

# Haptic Technology for the Blind: a Grid Map Using Dynamic Forces and Sound

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## 1. Introduction

Haptic technology is the study of touch. For blind/visually impaired users, there needs to be another mode besides sight to send information to the user. Our research is centered on developing a navigational aide. Combining a static 3D map and programmable mouse forces, our map provides information in an environment that the user can explore and learn. However, the mouse can only support a maximum of 20 forces at one time. Since this would not be enough for a large map, the active forces needed to depend on user location. In addition, sound was added to provide further environment clues.



Logitech Wingman Force Feedback Mouse

## 2. Approach

Since there is a 20 force limit, algorithms needed to be developed to only activate forces based on user location.

To do so, we created 8 boundaries; 4 for the overall grid and 4 for the block of 4 squares (see Figure 3) When the user moves past one of these inner boundaries, a method is called to update variables that hold the user's location. This function determines if the user is moving North, South, East, or West. It then activates/deactivates the specified forces and resets the inner boundaries to their new location.

To add sound, we used the SAPI (Sound Application Program Interface) library for C++. This library supports Text-to-Speech. This type of sound has the advantage of not having to store wave files with the program, saving memory and access time. The sound to be played is tracked along with the user's movements.

## Part One: Dynamic Forces

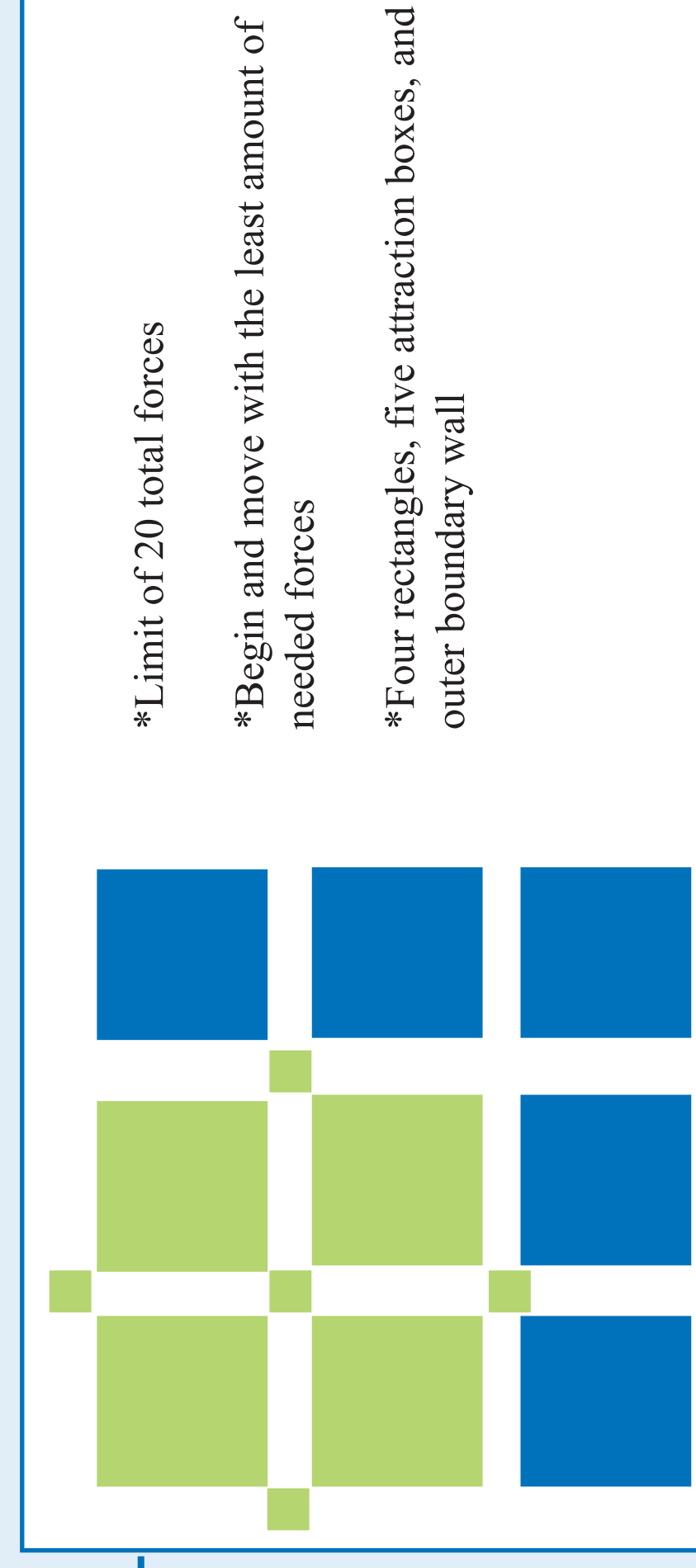


Figure 1: Initial forces.

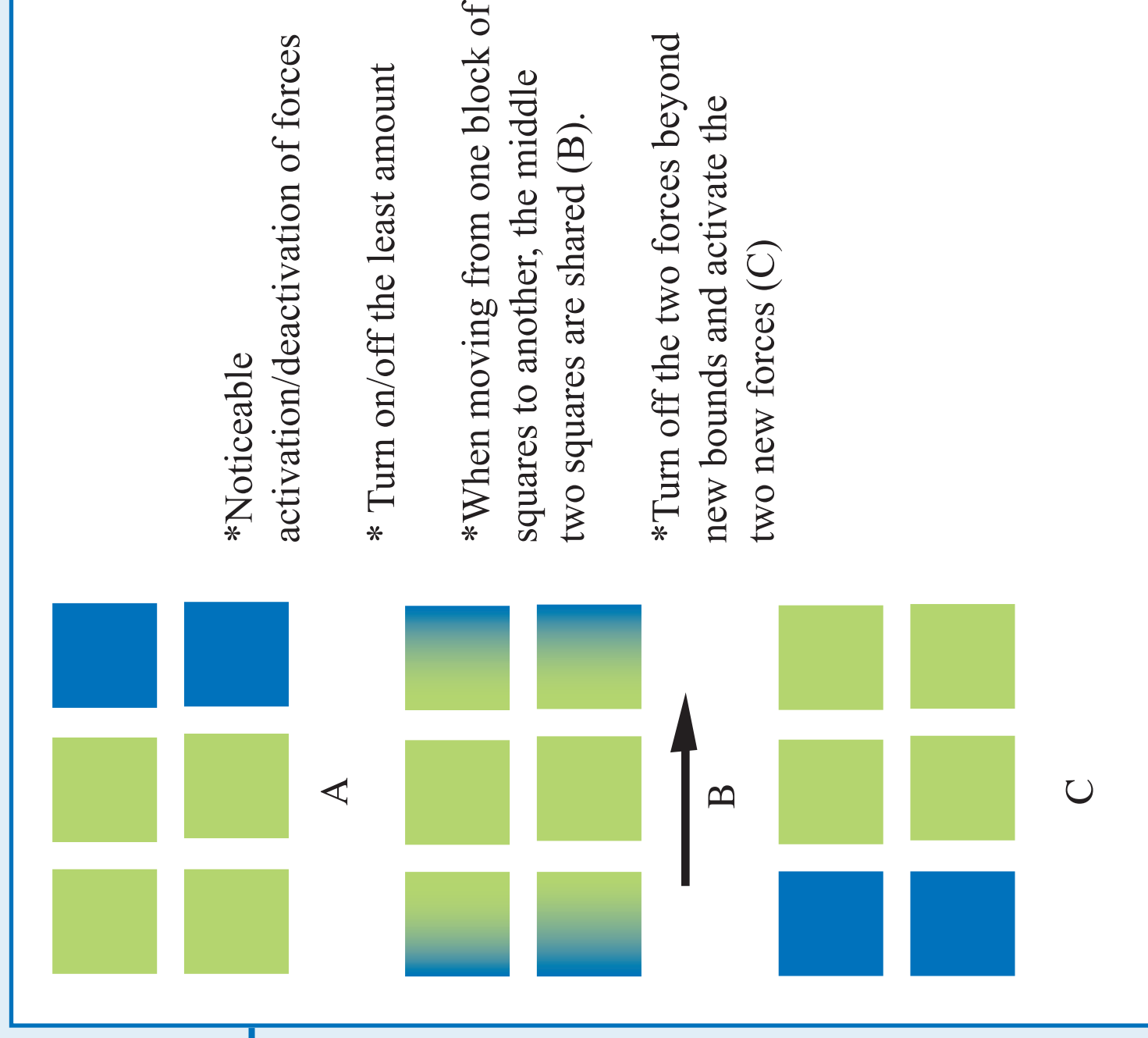


Figure 2: Changing the forces.

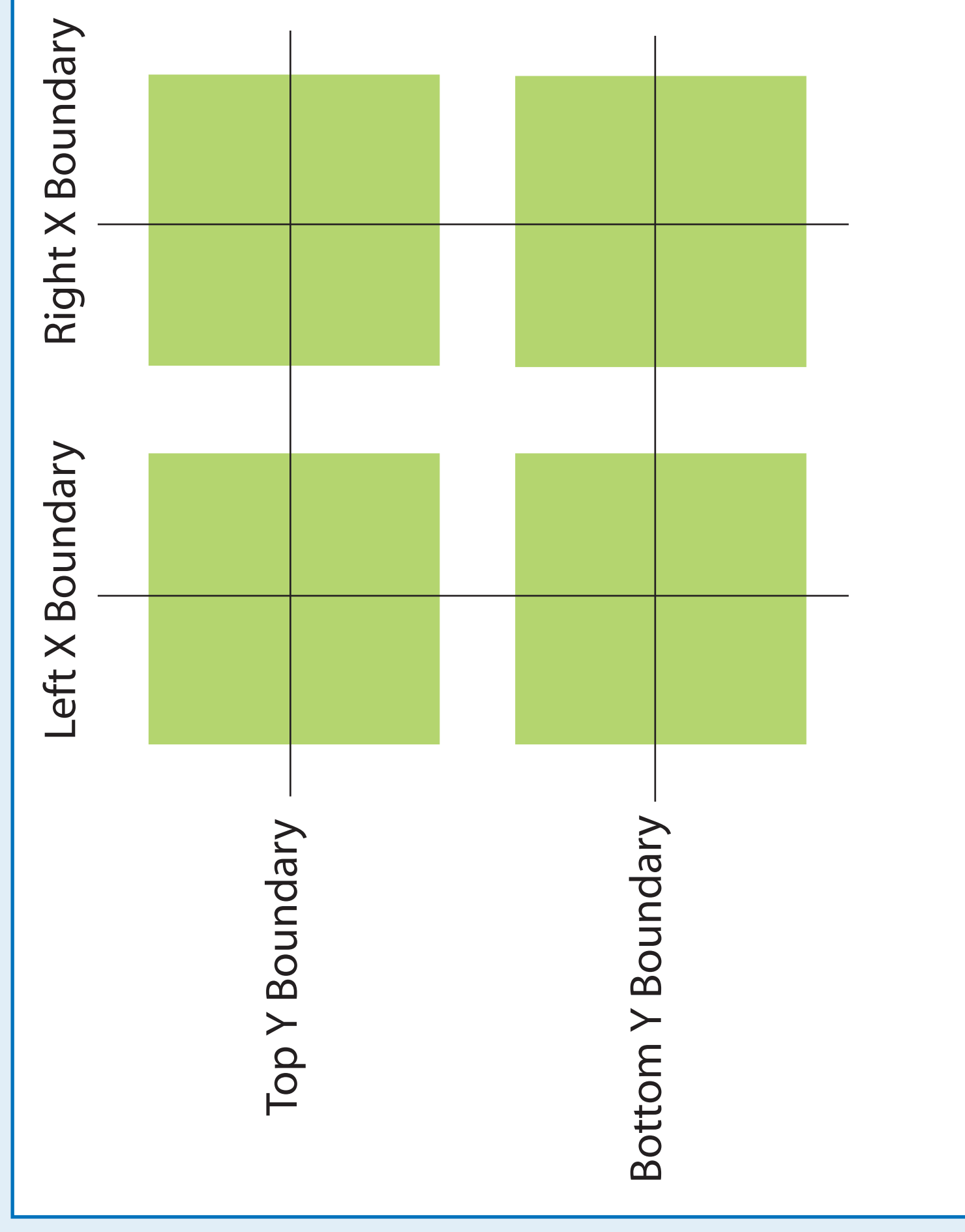


Figure 3: Square boundaries.

## Part Two: Dynamic Sound

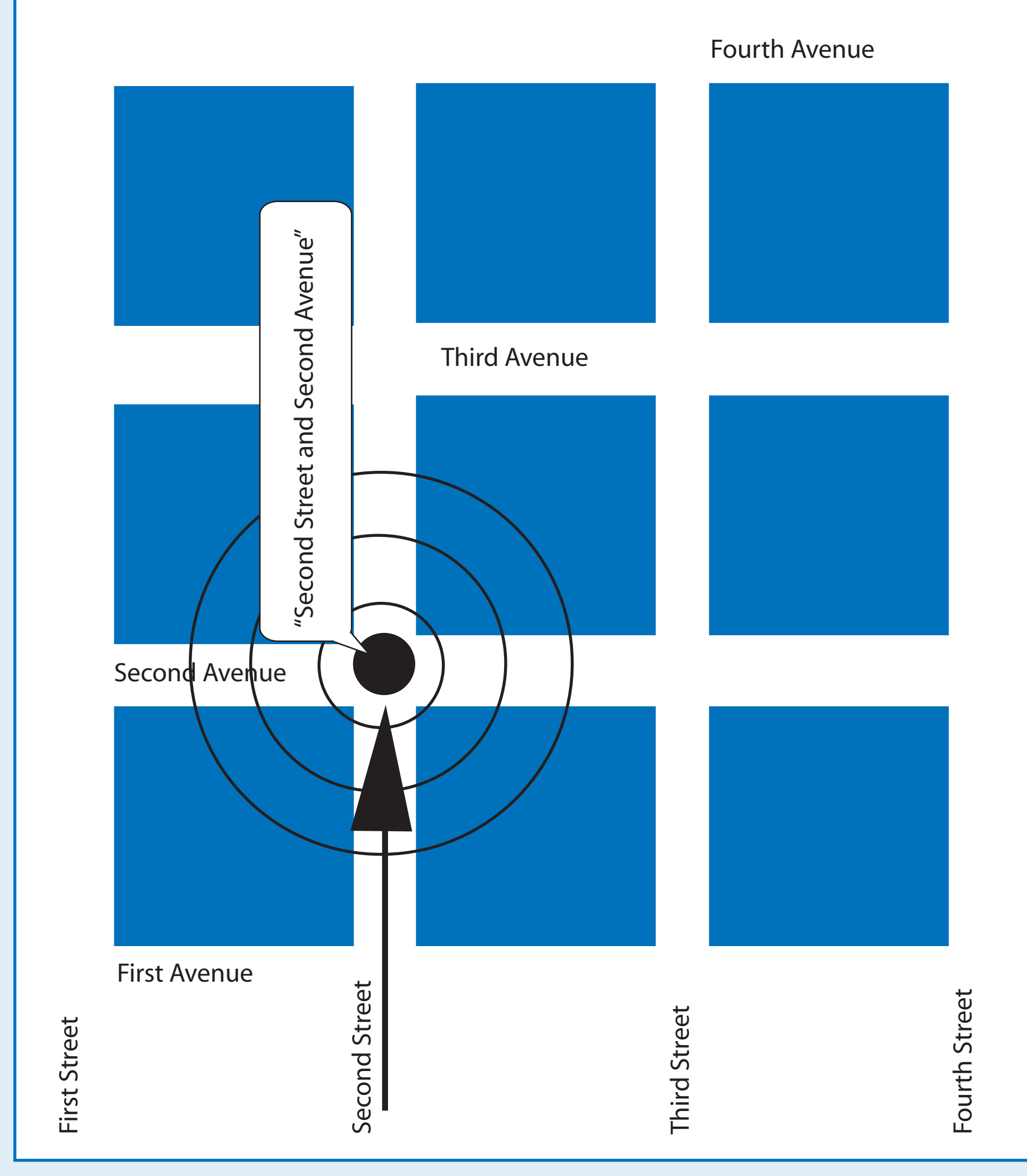


Figure 4: The Grid Map with coordinating sound

```
void play_sound() {
    ISpVoice * pVoice = NULL;
    if (FAILED(CoInitialize(NULL)))
        return;
    HRESULT hr = CoCreateInstance(CLSID_SpVoice, NULL, CLSCTX_ALL, IID_ISpVoice,
        (void**)&pVoice);
    if (SUCCEEDED(hr))
    {
        hr = pVoice->Speak(Sounds[soundNumber].AllocSysString(), 0, NULL);
        pVoice->Release();
        pVoice = NULL;
    }
    CoUninitialize();
}
```

Figure 5: Text-to-Speech Code

```
if (point.y < TopYBoundary) {
    //move off Southern boundary
    if (point.y == gridBottomBoundary && !boundary) {
        boundary = false;
        move = true;
    }
    //hit Northern boundary
    if (point.y < gridUpperBoundary && !boundary) {
        boundary = true;
        move = false;
    }
    //just move North
    if (point.y < gridBottomBoundary && !p.y > gridUpperBoundary) {
        boundary = false;
        move = false;
    }
    soundCaseNumber += 4;
    TopYBoundary = constant;
    BottomBoundary = constant;
    caseNum = 1;
}
```

Figure 6: portion of the move tracking algorithm

## 3. Conclusion

With the development of this grid, researchers can now further test the effectiveness of force feedback devices as aides for the blind/visually impaired in regards to map navigation. A tool such as this is more portable than an embossed map, contains more information than a Braille printout, and has various means to interact with the user. This technology also has the capability to be used over the Internet to reach a broad audience.

## Future Work

- \*More complex map: including diagonals, ellipses
- \*Aural Legend that will state what each sound signifies
- \*Bi-level sound hierarchy
  - First level: General sound (i.e. train whistle for a train station)
  - Second level: Specific information (the name of the train station)
- \*Guided tours through the map from a specified entry point to a specified ending point

## Literature

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