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FLASHFIND

On-board Search Engine for Mobile Applications

Mobile users expect information to be accessible anytime, anywhere: Maps of an entire continent, music collections with thousands of tracks, or one's favorite e-books can be conveniently stored on personal navigation devices, portable media players or e-readers. Through web-based search engines like Google or Bing, today's users have become accustomed to routinely finding virtually any desired piece of information quickly and intuitively via full-text search. However, current mobile devices often fall short of user expectations considering the substantial amount of data stored on them locally. On-board search functionality is often missing or covers only a small subset of the stored data, or is just a far cry from the flexibility and speed of a web search. With FlashFind, Fraunhofer FOKUS is now offering a technology enabling convenient and efficient on-device full text search in large datasets without network connectivity. FlashFind offers features like instant search, auto-completion and phonetic search, which are still considered innovative even in web-based search.

FlashFind in GPS navigation: Destination entry redefined

A search component for navigation systems was implemented as a pilot application, making any destination among 13 million streets, cities, and points of interest in an on-board map of Western Europe instantly retrievable. A single search entry field replaces the customary hierarchical, multi-screen destination input sequence. Results are updated after each key stroke, auto-completions are proposed, tolerance against typos supersedes grayed-out on-screen keyboard buttons.

Minimize Interaction, maximize Speed

On mobile devices, efficiency is paramount: The system should understand the user's intent after a minimal number of key strokes or taps, and preferably abstain from requesting additional attention for dialogs or messages. Equally essential for the user experience is a fast response to all inputs.

Single-widget input

Similar to an online search, the user types everything coming to his or her mind about the desired destination into a single search field. Type and ordering of search words are flexible, e.g. a city name can be followed by a street name, or vice versa.

Instant search: Type-until-found, single-shot entry

The result display is updated after each key stroke – no "search button" is needed. The user simply types on, extending the query until the desired result shows up. FlashFind supports prefix search, rendering the full entry of longer names unnecessary. For multi-word names the user is free to supply one, several, or all name components. Hyphens can be typed or omitted. Auto-completion

FlashFind tolerates a large range of misspellings and typos

proposals are displayed which the user can confirm with a single click. Avoiding a fixed scheme, input is provided in "single-shot" style – situations in which the user might be required to repeat an earlier step do not arise.

Fuzzy/ Phonetic Search

Recalling the correct spelling for geographical names proves to be difficult sometimes. FlashFind thus tolerates a wide range of misspellings and typos: the desired result is retrieved even when resembling the query only phonetically, or if a character was inadvertently double-typed – even with several such errors. Accents can be omitted, umlauts can be transcribed and geographical abbreviations are supported. Nevertheless, short queries (for which many phonetic or prefix matches will exist) sharply retrieve the intended target: For instance, the query EU FRA returns the French city of Eu – which recently even considered renaming itself because it was very hard to find on the web. Navigation-specific features like local search (in city, around co-ordinate, near route) and associative search (finding an intersection with two street names) are implemented, as well.

First things first

Intelligent heuristics not only ensure that results with a high relevance assessment appear near the top of the ranked result list, but also that they are provided early on in the search process.

Connected Navigation

FlashFind yields benefits in connected navigation, as well: Even when the network is temporarily unavailable, on-board search results will always be shown instantaneously while server-based search results can later be integrated as they arrive.

Method and implementation

FlashFind combines several innovations into a novel, patent-pending search method: Compact index data structures, an optimized representation of geographical regions and a highly efficient spatial join algorithm enable rapid search space reduction to a small candidate region. Within this region, a bit-parallel string matching algorithm checks all on-board database records for matches with the query and assesses their relevance. Intelligent query analysis and a heuristics-based workflow complete the method. FlashFind has been implemented in C++ for mobile, desktop/server and embedded platforms. The code base is free of third-party rights and is available for licensing. While the demonstrator uses the on-board map database (PSF) of FOKUS's Future Navigation Toolkit, the search engine can be used separately and be integrated with the customer's on-board database.

Technical data

– Implementation in cross-platform C++
– Tested platforms: Windows Mobile 6, Maemo, Linux, Win32, QNX
– Disk footprint: e.g. 140 MB of index files for a Western Europe PSF (ca. 2 GB) covering 25 countries (about 13 million streets, cities and points of interest)
– RAM footprint: about 20 MB (can be reduced with some performance loss)
– Latency until target entry is found: 1.5s avg., 0.5s min., 6.0s max. (test suite containing 30.000 queries, executed on Nokia N900, CPU: OMAP 3430 ARM Cortex-A8 600 MHz)

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Further information and a video:
www.fokus.fraunhofer.de/go/flashfind-en