



The Magic Glove

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- **Effect Overview**

We try to demonstrate a hi-tech presenting method without any projector, white board, pen, etc. There will be a semi-transparent “screen” floating in the air for the demonstrator to show something or draw something on.

- **Shooting Script and Raw Footage**

<i>Scene1</i>	
	A teacher comes into a classroom and will give a class on “ $E=mc^2$ ” formula. He tries to write something on the whiteboard, but the pen is out of ink; he tries to open the projector.
<i>Scene2</i>	
	But the projector doesn't work either.
<i>Scene3</i>	



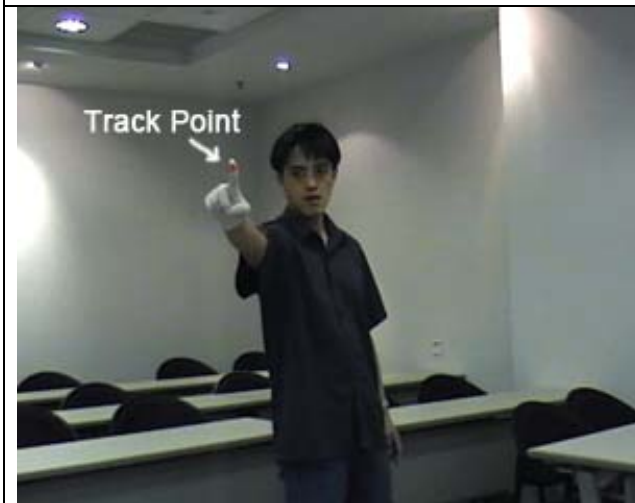
He tries to find a solution for his lecture presentation, and suddenly, an idea comes across his mind. He slowly takes out a glove from his pocket with a mysterious smile.

Scene4



He wears the glove, but the glove appears nothing special.

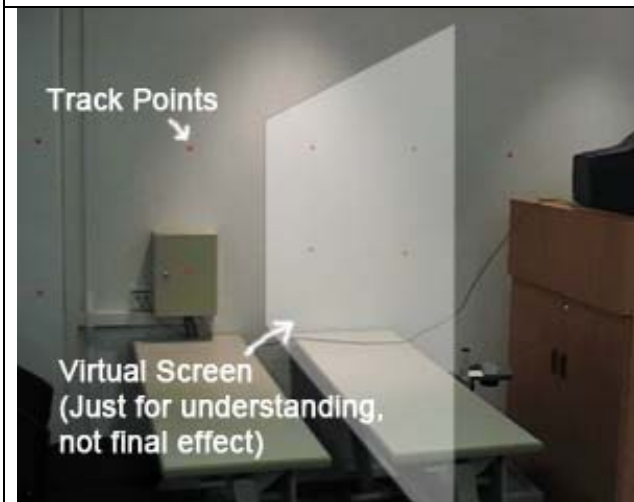
Scene5



He stretches out his hand with the glove, and a semi-transparent screen slips down in front of him. He finds that the contents on the screen are not what he wants, and removes the screen. Another screen slips down but contents are still not what he expects, and is removed by him again. Finally, the third screen slips down and he smiles with satisfaction.

and starts to write
“E=mc²” only with a
finger on the virtual
screen.

Scene6

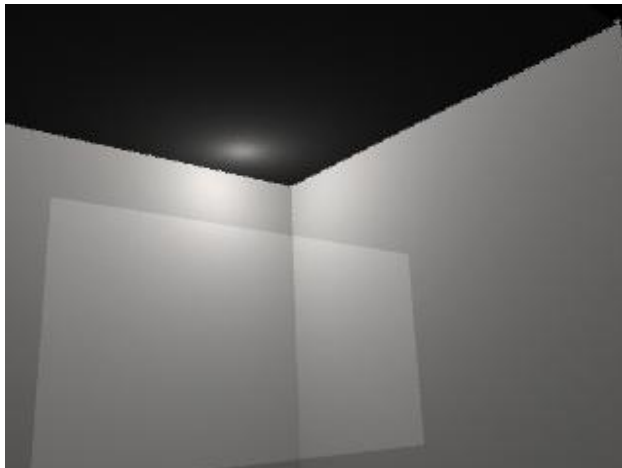


Camera begins to move
around the screen from
back side to front side.
The last image will lock
on the “virtual screen”.

*The underline parts involve special effect which will be composited with real footage.

■ Maya Model

The screen will be created with Maya. To do this we measured the size of the classroom and assessed the position of the screen. The image show the models of classroom and screen rendered in Maya.



■ Technical Aspect

The key issue of making effect in this short movie is the motion tracking of finger and trajectory reconstruction of the camera. In the light of previous survey, we

paste some track points on the finger and other reference object in the environment. These points have sharp color and are easy to be extracted. According the position of these track points, we can compute the motion trajectory of finger and the camera with Kalman Filter or some other ToolKits.

So far, the toolkits we have tried are: Maya Live, MatchMover and Boujou.

After these experiments, we find the tracking results are not as good as we expect. The main reason is that the image quality is too low and the tracking points are too small. So we decide to shoot the footage again with another digital video camera and more and larger tracking points.

Here are some screen shots of Boujou:



▪ Potential Complications

1. Creating a realistic “virtual screen” could be problematic. We want to make it like glass, but it will require some environment map and reflection which turns out to be too complicated. After all, we will try more materials.
2. How to eliminate the tracking points is also a problem for us now. Masking them one by one will be too boring and time consuming. We will try to develop some algorithms to solve it.

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What we have done

Re-shoot the footage

The lumination in the first footage is not good. So we change our site back to S16-SR2. Moreover, the tracking points in the first footage seem to be too small for the tracking software, and now we change them to bigger ones.

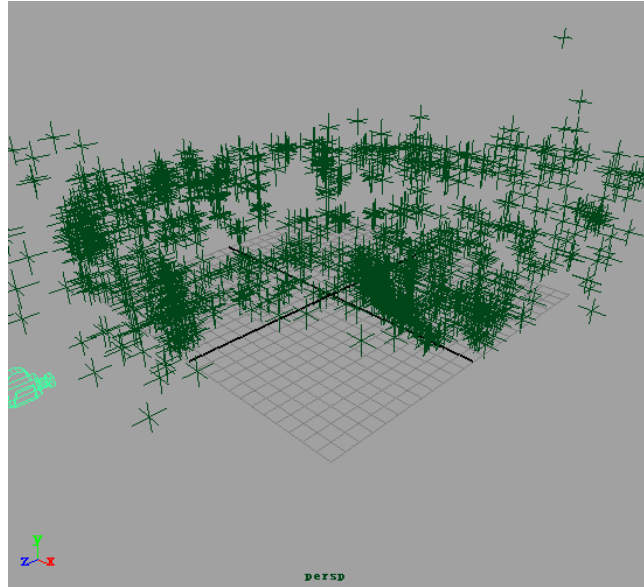


Frames from new footage

Track the trajectory of the camera using MatchMover 3.0 Pro, and export the trajectory to MAYA

MatchMover seems to be much better than boujou which we used before. We mask out the movement of the person, and use auto-tracking, MatchMover will find all the feature points (including those we pasted) and track them. It can also

solve the camera automatically. The trajectory reproduced by MatchMover is almost the same as which we moved the camera along.



Tracking points and camera position in MAYA

Track the movement of the instructor's hand

We wrote some C++ code to track the tracking point located in one finger of the instructor. The tracking point is green colored.

```
right.x = center.x + size;
right.y = center.y;

top.x = center.x;
top.y = center.y - size;

bottom.x = center.x;
bottom.y = center.y + size;

cvLine(img, left, right, CV_RGB( 255, 0, 0 ), 1, 8, 0);
cvLine(img, top, bottom, CV_RGB( 255, 0, 0 ), 1, 8, 0);

cvShowImage(win_name, img);
}

void FindMatch(CvPoint *point)
{
    int x,y; //coordinates in search window
    double max=0.0; //initialize min
    BOOL bFound = FALSE;

    //search in search window
    for(x = currentX - SEARCH_RANGE/2; !bFound && (x <= currentX + SEARCH_RANGE/2); x++){
        for(y = currentY - SEARCH_RANGE/2; !bFound && (y <= currentY + SEARCH_RANGE/2); y++){
            point->x = x;
            point->y = y;
            if(IsGreen(image, point)){
                FindCenter(image, point);
                bFound = TRUE;
            }
        }
    }

    //update currentX and currentY
    currentX = point->x;
    currentY = point->y;
}
```

C++ tracking code

Create 3D model of the virtual screen in MAYA

Create animation texture

We need the animation texture to display a image sequence on the virtual screen.

Create “hand-write” effect in MAYA

1. Use EP Curve Tool to draw strokes along the finger.
2. Attach Brush to strokes
3. Set brush color
4. Set the starting key frame and ending key frame of animation for each stroke.
5. Check frame by frame, adjust the animation speed in Graph Editor to make sure each stroke is “written” following the finger action.

Render the virtual screen in MAYA

We adjust the some properties of the virtual screen such as transparency, diffusion, glow, etc. to make the screen “real”.



The “hand-write” effect after rendering

What we need to do next

1. Remove the tracking point in the footage
2. Create the head and the tail of the clip.
3. Composite the virtual screen image with the background image.
4. Add audio effect.
5. Create the making-of movie.