How blind people can see even better with their hearing. General part. *Pure Google translation*.

Document 1 of 2 - The translation of the technical part is pending.

The document is being processed in January 27, 2021.

Concept proposal by Hans Ulrich Stalder ©.

June 11, 2018. The project started in January 2018.
The project was suspended at the end of September 2018.
The structure and font of this document version 8 was written primarily for blind people.

1. Introduction.

With this a procedure is presented how blind people can become more independent. Obstacle detection while walking is primarily presented. Furthermore, the blind person is able to perceive the space in the walking direction. This is based on special acoustic signals.

a) The importance of hearing.

It is generally known that blind people in particular develop special hearing skills. This is taken into account. This means that the auditory canal is still continuous for outside noises and hearing through the ear cups and the ear cartilages remains unchanged. In concrete terms, this means that the loudspeakers required are not placed in the ear canal. This is anticipated here, the acoustic signals are noise colours as they are also used for calming therapy. As a rule, these noise colours are discreetly quiet or do not exist at all and only dominate in the event of danger or intentional action. In addition, a detected obstacle is perceived from where it is actually located and not in the head with the other noises from outside.

b) From hearing to seeing.

The eyes and the physical hearing complex are the connection to the outside world, but the actual hearing and seeing take place in the brain. Spatial perception is transplanted, for example, across different areas of the brain into the visual cortex. In the present case, this means, in somewhat exaggerated form, where the information arriving in the visual cortex for spatial perception comes from is irrelevant. The transformation from hearing to seeing in the spatial visual cortex is intuitive. This can be compared to a kind of deliberate hallucination. It is undisputed that even in adulthood, the brain has sufficient flexibility and plasticity to re-function brain areas.

c) Tongue clicks and click sonar.

Tongue clicks are used by blind people and operate an active "imaging" echolocation. Klicksonar praises its product accordingly with the following text: “This advanced form of active echolocation means to obtain a very differentiated picture of the environment from the echo falling back from a sharp click of the tongue. Just like with sighted people, who generate three-dimensional images in the visual cortex of the brain. "

If a blind person is already used to such a product, nothing stands in the way of continuing to use this technique for intuitive distance estimation. The present concept is open to all kinds of additional functions, therefore also to the generation of these tongue clicks.

d) General information on this concept.

The present concept is not only a novelty, but also the targeted merging of what is already known, for example with the blind glasses supplement “MyEye” by Jennifer Kietzke, infrared blind glasses (visor), smartphone LED glasses, etc. This concept can also be used with Aids can be added that require residual vision, such as the "eSight" product. The actual goal is to enable blind people to perceive and identify individual objects spatially without extensive training. After a short theoretical introduction and a short familiarization phase, the system can be used intuitively. So it behaves like the seeing of the sighted, not everything that is seen is consciously analyzed.

e) Required hardware components and their adaptation.

Only two hardware components are required for this concept, that is a headphone system in which the noise patterns are conducted via the cheekbones to the hearing, together with special camera glasses that keep the eye area free and a bag with a computer and the Battery pack. If the blind person already uses hearing aids, the existing hearing loss compensation is integrated into the present system. Conversely, this system can of course also be adapted to cochlear implants and brain stem implants.

f) References to sources and background knowledge.

Due to the failure to note down all sources, a directory was not used. Since this is not a scientific work, the author may be forgiven. Most of it is already common knowledge and the origin is hardly known. In addition, it only takes a few clicks today to get to the background knowledge of what is described here on the Internet. However, the author has carefully noted down some sources.

g) Three more small additions.

First, the term “blind people” includes the severely visually impaired.

Second, hearing aid systems are advanced head-mounted headphones or advanced behind-the-ear hearing aids. Extended behind-the-ear hearing aids are used for optimal hearing. "Open-ear" headphones are used for absolutely undisturbed hearing of the ambient noise. The noise information is transmitted via the cheekbones.

Third, auditory vision is a new term and should only be used in the context of this concept. The hearing-sighted person, which also includes female persons, is the person who uses this object recognition aid.

h) Disclaimer.

No legal responsibility or liability of any kind can be assumed for incorrect information and its consequences. I hereby expressly distance myself from all content on the linked pages and do not adopt them as my own. Subject to changes.

Inhaltsverzeichnis

2. Overview of obstacle detection.

Everything that comes into focus from the front of the detection system is signalled with a noise pattern. The closest detected object determines the noise pattern. It can be the street itself, a person or an object.
Ultrasound is primarily used for obstacle detection. However, to ensure obstacle detection even in rain and fog, the results are verified with radar pulses [1] .

2.1. The general obstacle detection.

In walking direction and with the head straight ahead, obstacles are detected at a distance of around four meters from eye level and on level ground. The width of the detected floor area is around two meters at this distance. A wall at the side with a distance of about one meter is therefore no longer detected. The fact that the distance between protruding objects and the person who can see is reduced, calculated from eye level, is used here.

2.2. The noise patterns, their colours and their uses are explained.

Different noise patterns are distinguished from one another by colour designations. The noise colours used here are blue, white, pink and brown. Only these four noise colours are used for obstacle detection. The noise noise colours blue and pink stand in this concept for more distant obstacles. The noisy noise colours white and brown represent obstacles that are closer to you. There is a virtual horizon between these two areas. These constructions are primarily used to detect obstacles in the walking direction.

2.3. The virtual horizon, the H and the H legs.

Seen from the front, the virtual horizon runs between the front and rear noise colours. The actual height at which this is located depends on the position of the head. The letter H is projected onto the floor from eye level. In general, the projected H follows the head position in all directions. For the following considerations, the horizontal line is extended from the H to both sides. This elongated horizontal bar is the effective virtual horizon.

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1 Inxpect SpA, LBK System v1.0 Juni 2018

2.4. The change of the noise colours in the extended H.

Within the H, the blue to white noise changes over the virtual horizon. Outside of the H, the pink to brown noise changes over the virtual horizon. There is a change from blue to pink noise and vice versa over the upper side legs. Over the lower side legs, the noise colours change from white to brown and vice versa. In one sentence, the noise colours change with every stroke transition from the extended H.

Conclusion, it is the transitions that enable an exact localization of objects. It must also be said that there is another central dividing line between the two legs of the H. That means, the inner part of the H has two separate areas without noise-colour changes. A transition of the middle dividing line is determined by a short noise interruption. This allows the edges of objects to be determined more precisely. That is anticipated here, further such dividing lines can be added continuously and individually, which ultimately results in a compound eye-like vision.

2.5. The three hearing levels explained.

In general, this documentation speaks of three hearing levels. Normal hearing is the level that takes place in the head. General hearing and language in the hearing cortex are analysed and processed. Therefore this level is called here "**Abstract hearing level**" called.

Where spatial hearing takes place in the form of noise colours, namely as perceived outside of the head, this is called
"**Panorama level**".

Between the two levels mentioned is that
"**Compound eye level**". Here colour information is imported into the positions of the honeycombs. More on this at the end of this documentation.

2.6. The obstacle detection explained.

A frontal obstacle is brought into the panorama plane by a specific noise colour. By nodding and lifting your head, the beginning and height of the obstacle can be determined. Lateral boundaries are determined by swiveling the head.
The following example explains how a blind person perceives the frontal environment with this system.

2.7. An example with a hydrant on the side-walk.

If a blind person walks straight ahead on the side-walk, the floor is detected and a soft white noise is played in the panorama level. If the head is raised just a little, the noise disappears completely. If, for example, a hydrant hinders walking that is only about four meters away, the silence on the panorama level changes to blue noise. This noise is heard with a defined bandwidth in the frontal panorama plane.

2.8. The exploration of the hydrant explained.

When you lower your head, the blue noise changes back to white noise, because now only the ground is detected. The point where the noise colours transition marks the approximate base of the hydrant. The head position when the noise changes between looking straight ahead and the nod position provides intuitive information about the distance to the hydrant.

When you lift your head, the white noise changes back to blue noise. With further lifting of the head, the blue noise changes to white noise, provided that the area of the blue noise is already above the upper end of the hydrant. If you lift your head further, the white noise also disappears, since nothing is detected any more. The transition from blue to white noise and the transition from white noise to no more noise indicate the upper end of the hydrant. This means that the restricted white area has been raised above the height of the hydrant. The head position between looking straight ahead and the raised head provides intuitive information about the height of the hydrant during the noise change.

Note: The explanations make the whole thing seem complicated, but it is not. If you had to learn to ride a bike on the basis of a description of where is what is to be done with the handlebars and when in connection with shifting weight, it immediately becomes infinitely complicated. Practising makes everything intuitive over time. It is the same in the present case.

The lateral expansion of the hydrant is determined by swivelling the head sideways. The blue noise changes to pink noise and when you swing back from the head it changes back to blue noise. Or from the white noise to brown noise and when swivelling back from the head back to white noise. This principle applies to both sides. Here the wacky head position gives intuitive information about the width of the hydrant when the noise changes. With an additional lateral kinking of the head, other noise change colours may occur. But the principle remains the same.

2.9. From the model of light projection to reflection.

The many approximate figures stem from the fact that a light projection was used for a simplified representation. In reality, what defines the noise colour is based on a reflection of the transmitted signals. However, the reflections behave differently. They depend on the shape and surface properties of an object, and also on the parametrization of the programs.

3. Aural vision with hearing aids explained.

3.1. The hearing aids and the 3D surround sound.

In the case of auditory vision, the interfaces, hearing to brain, are the two hearing aid systems, which can be conventional hearing aids, headphone headphones or “open-ear” headphones. If an obstacle is approached, as mentioned at the beginning, a special noise that also conveys a feeling of distance is played into the hearing systems. This noise takes place as perceived outside of the head. This is made possible by the 3D surround sound. In order to have an optimal listening experience, the hearing aid for 3D surround sound must be calibrated once with the hearing aid wearer. If a distance message to the obstacle is spoken in the "line of sight", the spoken collision warning has priority for moving objects. The noise in the 3D surround sound is not interrupted in any of the cases.

3.2. The extended noise pattern becomes the noise profile.

If an obstacle is detected from the front, blue or brown noise is played in the middle of the panorama plane. Obstacles detected from the side are also perceived acoustically from the side in the panorama level with pink or brown noise. This means that by nodding and turning your head you can get a spatial impression. Silence means that there are no obstacles in the "line of sight". If necessary, the noise is expanded by defined noise patterns, for example as indicators for ditches, steps and free seats in the bus or train. Everything together results in a noise profile that is fed into the panorama level as continuous, or as trembling or pulsed noise. Overtones that are superimposed on the noise and offset in time can convey additional information.

3.3. An example with a side obstacle.

If a blind person walks along a wall from which a side obstacle protrudes at head height on the left, a trembling pink noise can be heard in the panorama level. The trembling pink noise means that the obstacle is not on the ground. If you move to the right, the pink noise moves further back and then changes to brown noise in the left panorama level. The pink noise then disappears in the direction of walking. The displayed obstacle now shifts acoustically in the panorama level further to the left and back and is ultimately only perceived as a weak noise, up to the side silence.

4. Summary as list items.

- Objects are mainly detected with ultra sound.
- Detected objects are generally indexed by noise.
- Blue noise indicates objects in the "line of sight".
- This is heard acoustically in the panorama level and results in the brain as spatial perception.
- The detection technique used does not require any intellectual effort.
- The technique used only uses four different noise colours.
- The user hears the noise colours in 3D surround sound technology.
- Objects are heard in the direction where they are, front or side of the head.
- The volume of the noise shows the relative distance to the object.
- The system enables the user to walk around an obstacle.
- With nodding and lifting from the head, the upper and lower edges of the object can be determined.
- By swiveling the head, lateral object edges can be determined.
- A voice output enables written text to be read, for example with stored street maps or even normal writing via the camera glasses.
- The speech output can name people or objects, but can also be used for individual purposes.
- The system is optimized for hearing aids, but also works with "open ear" or normal stereo headphones.
- The extended H can change continuously to the compound eye technique.
- An infrared camera can determine free seats in buses and trains.
- The intuitive handling sets in after a short time.

5. Bionics.

The techniques of the bat, namely emitting and detecting ultrasound, as well as those of the barn owl with regard to acoustic location are used. The explanation of why blind people can possibly be seen with compound eyes is somewhat more complex. To do this, you have to go back around 550 million years, to the time when nature developed light-sensitive cells. The Pax6 gene family has prevailed and is still present in all vertebrates, including the human genome.
Contrary to earlier opinions, the human eye is not a continuous development over hundreds of millions of years, but developed in parallel with around forty other light-sensitive systems in a very early phase. Hearing, on the other hand, is a recent achievement of nature. It wasn't until around 260 million years ago that vertebrates first had hearing systems. The fact that nature is generally based on the transmission technology of the compound eye (complex eye) speaks for a proven system.

How is the bridge between hearing and seeing with compound eyes built? This is justified as follows. In the hearing, what is perceived is transmitted as individual impulses and put together in the brain. The transmission technique used in hearing thus corresponds to that of an insect with compound eyes. From an evolutionary point of view, this method is still present in the human genome. As already mentioned, a spatial perception is transplanted through different areas of the brain into the visual cortex.
In the human eye, what is perceived, in contrast to what is heard, is transmitted as an image. This means that the graphic pattern is transmitted from the thalamus to the brain. Therefore, the transmission technology from the eye to the thalamus, more precisely to the lateral knee cusps, cannot contribute to vision with compound eyes. In contrast, it is likely that the lateral knee cusps and the medial knee cusps (the auditory tract) can exchange information (all of these connections are reciprocal [2]).

2 Jochen Fahrenberg, Neurobiologische Grundlagen. Ergänzung vom 28.10.2018

5.1. What justifies the theoretical compound eye technique.

(Addendum from September 25, 2018)

- the compound eye technique can be trained (from coarse to small);
- the simplest "seeing" are distinctive brightness transitions, analogous to the noise pattern changes in the extended "H", resp. the honeycomb edges;
- The image of the fovea, that is the location of the sharpest vision on the retina, is eaten up (torn apart) by the thalamus in the lateral knee cusps and passed on to the visual cortex, i.e. the information from the 120 million sensory cells per eye is transferred to the Most important passed on reduced - here corresponding to the brightness transitions in the honeycombs from "scanning", as well as the memory of previous brightness transitions, which together correspond to the compound eyes;
- the medial knee hump is the switching station of the auditory pathway with a distance of only a few millimeters from the lateral knee humps - an overflow of information (afference) is easy to imagine;
- Brain regions are connected via the thalamus (effectively via sensory thalamic nuclei for sight, hearing and taste), hence the auditory cortex with the visual cortex as well as with previous experiences;
- The Pax6 gene for compound eyes is still present in the human genome and can possibly be activated, namely by:
  - find and activate the compound eye gene (demethylate);
  - a "biological" switch-on via hormone releases 1, namely through the attachment of simple chemical markings, so-called methyl groups, to our genetic material, which like a switch, permanently change the activity of genes, is more likely.

6. Basis for the further development of the system.

6.1. From the barn owl to the compound eye.

According to the sources about the barn owl, it is possible to send spatial perception, directional features and intensity features to the eardrum offset by fractions of a second. In relation to the panorama level, when moving from the head that would be a very short sequence of volume changes and at the same time noise colours changing noise packages.

Quotation from Spektrum der Wissenschaft: “We have found that the owl brain does not determine the various spatial features of the auditory stimuli all at once, but in an astonishing sequence of individual steps and finally combines them: Information about the duration and intensity are processed independently of one another in parallel nerve tracts that converge very late. It is very likely that such a binaural, and therefore two-ear, linkage occurs in mammals, and also in humans, in a very similar way. ”End of quote.

In relation to this concept, very short noise packets with different intensity and noise colour could be imported into the panorama plane. What ultimately arrives in the visual cortex is something like the view with a wide-meshed compound eye.

6.2. How the compound eyes get the colour information.

If it is determined that the human brain can also process very small honeycombs, the colour information can be superimposed on these in addition to the noise. The colour information is provided by camera glasses. This colour information is converted into beeping tones and fed into the positions of the honeycombs in the compound eye level. The frequency assignment is based on the rainbow colours. These go from dark purple, violet, dark blue, light blue, green, yellow, orange to red. No colour information means white or indefinite. The beep tones cover the frequency spectrum from around 1000 Hertz to 3000 Hertz. Possibly, using "Binaural Beats" [3] the hearing load can be reduced by beeping sounds.

6.3. How the moving image sharpens in compound eyes.

In the case of a still image, a compound eye has a reduced resolution. According to an article by Spektrum.de, an insect's brain can construct a higher resolution from a moving image. If the head is now moved, it is the same as if the object is moving.

3 Sebastian Rossböck (Mag. Phil.). Ergänzung vom 28.10.2018

6.4. Analogy hearing and compound eyes.

Because of the head movements, we perceive audio signals to be a little different every moment, namely always in relation to the respective head position. In this respect, the human ear is similar to the compound eye of an insect. As already mentioned, in both cases the signals are transmitted “individually” to the downstream neurons and put together to form an image. Whether the human brain can do this has not yet been confirmed, but there is at least a probability.

6.5. From the outer panorama level directly into the visual cortex.

According to GEO 12/2017, the brain is capable of far more than previously assumed. The article "From Darkness to Light" points this out impressively. Children who have never seen anything for years must first learn to see after an eye operation, but ultimately the information reaches the cerebral cerebrum in the visual cortex. There is therefore hope for those who can see with hearing that over time the brain areas will reconnect and the artificial noise will be separated from the rest of the hearing. This means that the artificial noise that takes place in the panorama level is no longer perceived as hearing but rather as visual visual information in the visual cortex.

7. GPS support, object recognition and voice output.

In principle, the system also works without GPS support. Using GPS, however, the computer can compile a spatial image of the detected object and save it. Every spatially prepared object is compared with an object database at regular intervals. If a match is found, a message is given. For example, “floor marking recognized for blind people”, “person recognized”, “plant recognized”, “person with light jacket recognized” or “table with bench recognized”. If you focus on the obstacle for a long time, a distance is also given. This function can also be switched off. Every voice message is perceived in the abstract listening level.

8. Outlook.

The blind person should be given spatial orientation by means of three-dimensional vision. Objects should be able to be identified abstractly in the close range. This means that the spatial impression should be passed on to the brain as authentically as possible via the ear in order to ultimately achieve the finest possible vision. You can also think about feeding in the noise colours via the cartilage behind the ear. With a cochlear implant, the eardrum and the inner ear would be completely excluded and seeing via the noise colours would be like an additional eye.

9. Differentiation from the application EyeMusic by Amir Amedi.

The EyeMusic application has a different thrust and is neither comparable nor competition.

10. End of document.