Aphasia is a partial or total loss of the ability to articulate ideas or comprehend spoken language, resulting from brain damage due to injury or disease, in the person whose language skills were normal. The applications dedicated for aphasic persons and designed for wearable devices, especially Google Glass, are still underexplored topic [1]. Our previous experience in application design for aphasic persons and in application prototyping for Google Glass [2] inspired us to implement a project combining these two domains, and prepare a storytelling application for Google Glass. The main goal of this work was to test to what extent wearable devices like Google Glass can support aphasic persons in the future in their rehabilitation and in improving the quality of their lives. Conclusions from the experiments performed are presented in the concluding section of this paper.

**Keywords**—aphasia, wearable devices, Google Glass.

I. INTRODUCTION

APHASIA is most often caused by stroke, but a mechanical injury to the brain or the head can also cause it. Aphasic persons suffer from a sudden inability to naturally use language.

Interpersonal communication is one of the most important factors of social life, and it usually takes a verbal form. Meetings and phone conversations are good examples of verbal communication, but written or graphical forms are also used. As a result of an impairment of language, aphasic persons have great difficulty communicating verbally. This influences negatively their everyday lives, especially when interaction involving speaking and speech understanding is needed. This significantly degrades the quality of their lives [3]. Communication ability impairment causes isolation; the person is withdrawn and suffers from increasing frustration and depression because of losing social bonds [4]. Aphasic persons cannot easily reconcile themselves to the fact that their communication skills are far below the level before aphasia.

There exist devices dedicated to aphasic persons, namely Augmentative and Alternative Communication (AAC) devices, helping in basic communication, and then later in rehabilitation. However, these devices have numerous limitations, for instance symbols the aphasic persons have to learn, in order to use the device in a very simple communication, regarding their basic needs [5]. This is why most of such devices are useful only in the beginning phase of aphasia. Aphasiacs are aware of these limitations and they lack of support in storytelling and sharing events of their everyday lives.

II. RELATED WORKS

Storytelling applications are a possible solution to the problems aphasiacs suffer from. These applications consist in creating simple stories, made of photographs or movies taken by the user. The pictures or movies can be marked with additional symbols or icons, and shared with other users [5]. Such a communication, based on stories created by the users, plays many roles, but first of all it stimulates the aphasic person and encourages her or him to be more creative in keeping her or his social bonds. The use of the user’s photographs allows remembering past events, sets them in timeline, supports narration, and rebuilds social relationships. This is why well-designed storytelling application can directly improve the aphasic’s mood, reduce the feeling of social isolation and the passive attitude towards her or aphasia [4, 6]. There exist storytelling applications that can be used for this purpose.

The Storehouse application [7] allows creation of everyday life stories using text, photographs, and video. This application uses very small space for icons controlling the use of the application. The icons are shown in a bar in the lower part of the interface. When a story is selected, the icons become hidden. Choosing a picture or a movie launches a pleasant and aesthetic transition to displaying the selected material in full screen. In order to go back to the previous display, the user simply has to touch the screen. The interaction within this interface is intuitive, and the use/adjustment of settings is not necessary.

Glossaic [8] is a social network service integrated with Google Glass. After registering and launching the service, the user can share pictures or movies directly from Google Glass. The pictures published can also have descriptions of their content. The users can rate materials created by the others (through messages, or they can like them) and the materials of highest rates can be placed on the main site of the service. The virtue of this service is its full integration with the Google Glass device, as no installation of the application is needed,
and the use of this service is intuitive. The drawback of this service is the lack of the possibility to edit the pictures, the required registration of the device, and the necessity to log on.

Memoirs [9] is an application integrated with Google Glass. After activating, voice comments can be created and placed on the official service web site for download. The application also allows saving pictures and placing them in this web site. The goal of this application is to document everyday life (a diary) using Google Glass. The virtue of this application is its integration with Google Glass (no installation needed), the possibility to create and save comments and pictures, and downloading them from the web site. The lack of comment editing is the drawback of this application.

III. GOOGLE GLASS

Google Glass [10] is a development platform based on the Android 4.4.2 mobile operating system. The device itself is constructed similarly to other mobile devices (phones, tablets, etc.), but taking its specific requirements into account. The hardware architecture is based on a SoC solution OMAP 4430, containing a 2-core Cortex A9 1-1.2 GhZ CPU, a PowerVR SGX540 GPU and 2 GB of RAM. The device uses a 16GB, non-removable Flash memory for non-volatile storage. It has a camera capable of recording 720P video and taking 5MP images, an audio interface that uses a bone-conduction speaker built into the frame, and also WiFi and Bluetooth connectivity. The screen is displayed on a small prismatic crystal using a 640x320 resolution, with a viewing angle corresponding to a 25” screen viewed from a distance of 2.4 meters. Apart from the voice interface, the main interaction device is a touchpad built into the side of the frame, with an estimated resolution of 1366x187 pixels and multi-touch capability detecting as much as 5 simultaneous touches. Just like many other mobile devices, it contains a 3-axis gyroscope, accelerometer, magnetometer, light sensor and a proximity sensor that probably also doubles as a blinking detector (which is not documented anywhere). The device does not have a GSM or a GPS module, but it uses a Bluetooth paired mobile device to seamlessly access these features when necessary.

The software development for the Google Glass platform is very similar to other Android devices, but given the UI (user interface) limitations of the device, the programing library was severely modified and exists as a separate SDK, called Glass Development Kit (or GDK). The major changes include application presentation layer (using cards in a timeline instead of regular activities), changes in layout (due to limitations of the screen), user interaction (lack of keyboard) and voice interaction (this was rather new for Android devices at the time).

IV. APPLICATION CONCEPT AND ITS IMPLEMENTATION

The Aphastory application concept is based on observations and experience gained by one of the authors, Marcin Wichrowski, while he was designing and implementing his storytelling application Aphasia Create. This application allows:

- Free drawing and taking notes,
- Taking photos with front and back camera,
- Accessing camera roll for loading and saving images,
- Reading QR codes for opening websites in a mobile browser,
- Accessing websites in a mobile browser,
- Adding text with full OS system features (spell checking, speech synthesis etc.),
- Adding current time and date,
- Accessing maps with Geolocation,
- Saving created images to camera roll and printing,
- Publishing canvas to Facebook with easy to use dedicated interface and sending emails.

![Fig. 1 Exemplary story from Aphasia Create](image)

An example of a story created using Aphasia Create is shown in Figure 1.

We decided to use some of these functions with Google Glass and address the limitations of this device. Because of great communications problems of aphasics, we decided to acquire the knowledge needed from experts working with aphasics, and from the literature [5, 6]. As a result we created the Aphastory application for Google Glass. It is a prototype, and the following functions have been implemented, among others:

- Creation of a story, built of several consequent pictures or movies,
- Adding pictures to the history using a built-in camera or an external device,
- Adding video to the story, using the built-in camera, or from a gallery in this device,
- Adding text descriptions to pictures or movies (simple sentences),
- Adding predefined emoticons to pictures or movies,
- Adding geolocation to pictures or movies,
- Sharing a story via email.

Interaction with the application is performed through tap
and swap gestures on the device’s touchpad. Voice interaction was not implemented, for obvious reasons.

The stories are created in the form of a show of consequent pictures/movies, which can be accompanied with predefined phrases and icons, helping in narration. Geotagging is also available for each story element. Such a package can be sent via email. The detailed workflow of this application is shown in Figure 2.

Figure 3 presents a story fragment, consisting of a picture, description, icon, and geolocation. The application is prepared for Polish users, so the interface and text elements are all in Polish.

The main problem encountered while working on this application was the interface of the device. The interface does not allow freely designing the screens, and standard position and size of icons in the screen had to be used.

V. Evaluation by Physicians

The Aphastory application for Google Glass was presented as a prototype to a physician, namely a neuropsychologist specializing in aphasia, in order to hear his medical opinion. After introductory presentation of Google Glass, the physician used the application for 15 minutes, to check its usability and test how it works in practice. We keep cooperating also with aphasics, and we are looking forward for their opinions about the application.

VI. Summary

The Aphastory application offers many functions, which are easy to use, and it allows sharing stories. The main difference between Aphastory and other applications is that the user is not required to record voice comments, he/she has predefined choices (to reduce confusion), and simplification of the application. Aphastory also offers a personal gallery with documented materials, available without using external devices. Other applications additionally required registering the Google Glass device.

Additionally, we are planning a simple usability test, with participation of aphasiac persons, in order to have the application tested in practice by the target users. However, the Google Glass device is not popular, and its interface is new for the users, so it can be a problem for the first time users. Early experiments with Aphasia Create for tablet computers proved that the main problem is that the users were not familiar with portable devices. This is why young users more easily used this application, as they used portable devices in their everyday lives. For this reason, persons familiar with new technologies and interfaces will be selected for further usability tests. The test will be designed as a quality test, in order to find most difficult parts of the interface, resulting in its potentially low usability, and also to get the users’ opinions about the application for Google Glass. All proposals of adding new functions to the application will be welcomed. The observations from the initial test will be taken into account in the next versions of the application. Especially, we would like to improve the way of creating stories, in order to prepare effective and intuitive method for reconstructing everyday events. We would also like to observe the use of our application for longer time, to see how the aphasiac gets used to the application and the interface.

We hope that our observations can also help developing applications for other special needs users, including persons suffering from dementia or Alzheimer disease.

ACKNOWLEDGMENT

The authors would like to thank Michal Jaworski for his help in implementing the Aphastory application.

REFERENCES


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