

## MUSIC REPRESENTATION OF SURFACE

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Today, sound maps is not so popular like other and not so interested for social oriented projects. Basically only these types of thematic maps are use sound like the way of representation: political, zoogeographical, vegetation, ethnographic is the most meeting application of sound registration to maps. In turn blind and visually impaired people can feel a surface only on elevation maps or maps with Braille type which basically are small-scale wall maps and cannot be easily used in an everyday life, as usual paper maps.

We can give some interesting examples of language use Braille in the maps. In Prague especially for blind travelers produce a map of the city. The map contains all the major sights - they are made of plastic, and all the palaces and monuments can be "expanded" as a children's book and felt the fingertips. Of course, the beauty of Prague you can not just touch it - in a guidebook about ten pages of text printed in Braille.

NASA Braille book released satellite images. In the 60-page book «Reach for the sky invisible» all pictures are made not only in graphic design, but also in Braille to the blind can see the cosmic beauty. All images are equipped with relief protrusions, textures, distinguishable by touch, many stamping and explanations about the object in Braille.

Development of computer technology in recent years has greatly expanded the scope of Braille. Thus, specially designed for blind users of Braille displays - special devices that allow blind users to take text information from the display in the form of relief-dot Braille characters. Textual information withdrawal of the special mobile caps. Usually on a bracket at the same time there 40 or 80 characters.

Also there is another kind of braille display - it is based on the technology of the rotating wheel when the characters are displayed on a rotating surface, which allows you to read the text at a given speed, without moving your finger across the letters.

An alternative to braille display is a program reading the screen through a speech synthesizer. In conjunction with a program of speech access to the screen is usually used and Braille keyboard.

Write text to the printer allows blind users Braille printer. This is the usual output of textual information, but in characters of Braille. True, the work of a printer produces a lot of noise.

Among the gadgets working with Braille, - GPS-navigator for the blind. These devices usually have a keyboard on the case of Braille, voice synthesizer, headphones and microphone and a wireless Internet connection. This system continuously provides users with information on his whereabouts, about which way it goes, what buildings are located nearby, how far it was a crossroads or junction. Through the Internet connection a blind man could send a message in case of accident or if he lost.

Also there is a new GPS system for blind and visually impaired people that uses the GPS navigation signals and digital maps to route in the city and beyond. «Trekker» designed on the basis of the CCP «Dell» and is intended to supplement, but not in any way replace the traditional methods of care used by visually impaired people - the white cane, guide dogs. With the new device, the user can record voice and text messages. And although «Trekker» does not contain a GPS receiver can receive navigation data from external GPS devices via Bluetooth-channel. In this case, all messages will be linked to precise geodetic coordinates. «Trekker» allows you to run routes, to keep all intersections and points of POI, warn about dangerous sites encountered on the road. You can also configure various types of messages for different types of points of the POI.

Of course, the architects often create three-dimensional models for the blind, but unfortunately, they are intended only for personal use only. Paper cards with protruding grooves that indicate the road is also not ideal because it does not contain all necessary information.

Also, developments can be noted a digitized version of the diorama, the most accurately reflects the world around us and can be simultaneously available to people from all over the globe. Additional information is also provided in the form of audio recordings.

In order to construct a virtual diorama, the developers first filmed architectural model. Then the resulting image, frame by frame, is processed using special software. How it works is simple: as soon as the camera angle changes, the program automatically keeps track of all new construction parts which come in sight of the equipment and determine their exact shape and location. Based on the data creates a three-dimensional grid of force fields, are used to create the final virtual model.

The interface consists of two components, designed to simulate the pressure on the user's hand from the force field, which mark the boundaries of virtual building model. Accordingly, one of the parts - kiberperchatka, put into the hands of the user, and the second - the so-called "ghost desktop» (The Phantom Desktop), to provide appropriate resistance unit effort by the hand that performs the function in this case a cane for the blind.

Virtual tactile maps, also known as "touch", created earlier, using the possibilities of stereoscopic images, which required special equipment.

Also developed a system that is capable of converting an image with traditional paper maps in a fully three-dimensional counterparts. The user need only run through your fingers or a pointer on the streets marked on the virtual map grooves, while the headphones will automatically be played back their names.

From other ways of presentment of a relief which it is possible to transfer graphic means for use by blind and visually impaired people it is elevation shader and contours. These ways of the image also are applied at the elevation print. It is necessary to notice that such important thing as hearing which is very important for blind and visually impaired, is not involved by working out of maps for people with the limited possibilities, especially from the point of view of transfer area hypsometric characteristics.

If more deeply to penetrate a sound essence, namely into its physical characteristics, in that sound it is the wave which has frequency and amplitude of fluctuations then it is possible to spend many parallels with hypsometric characteristics of surface. By consideration of a sound wave in a graphic representation and a hypsometric profile of any territory it is possible to find much in common. In a sound wave on an axis «X» will be frequency, and on axis «Y» decibels, and in a hypsometric profile distance and absolute height. Also it is possible to draw analogies of a sound wave and digital elevation model.

All musical sounds or tones, as well as any noise that arise simply from changes in air pressure. However, the conventional noise of these changes are chaotic, and music are repeated in certain patterns, which can be described. For example, a tuning fork vibrations cause a movement of air molecules that his pressure is periodically increased, then decreased. These oscillations propagate as spherical waves, which the human ear perceives as sound.

Pressure wave can be represented graphically as wave functions of the simplest of which is a sine wave. Sinusoid is characterized by two parameters - the frequency and amplitude. Frequency determines the number of periods (ie, one maximum and one minimum) waves in 1 second. This option is our brain perceives as the pitch. Wave amplitude, ie, the intensity of pressure change, the human ear and brain perceive as loudness. Like all of the periodic oscillations, musical sounds are made up of dozens of sine waves of different frequencies. In 1822, French mathematician and physicist Jean Baptiste Fourier, who investigated the complex structure of the waves, has developed a powerful mathematical method to decompose periodic functions on the sinusoidal components. Principles of Fourier analysis - as they call this method - now used in programs in which a computer analyzes the sound wave, just as it automatically makes a person a hearing aid.

If a complex sound wave can be decomposed into simple components by Fourier analysis, then perhaps the converse - to build it from individual components. One method of creating computer music called additive synthesis. In this process, the program generates digital descriptions of individual sine waves, and then combine them according to mathematical laws in the complex wave functions.

Method of digital frequency modulation yields sounds rich tone without too much computation. Unlike analog frequency modulation used in radio communication, digital frequency modulation - a purely mathematical process.

Modulated wave has a fundamental frequency component - carrying numerous overtones that were introduced into the process of modulation. Modulated signal can even contain random noise, inevitable in the sound of conventional instruments.

To play the sound for a second want to tens of thousands of arithmetic operations. But as in the described process involves only a few waves, rather than a few dozen, as in additive synthesis, the amount of computation can be reduced significantly.

A mathematical model that includes some or all of the physical properties used to construct the wave functions, as would result from these properties. One such model is able to simulate the physical characteristics of the surface. Among the input parameters of the model parameters are taken hypsometric maps or digital elevation model. To make the resulting sound is more rich and soft, the model should also introduce a mathematical description of the smoothing of the sound wave.

At a graphic method of construction of a sound wave if two parametres (frequency and decibels) to add the third parametre time a graphic picture of a sound of piano key lasting some seconds will be very similar to

digital model of any ridge smoothly passing in foothills, and then in plain. Being based on this way of surface representation the program application «Elevation Music» has been developed. The program is based on a sound principle of representation of surface. In this program it is possible to hear elevation sounds both on longitudes and widths, and on elevation shader. Applying the given way of surface representation and the developed program, blind and visually impaired people can receive representation about surface and its characteristics.

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