Overview

- Artists draw on blank 800 by 600 screen
- Camera recognizes gestures
- System translates to virtual brush and paint
• **Gesture Detection**
  Identifies the location of the user’s hands, velocity, and intention.

• **Paint Genesis**
  Translates the position and speed of user’s hands to paint.
Gesture Detection

- Video capture
- Center of mass calculation
- Velocity calculation
- Intention detection
• Obtain data from camera
• Filter to accept/reject pixels based on threshold
• Write to ZBT (debug only)
Gesture Detection Center of Mass

- Calculates the left and right centers of mass
- Saves two centers of mass clusters
- For each pixel input, if distance is < threshold, updates center of mass. If distance is > threshold, counts as second center of mass or discards
- Keeps track of the last 8 centers of mass and outputs the average
Gesture Detection

Velocity Calculation

- Averages the two centers of mass
- Stores last 32 averages
- Keeps a total distance
- For each new average center of mass, subtracts off the squared distance from the oldest two points and adds distance from newest points
• Determines if the user is trying to pick up paint from the palette or trying to paint
• Looks at the left center of mass
• If the user is picking up paint, intention generator also outputs color
Paint Genesis Saturation Module

- Keeps track of whether the saturation is increasing or decreasing
- Interacts with Intention & ColorGen modules
- Counts the number of absorb or paint signals at 65mHz
- sel_saturation is either -1 or +1
Paint Genesis Color Generator

- Remembers and modifies the current color on the paintbrush
- Keeps internal state of color and saturation
- \( \text{color} = a \times \text{curr\_color} + (1 - a) \times \text{sel\_color} \)
- \( \text{saturation} = \text{curr\_saturation} + \text{sel\_saturation} \)
Paint Genesis Brush Generator

- Takes the \((x, y)\) coordinates & velocity
- Makes three equidistant, intermediate points
- Total of 5 \((x, y)\) points to use as centers of blobs

![Diagram showing the brush generator process](image-url)
Paint Genesis Painter module

- Gets color information for pixel
- Determines whether the color changes
- Weights previous and paintbrush colors
- Creates new color
- Writes new color into ZBT
- 5 clock cycles
- Stores pixels of the picture, RGB value = 18 bits
- Clocked at 80MHz
- Interact with Painter & Display modules
- Painter writes current, reads 5 pixels ahead
- Display reads current pixel to display
Paint Genesis Display

- Shows picture and positions of LEDs
- Displays a new frame at 60Hz
- Fetches color information for at 40MHz
<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Sat/Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 10</td>
<td></td>
<td></td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Saturation &amp; Brush Generator &amp; Color Generator &amp; Display</td>
<td>Filter &amp; Center of mass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>ZBT &amp; Painter</td>
<td></td>
<td>Velocity &amp; intention</td>
<td>Integration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>Integration</td>
<td></td>
<td></td>
<td></td>
<td>Expansion</td>
<td>Expansion</td>
</tr>
<tr>
<td>December 1</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Expansion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Expansion</td>
<td></td>
<td></td>
<td></td>
<td>Integration</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>
Expansions

• Intention detection
  – Circular motions to absorb color
  – Blinking LED

• Paint genesis
  – Additional brush options
  – Fading of paint

• Game
  – User attempts to match system motions