

# THE DEVELOPMENT OF THE I-MAIL PROTOTYPE

Final Project Report  
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*Leo Burd, Jan Kaiser and Thuha Nguyen*

## **1. Introduction**

The goal of this project is to develop an interface prototype for the I-Mail (Inclusive Mail) tool, which is an e-mail client targeted at people with mental and/or physical disabilities.

Currently, there are many communication devices developed to address the specific needs of the disabled. However, there seems to be a lack of Internet communication tools for this population. Challenges involved in this kind of project include dealing with a domain we are not familiar with and do not know much about, specific technical constraints, and the novelty of the field itself.

In order to deal with this problem, the design of the I-Mail interface requires not only the involvement of assistive technology professionals, but also the constant interaction with the disabled in their real settings. Moreover, it requires the application of universal accessibility guidelines and a continuous assessment of the right level of personalization and scaffolding to be provided for each user in different situations.

## **2. Related Work and References**

To guide our project, the following references have been used:

- Catalogs and web sites of special technology companies such as
  - Laureate Learning (<http://www.laureatelearning.com/>)
  - Slater Software (<http://www.slatersoftware.com/>)
  - Don Johnston (<http://www.donjohnston.com/>), and
  - Mayer-Johnson (<http://www.mayer-johnson.com/>)
- Accessibility guidelines like the ones proposed by the
  - Trace Research and Development Center ([http://trace.wisc.edu/docs/software\\_guidelines/software.htm](http://trace.wisc.edu/docs/software_guidelines/software.htm)),
  - The Center for Universal Design (<http://www.design.ncsu.edu:8120/cud/>), and
  - the W3C Web Accessibility Initiative (<http://www.w3.org/WAI/>), and
- Articles about the design and use of PapoMania, a chat tool developed in Brazil for people with Down Syndrome (<http://www.caleidoscopio.aleph.com.br/>)
- Technical descriptions of the most common disabilities and their necessities in terms of technology. In special, we focused on descriptions provided by the professionals that were involved in the project and on the "Telecommunications problems and design strategies for people with cognitive disabilities" report developed by the World Institute on Disability (<http://www.wid.org/>) in 1999.
- Access to other products being developed that are pretty similar to I-Mail. The best example is Inter\_Comm, by Widgit Software LTD. (<http://www.widgit.com/>), an e-mail client for people with special needs. It is worth mentioning that Inter\_Comm is part of an European Community project entitled ALDICT (<http://www.inclusion-europe.org/aldict/>). In 2001, Inter\_Comm is supposed to be released in US market.

### **3. Our Approach**

Since none of us have developed anything like I-Mail before, we decided to carry out some research to identify what needed to be provided. The idea was to create something simple enough to be used by people with disabilities and, yet, powerful enough to motivate them and facilitate their communication via the Internet.

To do that, we consulted the references, described in section 2 above, and decided on important characteristics that the interface could not lack. These characteristics are described in great detail in section 4.1.

After acquiring the initial ideas and defining the overall guidelines, we started to develop the prototype on paper. We went through a couple of revisions of the prototype, with changes made initially based on the heuristics evaluation. We then visited the Eisenhower Elementary School several times and used the hand-drawn version to gain feedback from the teachers. Besides being experts in special education, they would be the ones helping the students using the software later on. Details of these interviews are described in section 4.2 and 4.3, respectively.

Once the paper-based prototype became stable, we developed a static, digital version using Photoshop. Then we went back to the school two more times and interviewed the teachers again.

The current version of the prototype reflects our best efforts in promoting ease of use as well as scaffolding to the I-Mail users.

### **4. Our Process**

As the field of assistive technology is very broad and new to us, we decided to start by developing something simple whose major challenges have already been addressed by existing technologies. Later on, new features could be added based on perceived demand.

For this reason, we decided to focus on physical disabilities, offering a variety of accessibility modes like direct manipulation (via mouse and/or touch screens), scanning (for single switches), audio feedback and special keyboards. On the cognitive side, we decided to offer a PCS (Picture Communication Symbol) –like interface, which combines pictures with their associated textual captions.

There are already several PCS libraries – some with more than 3000 symbols – available in the market. It would be nice to build I-Mail on top of them.

The process of developing the prototype for I-Mail included:

- Familiarization with technologies for people with disabilities
- Study and identification of design heuristics
- Development of a paper-based, static, hand-drawn mockup
- Heuristic evaluation of the mockup
- Interview teachers with the hand-drawn version of the mockup
- Mockup digitalization

- Cognitive walkthrough
- Additional interviews
- Mockup finalization

The most relevant steps are further discussed in the following sections.

#### **4.1. Heuristic evaluation**

In order to design an appropriate interface for the I-Mail project it is an essential task to consider the currently existing heuristics. This includes both, general guidelines for designing interfaces as well as existing guidelines for the development of interfaces for disabled children. The below mentioned heuristics have been applied to the I-Mail interface prototype:

- **Keep it as simple as possible:** focus on the most common tasks and options the user is likely to use. Add more stuff only if necessary. Always ask whether a given functionality or button can be removed or substituted by something better. Personal settings that do not change very often should be moved to the profile manager, a sidekick application that will deal with all the technical details and configurations that only facilitators (caregivers, special-education teachers, relatives, etc.) are supposed to deal with. This is the case, for instance, of e-mail server settings, configuration of specific input/output devices, etc. In addition to that, concepts that are not directly related to e-mail should be avoided. In this direction, the I-Mail hides the idea of file systems -- with files and folders -- and network connection from the user.
- **Be consistent:** Screens must follow the same structure, color pattern and location of buttons. The system should behave as expected for tasks that users perceive as similar. For instance, the button that returns to the main menu is always at the same position. So are the scroll bars and other controls. The way a message is replied to is very similar to the way a message is sent, etc.
- **Be accessible:** provide basic accessibility mechanisms and allow the user to configure them for his/her specific situation. In terms of physical access, provide support for single-switches, pointing devices, special keyboards and so on. Let the user -- or the facilitator -- adjust color, size, volume, fonts, speed, etc. Avoid timed responses. Test the system with monochrome screens and with the absence of any of the above mentioned kinds of feedback. Design accessible references and manuals.
- **Allow for complementary/redundant feedback:** all audio and/or visual elements should have a text description. Textual elements should be complemented by an audio-visual representation. On the I-Mail interface, every button has a clear text description and an associated icon and audio output. Avoid referring to screen elements by their associated color, shape, associated sound, or relative position.
- **Prevent user errors and provide understandable support:** this can be achieved by means of

- a) **Comprehensive feedback:** let users perceive the effects of their actions. Also important steps (delete, send, etc) have to be confirmed by the user. Users should be aware of what is happening in the system.
- b) **Sense of location:** it is important for the user to know which part in the interaction they are currently in and which branches can be taken. (Also: which consequences will result when taking a certain branch). For instance, the "main menu" button is always accessible and helps users return to the first screen of the system. We also avoided relative references from one screen to the other, i.e., a button called "back" instead of the "main menu".
- c) **Guidance:** make explicit the exit and next obvious actions that can be taken. Limit the choices the user can make. Break tasks down into meaningful and simple pieces. For instance, the "main menu" asks what the user would like to do and presents a small set of options. If the user chooses "write message", he/she is led to a page with just two options: either select a person from the address book that he/she wants to write to, or hit "main menu" to go back.
- d) **Online help:** this includes immediate feedback on errors as well as counsels of how to avoid them in future. For instance, pressing the "send" button before writing any single line of the message will pop up a window with a warning.
- **Make it attractive and fun:** the interaction with the I-Mail interface should not only be accessible and easy to use, but also aesthetically pleasant and, whenever possible, fun. Disabled users should feel as if they are using a tool like everybody else. Moreover, users should enjoy using I-Mail and be motivated to keep writing and reading messages.

#### **4.2. Interviewing users (hand-drawn mockup version)**

The purpose of our visits to the Eisenhower Elementary School in Boulder was to learn about the future users of I-Mail, which included the disabled and their facilitators (the people who usually support them in daily activities), and the way they interact with one another and with technology in general.

We got very useful information from our discussions with special-education teachers and also by watching the children work and use existing computer tools. The results of our visit contributed a lot to the design of the I-Mail prototypes. Below are some questions we asked the teachers:

- What kind of disabilities do the students that you are working with have?
- What kind of communication tools do you use?
- Do the children use computers? If yes, which software and for which purpose?
- What are the good and bad sides about the software used?
- Would I-Mail be useful for the children? Would they like to use it?
- What would be the pros and cons of a tool like I-Mail?
- Which changes and adaptations would you propose to the I-Mail interface?

Even though we initially intended to ask questions to the students as well, we decided that the advice and information that we got from the teachers was plenty and answered all the questions we had at this stage of the development. Later on, after developing a more realistic and dynamic prototype, we would like to come back and interact directly with the students. We also thought that a paper-based mockup would be too abstract for the cognitive level these students had, or even too inaccessible for their physical conditions.

Below is the detailed report of the feedback the teachers gave us.

- The first person that we talked to was Erika, a teacher who is working with kids at 1<sup>st</sup> and 3<sup>rd</sup> grade who have reading disabilities. She told us that most of her kids were able to use computer tools and would use the computer frequently to write text. Educational games on computers are used as well. The general tools used to teach children are picture cards with text, “syntax sheets”, “Co: Writer” (by Don Johnston) and “Write: Outloud” (a computer based tool published by Franklin Electronic Publishers). According to Erika, most of her older students would probably have no problems using standard e-mail programs. This means that students with this sort of reading disabilities will not be the primary target group for the I-Mail program. However, she mentioned that a tool like I-Mail would probably motivate her students better because of its ease of use and graphical interface.
- The situation is different for children with cognitive disabilities, though. Our conversation with Barbara, a teacher who works with multiple-handicapped kids aged five to twelve, showed that this group would have many difficulties using existing e-mail programs. She explained that in general computers are a big help in teaching and that I-Mail could be helpful for some of her students. She recommended us to focus on the cognitive level rather than the age for the specification of the user group. The cognitive level differs a lot among her students, but almost never reaches beyond that of an average 3rd grade student. She explained that, in particular, autistic children like dealing with pictures. Her largest concern was that her students do not like to write by themselves. They have to be pushed. “They do not see the point in writing”. So motivation would be a key aspect for the I-Mail success. We hope to motivate the users by combining text with pictures and by providing alternative and complementary means of feedback. Receiving and replying messages should also be a motivation by itself. Barbara also showed us the computer tools some of her students are using currently. These tools are all based on simple interactions and task visualization.

In the end, most of the feedback we got regarding the I-Mail prototype was positive. However, there were some specific suggestions to optimize the interface. They included:

- The ‘read message’ button should blink or change to a specific color when there are new messages.
- Use frames and/or highlights to identify new message in the Inbox folder.
- Make background that indicates the cursor position very obviously.
- The ‘help’ button we intended to place on every page is not necessary.
- Simplify the ‘write message’ screen by getting rid of all unrelated buttons.

- Sent messages should be stored automatically and be available in the profile manager.
- An unfinished message is stored as an unfinished message and can be finished at the next session.
- Unfinished messages should be stored and become available to the users in the main menu.
- Received messages are organized and presented by date.
- The presence or not of some buttons should be customizable.
- Provide template messages (e.g. birthday card, Christmas card, letter to parents, etc) to be filled in so that students who are not able to compose messages from scratch will be able to use I-Mail as well. We will keep this proposal in mind and might implement it as an option to be set in the profile manager.

### **4.3. Cognitive walkthrough**

After several visits to the school and interviews with teachers, our prototype became more stable. We then started to implement a digital version using Photoshop. Since we started out with only one design, we did not have to go through the process of selecting the best one to implement.

After implementing the digital version, the next step was to test it with the teachers. Since our prototype was so simple in both layout and functionality, we did not ask our interviewees to go through all of the tasks. In some cases, we just applied the experience we had gained from the heuristics and the interviews.

We tested the basic tasks that were to be supported by I-Mail. They included reading messages, writing messages and finishing a message. For example, the task of writing a message is accomplished using the steps below. Screenshots of the prototype are attached in the Appendix. The picture numbers in the described steps also refer to the pictures in the Appendix.

*Step 1:* Go to the “Write Message” screen

In figure 1, click on "Write a new message", or press enter when the option is highlighted.

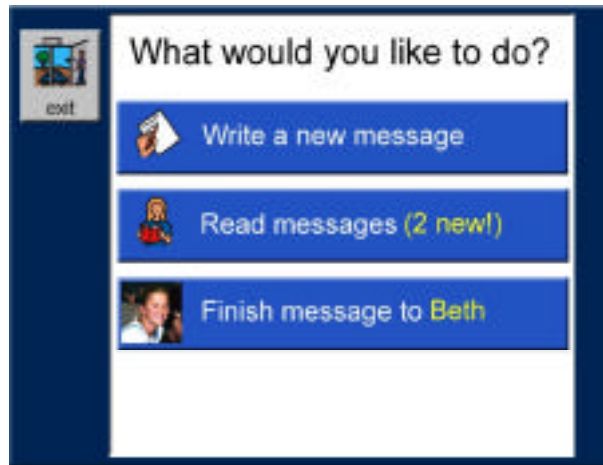


Figure 1: Main screen

Step 2: Choose a person the message will be sent to

Figure 4 appears, click on the person to whom the message is sent, or press enter when the person is highlighted.

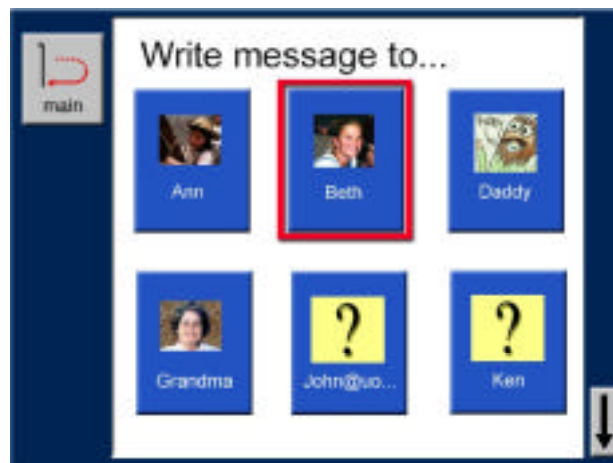


Figure 4: Write a message

Step 3: Write the message

When figure 5 appears, type the message in the text area. As soon as a word is entered, its associated picture is shown on the screen. To go to "picture keyboard" mode (represented in figure 6), click on "pictures" or press enter when the icon is highlighted.

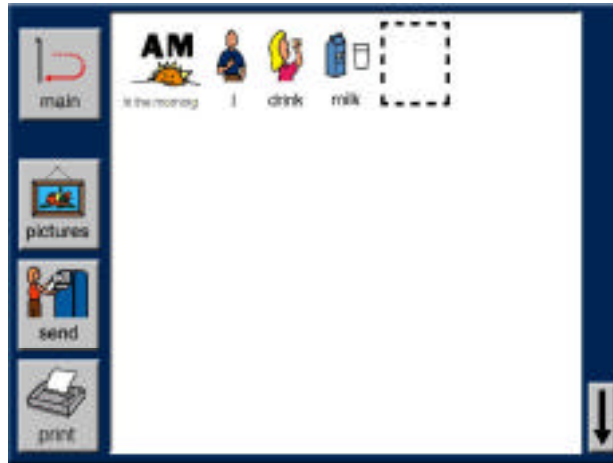


Figure 5: Write a message in "standard keyboard" mode

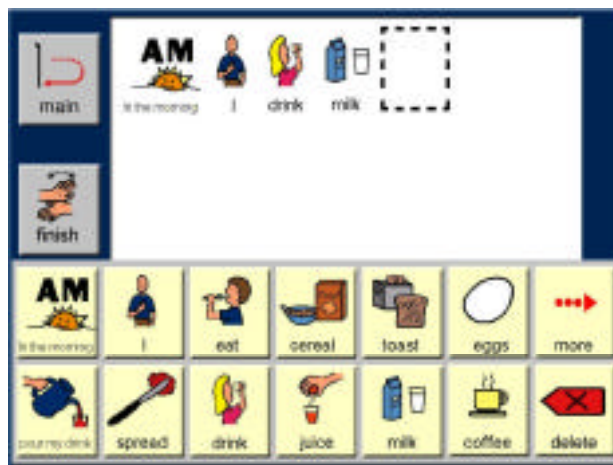


Figure 6: Write a message in "picture keyboard" mode

In "picture keyboard" mode, click on the picture or press enter when it is highlighted to insert it in the message. To return to "standard keyboard" mode, click on "finish." And figure 5 is displayed again.

At any time in step 3, if the "main" button is pressed Figure 9 appears asking if the user would like to finish the message later. If "yes" is chosen, the message is saved and figure 1 appears.



Figure 9: Saving Confirmation

If “no” is chosen, figure 7 appears asking for deleting confirmation. If "Yes" is chosen, return to figure 1 (main screen). If "no" is selected, return to figure 6.



Figure 7: Delete Confirmation

Doing the cognitive walkthrough helped us minimize the steps of accomplishing a task. However, we needed more confirmation from the teachers at Eisenhower Elementary School to be sure that our prototype was indeed the simplest and easiest to use.

#### **4.4. Reviewing the digital prototype**

We went back to the school with our digital version of the prototype and asked for some more feedback. Since we had only implemented a static prototype we did not actually make any user tests. Thus we introduced the interface to Barbara, the teacher who already helped us evaluate our hand-drawn prototype. Her reactions were very positive. We presented the screens and went through them one by one, discussing the good and bad sides of each screen. Here are the results of our discussion:

- *Figure 1*: There was only one change, which is not related to the design. We decided that it might be good if the user was able to choose between more than one unfinished messages. Thus all unfinished messages will show on the first screen.
- *Figure 2*: Barbara argued that the way we were showing the sender and the subject of the messages could be confusing for the kids. So we decided to present the messages in the same way as in the “Write a message to...” screen by only showing a picture of the sender. The advantage would obviously be that the options would be easier to identify and choose. The disadvantage would be that the title line is not shown. The user has no idea what the message is about, especially if the sender is unknown.

- *Figure 3:* The mockup of this page will be left unchanged. The “read out” button will read the whole message at once. Options like “read only one word at a time” and “read only one sentence a time” will not be available. For educational reasons, Barbara also suggested that the option "read out" could be very useful, especially if each word is highlighted when read out.
- *Figure 4:* There was nothing to be changed.
- *Figure 5:* We decided that depending on the options marked in the profile manager, a different screen will appear. If the settings are made for a picture library showing up on the bottom of the screen -- like the "picture keyboard" mode mentioned in the previous section, there will be a button “finished” which leads to a second screen showing the message on the whole page and the buttons “send”, “print” and “pictures”. If the settings were made differently, the user would directly go to this page and write a message without choosing pictures from the library. However she/he has the possibility to go to that screen by pressing the “pictures” button.

We were also glad to hear that Barbara liked the colors and that she is “getting excited to test the program”. The proposed changes have been implemented and constitute the version presented in the appendix.

## **5. What we have learned**

Based on the heuristics evaluation, we started to design the very first version of the prototype and found that sometimes it is not feasible to follow the heuristics strictly. In some cases, conflicts occur when these guidelines propose different solutions or disagree in certain areas.

Since there are no specific guidelines for the design of e-mail programs for people with disabilities, a lot of the decisions have to be taken intuitively or based on concrete understanding of user needs, and then be revised later if they turn out to be inappropriate. The most important goal will be to keep the interface as simple as possible and easy to use. However, to keep the interface simple yet provide enough functionality turned out to be a more difficult task than one would expect.

In fact, we had to redesign the I-Mail interface several times. Our images and mental models of how an e-mail program should look like and behave were so dominant that it was hard to reduce the I-Mail interface to the absolute minimum.

Our visits to the Eisenhower Elementary School, where children with physical and/or cognitive disabilities are taken care, provided important contributions to the design the I-Mail interface prototype. After talking to some of the teachers we agreed with them that we had to turn over some guidelines that we considered important in the first place. This is why, for instance, the I-Mail interface does not have help buttons, configurations can only be made in a separate profile manager, and users are not asked whether they want to save their messages.

Below is what we have learned from the situation described above.

- **Universal design is more than design for inclusion.** We want to develop a tool that even people with disabilities are able to use. Something that is physically, cognitively **and** aesthetically accessible. In fact, we want the same tool to be used by everyone. We do not want to segregate people with disabilities even more. We did not have this idea at the beginning and it seems to make more sense to develop a "universal mail" than an "inclusive mail". If we follow in this direction, we will have a strong differential to tools like the Inter-Comm, which focus only in people with special needs.
- **Do things as simple as possible, but not simpler.** Obvious things are usually not obvious. Sometimes we are so used to things that we do not even imagine that there are other possibilities. For instance, do we need to explicitly save files? Do we need to explicitly delete files? Do users need to know what a file is? Do they need to worry about message folders? What can be eliminated from the e-mail client without restricting its use too much?
- **User's opinion is vital.** In our case, we need to interact with special education professionals to understand what is essential and what is desirable. We also need to see actual users interacting with special tools. For instance, how would we find out that writing a single message is an activity to be broken down into several sessions?
- **Defining users.** Instead of defining users per general disabilities like Down Syndrome or Cerebral Palsy, it is better to define them in terms of physical and/or cognitive disabilities. It is very hard to characterize general disabilities -- they hardly appear alone and can include a large range of variations -- and professionals do not deal with disabled people this way. There are too many variations within the same disability. If we approach the design focusing on basic physical and cognitive disabilities, we provide more flexibility for everyone and can deal with different combinations of disabilities. The problem is that we will add more complexity to the "profile manager".

Based on this rationale, we defined I-Mail users according to the following table:

Kind of disability	I-Mail feature
Physical Disabilities such as motor skill deficiencies, hearing and/or vision impairments	<ul style="list-style-type: none"> <li>• Audio feedback</li> <li>• Scanning for single switches, no timed responses</li> <li>• Direct manipulation interfaces like mouse and touch-screens</li> <li>• Alternative keyboards such as IntelliKeys and Liberator</li> <li>• Possibility to change the visual organization of the elements on screen (like having 4 pictures per screen or 8 pictures/screen...)</li> </ul>

Cognitive Disabilities such as low-cognitive levels, or even people who are learning to read and write	<ul style="list-style-type: none"> <li>• Provide combinations of text-only, picture and symbol based interface</li> </ul>
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And our users go beyond the people who are going to write/receive e-mail messages. They include the facilitators who work with them, researchers and so on. It is important to notice that facilitators are really part of what is required for a disabled person to deal with messages. They help configure the system and provide motivation and support to users. They are the ones who create the context for the tool usage. In fact, we see I-Mail not as an e-mail tool; it is a tool that provides support for the whole task of dealing with e-mail messages.

- **We do not need to become experts in disabilities.** We need to have experts available and know how to communicate with them, though. However, it is very important to play with augmentative communication tools and other devices that are used by people with disabilities. This may help us build an understanding of state-of-the-art technologies and the kind of solutions that seem to work for specific problems. It really helps us to not reinvent the wheel. For instance, how to implement scanning? What kind of support can be offered for writing and/or reading?
- **Design for a different platform.** For people with disabilities, communication devices can be seen as a combination of computers and special hardware interfaces. This opens a series of possibilities that are not usually explored in the design of more traditional applications. For instance, if we want more space on the screen, we can move some of the buttons to a special keyboard.
- **Lack of tools.** There does not seem to exist special development toolkits targeted at the construction of applications for people with special needs. On the one hand, software combinations like Photoshop and Toolbook help create very nice looking applications that are hard to be tested or extended to deal with people with disabilities. On the other hand, systems like Dynavox System Software -- that have not been created as software development tools -- already come with hundreds of components and combinations of components. Everything that you do with these components already supports all kinds of special interface devices. However, the system is pretty complex and expensive to program -- at least for beginners.
- **The importance of a paper-based mockup.** Even though our paper-based, hand-drawn mockups lack the details and the color of digitally implemented mockups, they proved to be good enough to communicate our ideas to the special education teachers. Moreover, they were simple enough to create, which allowed us to quickly change them to represent ideas being discussed right at that time. They also opened space for the teachers themselves to draw their own views of the system. We believe this could not be done in the computer. Now that the mockup is more stable we will implemented it on the computer and go for another sessions with prospective users.

## **6. Next steps**

- Define the profile manager
- Implement the functionality of the prototype
- Test the prototype with real users
- Compare the prototype with other special e-mail tools being released in the market.

## **7. Acknowledgements**

This work would not be developed without the support of a good number of people. Special thanks to the Coleman Foundation for the funding, and to Rosemary Bogart, Erika Brandstatter, Rogerio dePaula, Anja Kintsch and Barbara Shuttenberg for the excellent ideas, gigantic patience and extraordinary collaboration skills.

## Appendix

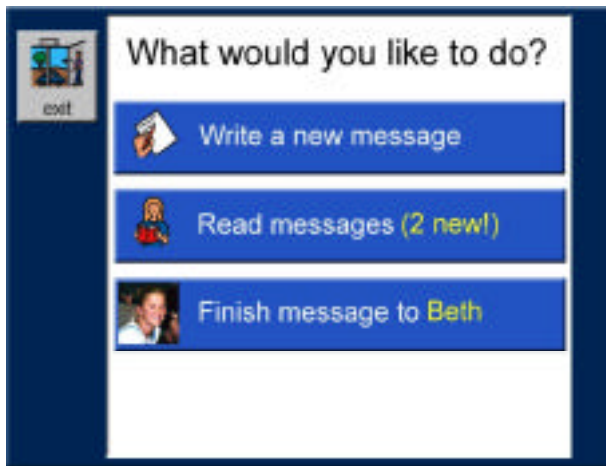


Figure 1: Main screen

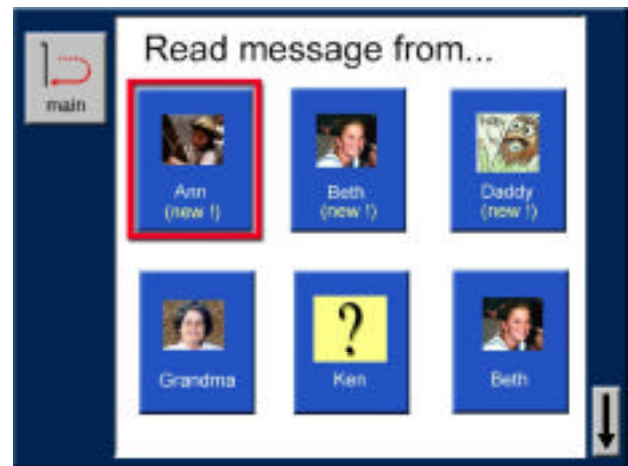


Figure 2: Read messages



Figure 3: Read a specific message

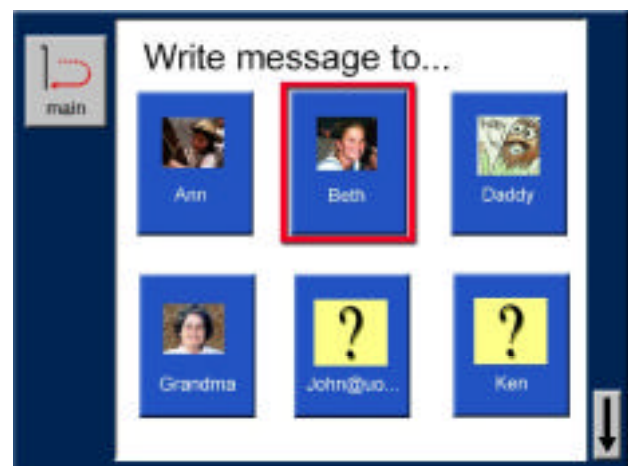


Figure 4: Write a message

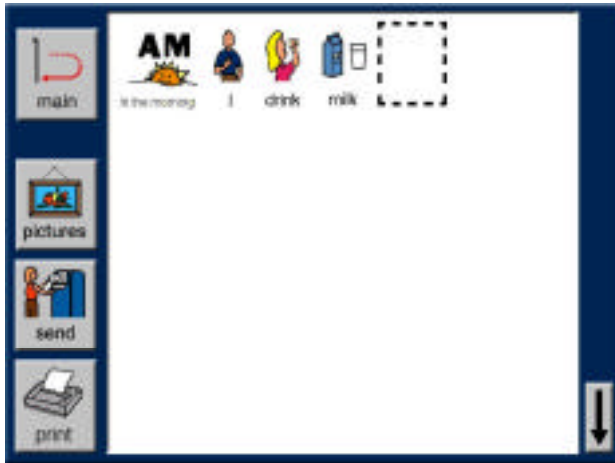


Figure 5: Write a message in text mode

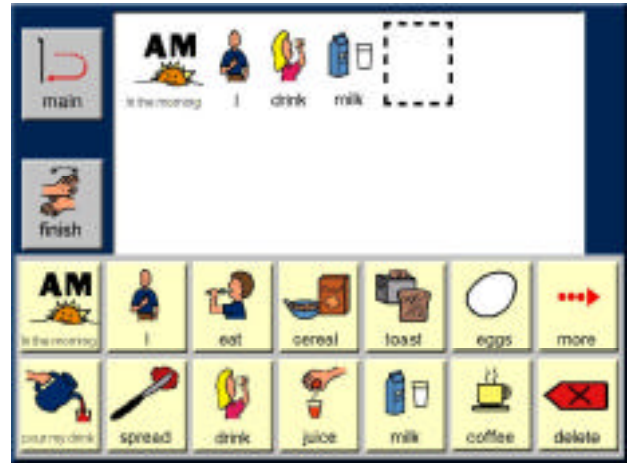


Figure 6: Write a message in "picture keyboard" mode



Figure 7: Confirmation of deleting

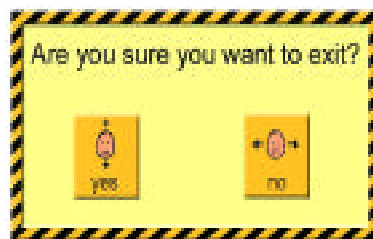


Figure 8: Confirmation of exiting



Figure 9: Confirmation of saving