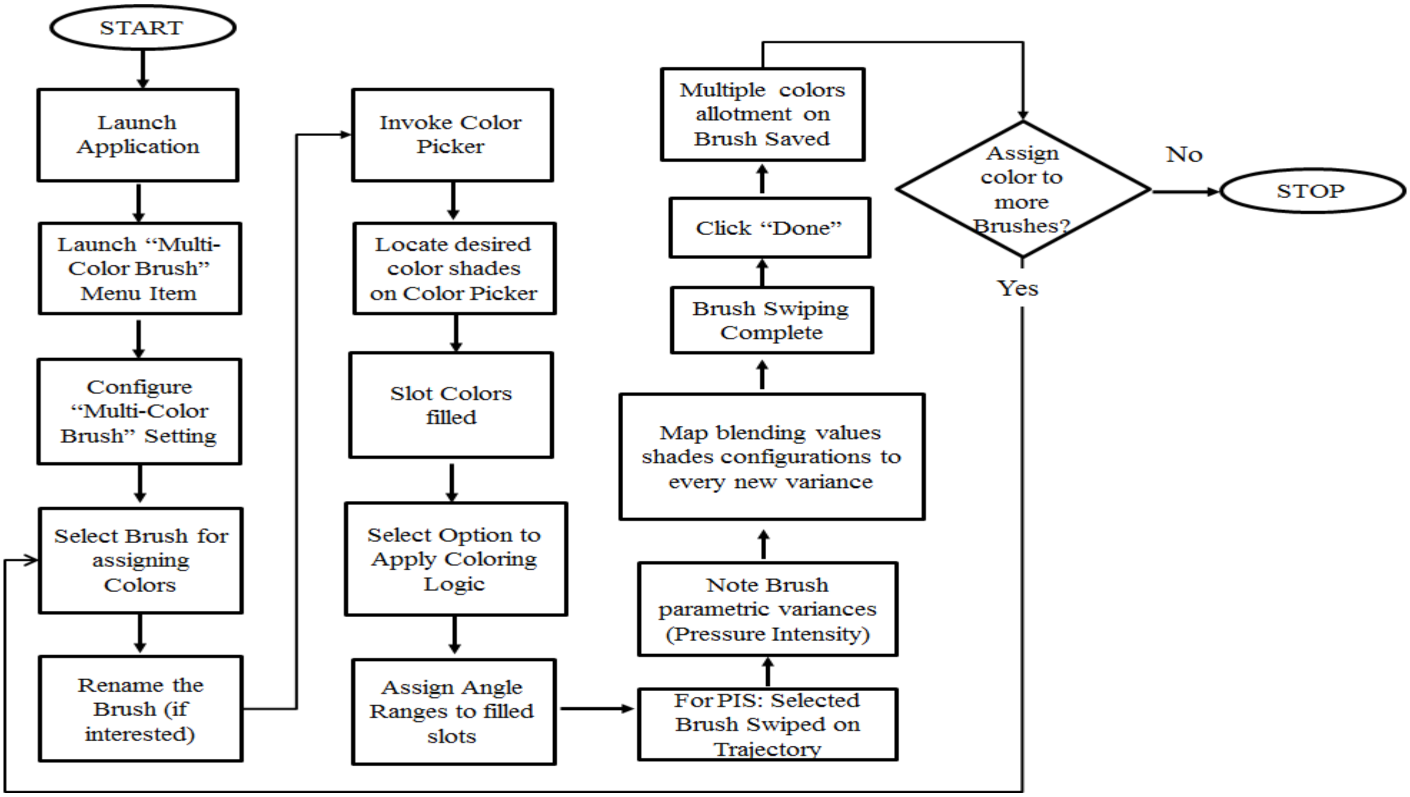

START
Launch Application
Launch "Multi-Color Brush" Menu Item
Configure "Multi-Color Brush" Setting
Select Brush for assigning Colors
Rename the Brush (if interested)
Invoke Color Picker
Locate desired color shades on Color Picker
Slot Colors filled
Select Option to Apply Coloring Logic
Assign Angle Ranges to filled slots
For PIS: Selected Brush Swiped on Trajectory
Note Brush parametric variances (Pressure Intensity)
Map blending values shades configurations to every new variance
Brush Swiping Complete
Click "Done"
Multiple colors allotment on Brush Saved
Assign color to more Brushes?
No
Yes
STOP

Figure 10: End to End workflow

Figure 11shows thenewly designed color selection and mapping template with an exemplary integration with a drawingapplication like Adobe Photoshop.

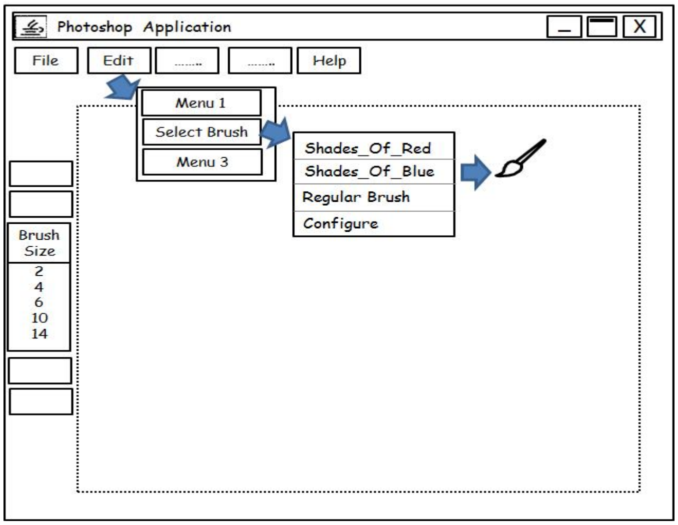
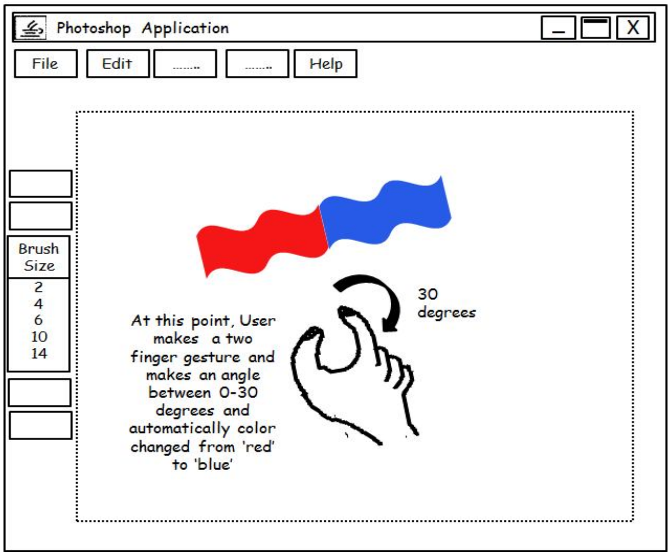


Figure 11: Multi color brush integrated within application

Picture shows invocation of brush selection from Edit> Select Brush menu.The Select Brush option now showsthe availability of user-created brushes (Shades_Of_Blue and Shades_Of_Red).

A user interface is also built that shows the currently drawn angle by the finger movement and the corresponding color which is mapped with the said angle. This user interface helps in facilitating user to know which particular color will get invoked if the user leaves his finger at the angle drawn at that particular moment.



At this point, User makes a two finger gesture and makes an angle between 0-30 degrees and automatically color changed from 'red' to 'blue'

Figure 12: Color change using Multi Color brush

Figure 12 shows a painter changing a color on the spot (from red to blue) with a simple gesture movement of second finger making an angle of a particular degree.

Thus, with the same brush or finger, a painter can now use multiple colors without spending any time in invoking the color palette and selecting a different color back and forth. Italso results in saving multiple clicks, which would have otherwise requiredwhen drawing with different colors.

5. CONCLUSION

The presented techniqueenablesthem to continue working on drawing on touch devices in a continuous free-flow manner without interrupting the flow, which would have otherwise happened, should he need to continue drawing with a different shade of the parent color. These results in:

- Minimizing clicks
- Prevents unnecessary interrupts
- Saves time
- Color switching effort

In addition, this solution can be easily adapted to control other parametric variations of certain tools associated with touch drawing, like:

- Brush size control
- Opacity control

For Brush size, certain angles can be mapped with different values of brush sizes, and as and when a user draws an angle using the two finger gesture, the respective brush size gets mapped to the new value, helping a painter to easily change the brush size without traversing any menu items.

PrototypeWe have built a prototype for Android touch devices based on the logic of allotting colors with defined angular ranges. In the prototype, we enabled a device user to select four colors, out of a listing of eight colors, by tappinga finger on these colors sequentially. Based on color tapping sequence, an angular range is allotted to each color.

The first color got 0-30 degrees range, the second is mapped to 31-60 degrees range, the third angle from 61-90 degrees range, and the fourth color is mapped to an angular range of 91-120 degree range. The prototype is also provided to a limited sample of touch device users in order to conduct a user study as well as to get their feedback on the color mapping.

6. REFERENCES

[1] Adobe Photoshop Touch [link]
[2] Adobe Ideas [link]
[3] Autodesk Sketchbook [link]
[4] Paper by 53[link]