

HCI Guidelines:

Overview of Nielsen's Ten Heuristics and How to Conduct a Heuristic Evaluation

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HCI Guidelines: Nielsen's Ten Heuristics

Learning Objectives:

- Here we will introduce another set of well known interface design guidelines proposed by Jacob Nielsen.
- Their application to specific situations like a web site will be discussed in the background of User Centered Designing framework.

Introduction

Jakob Nielsen* (working along with Molich in 1990) proposed a set of ten guidelines that can be used as Principles of Design for a new Interface. These guidelines can also be used as Heuristics for evaluating an Interface.

Since these ten guidelines were more in the spirit of “Rules of Thumbs” than the specific rules, they are referred to as ‘Heuristics’ rather than rules or laws that hold true in every case.

A heuristic is an approach to problem solving or self discovery that employs a practical method that does not guarantee an optimal, perfect or rational solution, but produces a near optimal or an approximate or a short-term solution. Thus, **heuristics** can be mental shortcuts that ease the cognitive load of making a decision. **Examples** that employ **heuristics** include using a trial and error method, a rule of thumb or an educated guess.

Heuristics in AI: A **heuristic** function, also called simply a **heuristic**, is a function that ranks alternatives in search algorithms at each branching step based on the available information to decide which branch to follow. For example, it may approximate the exact solution.



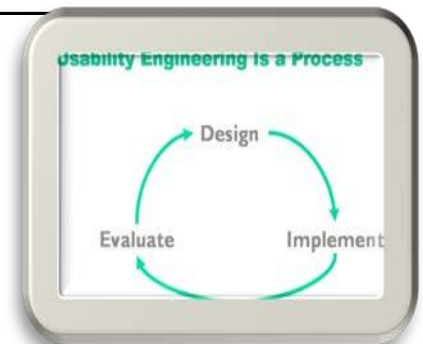
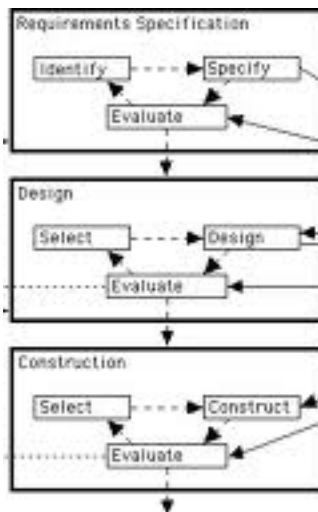
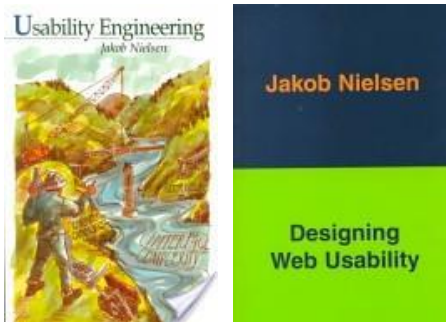
Jakob Nielsen

Jakob Nielsen is a leading web **usability consultant**. He holds a Ph.D. in human–computer interaction from the Technical University of Denmark in Copenhagen.

He has authored many books in Usability, HCI, and Experience Design. His book titled “Usability Engineering” 1993 is a textbook on methods to make interfaces easier to use.

Usability Engineering involves User Research; Design Research and Validation of Design through Construction & User Testing.

In some institutions it is taught as an independent discipline while in others it is part of HCI discipline.



Introduction

Heuristics means “Rules of the Thumb”.

These Ten ‘Rules of the Thumb’ were derived after careful research by Nielsen who after conducting a factor analysis of 249 usability problems, came up with ten simply stated guidelines in 1994.

Nielsen’s heuristics are empirically based derivations. Widely used by Usability professionals (which includes Interface designers), they are a means of quickly identifying likely interface design problems in an application.

Method suggested by Nielsen is popular because of its simplicity and low cost. It is preferred evaluation technique at the preliminary design stages by the HCI professional.

Nielsen's Ten Heuristics

- 1. Visibility of system status**
- 2. Match between system and the real world**
- 3. User control and freedom**
- 4. Consistency and standards**
- 5. Error prevention**
- 6. Recognition rather than recall**
- 7. Flexibility and efficiency of use**
- 8. Aesthetic and minimalist design**
- 9. Help users recognize, diagnose, and recover from errors**
- 10. Provision of Help and documentation**

Each principle will be explained in the following slides.

Visibility of system status

Users need to be kept informed by the system about what is going on, through appropriate feedback within reasonable time.

Elaboration: This means the user needs to be constantly made aware of his/her interaction with the interface while interacting. The control response ratio (input – output time) need to be as small as possible. Any interface needs to communicate that it is in a ready state to be operated upon – at the start of an interaction cycle.

For example :

A glowing LED / flashing element indicating that the interface is live.

An animated symbol that states that 'saving' act is going on.....



Most important to users is to know "Where am I?" and "Where can I go next?" Internal reference is a must to feel in control.



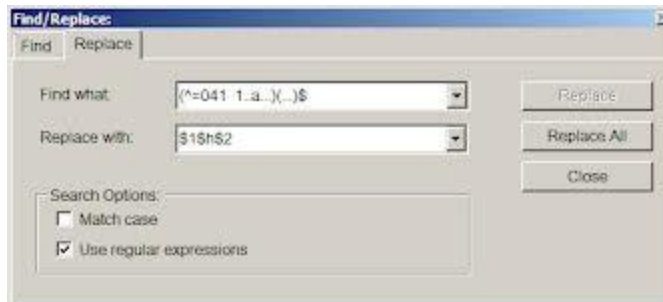
Match between system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

Elaboration: Technical jargon or using terms like 'Initiate' or 'Load' in place of 'Start' contributes to initial mismatch between the users cognitive process and machines feed back dialogue.

An interface need to allow smooth transition from contextual 'reality' world to artificial machine world.in other words from ' reality' to 'digitality'.

Tendency to use programming language and syntax on the display, while understandable to the software programmer, will certainly be a mismatch to a user.



Users can come from different backgrounds, skills levels , specializations & culture.

The context on the screen needs to match with the context of the user's mental model

User control and freedom

Users often choose system functions which they did not want. (Mouse click due to haste). This calls for Support undo and redo.

A user need to go through tracing too many steps back to regain control.

Elaboration: Sequential thought process in a user that follows a simple everyday human habit need to be reflected in the dialogue between the device and the user. A good interface facilitates this.

Being in control implies that one can choose to stop interacting an time rather than be forced or trapped by the interface into inaction.

Feeling in the user that he/she is in control at all times must be created. If the user attempts to gain control and if a message like 404 error occurs the systems is unfriendly & unhelpful !



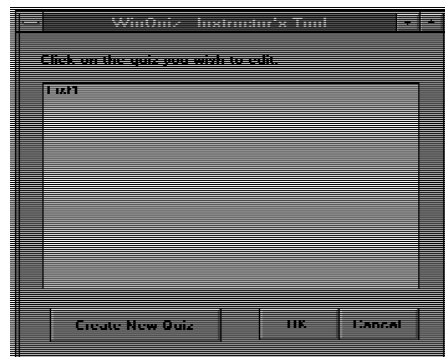
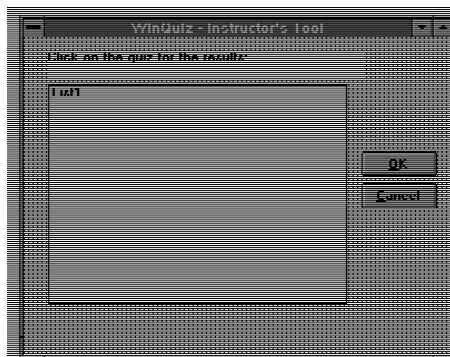
Can users select and sequence tasks? Can they easily re- turn to where they were if they choose an inappropriate /action path? The first example “accuses ‘ them of committing an error. The second one is much better but does not tell the user what to do next ! The third example is inappropriate!

Consistency and standards

Using different words to mean the same action or using different symbols on different pages can be confusing to the user. Users should not have to wonder whether different words, situations, or actions mean the same thing. They should not be in doubt as to what to do next.

Elaboration: Within an interface if multiple words or actions are used to mean the same thing, it only leads to confusion in the user due to perceived lack of consistency. Interaction pattern gets disrupted. When pattern becomes complex, user's cognitive load increases.

Consistency in dialogue as well as in visual elements is achieved by specifying and adhering to a dictionary of words / labels/ symbols/ colors which together form a 'standard' – a prescribed set – compulsorily to be followed.

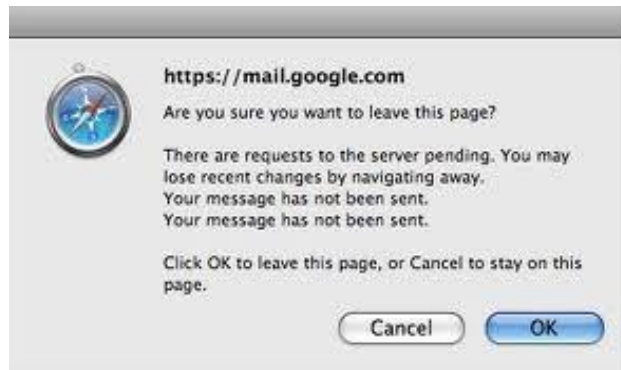


Inconsistent wording & windows / buttons can confuse users when the destination page has a different title from the link. The two screens belong to the same software but appear differently at different places within the website.

Error prevention

By research it is possible to pinpoint the typical errors that users normally tend to commit. Prevention of error is the best approach. However recovery from error prone actions through a well designed error message should be adopted.

Elaboration : To err is human. Errors can happen regardless the level of expertise of the user or familiarity of the interface. A good principle of design is to seek out error prone interactions, build in error prevention within the dialogue. Forewarning, restricting, prompting, retracing or recovery routes, etc. are means of addressing errors. Errors lead to a situation wherein users feel subdued by a machine. Anticipating for errors and incorporating preventive measures ensures fear free and ego free user thereby giving importance to 'H' in HCI through 'I'



GUI-style widgets cut down on the errors but may still have to be double checked before confirmation

Recognition rather than recall

*Loading the STM- short term memory of the user beyond a limit has negative consequences. Given a navigation path, a user need not have to remember or recall all the instructions. Users are better at **recognising** things they have previously experienced. Prompts, visibility, sequential direction, pop-ups etc. should come to the aid of the user. Help needs to be easily retrievable.*

Elaboration : Reduction on cognitive load during the interaction ensures that the user is not asked to rely on means and methods that extract human cost. If an interface requires specialized training and use of memory to operate - it will be quickly abandoned by the user. Analogy, metaphor, symbols, sounds, etc. are used as design elements in an interface to ease recall thereby eliminating the need for 'thinking while interacting' and memory loads for the user.



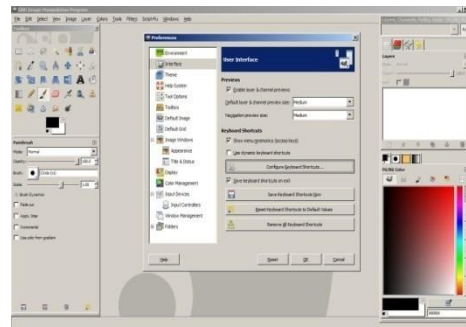
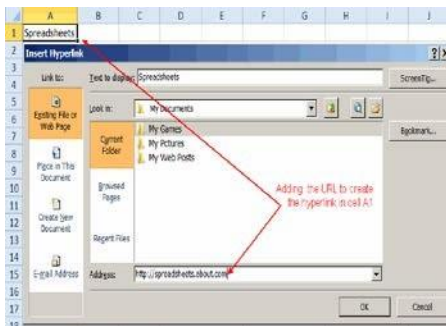
Good labels and descriptive links are crucial for recognition.

The first two icons are difficult to recognise or to recall. The third helps the user recognise where they are and recall which file is currently open.

Flexibility and efficiency of use

The system can cater to both inexperienced and experienced users. As the user becomes proficient - shortcuts can be encouraged. Thereby increasing the efficiency. Allowing the rearranging of the screen elements by the user can also be adopted.

Elaboration : Once a user becomes adept at using an interface, he/she upgrades into a higher level user from a novice. Such users will always seek to complete the task faster. Such users seek out shortcuts. An interface need to allow this. It needs to be flexible and make it possible for the user to adopt quicker dialogues through shortcuts. The user feels efficient as well as proficient. The feeling of having mastered the software is a flexible sign of being in control thereby.



Advanced users can opt for shortcuts in the spreadsheet example in the first picture.

Flexibility of keeping the required buttons / sections in view or hiding them gives the option to the user to rearrange GUI as needed as shown in the second picture.

Aesthetic and minimalist design

Relevancy, simplicity, minimum amount of labels, uncluttered graphics result in efficient communication dialogue between the user and the interface. All unnecessary superfluous elements need to be dropped.

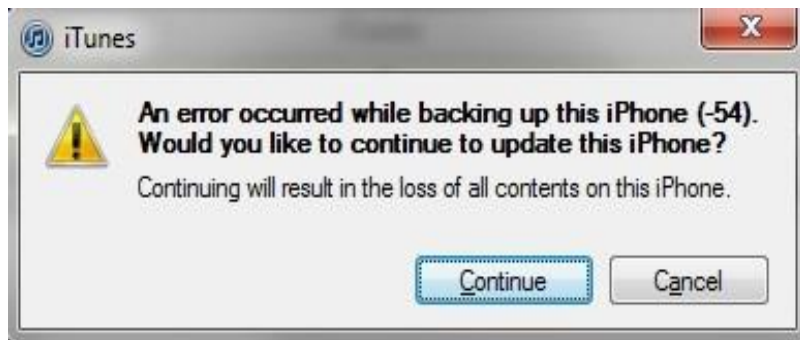
Elaboration : Visual clutter in the interface only adds to inefficiency however impressive it is visually. Simplicity is equal to efficiency is equal to elegance is equal to beauty is the aesthetic algorithm in minimalism. Use of least number of elements (minimalism) is more 'scientific' rather than 'artistic'. **Visual noise needs to be completely eliminated.**



Help users recognize, diagnose & recover from errors

Preventing a user who is about to make a error would be a good approach. Gentle wording of error messages, constructive suggestions, reeducating the user- all can contribute to a happy self confident user who is not afraid of being caught unawares or penalized.

Elaboration : No body likes to be loudly informed that he/ she has erred. Error messages need to be disused as suggestions / prompts and precise instructions so as to be able to correct the error and recover. The learning component in errors so that the user recognizes the error as it is being made, or recognizes the reason why the error happened in the first place – helps the user learn.



There is no way to understand the consequences of canceling. The onus seems to be on the user who will be held responsible for what ever is opted for. proper diagnosis & how to possibly recover is not clear. Very unfriendly interface./

Help and documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Help quarries need to be answered promptly without the user having to go through an elaborate eliminating list.

Elaboration : This again is to assist the user *learn* and understand the dialogue between the user and the machine or understand - where what went wrong - or aid recall during memory-lapses due to long usage time gaps. Adequate 'Help' support system when the user wants and at the point where the user wants it - is a good principle of Interface design.



The screen shots (1&2) attempt to Train the user by offering information on the consequences of their decision

Conclusions:

- These ten heuristics of usability help in refining a potential design into a good design. These ten principles will ensure that interfaces evolve in the right direction.
- These rules of the thumb act a check list to evaluate a design.
- They also can be used as check list while evaluating any GUI.

Assignment:

You are asked to choose any Interface of a device or a website and conduct an audit to identify where the Nielsen's ten rules have been (i) adhered to (ii) not adhered to.

Further, you are asked to suggest relevant corrections.

HCI Guidelines: How to Conduct a Heuristic Evaluation

Learning Objectives:

To understand the process of evaluation using the Nielsen's ten principles of Heuristics.

To employ the Nielsen's ten principles for evaluating an interface.

Introduction

Heuristics evaluation is a systematic process of inspection of a user interface for usability problems. It is both- “before design finalisation’ predictive method - as well as an ‘after design ‘ evaluation and rating method.

The goal of heuristic evaluation is to find the usability problems in design so that they can be attended to, as an integral part of iterative design processes.

Heuristic evaluation method involves having a small set of evaluators (5 to 7) examine the interface and judge its compliance with recognized usability principles such as Nielsen’s ten Usability principles.

Nielsen's Ten Heuristic Principles

- Visibility of System status
- Match between system & real world
- User control & freedom
- Consistency & standards
- Error prevention
- Recognition rather than Recall
- Flexibility & efficiency of use
- Aesthetic & minimalist design
- Help, diagnosis & recovery from errors
- Documentation & Help

Nielsen's ten points aid as a check list for the heuristic evaluator to audit a interface/application/product.

According to Nielsen the ten points help in identifying and explaining problems. Other researchers have added to the above list of principles.

A frame work of Usability principles is also used for conducting the heuristic evaluation.

Heuristic evaluation is performed by having each individual evaluator inspect the interface alone.

Only after all evaluations have been completed are the evaluators allowed to exchange & discuss and have their findings aggregated. This procedure is important in order to ensure independent and unbiased evaluations from each evaluator.

The results of the evaluation can be recorded either as written reports from each evaluator or by having the evaluators verbalize their comments to an observer as they go through the interface.

Heuristic reviews are less expensive and less time consuming to conduct.

Heuristic evaluation can be accomplished using only a simulation prototype or mock up as a complete finished product is not necessary. Even wireframes suffice.

Examples of how Heuristics analysis is conducted are presented in the following slides

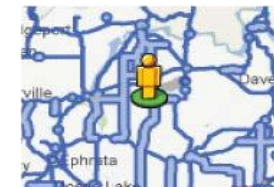
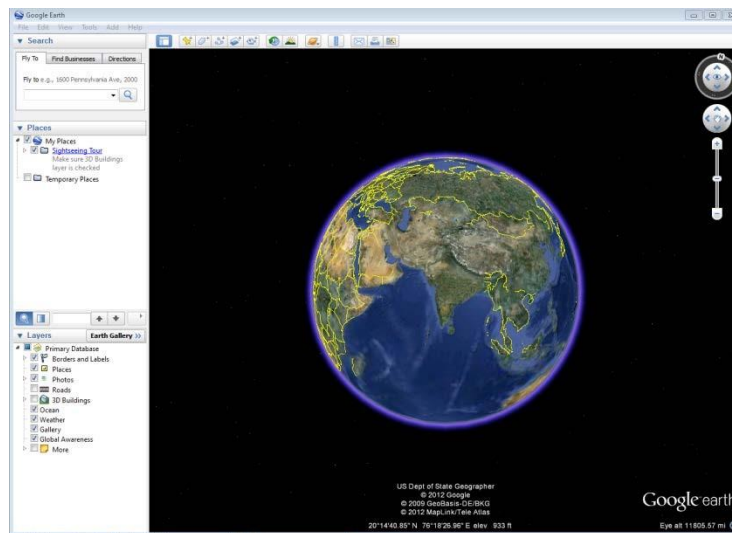
Case Study 1 **GOOGLE MAPS** in Goggle Earth

Evaluator: Expert user

Heuristics Used: Nielsen's Ten Heuristics

Google Maps is a well known free service provided by Google world wide.

It's not just a bunch of maps, it includes multiple layers: roads, terrain, satellite, street view, traffic etc. It also integrates user ratings and pictures with locations and businesses in the area.

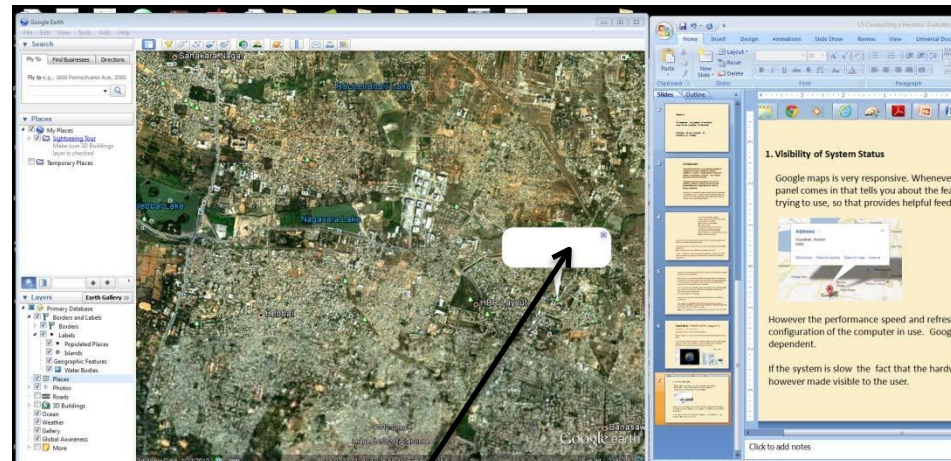


Controls & Views

1. Visibility of System Status

Findings of the expert on visibility & status capability of Google earth is explained bellow

“Google maps is very responsive. Whenever you click a button, a panel comes in and tells you about the feature that you're trying to use, so that it provides the helpful feedback.”

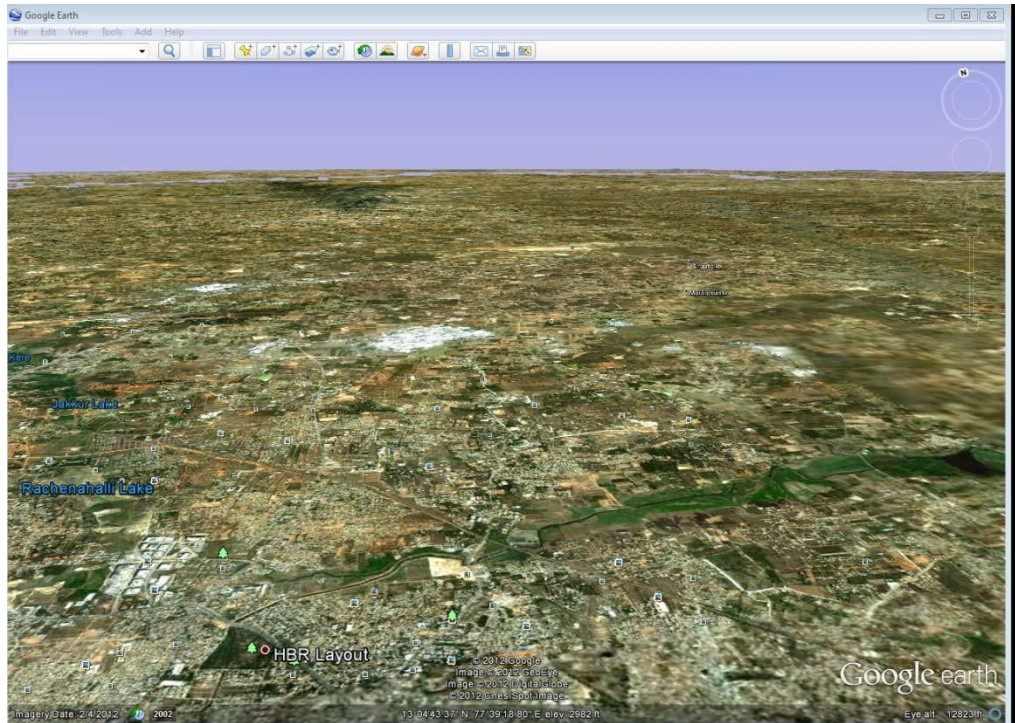


“System status if the Network connection is absent or suddenly is lost is not made visible to the user. The user sees a blank label” (second screen shot)

“However the performance speed and refresh rate depends on the hardware configuration of computer in use. Google is very CPU intensive and RAM dependent.

If the system is slow due to hardware mismatch this fact that the hardware is not optimum - is not however made visible to the user“.

2. Match between System and Real-World



Closeness to Real-world is very good.

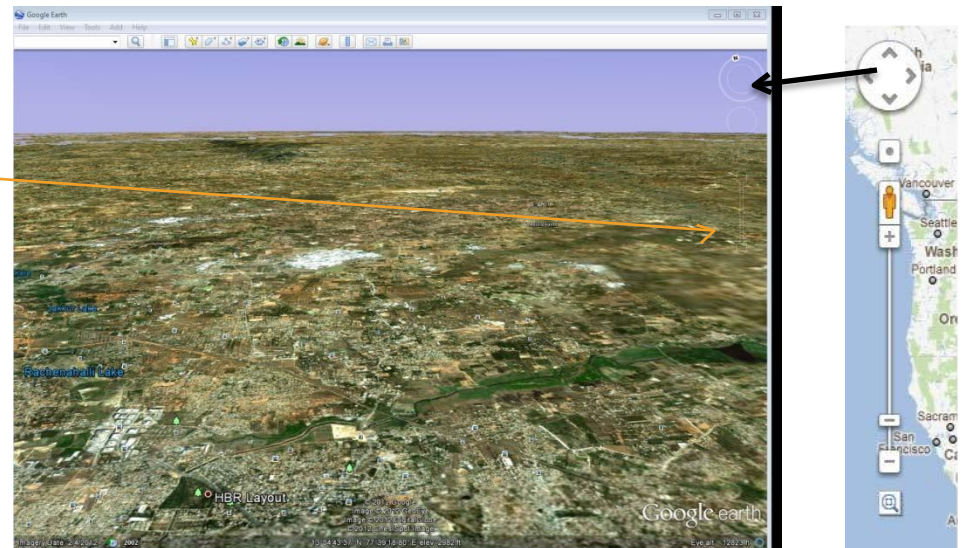
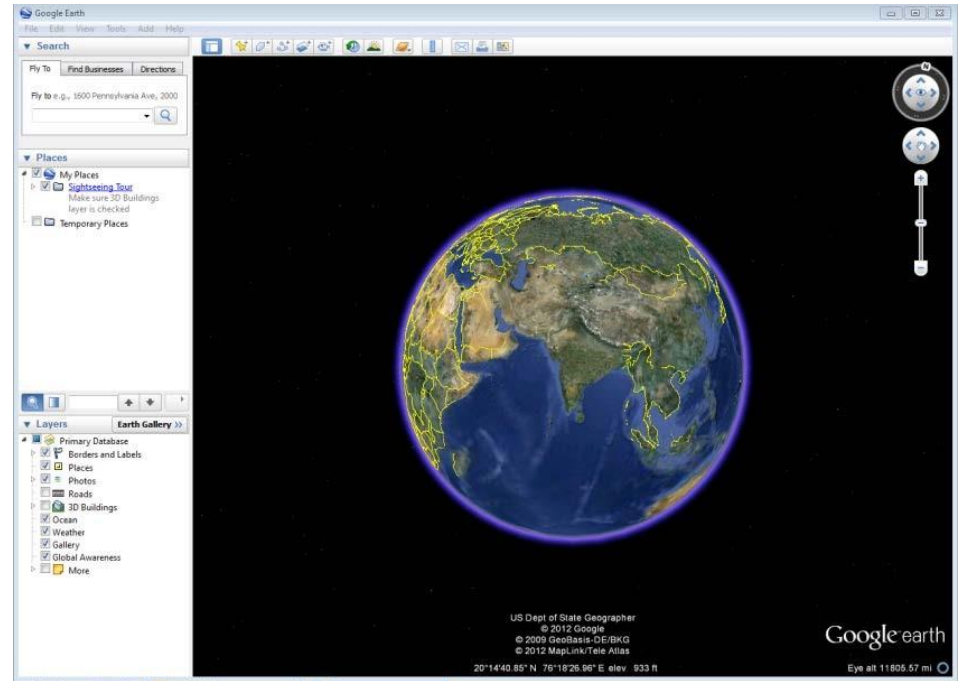
The window can be panned and horizon can be lowered giving a very Real-world view.

3. User Control and Freedom

Almost all the features are available as checkboxes. When they are checked, those items are added to the map and when they're not checked they go right back off the map.

The zoom in controls are fairly intuitive. They recede into the background and come alive when mouse hovers on it. The direction ring gives full control to the user.

Freedom for the experienced user but for a novice a disappearing zoom slider bar can be confusing!



4. Consistency and Standards

Google maps is pretty consistent with the words and phrases that they use.

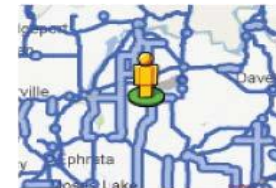
the symbols are pretty clear and a user could probably figure it out without even needing the labels.

Successive screens maintain consistency in continuity in terms of how & where tools / buttons appear.

The response of various interactions is standardized across the entire application.



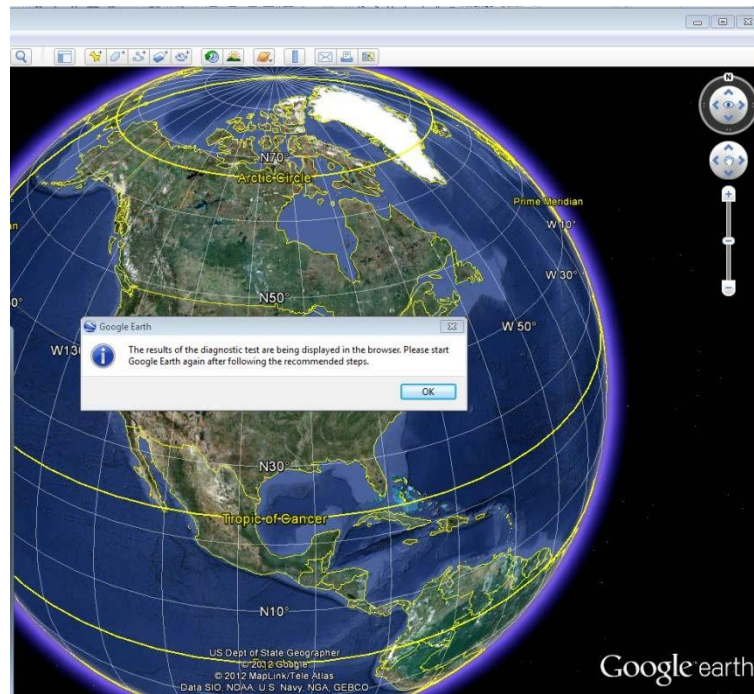
Controls & views



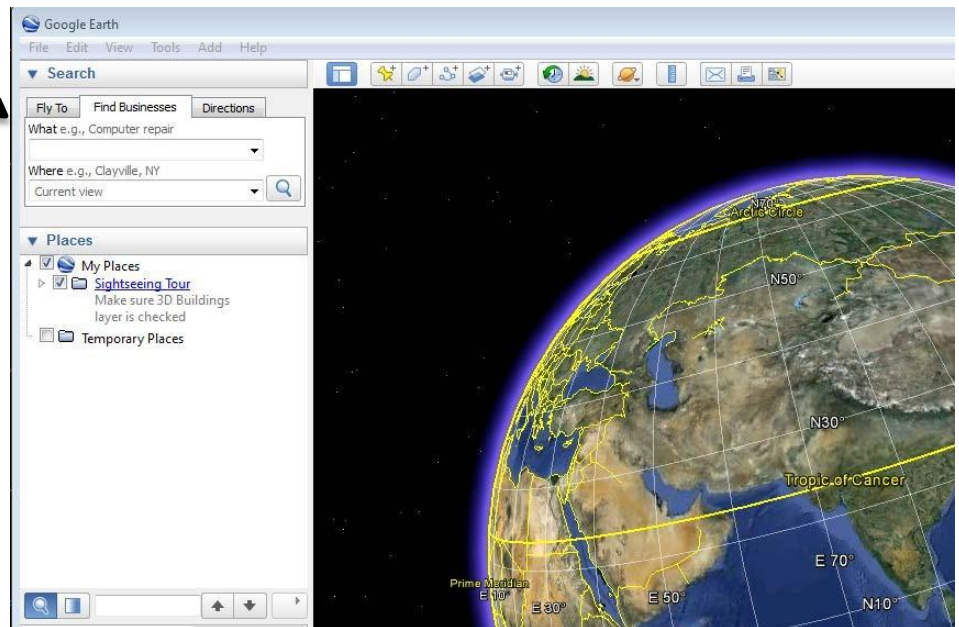
5. Error Prevention

There really isn't much error involved in a mapping program.

There is a possibility that a user may enter the wrong address, but Google maps is well configured to automatically decipher what the user may have been looking for and presents them with a list of options that could be correct.



This not only prevents accidental errors but also suggest corrections for the user.



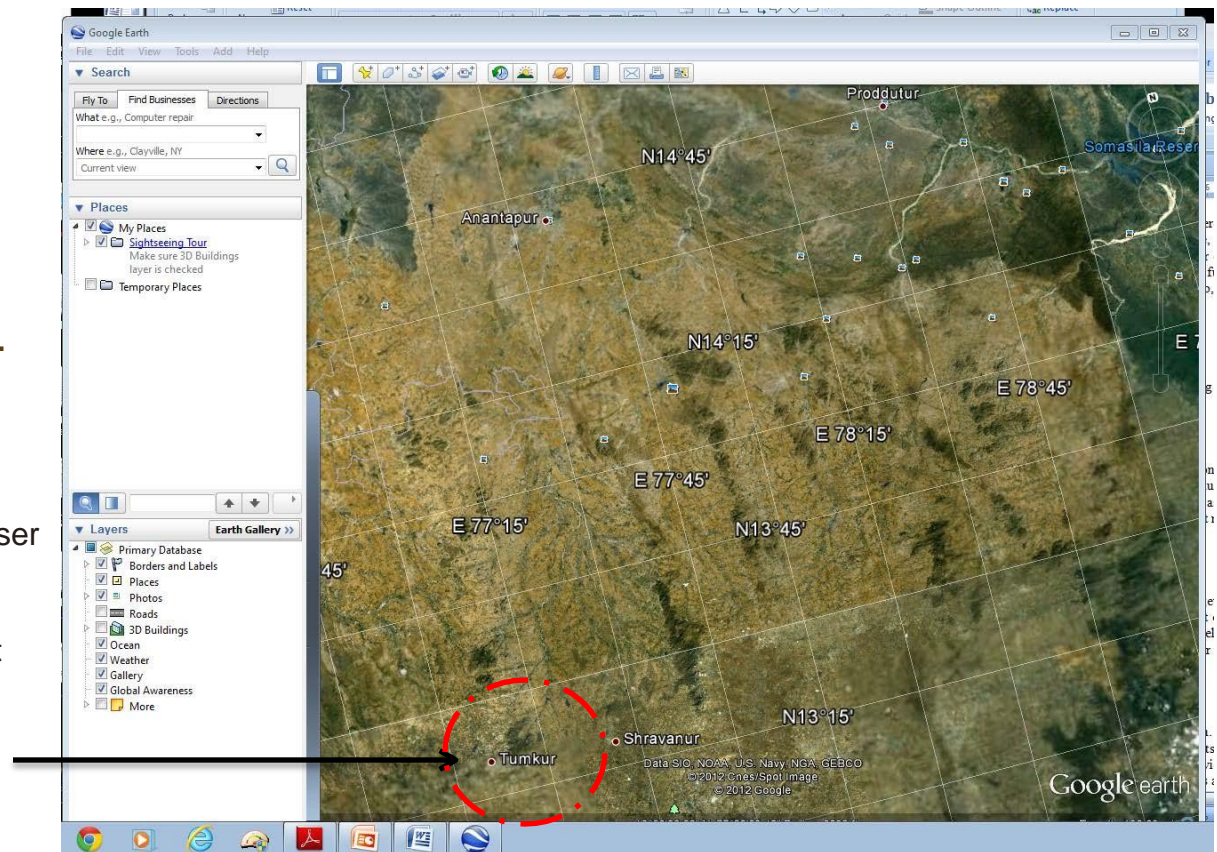
6. Recognition Rather than Recall

While most of the more useful functions are visible, but a user must click a button to get directions.

Navigating by panning and zooming often leads to being lost. Users often want to know which direction they need to pan.

Ex: On the right TUMKUR is visible. For a user to now go to BANGALURU & (if the user is not sure where Bangalore is with respect to Tumkur - East, West, North, South) or is not familiar with the latitude - longitude of Bangalore – will have to recall or

recognise or resort to trial and error by first zooming out. Zooming out also leads to disappearing of small towns like Tumkur -. At lower zoom levels the user will have to 'RECAL' which is not an easy thing to do on a map of an unfamiliar geography.



It is here that recall is required or in order to become aware (recognize) where in the map one is with respect to overall map.

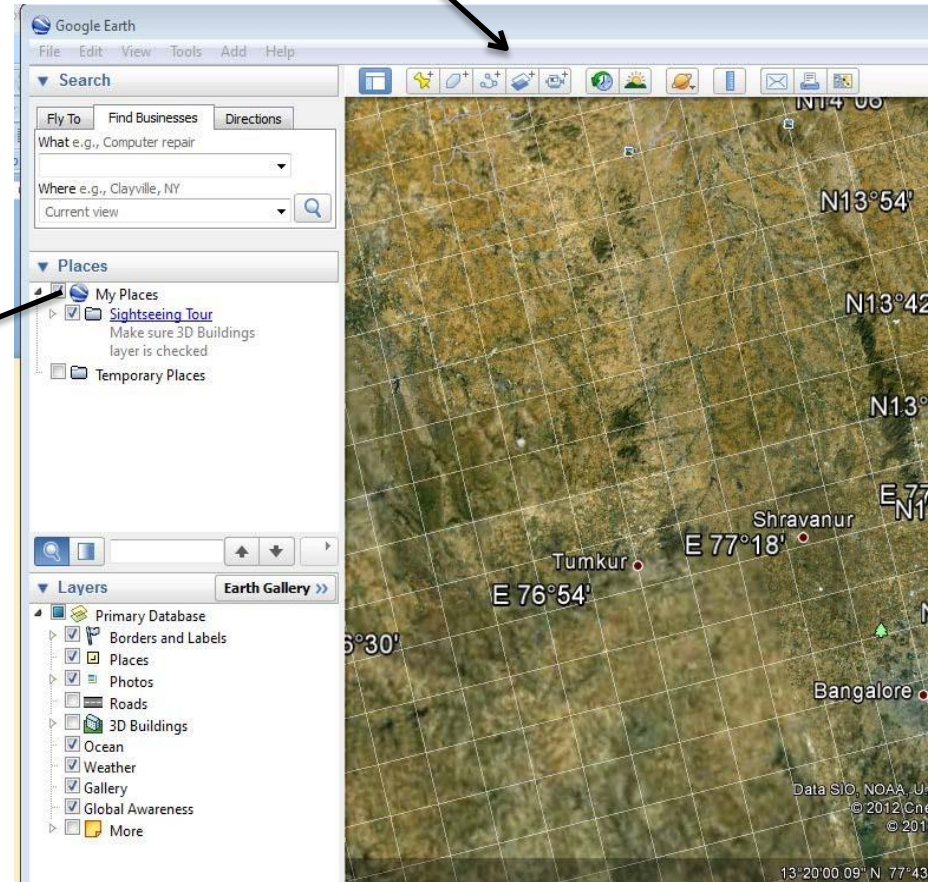
7. Flexibility and Efficiency of Use

The Google Earth is highly flexible & efficient. Even if a GPS connection is not available

A user can set a reference location “starting point” and also key in where one wants to go –

The software map navigates itself by either panning, zooming, turning, and makes the destination visible.

The buttons on the task bar reflect the flexibility that is built in.

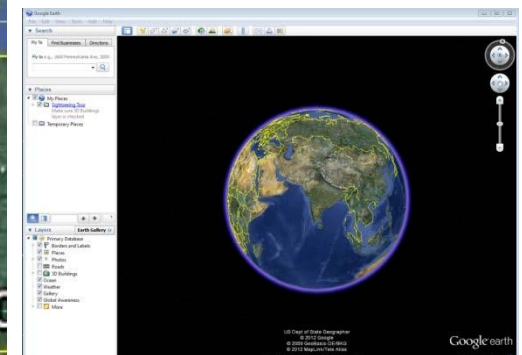
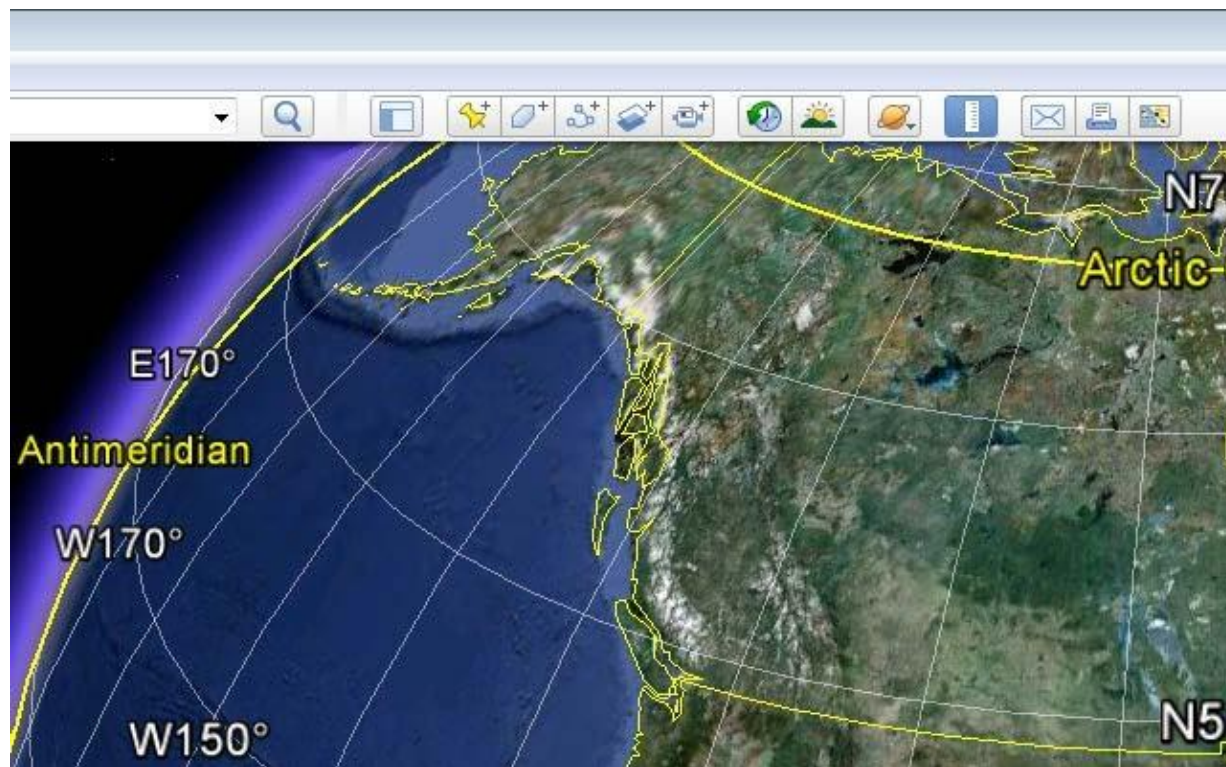


8. Aesthetic and Minimalist Design

The entire user experience is pleasant. The design of the interactive buttons is subdued and minimalist.

The colour tone of the labels, instructions etc. that appear are not loud and brash.

The whole graphics is tuned to make the Map window important (which is the main function of the software)

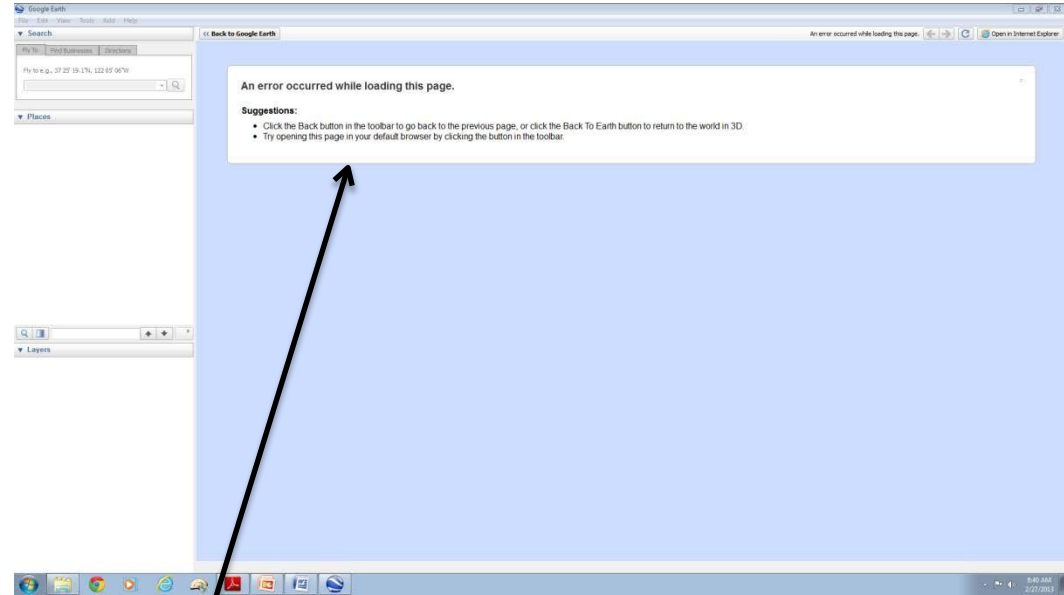


9. Help Users Recognize, Diagnose, and Recover from Errors

If a user enters an address that is not in the maps database, Google maps will suggest alternatives to help the user figure out the correct address they are looking for.

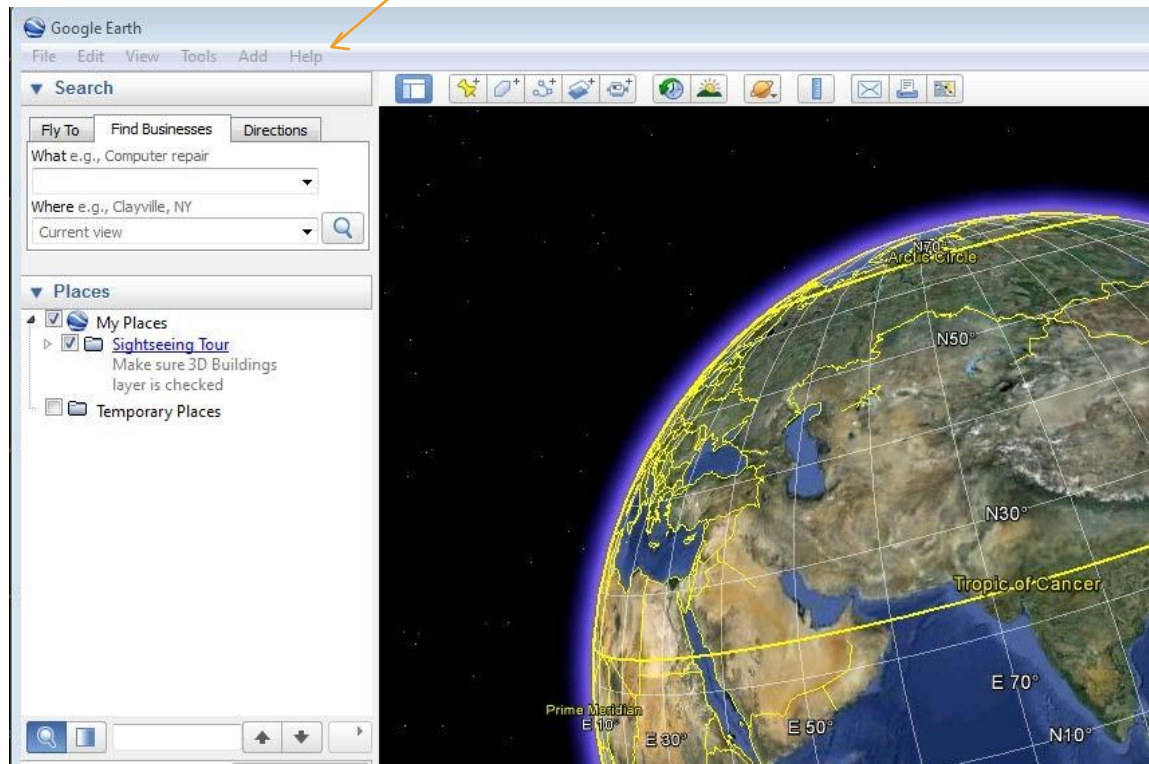
The software is user friendly.
It does not penalise the user for not knowing how to use the software.

Even if an error happens, the software recovers quickly without the user having to do much more than going back to a previous screen by pressing “Back” button.



10. Help and Documentation

In the Documentation under 'Help' it is easy to use and figure out where to find the information you're looking for.



Conclusion

The Heuristic evaluation is compiled into a consolidated report by including results of other evaluators.

Intensity of the problem may also be indicated in terms of severity.

High severity means it is a HCI problem.


Medium means the problem needs attention as it is partially resolved.

Low means improvement can still be done to the existing state.

Heuristics	Evaluator 1		Evaluator 2	Evaluator 3		Evaluator 4	
1. Visibility of System Status	System status if the Network connection is lost is absent	Severity: Medium					
2.Match between System and Real World	Good. No intervention required	NA					
3. User Control and Freedom	For a novice user disappearing zoom slider bar can be confusing!	Severity: Low					
4. Consistency & Standards	Good. No intervention required						
5. Error Prevention	Good. No intervention required						
6. Recognition Rather than Recall	Navigating by panning and zooming often leads to being lost. Direction of movement is required	Severity: HIGH					

Assignment:

For the same Google Earth application conduct a Heuristic evaluation for all ten Nielsen's heuristics and fill up the space under Evaluator 2 in the Table. What new aspects did you (expert) identify that the first evaluator did not?



Heuristics	Evaluator 1		Evaluator 2		Evaluator 3		Evaluator 4	
1. Visibility of System Status	System status if the Network connection is lost is absent	Severity: Medium						
2.								
3.								
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References:

- Molich, R., and Nielsen, J. (1990). Improving a human-computer dialogue, *Communications of the ACM* **33**, 3 (March), 338-348.
- Nielsen, J., and Molich, R. (1990). Heuristic evaluation of user interfaces, *Proc. ACM CHI'90 Conf.* (Seattle, WA, 1-5 April), 249- 256.
- Nielsen, J. (1994a). Enhancing the explanatory power of usability heuristics. *Proc. ACM CHI'94 Conf.* (Boston, MA, April 24-28), 152-158.
- Nielsen, J. (1994b). Heuristic evaluation. In Nielsen, J., and Mack, R.L. (Eds.), *Useability Inspection Methods*, John Wiley & Sons, New York, NY.
- The Ten Heuristics and description have been adapted from the authors publication. Copyright 2005 by Jakob Nielsen.