

Gim

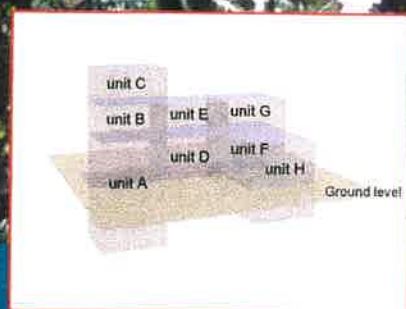
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Augmented Maps



Dynamic Map Handling

Mobile Navigation for a Broad Consumer's Market

Dynamic Map Handling

Current mobile phones have Internet capabilities by default. Region-wide low cost network access will soon be a reality everywhere mobile phones are in common use. This development enables mobile navigation for broad consumer use. The author sketches a mobile navigation scenario based on dynamic map handling and aimed at users wanting simply to find on their mobile device a map of their present location, without bothering how the map gets there.

By Dr Pasi Fränti, University of Joensuu, Finland

A general consumer is hardly interested in spending time and money buying and downloading maps and worrying about whether the maps will cover all the places he is visiting. He probably prefers ad hoc travelling and appreciates completely automatic map handling. This scenario is becoming possible due to two developments:

- ◆ Locations can be determined and updated in real-time about once or twice a second on a mobile device using a low cost positioning service (GPS or a Mobile Positioning Service)
- ◆ Compressed raster maps of the

environment – stored in a remote server – may be accessed and retrieved using location as search key. In addition, these maps can be rapidly transmitted by current wireless services and displayed on mobile device screens

Vector or Raster

Maps are widely available in raster, as well as vector formats. Vector maps may be displayed in any resolution and are thus convenient for zooming. Panning can be performed by retrieving neighbouring map blocks. How-

ever, mobile devices have limited computing and storage capacities and are thus unable to handle a complete Database Management System (DBMS). The use of vector data is thus impractical. In addition, maps are sometimes unavailable in vector format, while the various formats and incompatibility between different systems may restrict their use. On the other hand, current compression technologies allow efficient storage and transmission of raster maps via wireless networks. This means that when maps need only to be viewed at

Only modest memory and computing capacities are required

the mobile device, storage and map sheet generation in varying scales at the server side becomes a feasible solution (Figure 1). The DBMS may be located at the server side, whereas the client stores raster maps only when needed. The advantages of this approach are:

- ◆ It does not depend on any database or vector format, as raster maps can be easily generated and reproduced from any source format, including paper maps
- ◆ Only modest memory and computing capacities are required, allowing operation on a mobile device

Blocking and Compression

Maps can be stored in a compact way using existing compression methods, such as GIF and PNG. However, more compact storage is achieved by dividing the image into semantic binary layers and compressing the layers using context-based statistical modelling

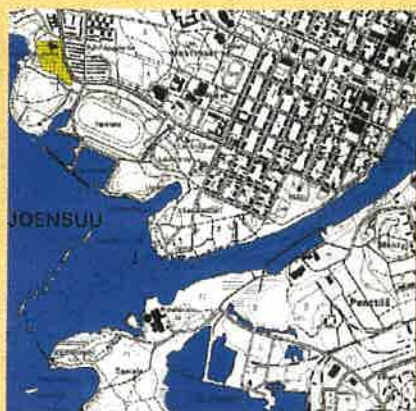


Figure 1, Two maps of different scale and type of use

the starting points of the code blocks. When the compressed map sheet is accessed, a block index table indicating the location of the block in the compressed file may be constructed. This provides direct access to the particular map sheet.

Dynamic Map Handling

Dynamic map handling means that map retrieval is invisible to the user; the device indicates the present location and makes a request to present the relevant map sheet on the display (Figure 3). This initiates a check of the

The current networks, such as GSM and GSRP, have enough bandwidth to handle this transmission in real-time. Essential operations are thus retrieval (insertion) and deletion of map sheets. In some applications the user may prioritise which maps he wants to preserve for further use and which can be removed because they will no longer be needed. A first approach involves insertion and deletion of maps occurring only at the explicit request of the user (static system). In a second approach the user has no control whatsoever over the maps. The maps just appear on

and arithmetical coding (Figure 2). This type of compression can be implemented using the latest international compression standards JBIG (Joint Bi-level Image Group) and JBIG2 when suitable

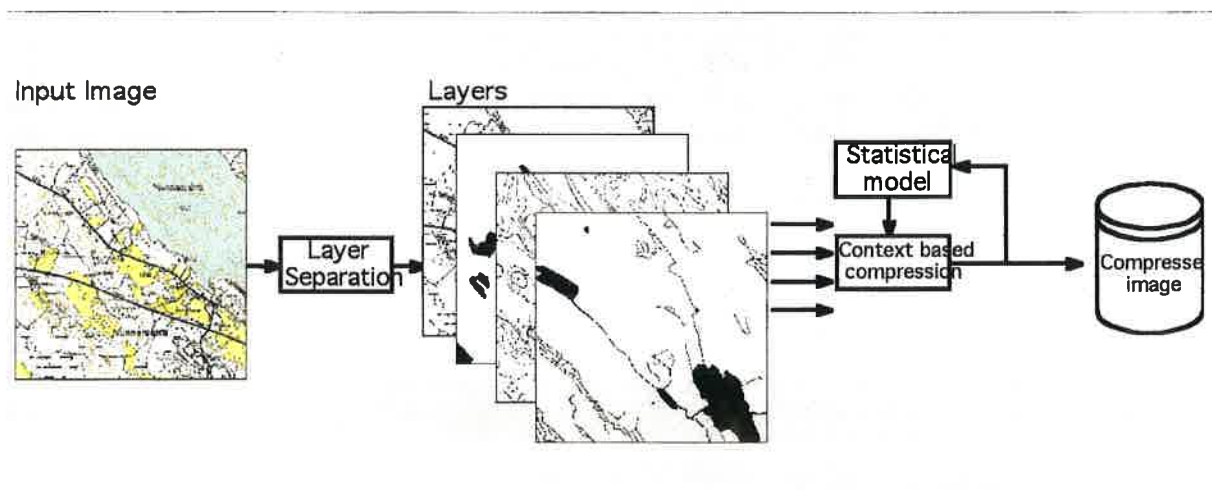


Figure 2, Outline of the map image compression based on JBIG and JBIG2 standards

layer separation is included. Division of the map into transmissible portions is done by dividing the layers into non-overlapping rectangular blocks and by separately compressing the blocks. The header of this file consists of an index table to locate

mobile device memory as to whether a previous download of the map is still present. If not, a request is sent to the server over the network. The server then looks for the proper map and sends the desired map blocks to the client in a compressed form.

the screen depending on the position of the user. A further sophistication of this dynamic approach allows the server to predict where the user is going and to provide maps in anticipation of his needs. In this way, both map handling and the utilisation of the network

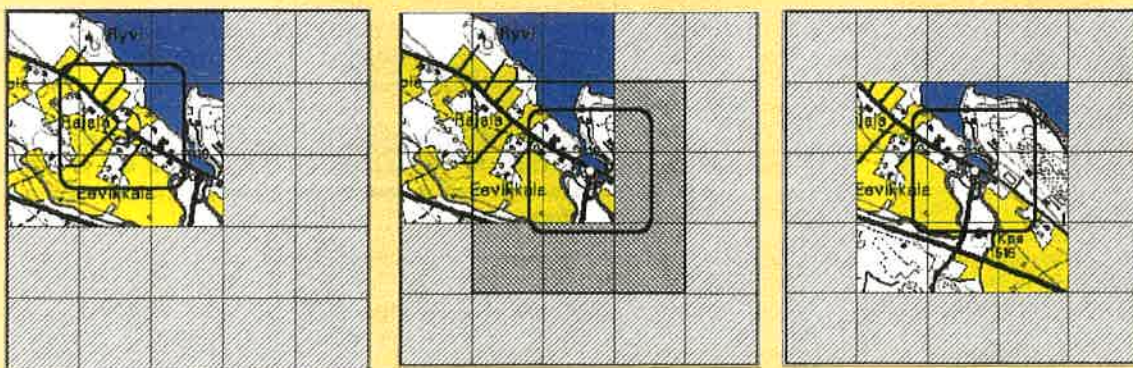


Figure 3, Typical use scenario. Only a small buffer area (left) around the current location is stored in uncompressed form. New image blocks are uncompressed when change of location is registered (middle). The view is then updated (right)

bandwidth acquire a dynamic character.

Costs

The costs of map retrieval consist of two aspects:

- ◆ Access to the map sheets
 - ◆ Transmission of the map sheets
- Any update strategy will depend upon a proper balance between the two. An expensive map access solution prefers a strategy in which all blocks are downloaded at once. This means an initial screening of the most relevant part, with the rest of the map sheet set into the background. If, however, transmission costs form the bottleneck the system should transmit only the most necessary elements and use dynamic structures to handle the fragmented map. In this case, the map is considered as disposable information which can always be re-retrieved when needed. Such a system would be truly dynamic.

Scenarios

A typical scenario is that of showing the user a map of the

surrounding area, or another area of interest. The representation scale may either be set by the user or automatically determined on the basis of speed or other parameters defined by the application. Only a small buffer area surrounding the current location is stored in uncompressed form (Figure 3). When there is no map of the current location the client creates a blank map image and then begins to request relevant blocks from the server (Figure 4). The image is gradually built up by the addition of new blocks. When the mobile device memory is full, less relevant maps are removed. This requires that the concept of relevance be well defined so as to minimise the cost of map transmission. The addition of new data must be implemented at block-level but removal may occur, for the sake of simplicity, only at file level.

Prospects

It is expected that dynamic map handling will be integrated with a mobile phone or GPS-based device so that the user pays for

map access just once, when buying the device. He will have no further need to worry about map access at all.

Mobile map imaging systems already exist but it remains to be seen when the first commercial applications with such truly dynamic map imaging systems will become available for broad use.

Further Reading

- ◆ Fränti P., Kopylov P. and Veis V., 2002, Dynamic use of map images in mobile environment, in IEEE Int. Conf. on Image Processing (ICIP'02), Rochester, New York, USA, vol. 3, pp. 917-920

It remains to be seen when commercial applications become available for broad use

- ◆ Homepage of the Image Compression research group, Accessed 14th November <http://cs.joensuu.fi/pages/franti/comp/>
- ◆ Howard P.G., Kossentini F., Martins B., Forchammer S. and Rucklidge W.J., 1998, The emerging JBIG2 standard, IEEE Trans. Circuits and Systems for Video Technology, 8 (7), pp. 838-848
- ◆ National Land Survey of Finland, Box 84, 00521 Helsinki, Finland www.nls.fi/index_e.html◆

Biography of the Author

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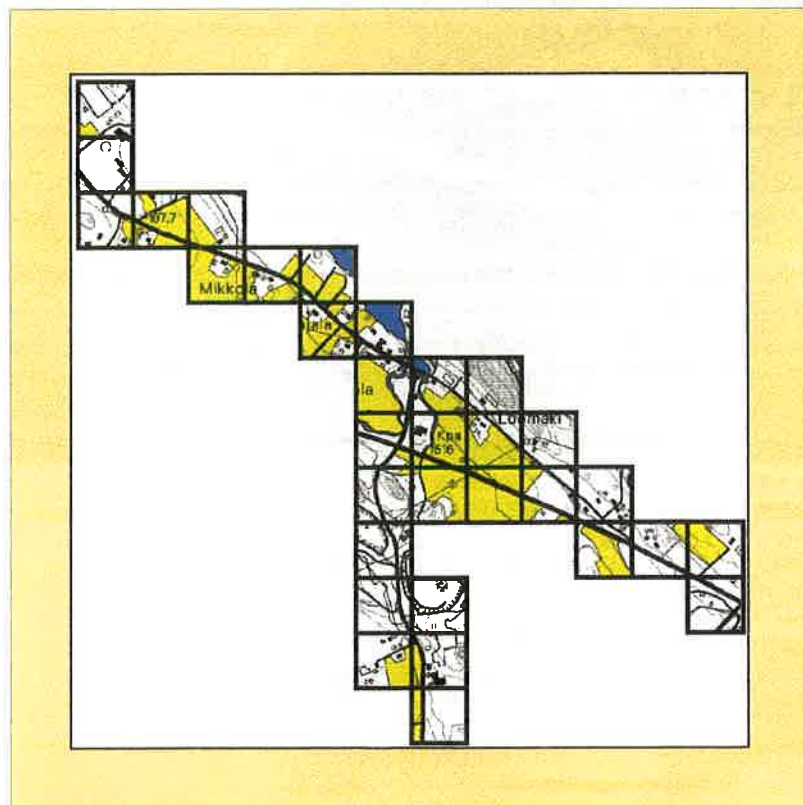


Figure 4. Dynamic map handling by composing a map sheet from individual map segments