Mr.McK NAV

A web application for location pathing

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Project Overview

This application is to solve the issue of a user being lost in an unfamiliar environment, by generating a path from their starting location to their destination.

The initial premise behind this project was to provide a path finding to meeting rooms, in an unfamiliar office.
However the base functionality could be extended to support pathing solutions in distribution centres taking into account chemical spillages, outbreaks, congestion.
And also to support custom obstacles in offices, such as important meetings, areas under construction or even dynamic obstacles such as fires.

The application's functionality is achieved in two main sections Admin and General User.

Each of the admin functions outlined below are all available on the admin page except for those marked as planned features (*Planned*)

The admin page currently is available to all users in the POC project but with future authentication can be access restricted.

Admin User Stories:

The admin wants to add support for a new location

To do this, the admin uploads an image, and selects a processing method, and clicks upload, after this a grid will be displayed showing the generated floor plan, if the admin is content with the layout of the grid they can save the generated grid to the database (*Database structure and queries to be defined, see the potential database layout section*).

If however the grid generated does not accurately represent the floorplan, then the admin can use a different processing method, for example tolerance tied processing which lets the admin have more control over the processing, (*See tolerance tied processing in the feature list*).

In the case that from using the processing methods the admin is unable to yield the results they desire there is the additional ability to manually edit the grid, by placing wall or floor cells into the grid to achieve the correct floor plan layout by manual clicks.

The admin wants to edit or add obstacles to a location

The admin selects the location, or uploads a new floor plan image. Using the manual editing method they are able to add custom walls blocking certain areas. (*See the feature list for specific improvement plans*).

The admin then saves the new floor plan grid layout into the database, these changes should now persist for any users.

The admin wants to define meeting rooms and locations of an office (*Planned*)

The admin selects the location they wish to edit, or uploads a new floor plan, from this the admin can then select a group of cells in the grid and associate a name with these cells, each of these named locations will be stored in the database.
The usage of these named locations will be to allow users to pick their destination by name from a list rather than by geographical location.

The admin wants to add multiple floors to a location (*Planned*)

The admin selects the location, for example: McKesson Cork, Ground Floor.
The floor plan corresponding to that location is now loaded, using similar functionality to the manual editing, the admin selects the cells that correspond to the first step of a staircase, and defines which floor and staircase these stairs lead to, by associating a floor plan name or names, and corresponding cells for each floor. (See multiple floor functionality)
Once the stairs in a floor plan have been defined the admin can save the updated floor plan to the database.

In the case that the office also contains elevators, the admin can define the elevator cells the same as a multiple floor stairwell (multiple floor plan names, and multiple cell locations in a list)

The admin wants to approve or reject guest pass applications (*Planned*)

The admin is shown a list of guest pass applications, consisting of an employee name, original workplace location, contact information, date and length of visit. The admin can then check with the appropriate person to verify that the employee is visiting. Once verified the admin can approve the guest pass, allowing the guest to have timed access to the floor plan of the office they are visiting.
(See Travel/Visitor Functionality)

General User Stories:

The general user wants to see the path to their next meeting (*Planned*)

The general user logs into the application, they will see a floor plan grid corresponding to the office they work in.
If their specific working location (desk/office) has not been set, or in the case of hot desking the user may be prompted to select where they are working from in the office.
The user can then select the option to see their next meeting, they will be prompted with a message advising when and where the meeting is, and the grid will now show a path from their starting location to their destination.
(See the pathing improvements feature for future plans and extras)

The general user wants to see a path to and from custom locations

The user can select two locations on the grid, and click the generate path button, from this the shortest path to the desired location from the custom starting point will be shown on the grid.
(See the pathing improvements feature for future plans and extras)

The general user is visiting an office abroad and needs a guest pass (*Planned*)

The general user can request timed access to a floor plan of an office other than where they work, in the case that they are travelling.
The user will be prompted to provide information such as their name, contact information, data and duration of visit, this will then be sent to the host office (visiting location) for an admin to approve.
Upon approval the general user will now be able to see the new location's floor plan in their list of available locations, by selecting the new location the floor plan will be loaded and made able to be used for pathing functions.

The user wants to find the path from their location to a named location (*Planned*)
Provided the user has their working location set, they can select a named location from a drop down list that will correspond to the name locations in the office location and upon selecting a named location, they can run the pathing algorithm to see the shortest path to that location.

In the case that the user has no working location set they will be prompted to select a starting location on the grid (or from the list of named locations)

Feature List

Please note the feature list is split by functionality area

- AD.* Admin only feature
- GU.* General user feature (includes admins)
- BK.* Background or backend feature

Feature AD.1 Image Upload
Status: Implemented
Location: Admin Webpage
Activation Criteria: Triggered by the Admin user clicking on the upload button.
Completion Criteria: An image file is sent to the backend system for processing.
Extra Notes: N/A
(See Supporting Image)

Feature AD.2 Image Processing (Automatic)
Status: Implemented
Location: Admin Webpage
Activation Criteria: Triggered by clicking submit on the admin page
Completion Criteria: A grid is generated, mapped from the pixels inputted of the file uploaded.
Extra Notes: This processing method is one of three methods used to generate a grid representing a floor plan. Automatic processing works by splitting the total range of colors from the pixels in the uploaded image into a 50/50 ratio, the highest density of pixels of a specific color range are considered floors and the lowest walls, this means that regardless of the color the floor plan can be converted into a usable grid. (See Supporting Image)

Feature AD.3 Image Processing (Tolerance Tied)
Status: Implemented
Location: Admin Webpage
Activation Criteria: Triggered by clicking submit on the admin page
Completion Criteria: A grid is generated, mapped from the pixels inputted of the file uploaded.
Extra Notes: This processing method is one of three methods used to generate a grid representing a floor plan. This method works by checking to see if in any given pixel the RGB values are less than the tolerance value, if they are less then they are considered walls, if they are greater than the tolerance value they are considered floors.
This processing method may cause issues with floor plans where the walls are a bright color, and the floors are a dark color.
(See Supporting Images, Low Tolerance, High Tolerance, Accurate Tolerance)

Feature AD.4 Image Processing (No Processing)
Status: Implemented
Location: Admin Webpage
Activation Criteria: Triggered by clicking submit on the admin page
Completion Criteria: A grid is generated, mapped from the pixels inputted of the file uploaded.
Extra Notes: This processing method is one of three methods used to generate a grid representing a floor plan. Using this method the grid will keep its original colors, this means that it is possible to generate grids unusable by the pathing algorithm. This method should only be used in the case that the floor plan contains white floors and black walls.
(See Supporting Image)

Feature AD.5 Manual Testing
Status: Implemented
Location: Admin Webpage
Activation Criteria: Triggered by selecting the testing mode and selecting start and end locations on the grid.
Completion Criteria: A path is shown on the grid showing the user the shortest path.
Extra Notes: Using the start and end locations, the backend system then runs the A* (A Star) pathing algorithm to find the shortest path.
Some considerations with the current implementation the pathing needs more testing as there can be cases where the pathing algorithm fails. (potentially due to errors in the new implementation), using multithreading to update and run the UI and algorithm separately as there can be some unresponsiveness when path finding.

Feature AD.6 Manual Editing
Status: Implemented
Location: Admin Webpage
Activation Criteria: Triggered by clicking editing mode on the admin page
Completion Criteria: The cells can be edited to represent either walls or floors
Extra Notes: The admin user can select an editing mode and is able to edit the grid by placing either black cells (walls) or white cells (floors). This editing feature is the base for allowing the admins to upload custom obstacles, area avoidance and multiple floor functionality. Setting named locations is also a future sub feature of the manual editing, this allows a selection of cells to be associated with a specific name. Provided a database was linked to the system the admin's changes could be persisted for future users, and named locations would also be available to the users allowing them to select named locations as locations to be used in the pathing algorithms instead of selecting the specific cells to use as start and end locations.

Feature AD.7 Multiple Floor Support
Status: Unimplemented
Location: Admin Webpage
Activation Criteria: Triggered by clicking editing mode on the admin page
Completion Criteria: Stair and Elevator cells can be assigned in a grid, pointing to the next location.
Extra Notes: This feature is aimed to support multiple floors of an office, by allowing the admin to set certain cells as stairs or elevators, these new types of cells will point to the floor plan that is associated with the floor above or below. Provided database integration was part of the project, this feature would rely on storing the names and cell coordinates of the associated floors.
An example of this, in the case of the McKesson Cork office, the ground floor, floor plan would have stair cells set by the reception, these stair cells would point to the floor plan of the second floor of the Cork office.

Feature AD.8 Guest Passes Approval
Status: Unimplemented
Location: Admin Webpage
Activation Criteria: Triggered by checking the admin section for guest passes
Completion Criteria: Guest passes can be accepted resulting in the requesting user gaining access to the floor plan of the office they are visiting for a timed period.
Extra Notes: This feature is aimed to provide an authentication and access restriction system on floor plans, as the application may be used throughout the McKesson offices worldwide, this timed access restriction would provide access to the floor plan when needed but not constantly. It would be up to the discretion of the office hosting the visit to confirm or reject the guest passes.

Feature GU.1 Manual Pathing
Status: Half Implemented
Location: Admin Webpage (in the form of manual testing)
Activation Criteria: Triggered by clicking manual testing mode on the admin page
Completion Criteria: A path is generated on the grid from the custom start and end location
Extra Notes: Despite this feature not explicitly being implemented for the general users, the functionality has been achieved in the admin testing section.

Feature GU.2 Setting working location
Status: Half Implemented
Location: Admin Webpage (in the form of manual testing)
Activation Criteria: Triggered by accessing the general user page and attempting pathing without having a working location set
Completion Criteria: A cell will be stored and associated as the user's working location.
Extra Notes: After logging into the application if the user has not previously set their working location they will be prompted to, this working location acts as a starting point for the pathing algorithm. In the case that the user partakes in hot desking the user will also be able to change their working location whenever needed. This feature has not been explicitly implemented for the general user but the functionality can be seen in the manual testing on the admin section. Further expansion will be needed in the form of database integration and web page support to allow the user to register their working location.

Feature GU.3 Next Meeting Pathing
Status: Unimplemented
Location: General User page
Activation Criteria: Triggered by clicking next meeting mode on the general user page
Completion Criteria: A path is generated on the grid from the start and end location provided by a query to outlook or somewhere similar to find where the next meeting location is.
Extra Notes: The pathing works exactly the same as in the manual testing however the difference with this feature lies in the start and end locations. The initial start location may be a working location that's been previously set, or it may be the location of the last meeting room in the case that the user has back to back meetings, or the user is also allowed a manual starting either selected manually on the grid, or by named location from a list. This feature potentially provides the most use, but requires the most research as it relies on integration with a database, queries to outlook or an external application that's tracking the user's meetings in order to provide the pathing algorithm with the required start and destination locations.

Feature GU.4 Request Guest Pass
Status: Unimplemented
Location: General User page
Activation Criteria: Triggered by selecting the travelling abroad object
Completion Criteria: A request is sent to the office to be visited for an admin to approve, on approval the user has then gained access to the floor plan of the desired office
Extra Notes: This feature is an access restriction feature, planned to be implemented as a way to provide timed access to a floor plan of an office that the user doesn't generally work in but will be visiting. As a security layer an admin of the office abroad will be required to authenticate and approve the request. The user may be requested to send data such as their name, contact information, date and duration of visit, contact in the office abroad and other information that may validate their request to the plans.

Feature GU.5 Login Authentication
Status: Unimplemented
Location: Landing page pre access to the application
Activation Criteria: Triggered on access of the application
Completion Criteria: User is given access to the application, provided they entered their correct login information.
Extra Notes: This feature is an access restriction feature, from research there is potential for oAuth to be used to allow users to login. Potentially with integration with Outlook the user may use their Outlook account instead, more research is needed into this area.

Feature BK.1 Database integration
Status: Unimplemented
Location: Backend
Activation Criteria: Passive data storage and querying capabilities to display required information.
Completion Criteria: Floor plans, user data, guest passes, etc are persisted into a database, making floor plans available to any user instead of solely the user who uploads the plan
Extra Notes: This is an important feature allowing floor plans to persist after a single session. (See database structure plan)

Feature BK.2 Outlook integration
Status: Unimplemented
Location: Backend
Activation Criteria: Passive data retrieval (finding what meeting is when and where)
Completion Criteria: Based on the active user details, and an Outlook connection, the main application is informed of when and where the user's next meeting will take place.
Extra Notes: This feature is more of a backend connection, from research into this feature there are several potential options. Firstly, if Outlook has an API that can be accessed to provide the users agenda information that may suffice. However from my research I was unable to find an API to provide that information. A second option would be to have an email that can be cc'ed into meeting invites, storing the meeting information from those invites. A third option would be a direct connection with Outlook, meaning the user logs in with that login information this may allow retrieval of the required information.

Database Design

This section outlines a potential database design, aimed at being built in MySQL or PostgreSQL.

Entity Relationship Diagram

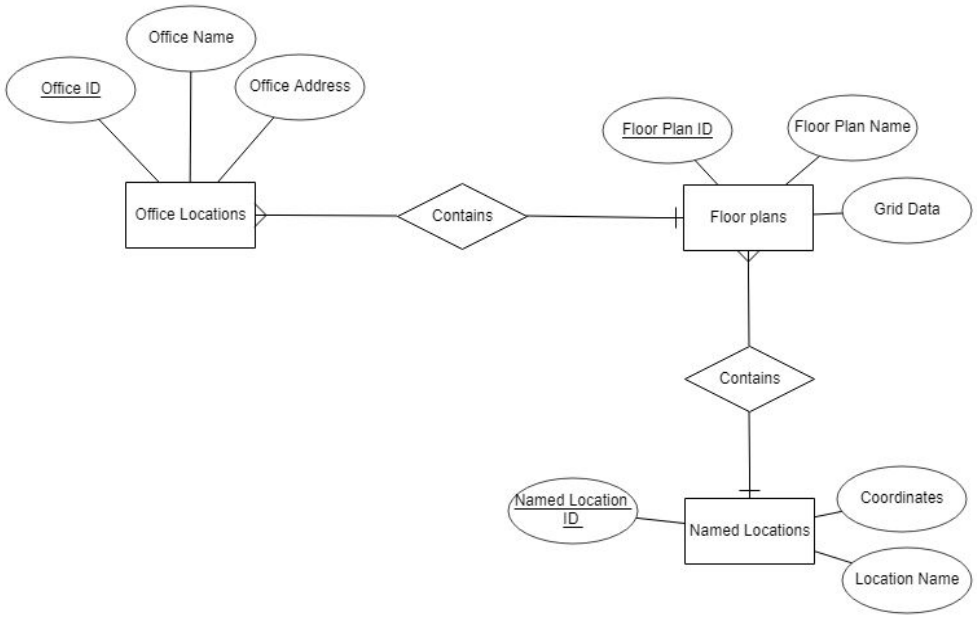


Table Layout Example
Here's an example for the above design

Office Locations

Office ID	Office Name	Office Address
IRE-1	McKesson Cork	T12 XN72
US-1	McKesson Irving	TX 75039

Floor Plans

Floor Plan ID	Floor Plan Name	Grid Data
1	McKesson Cork Ground Floor	Grid Data Array*
2	McKesson Cork Second Floor	Grid Data Array*

Grid Data Array
This object is an array containing the coordinates for each cell, as well as the hex code corresponding to black or white, as black cells are walls, and white cells are floors.

Named Locations

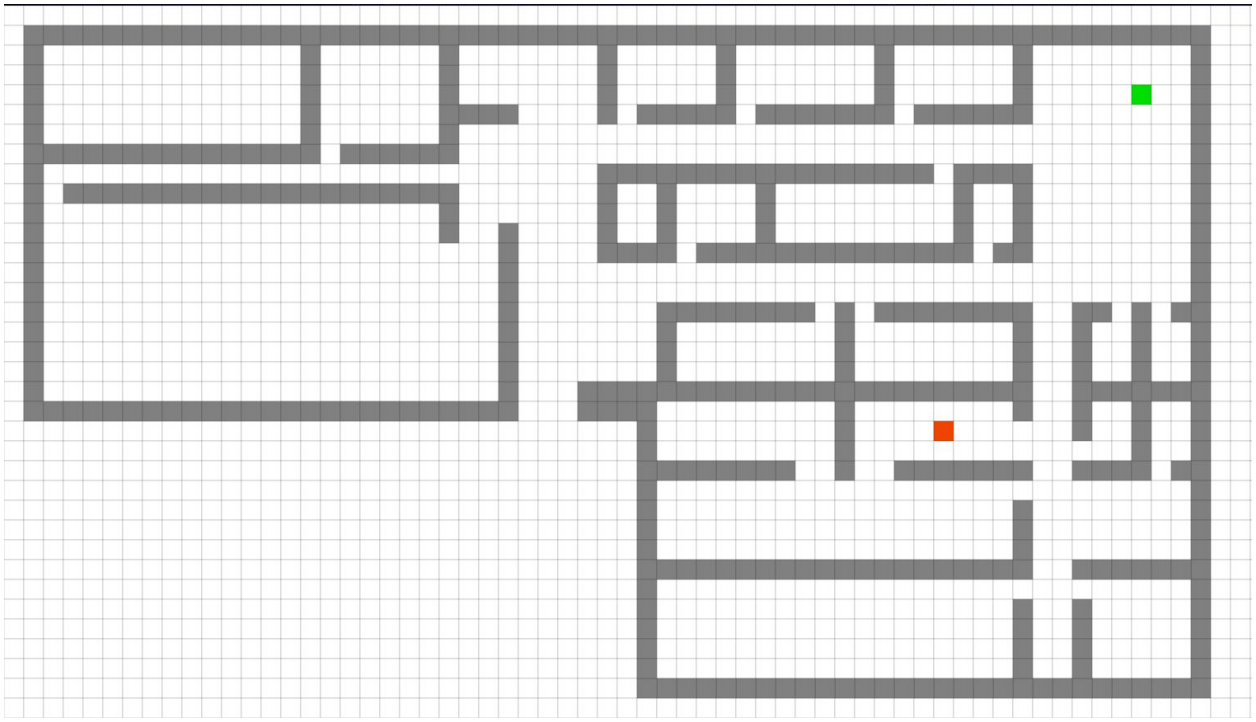
Named Location ID	Coordinates	Location Name
1	Range of coords that encompass the specified area	Canteen
2	X-10, Y-53 X-50, Y-11	WB Yeats
...	...	...

Coordinates
For the coordinates, an array of x and y values could be stored corresponding to the specified area, this would allow for strange shaped locations, or a less viable option is to store the range (X=0, Y=0) (X=10, Y=10) creating a rectangle.

Supporting Documentation

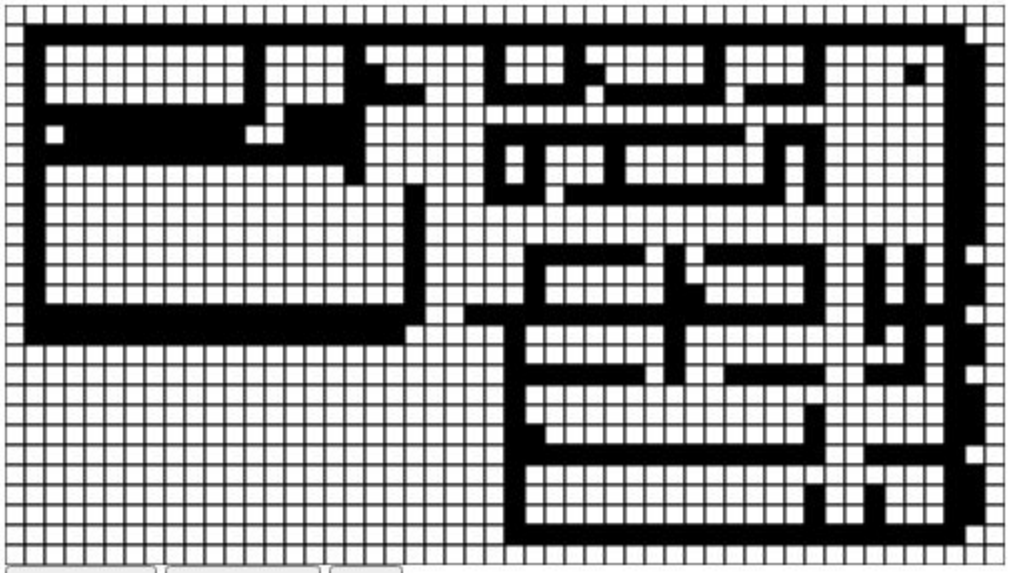
IMG.1 Floor plan image used

(This is the image the admin would upload)

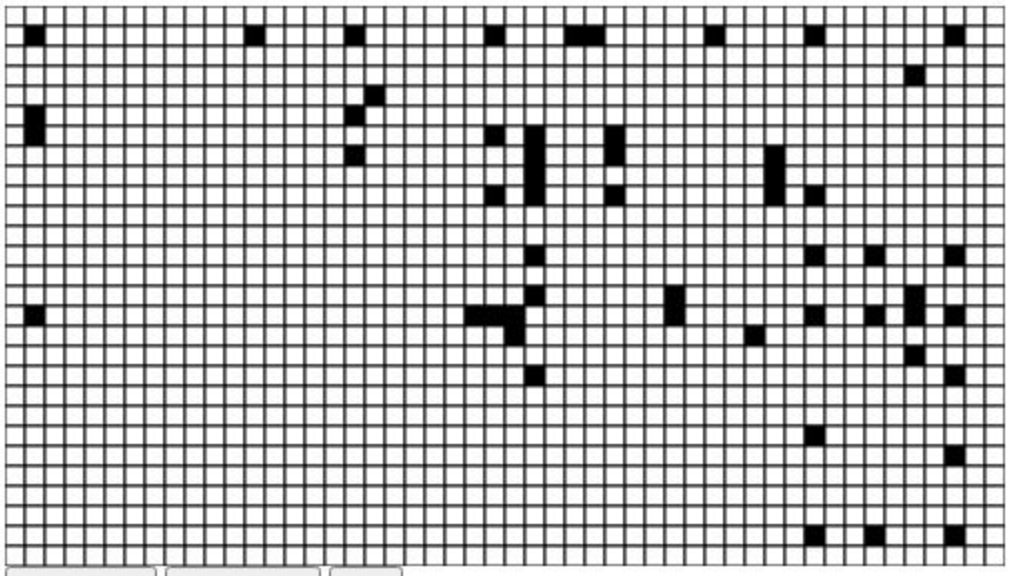


IMG.2 Floor plan converted using Automatic processing

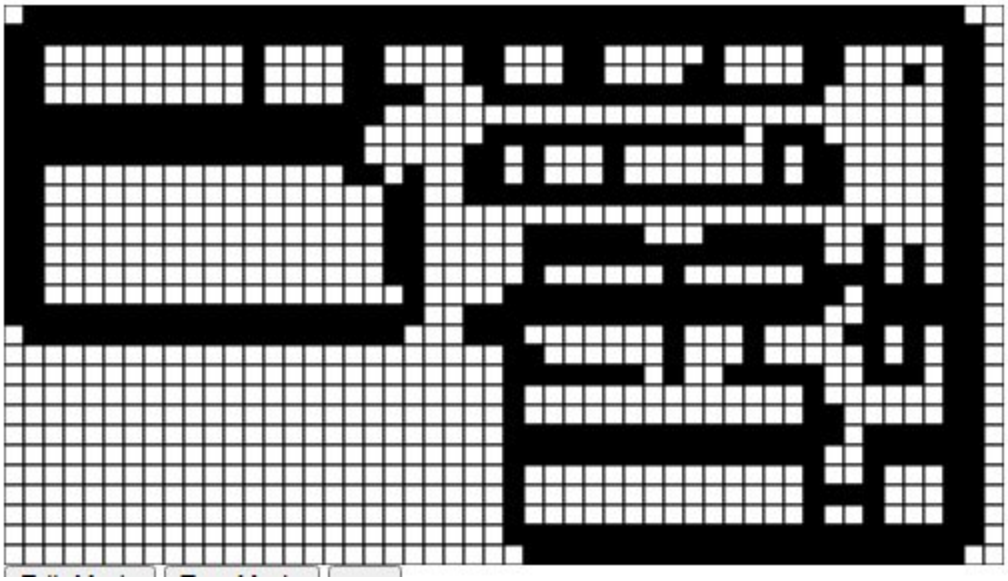
(This is the grid result of Automatic processing on IMG.1)



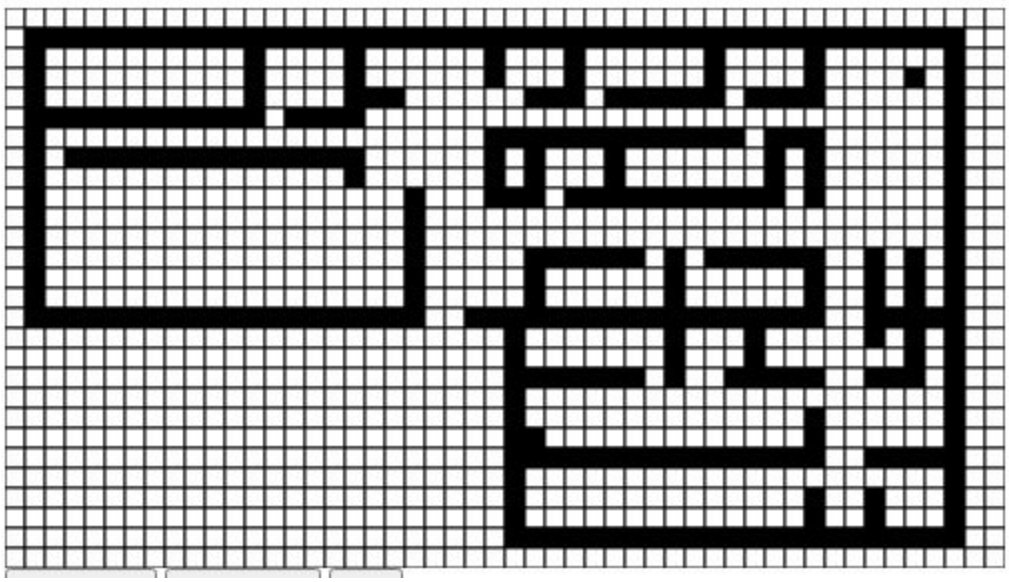
IMG.3 Floor plan converted using Tolerance Tied processing with a low tolerance value
(This is the grid result of Tolerance Tied processing on IMG.1)



IMG.4 Floor plan converted using Tolerance Tied processing with a high tolerance value
(This is the grid result of Tolerance Tied processing on IMG.1)

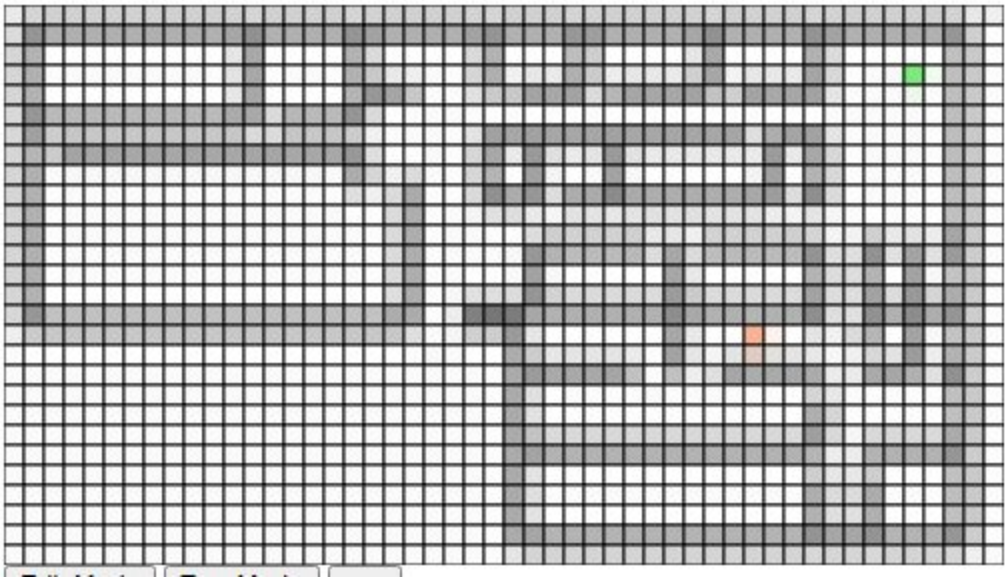


IMG.5 Floor plan converted using Tolerance Tied processing accurately
(This is the grid result of Tolerance Tied processing on IMG.1)



There is no right way for getting the correct tolerance value, simply trial and error.

IMG.6 Floor plan converted using no processing
(This is the grid result of Tolerance Tied processing on IMG.1)



From this image you can see the effects of the antialiasing, and resizing done in the background, this is also a prime example of a floor plan that will not work in the current state of the application. As walls cells are defined as cells that contain the hex code **#000000**.

For any queries contact Zac Dair: zacdair@gmail.com