VISUAL ANALYSIS

Google Maps for Mobile

SI622: Evaluation of Systems and Services
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1. INTRODUCTION

This document describes the visual analysis of Google Maps on Mobile (GMM) application as experienced on Blackberry Curve 8310 mobile phone. This analysis contributes to more rigorous, semester-long student project for the course SI622: Evaluation of System and Services, carried out under the guidance of Prof. Mark Newman. The goal of this analysis is to evaluate how the visual characteristics of GMM impact its usability, and to determine prioritized issues for improvement, and propose possible solutions to the developers. This report will assist the professionals responsible for the development and marketing of future versions of the application.

1.1 About Google Maps for Mobile (GMM)

Described as "the power of Google Maps on a mobile phone," Google Maps for Mobile (GMM) delivers step-by-step driving directions, traffic information, satellite imagery, and interactive mapping on mobile phones. The application takes advantage of Google's informational prowess by allowing users to search for map features by category, vague location or colloquial name, and returns results that include location, phone number, reviews and relevant details. GMM integrates search results with phone services via its click-to-dial feature, and allows users to personalize the application with an option to save favorite locations. In addition, the latest version of GMM is location aware, allowing users to map to and from their present location.

1.2 Target Population for GMM

Though we do not have an explicitly stated target audience for GMM from its development team, an assessment of market trends and user data we've collected thus far has revealed a few potential characteristics. As a priori characteristics, we postulate that GMM is targeted toward users with a moderate to high level of mobile device savvy, since the application runs solely on data-enabled smart phones, and secondly, GMM is targeted towards users of Google Maps Online (GMO), since the application is designed in many ways to mimic the functionality and features of the online version. This is bolstered by the fact that our survey revealed that most users of GMM are also users of GMO.

We also postulate that GMM is pursuing two emerging market segments. First, we believe they may be attempting to capitalize on the exploding population of mobile phone users who are converting to data-enabled smart phones. In recent years, smart phone sales have been growing enormously; between October 2005 and October 2006, smart phone sales increased by 75%. There has also been a complimentary growth in the development and adoption of applications for smart phones: in 2005, 11,000 new smart phone applications were released. This indicates that more and more people possess smart phones and are becoming proficient with applications on them, providing GMM with a potential conversion population that is ripe for extending their desktop experience with Google Maps to a version on their mobile phone. This postulation is bolstered by the fact that the GMM team appears to be actively working toward extending the application to most smart phone brands.

In addition, judging from their recent launch of geographic awareness in November, 2007 (through cell phone tower triangulation technology), we postulate that they are actively working to become a competitor to other mobile mapping services, such as TeleNav, VZNavigator, and Nokia Maps, and possibly even to hand-held GPS-only units. In our interviews, competitive analysis and surveys, we found that most GMM users have at one time used handheld GPS devices. In 2006, Gartner postulated that over 40% of handheld devices will be GPS enabled in just two years. With GPS enabled smart phones becoming increasingly popular and the development of a complimentary technology for those which are not, GMM can capitalize on this

potential conversion group, who may find the convenience of high-level mapping capabilities unified with their day-to-day mobile device appealing.

2. GOALS FOR VISUAL ANALYSIS

The goal of this analysis is to evaluate how the visual characteristics of GMM impact its usability, and to determine prioritized issues for improvement, and propose possible solutions to the developers. This report will assist the professionals responsible for the development and marketing of future versions of the application.

3. METHODOLOGY

For visual analysis, we used heuristic evaluation method, which is known as an efficient, and 'discount' method of usability assessment. Since consolidated visual design heuristics (for evaluating color, fonts, placement of interface elements etc.) are not available to usability professionals, each member of our team generated a separate list of heuristics for analyzing known parameters of human visual system such as Features, Objects, Gestalts, and Memory. Our efforts to create visual design heuristics were based on long standing research on human visual perception by Anderson et al, including the seminal work of the Gestalt school (Katz, 1950). We also used the guidelines provided by Olson (2007), and Ackerman (2008.) A total of 22 heuristics (Table 1) were generated:

Table 1: Visual Heuristics

#	Heuristic	Category
1	Contrast, saturation and color should be used effectively to differentiate text or objects from their background.	Features and Text
2	Variation in color, shape, and weight of objects and text should correspond accordingly to their function or purpose.	
3	Items should be placed from center to periphery in the visual field according to their importance.	
4	Movement should be used judiciously and as a tool for information conveyance, such as feedback.	
5	Text should be sized to be readable.	
6	Visual objects should be used consistently throughout all of the interfaces.	Objects
7	The visual objects should have appropriate associations for users.	
8	System's use of proximity (i.e. putting similar things near each other in order to imply connection) should effectively describe and reinforce the operation or data represented.	Gestalt Principles
9	System's use of similarity (i.e. making related concepts or objects appear the same visually) should effectively describe and reinforce the operation or data represented.	
10	System's use of continuity (i.e. creating and using lines and curves) should effectively describe and reinforce the operation or data represented.	
11	System's use of closure (i.e. creating and using shapes and territories) should effectively describe and reinforce the operation or data represented.	

12	System's use of symmetry (i.e. matching images, shapes, and indicators) should effectively describe and reinforce the operation or data represented.	
13	System's use of common fate (i.e. moving related items together) should effectively describe and reinforce the operation or data represented.	
14	Long-term information encoding should be supported so that users can find it when they need it. (i.e. UI should not require the users to commit things to long-term memory.)	Memory
15	Temporary, active state information storing should be supported so that users can store and retrieve it quickly whenever they need during the task.	
16	Information retrieving should be supported for both random (middle of task) and planned searches.	
17	Enough clues should be provided to refine a search.	
18	Enough clues should be provided to recognize a right solution/ information.	
19	Savings in learning should be supported by providing information recognition rather than recall.	
20	System should relate new information to what they already know in long-term memory.	
21	There should be no memory interference: same command shouldn't mean multiple things in different contexts.	
22	Users should not be required to keep too many things in working memory (7±2 principle.)	

Utilizing this set of heuristics provided us with a broad checklist for identifying, categorizing and evaluating a wide set of visual concerns. GMM was evaluated against each heuristic by each evaluator. When issues were identified, their severity was ranked along Jakob Nielsen's rating scale for usability problems:

Table 2: Priority Rating Scale

Priority	Definition
0	I don't agree that this is a usability problem at all.
1	Cosmetic problem only: need not be fixed unless extra time is available on project
2	Minor usability problem: fixing this should be given low priority.
3	Major usability problem: important to fix, so should be given high priority.
4	Usability catastrophe: imperative to fix this before product can be released.

4. KEY FINDINGS

4.1 Problems Summary

The following table summarizes the problem areas identified by the heuristic evaluation. Issues are grouped in the order of priority:

Table 3: Problems Summary

#	Issue	Priority	Heuristics violated	Category
1	Crosshairs on map are nearly invisible	4	1	Features
2	Road intersections are not clearly differentiated	4	11	Gestalt
3	Variants of same color are used for different purposes	4	21	Memory
4	Low contrast, peripheral placement and overlapping with Loading Progress Box	3	1,3	Features
5	Links are nearly identical in color to text on results screen	3	2	Features
6	Inconsistency between user direction and map direction	3	7	Objects
7	Too many color codes are used on the map background	3	19, 22	Memory
8	Lack of visual, contextual information of landmarks	3	18, 20	Memory
9	Key commands box is on periphery, changes without indication, text has low contrast	2	1, 2, 4	Features
10	Favorite stars are hard to see	2	1	Features
11	Feedback about data transfer has no meaning to users	2	7	Objects
12	Star button is inconsistent in behavior	2	6	Objects
13	It is difficult to identify and follow roads when using view traffic	2	10, 11	Gestalt
14	Middle-of-route searching is not supported	2	14, 15, 16	Memory
15	Re-routing in the middle of route is not possible	2	16, 17	Memory
16	Waypoint markers do not appear connected to the route	1	9, 10	Gestalt
17	City labels are occasionally not proximate to city location	1	8	Gestalt

4.2 Details of Specific Problems

#	Issue	Priority	Heuristics Violated	Category
1	Crosshairs on map are nearly invisible	4	1	Features

Explanation: The crosshairs at the center of each map reveals information and action options about favorites, pins and route turns when the user scrolls the point underneath them. Despite their functional importance (they are the only method for revealing some of this information),

they are very small and drawn in thin lines that blend into the background. This occurs both when they are in black on the map view and when they are white on the satellite view.

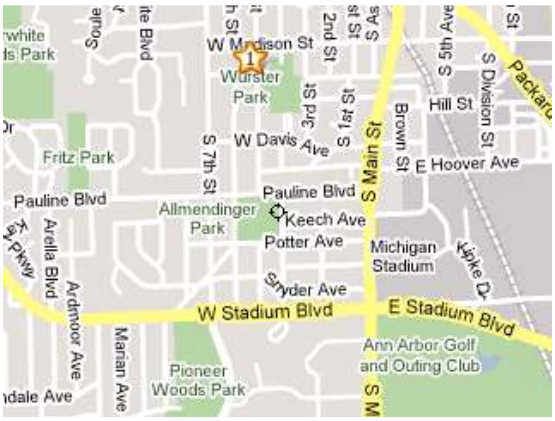

Figure 1: The black crosshairs on the map view blend in with the black road names.

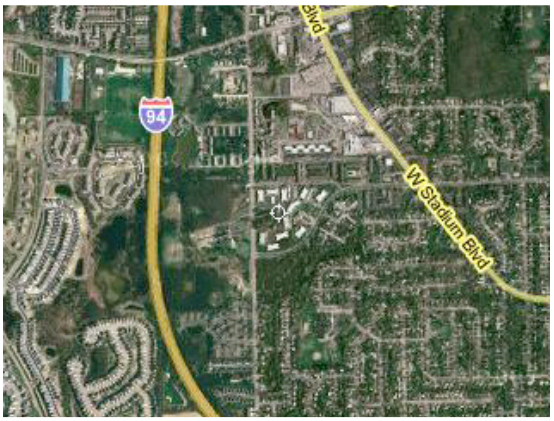

Figure 2: The white crosshairs on the satellite view blend into the detail of the background.

Possible Solutions: Increase the visibility of the crosshairs by: a) making the lines heavier so they stand out more, and making the negative space in the center of them a translucent red or orange, and b) making them blink or fade in and out to catch the eye when a point with information to be revealed comes within a certain proximity of them.

#	Issue	Priority	Heuristics Violated	Category
2	Road intersections are not clearly differentiated	4	11	Gestalt

Explanation: Typically, GMM shows an intersection in two roads that connect by using the Gestalt principle of common contour or continuity, allowing the outline of the two roads to flow together. However, in the case of road intersections that do not connect, there is no visual distinction to indicate this reality in GMM. This might lead to users attempting to follow an ad-hoc route that is not navigable, leading to frustration and anger.

Interestingly, this is not the case with Google Maps Online (GMO), where the intersection exhibited below is drawn slightly differently, with a solid border on Ivory Ave, indicating that it does not intersect with McKnight Road. It is possible that this level of detail was omitted in GMM due to concerns about map readability on a small screen.

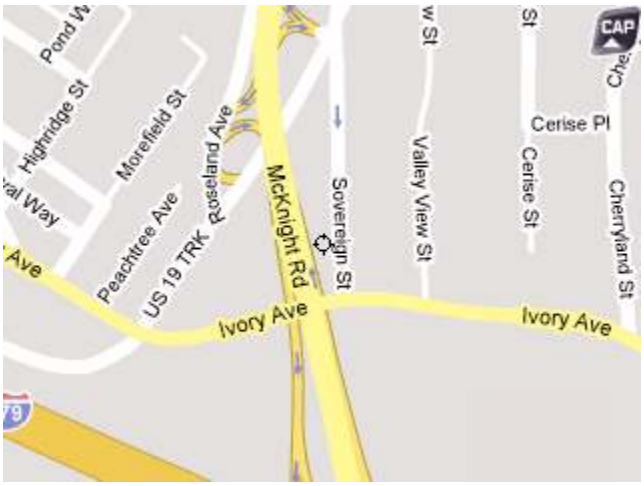

Figure 3: An intersection near Pittsburgh, PA at the highest map view zoom level. The continuity shown indicates that Ivory Ave connects with McKnight Road.

Figure 4: The satellite view of the same intersection, showing that the roads do not connect.

Possible Solution: GMM should consider adopt the same distinction that GMO uses, utilizing the Gestalt principal of closure to indicate when two roads do not intersect. If it is determined that this is not feasible on the small screen that GMM targets, then the GMM team should consider indicating a visual break or separation between the two roads at the intersection.

Figure 5: The same intersection in GMO, showing that the two roads do not intersect.

#	Issue	Priority	Heuristics Violated	Category
3	Variants of same color are used for different purposes	4	21	Memory

Explanation: Yellow color is used to represent roads on the map (as different from suggested navigable roads on the route in purple color.) However, another variant of yellow is used to indicate traffic overlays for particular portion of route. This is a clear instance of memory interference for a user, as (almost) same color is used to mean multiple things in different contexts. This problem becomes pronounced in bright sunlight when the screen luminance fails to distinguish colors.

Figure 6: Map background showing variants of yellow.

Possible Solutions: Use distinct and sufficiently contrasting colors to represent roads and traffic overlays on the roads. Alternatively, give users an option to disable surrounding roads (that are in yellow) but see only the navigable roads (that are in purple), and then let use contrasting yellow color for traffic overlays.

#	Issue	Priority	Heuristics Violated	Category
4	Low contrast, peripheral placement and overlapping with Loading Progress Box	3	1,3	Features

Explanation: The Loading Progress Box, which indicates that a data is being transferred to the application, has several problems. First, it is at the periphery of the screen, out of the main area of visual concentration. This can be confusing if a user sees that they system is hung up, but doesn't notice the feedback that they system is loading data. This problem is exacerbated by the fact that the loading box is dark blue, with black text that blends into it somewhat. Further complicating things is the fact that the box is placed directly below the Blackberry's blinking blue arrows, which also indicate data transmission. Since the arrows and the box are nearly identical in color, this possible fallback indicator, which makes good use of motion by blinking, is lost.

Figure 7: The blue of the progress box does not pop out form the screen, and sits behind the similarly colored Blackberry progress arrows.

Possible Solutions: Move progress box to center of screen. Use motion to indicate progress (See Figure 14 below.) Increase contrast between the box background and the map, and between the box text and the box background.

#	Issue	Priority	Heuristics Violated	Category
5	Links are nearly identical in color to text on results screen	3	2	Features

Explanation: On the Search Results and Details screens, linked text is navy blue, only slightly different in color and almost exactly the same saturation as unlinked text, which is black. This makes it very hard to visually discern, necessitating that the user scroll through all the text on a screen to distinguish between links (which show a blue bar when rolled over) and supporting text.

Figure 8: On a small screen, the black of the unlinked text is very close in color to the blue of the lined text (shown below the "Press # to see on map" line.)

Possible solutions: Increase the difference between the color of linked text and unlinked text. Consider underlining linked text, a common web convention that is used by many other mobile applications.

#	Issue	Priority	Heuristics Violated	Category
6	Inconsistency with user heading and map direction	3	7	Objects

Explanation: As mobile user navigates a route, GMM represent user's current location by a blue dot and their direction of travel with an adjacent blue arrow. However, GMM doesn't rotate the map to correspond to the user's heading direction. This forces users have to rotate the device themselves to make the map correspond to their direction of travel.

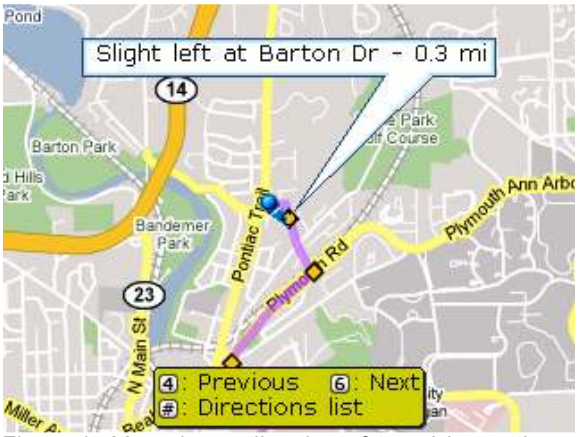

Figure 9: Map shows direction of travel by putting a blue arrow next to the blue dot, but doesn't turn when user turns and travels in that direction

Proposed Solution: Incorporate an application setting that allows users to have the map automatically turn to match their direction of travel.

#	Issue	Priority	Heuristics Violated	Category
7	Too many color codes are used on the map background	3	19, 22	Memory

Explanation: Information about physical environment is presented using too many different colors. On a typical route, GMM uses more than 8 colors to represent different physical locations and/ or routes. For example, contours are in white, pale yellow, medium yellow, bright yellow, bright orange, purple, as well as in crossed-lines, and physical locations are in pink, green, blue, and dark blue. Worse yet, GMM also offers the option to overlay real-time traffic

information on the map, color coding area freeways and interstates to indicate traffic flow rates. This feature uses green, yellow, and dark red colors to indicate the levels of traffic flow, as well as white to indicate where no data is currently available. Clearly, too many color codes clutter the relevant information and become an overload on users' working memory. Specifically, new users face a hard time in figuring out the meanings of colors. Furthermore, even returning users have to exert significant amount of effort in re-learning to distinguish meanings of different colors.

Figure 10: Map background showing numerous color codes [Note: Traffic overlay screenshot was not available]

Proposed Solutions: Maximize data-ink and minimize non-data ink. In other words, use minimum and uniform colors irrespective of variety of physical elements in the background, and reserve bold and bright colors for actual route information. Occasionally use other colors for displaying relevant contextual information.

#	Issue	Priority	Heuristics Violated	Category
8	Lack of visual, contextual information of landmarks	3	18, 20	Memory

Explanation: GMM does not take advantage of user's pre-existing knowledge of the physical world. For instance, if a user were given visual icons of a famous landmark, that he/ she is already aware of, then he/ she would not need to read further complex instructions or route drawings to interpret the route on the map. Due to the lack of such visual aids, user constantly searches for the right clues in the both in the physical environment and on the map. This is also a clear instance of underutilizing users' recognition abilities.

Possible Solutions: Include visual icons of famous landmarks. Alternatively, give instructions in the form of "When you take a left on this street, you will see FBI building. You need to pass this building and then take a second left on this street."

#	Issue	Priority	Heuristics Violated	Category
9	Key commands box is on periphery, changes without indication, text has low contrast	2	1, 2 ,4	Features

Explanation: The Key Commands Box, at the bottom of the Favorites, Routes and Search Results pages, indicates to users which keys are mapped to which actions for a particular screen. Since using key commands is saves time by minimizing the number of clicks and saccades a user must make to achieve a goal, this information should be easy to see.

Placement on the periphery of the screen makes sense, since this box should not cover salient map information. However, combined with the fact that the box is a drab, de-saturated color upon which text does not stand out, it can be hard to extract information from it at a glance. Furthermore, the contents of this box change from screen-to-screen and action-to-action. Sometimes the box changes shape, indicating a change; however, when the box stays the same and only the contents change, this can be hard to notice.

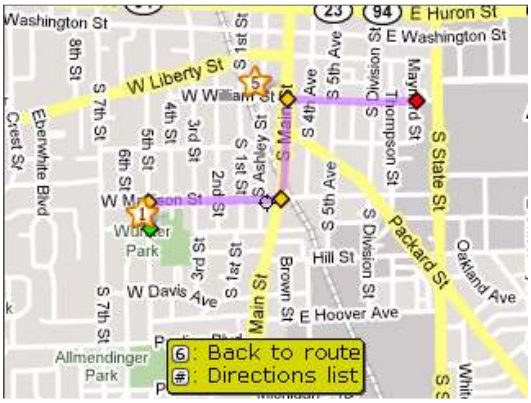

Figure 11: There is no visual cue when the (low contrast) contents of the key commands box change.

Possible Solutions: Slightly increase the contrast of the text on the box background, but not dramatically. Indicate change of contents by using a flash when menus change, or a wipe-and-replace motion.

#	Issue	Priority	Heuristics Violated	Category
10	Favorite stars are hard to see	2	1	Features

Explanation: Favorite stars are white with a thin orange border, making them somewhat hard to distinguish against the de-saturated background of the map view. This minor problem is made more serious by the fact that the placement of a star on the map is the only feedback one gets that a favorite has been successfully saved.

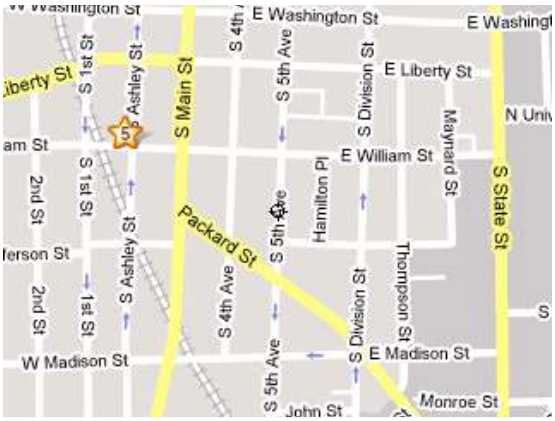

Figure 12: Favorite stars tend to blend into map view backgrounds due to similar colors and saturation levels.

Possible solutions: Use a color that has higher contrast with the map view to increase pop out. Make the star blink a few times when a favorite is saved to call attention to the success of this action.

#	Issue	Priority	Heuristics Violated	Category
11	Feedback about data transfer has no meaning to users	2	7	Objects

Explanation: The existing data transfer feedback only displays how much data is has loaded in the current transaction; it does not inform users what percentage of the total data this number is, nor how much is remaining. In the absence of this contextual information, the number has no meaning to users.

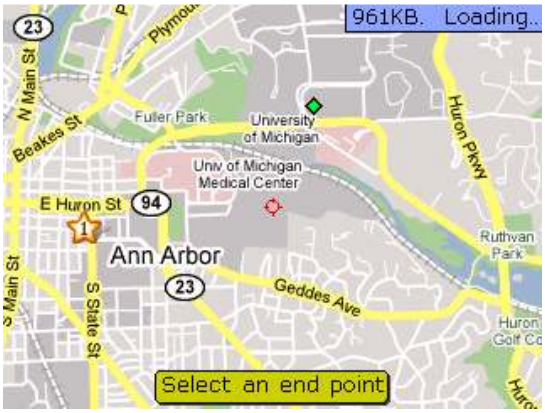

Figure 13: The data transfer feedback box only displays how much data has been loaded, not what portion of the total data to be loaded.

Possible Solutions: Show data loading as a fraction or percentage of total data to be loaded

Figure 14: Wireframe of a suggested dialogue box showing the amount of data loaded.

#	Issue	Priority	Heuristics Violated	Category
12	Star button is inconsistent in behavior	2	6	Objects

Explanation: The star button allows users to access their favorite address list from most screens. This is beneficial in that it helps users create mental map of menu options for the entire interface. However, this consistency is undermined by the fact that in the Favorites List screen only, the star button's function changes to dropping a favorite on the map. This exception violates the consistency of objects.

Possible Solutions: Assign another button the function of dropping a favorite on the map on the Favorites List screen.

#	Issue	Priority	Heuristics Violated	Category
13	It is difficult to identify and follow roads when using view traffic	2	10, 11	Gestalt

Explanation: GMM offers the option to overlay real-time traffic information on the map, color coding area freeways and interstates to indicate flow rates. This feature uses green, yellow, and dark red to indicate the levels of traffic flow, as well as white to indicate where no data is currently available. However, the issue is that overlaying traffic information on a road destroys the continuity of the road, thus making it difficult to follow the actual course of the road.

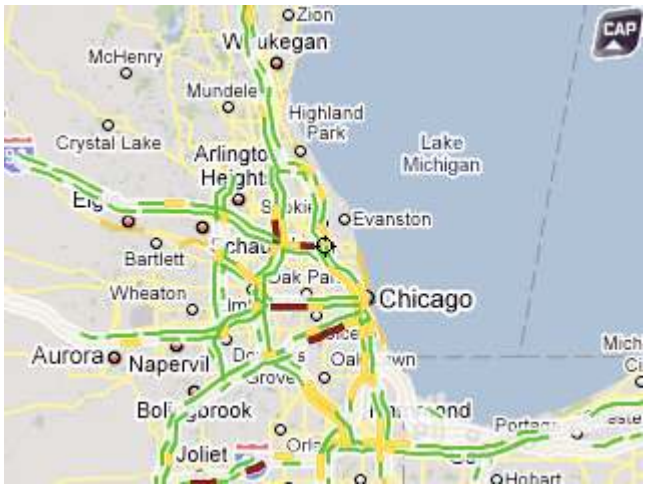

Figure 15: A view of Chicago, showing the real-time traffic information over-layed on area freeways.

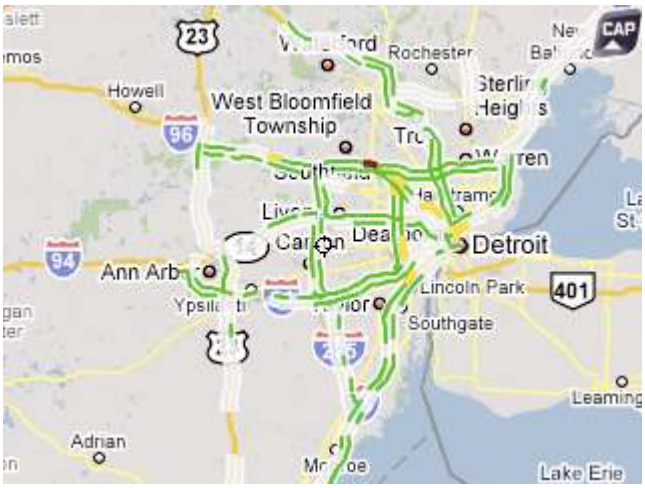

Figure 16: A similar view of Detroit, showing real-time traffic information

Possible Solutions: One possible solution would be to make the original road lines wider when overlaying traffic information so that they can still be seen underneath the traffic overlay. This would restore the Gestalt principal of continuity so that the user can still discern the course of each road.

#	Issue	Priority	Heuristics Violated	Category
14	Middle-of-route searching is not supported	2	14, 15, 16	Memory

Explanation: When a user is traversing though a route, the GMM interface does provide 'Search' button perennially. But, in the middle of the task, the search button does let the user search for a recently searched location unless the user saved it as a favorite. Furthermore, even the use of favorites provides access to recent searches (start and end point) but not recent directions/ routes, which is what the user is more interested to see while not getting too much distracted from the other task.

Possible Solutions: Store recently accessed routes in the session memory or usage history, so that users can access them whenever they needs regardless of whether they saved it as a favorite or not. Support random route search from the middle of main activity (such as route traversing.)

#	Issue	Priority	Heuristics Violated	Category
15	Re-routing in the middle of route is not possible	2	16, 17	Memory

Explanation: If a user strays from the route, he needs to remember the route to the last correct point he passed. Access to the route list is provided, but unless the user travels back to the last correct point, there is no way that the lost user, who is unaware of his current location, can find a new route to his destination.

Possible Solutions: detect user's current precarious location, and provide one-touch option to re-route towards the destination.

#	Issue	Priority	Heuristics Violated	Category
16	Waypoint markers do not appear connected to the route	1	9, 10	Gestalt

Explanation: The markers that indicate turns in the route are larger than the route highlight line and do not appear to be a part of the route line itself. This could cause confusion where the user is not aware that the markers represent information relevant to their task of following a route.

Figure 17: Small orange diamonds are used to show the turning point in a route.

Possible Solutions: These markers should be changed to visually indicate that they are continuous with the route highlight line. This can be done by changing the color to better match the route highlight line and by making the markers slightly smaller so that appear to be part of the route. This would utilize the Gestalt principal of continuity.

#	Issue	Priority	Heuristics Violated	Category
17	City labels are occasionally not proximate to city location	1	8	Gestalt

Explanation: As the zoom level of the map changes, GMM employs an algorithm to place city markers. At closer zoom levels, these markers are simply the city name placed on the city's approximate location. At more distant zoom levels, these markers consist of both a red dot and a city name label. In this case, GMM places the labels in various spots relative to the city location dot, presumably to avoid overlap in the labels.

The problem arises when these city labels are placed in such a way that it is not visually obvious which red dot they are associated with. This is because the Gestalt principal of proximity is not properly utilized; however, this may be due to the aforementioned label layout concerns. The figure below shows how it is difficult to locate South Bend, IN, and it is not immediately clear which red dot represents Naperville, IL and which represents Aurora, IL.

Figure 18: A map of the cities surrounding Chicago land. At this zoom level, cities are indicating as red dots. Notice how it is difficult to located the city of South Bend, IN

Possible Solutions: When showing a city location as both a red dot and a label, GMM should use a line or other visual indicator in order to show which dot each label is associated with. This would enable them to continue avoiding label overlap, but should make it possible to continue avoiding label overlap.

5. SUMMARY

This visual analysis identified seventeen issues pertaining to a) Features, b) Objects, c) Gestalt principles, and d) memory. In the order, the most severe of them are:

1. Crosshairs on map are nearly invisible
2. Road intersections are not clearly differentiated
3. Variants of same color are used for different purposes
4. Low contrast, peripheral placement and overlapping with Loading Progress Box
5. Links are nearly identical in color to text on results screen

6. Inconsistency between user direction and map direction
7. Too many color codes are used on the map background
8. Lack of visual, contextual information of landmarks

These problems, when addressed by developers, will greatly improve the visual design of GMM. This study also assisted us in developing deeper and broader understanding of the mobile mapping applications in general. If applied meticulously, this understanding will not only assist the development process, but also help in crafting more marketable, user-centered mobile mapping applications in future.

6. CITATIONS

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