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# Grocery Order Application for Elderly



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# Abstract

The purpose of this thesis was to create a system for elderly to independently order groceries from their home using the Anoto pen and paper technology. Working with elderly combined with IT puts stringent requirements on the technology. There are several reasons for this and the more explicit of these are the implications on the body with age such as sensory perception and cognitive skills. This required an extensive pre-study into elderly behavioural patterns through research and user tests. The more implicit requirements are the psychological factors of integrating technology with elderly. This is a barrier of acceptance from elderly that has to be overcome in order for the product to be a success. Based on the pre-study of elderly combined with research into available grocery-ordering methods and the Anoto system, the implementation phase was commenced.

The first part consisted of designing an intuitive graphical interface for placing the order. This involved several user tests as well as contacting people in the grocery industry, design industry, and researchers in the field of work sciences. The result was an order form based on four steps namely choice of store, selecting the desired products, deciding a delivery time, and finally sending the order.

The second part of the implementation involved the supporting technology behind the order form. A dedicated part of the Anoto pattern, which consists of a grid of slightly displaced dots for absolute positioning on the paper, was printed on the order form. When writing on the pattern with the Anoto pen, every stroke made is interpreted by an infrared camera underneath the pen tip and stored in the pen. Once the whole message has been written, it is transferred via Bluetooth to a mobile phone, which sends it over the Internet to a predefined destination contained in the message.

The grocery order application consisted of three main parts. The first part interpreted the incoming order strokes and either creating images such as the handwritten product selections or logical analysis of what boxes had been crossed. Secondly, this information was stored in a database, which also contained user information linked to the owner of the pen. The third and final part extracted the whole order from the database and created an order with products sorted to create an easy to use packing list based on which store the order was sent to. The whole order was encapsulated as an email and sent to the relevant store.

The system was tested with a small group of elderly, which gave positive results. Being a low-tech application in the eye of the user, it was well received. There are several improvements that can be made in order to establish faith in the technology. The tests were however carried out in a prototype environment, which obviously puts limitations on what can be achieved. The conclusion can be drawn that elderly understand this method of ordering and it can be of great benefit to them. The technology would also improve the Social Services quality of care for the elderly.

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# 1 Preface

Being two students having created a cigarette holder for a person in a wheelchair in a previous project, it felt natural to create an application for people with some kind of disability.

First we would like to thank each other for a fantastic cooperation and many memorable late evenings.

A special thank to our supervisors Gunilla Knall, Certec and Kristofer Skantze, Anoto. Gunilla has been a great support from the human angle and supported us when things haven't been what they're supposed to be, according to us. Kristofer has been very interested and enthusiastic and he has given us constructive criticism throughout the project.

We also want to give a special thank you to Ola Sandström, Communication Software Anoto, for many important hours of help with developing the software, and to Henrik Ekenberg, Database Engineer Anoto, for invaluable help with our database in Stockholm.

Thanks to Mattias Bryborn, Software, Stefan Lynggaard, Operating System, Andreas Olsson, Image Processing, Markus Narding, Database Engineer and to all other people at Anoto who have been in contact with our project.

We have learned a lot of theories from Britt Östlund, PhD, Telematics and our test persons have given us the connection to the reality. Thanks to you and thanks to everybody else mentioned in this thesis.

Finally we want to show appreciation for our families and friends who have supported us throughout.

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# 2 Introduction

Usefulness is a very important subject that has often been neglected in any form of design in the past. To create an application with a useful interface for both the user and others affected by it was the overall goal for this thesis. The application itself was a Grocery Order Application for elderly using the Anoto technology.

The beginning of the project contained an extensive pre-study of elderly and IT, research of the requirements for this application, and a look at the already existing competitors to it.

The application was structured and then followed a design process of the graphical interface, mainly consisting of meetings and tests to be able to create an intuitive and useful interface for the user.

Later in the thesis there is an overview of the implementation phase, which became a huge part of the project.

Finally a test of the application was made to evaluate our final product. An analysis of the whole project as well as conclusions made, are found in the end of this thesis. The multi-faceted nature of the project has limited the knowledge depth of each area of interest to the requirements of successfully creating a working application.

*Keywords:*

Elderly, groceries, interface, intuitive, ordering, pen and paper, social contact, usability.

# 3 The Anoto concept

This section will give an insight into both the concept of Anoto as well as an overview of the actual technology behind it. The main reference for this is the website at <http://www.anoto.com> [9] in order to avoid any breach of the non-disclosure agreements. A more in depth look at the actual pattern and pen technology lies beyond the scope of this paper.

## 3.1 Concept

### 3.1.1 Overview



Figure 1 The Anoto pen

Anoto's goal is to create a global standard for so called digital paper. The use of pen and paper is a basic skill common to most people today. This tool simplicity is the beauty of the whole concept. Underneath this facile surface however lies cutting edge technology, which the user hardly has to know about. The user will regard the Anoto pen as any other pen and the paper is still an ordinary piece of paper. This means that there is virtually no time spent learning how to use it which is a common denominator for most hi-tech products today. It is a way of reinventing an old and proven tool and also enabling the use of new technology without having the technical know how.

### 3.1.2 A slice of history

The origin of language is the primitive communication form of cave painting 20 000 years B.C. The reason for these paintings could have been to fulfil several purposes such as mark important events, to log their own history or perhaps a way to communicate easier with other humans. The reasons can be many but the key fact is that they wanted to communicate on a higher level in some form.



Figure 2 The writing tool has taken on many appearances

Writing began about 6000 years ago and emerged in a region from Egypt to the Indus valley. Compared to speech or painting, writing is a relatively new form of communication but far superior in several aspects. When we write, we think and analyse what we are communicating. The ability to express thoughts and emotions for someone else to appreciate asynchronously is recognized as very valuable. Writing is a cornerstone of civilization and is constantly changing. The tools remain the same for both painting and writing, and even if it has taken on several appearances over the years, it is still a form of pen and paper.

### 3.1.3 Applications

As we stand at the brink of the second millennium, the shape of pen and paper has moved into the digital world. The tool is the same but the set of applications where it can be used, has broadened dramatically. The pure communicative applications have now extended from writing an ordinary letter to being able to send email, fax, SMS, and digital postcards without having to use a computer. Organizational activities can be greatly improved with Post-it<sup>®</sup> notes and organizer entries are automatically entered in a digital version on a computer for reference and backup. All journaling and filling in forms are automatically inserted in databases without any additional manual labour, and can immediately be accessed for analysis. On a commercial level, there is a vast amount of applications where orders can be placed straight out of magazines, newspapers, and catalogues. These services are yet another application area, which can be seen as a form of order, under which GOA (Grocery Order Application) falls. Anywhere a pen is used today, the Anoto pen can be used but with the added advantage of having embedded intelligence to perform a variety of tasks automatically.



Figure 3 Information of the patient's health is sent directly from the ambulance, as it is jotted down, to the hospital so that any necessary preparations can be made

## 3.2 Technology

### 3.2.1 Overview

The technology consists of three main building blocks namely; 1. The Anoto pen, 2. The Anoto Paper and 3. The Anoto Communication System. They will be discussed in detail further on. In order to get a clearer picture of how the three blocks fit together, it is necessary to draw up a mental picture of a chain of events.

A small part of a special pattern is printed on ordinary paper on which the pen can uniquely recognize an area of 2x2mm<sup>2</sup> to pinpoint its location. The total size of the pattern can roughly be compared to the land area of the US. Every line drawn on the paper is stored in the pen until a "function" box is marked.

These "function" boxes signify that an action is to be performed upon all the text written and images drawn. The information is either to be sent off as an email or stored in a computer or some other application, to which that particular part of the pattern refers.



Figure 4 The pen sends messages via a mobile phone, relayed by the ANS to the recipient, which in this case is a laptop.

\* Bluetooth™ is wireless technology that eliminates the need for devices to be connected by cable in order to send and receive information

The transfer of the data from the pen is either to a local computer, mobile phone or other \*Bluetooth™ device. If a direct connection to a computer is made, the data knows where to go but if the data is to be transferred over the Internet then the destination has to be determined. This is determined in the ANS (Anoto Name Server), which keeps track of the function boxes and redirects the data from the pen to the correct receiver, be it a mail server, order department, or mobile phone.

### 3.2.2 Anoto Pen

The pen has the appearance of an exclusive ballpoint pen and indeed serves as one with an ordinary ink tip. Inside it however, there is a circuit board containing all the electronics to read the pattern, store it, and send it. Figure 5 reveals the main parts of the pen.

There are no buttons on the pen, just one LED (Light Emitting Diode) communicating different states such as charging etc. with the user. The pen is switched on when the cap is removed and it can be used instantly.

When writing, the camera takes snapshots of the pattern on the paper 100 times per second. Since the pen emits infrared light onto the paper to illuminate the printed carbon based ink dots, which make up the pattern, it can take sharp images without interference from the ink in the pen. This means that no matter how many times you draw a line in a certain area, the pen will always be able to determine its location.

The digital images are then computed upon in real-time in the processor to determine the exact coordinates at any given time. The data is stored in the memory until the user indicates that it is time to send the information. The information is then transferred by the Bluetooth transceiver to a Bluetooth compatible device such as a computer or mobile phone.

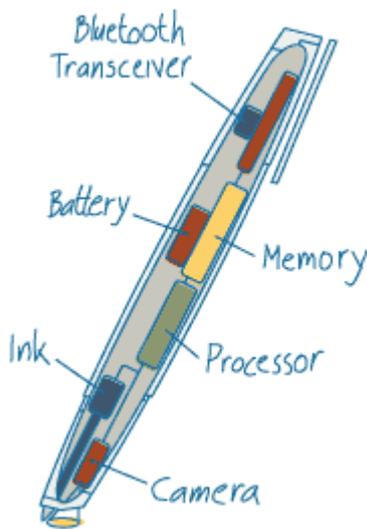


Figure 5 The main parts of the Anoto Pen

### 3.2.3 Anoto Paper

When talking about the Anoto paper, the actual interest lies in the pattern printed on the paper. This pattern has a total area of 4.6 million square kilometres, which is equivalent to 73 trillion unique letter-size sheets of paper. Each area of the pattern can be dedicated to a certain function. To illustrate this, a certain part of the pattern may be dedicated to send the message while another area can be a text or tick box.

When the processor recognizes the send part of the pattern it knows to send everything in the memory. Some areas of the whole pattern might belong to a 3<sup>rd</sup> party service provider who can decide what each area of his/her piece of the pattern is used for, such as a message box or a tick box in an advertisement. The pattern is printed with carbon-based ink that absorbs infrared light. The camera can therefore read the pattern even if there is something else printed on top of it. The pattern can be printed on any surface allowing 1000 dpi resolution i.e. most types of paper. The actual pattern is a slightly misaligned grid pattern made up of dots that with their relative position to each other gives a unique location in the grid for each area of 6 times 6 dots.

### 3.2.4 Anoto System

The pen reads the patterned paper and can store several pages of written information. When it is ready to send the information via Bluetooth, the information can take two directions. These are to a local recipient such as a computer or remotely over the Internet via a mobile phone or other intermediate device. In the case of an Internet transfer, a header containing the user information is sent to the ANS (Anoto Name Server).

The ANS returns the IP (Internet Protocol)-address of the 3<sup>rd</sup> party service provider that owns the particular application, which the pen has read from. The redirection of the data stream is performed by the ANS while the actual stream goes straight to the service provider server. This so called Anoto look-up service (ALS) works as the spider in a web and connects pen users to various service providers. The receiving end i.e. the providers, will then analyse the stream of data and determine what has been sent in accordance with how they designed their application.

The steps of the operations to a local computer can be seen below and in figure 7 (reference from web page [9]).

- 1 Data (pen ID, x,y-coordinates) from the Anoto pen is sent to your computer.
- 2-3 The software together with the Application Definition Database gives instructions to the pen on what data to send, how to format and tag the data, and to which local application to send the data.
- 4-5 Pen-stroke information, together with information about the local application, is sent to the local application that handles the request.
- 6-7 "OK" is sent back to the pen, clearing the area.

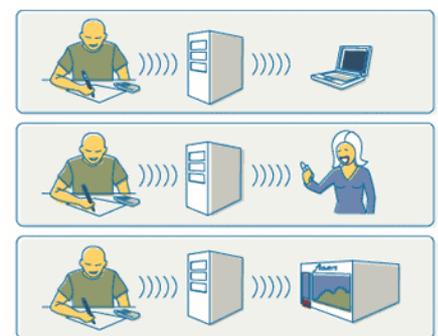


Figure 6 Send messages to laptop, mobile phone or store

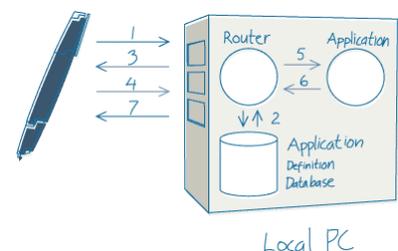


Figure 7 Local Connections

The steps of the operations over the Internet can be seen below and in figure 8 (reference from web page [9]).

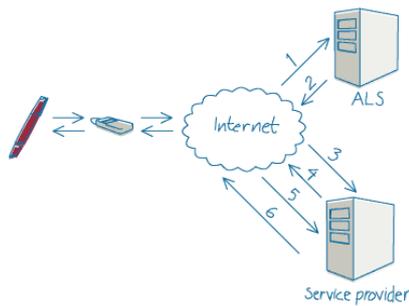


Figure 8 Internet Connections

1 The information (pen ID, x,y-coordinates) is forwarded via a Bluetooth device, such as a Bluetooth mobile phone. The phone relays this information to the ALS (Anoto Look-up Service) via Internet.

2 The ALS instructs the pen to contact the service provider's name server.

3 The information (Pen ID, x,y-coordinates) from the pen is sent to the provider's name server.

4 The provider's name server instructs the pen on what data to send, how to format and tag that data and where (to which service handler) to send that data.

5 Data is sent to the service handler.

6 "OK "is sent back to the pen clearing the area.

# 4 Pre-study

## 4.1 Introduction

From the beginning it wasn't clear which target group to prefer for this project and what application there was a need for in that specific group. Since focus was on elderly people and not their carers, the people receiving help from the Social Services were to be preferred. The reasons for this are because elderly people using Social Services live in their own homes and spend a lot of time by themselves. There was now a focus on meeting the needs of the elderly using Social Services but also to increase the efficiency of the carers, which in the end would benefit the elderly.

After having decided to put focus on people using Social Services, contacts were set up with several groups of carers in different areas in Lund. The reason for contacting groups in several areas was the many differences between them due to organizational structure, geographical limitations and social classes. The worst-case scenario occurs when trying to find out what an organisation needs by asking the direct question, "what do you want?" The interviewee can't possibly know what the technology can offer them and thus can't make a valid judgement of the needs that can be fulfilled. Therefore there was a short research of the Social Services before meeting them to have some ideas to introduce to them and letting them evaluate these. After the meetings, it was clear that the main problem for all parts was the buying of groceries for the elderly. This included the handling of their money and the physical buying of the food, which led to lack of time to socialize with the elderly. It has to be taken into consideration that this was the carers' point of view but in fact it's the elderly people who are affected by the problem. The elderly people receiving care from the Social Services and require help with their shopping, actually get a decreased quality of life since the carers don't spend their time socialising with the elderly.

It was now clear that the objective was to create a grocery order application for elderly people using the Social Services. In order to continue the research we decided to engage the USERfit model [8] to some extent, where we would focus on a handful of individuals and tailor the application around them. These individuals would thereby be a representation of the elderly community. There was now focus of the pre-study to a well-defined area within the care for elderly people.

## 4.2 Elderly and IT

### 4.2.1 Introduction

This section summarizes our research of the interaction between elderly and IT. Conclusions are based on own thoughts and experiences but also on discussions made with Britt Östlund (PhD Telematics) as well as reflections relating to her literature.

### 4.2.2 The implications of ageing

A large problem in our society is that the amount of people aged 16-64 in relation to those aged 65 or more, is decreasing. Back in 1960, the ratio between supporting people and people older than 65 was more than five. Statistics say that in 2025 the ratio will have decreased to three [3]. Since technology is continually becoming a greater part of everyday life and the fact that the elderly represent a growing community, it is important to amalgamate the two to function in harmony.

Nbr of people 16-64 in relation to a) older than 65+ and b) younger + older (0-15 plus 65+)

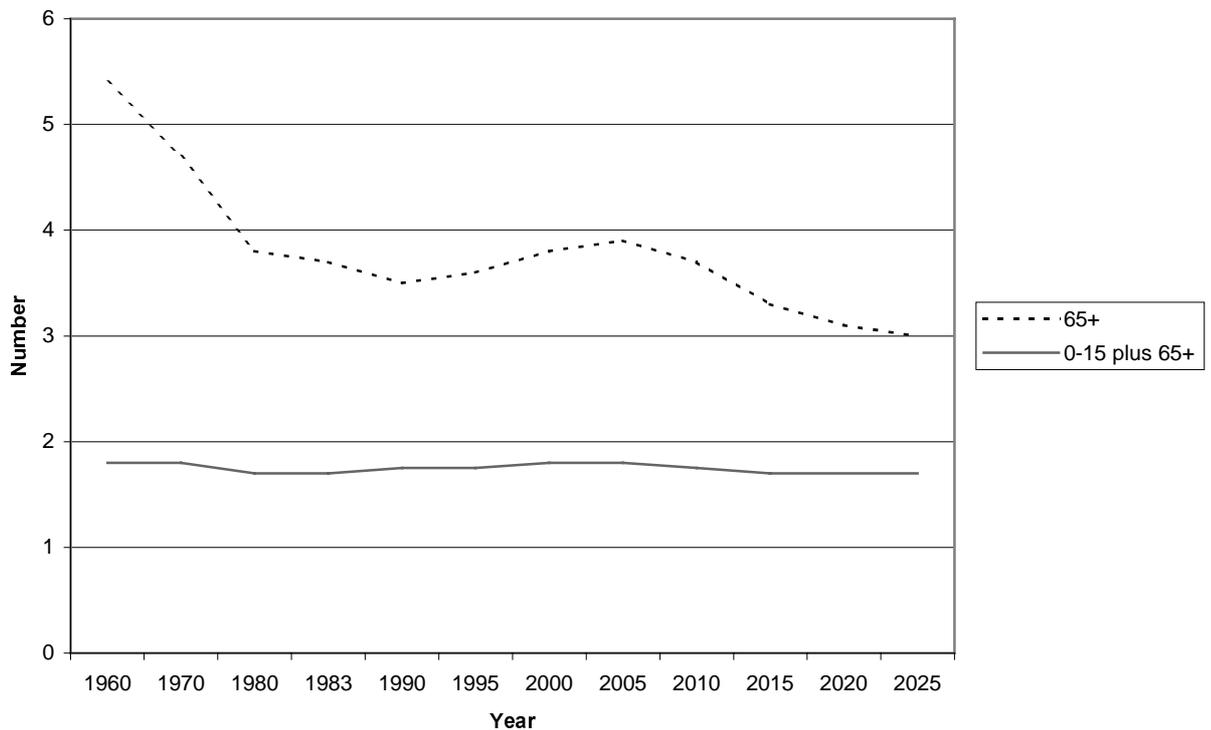


Figure 9 Graph of number of elderly in relation to people aged 16-64 over time

The ageing process inflicts restrictions on a human being such as mobility, sense reception, cognitive skills and memory. On top of this there are social changes, an altered perspective of life, and a different competence level exchanged with society [1]. In the case of introducing new technology to elderly, all these restrictions have to be taken into account in the design. In the case of GOA, the main areas of interest have been eyesight, cognitive problems understanding the concept and the actual order form, mobility regarding handwriting, and the general acceptance of the whole application. By correctly designing new technology aimed for this market, it may be accepted and used. Thereby the quality of life of the elderly can be greatly improved.

#### ***4.2.3 Attitude to new technology***

It is also important to understand elderly peoples' attitude to new technological developments in order for the product to receive positive feedback. There is a general belief that elderly are against new technology, lack ability to understand it, and prefer the old way of doing things. This however is a common misunderstanding and is just how they are perceived. This is particularly the case in today's IT industry with its future focused tendencies [2], where this project is an exception. The reason for this conflict is the lack of understanding of the stage in the life of an elderly person. Elderly do not lack the ability to learn but rather the motivation to get to grips with yet another innovation. The cause for this is their relatively short perspective of the future and that they put more value in the past. Less interest in new technology can also be caused by elderly being more circumspect and to some extent, increased fatigue. When the desire to understand the technology is absent, assumptions are made about it. Many elderly believe that all technology costs a lot of money. This theory is based on assumption and strengthens the image of elderly as resistive to new technology. Research concerning elderly and communication by Britt Östlund (PhD, Telematics) has shown that there are no resistive signs towards new technology amongst elderly.

#### ***4.2.4 Adaptation of technology***

One difference between elderly people and younger generations is the lack of experience of the elderly to sort and choose information. They have grown up in a society with a shortage of information, which results in a scenario where they first read all information followed by a step where everything is filled in.

The fact that there are barriers between elderly and technology doesn't mean that they can't be overcome. Since the old saying "you can't teach an old dog new tricks" is true to some extent, the technology should be moulded around the elderly and not the other way around. The neglect of this theory has caused a critical gap between intended use and actual use. This is the main problem with technology design today, especially when designing for elderly users. Methods of grocery ordering for elderly are of particular interest for comparison reasons to GOA.

In 1991 there was a brave attempt to incorporate elderly people requiring home delivery in an IT project called "Handla hemma" (shop from home). It consisted of 700 computer terminals placed in the homes of the elderly. The elderly were supposed to log on by putting a card in a slot on the computer, typing a four-digit code followed by a password. Then followed a complicated menu system, which the carers were trained to use but had problems understanding too. The main concerns regarding the project were costs, usefulness and level of compliance. The scepticism amongst the elderly was not so much the lack in faith of getting to grips with the system, but rather the fear of loss of the carers help making the purchases. Many therefore claimed that they weren't able to use it or had any use for it for that matter. If the carer had a positive attitude, it would have been easier for the elderly to accept the new technology. The carer is often negative due to the risk of knowledge and power being moved to the elderly. It was a step in the right direction to incorporate IT in the lives of the elderly, but the lack of knowledge of how it would be received caused the project to die out with only 3 of 700 using it on their own. There has been a lot of research done since then, concerning elderly interaction in a simulated 3D environment, in order to improve the on-line experience. The reason for this is that the way elderly acquire spatial knowledge differs. Obviously, there is no way of getting around the use of a computer, which in itself is an obstacle for the integration of IT with elderly. GOA is therefore a different approach, avoiding these obstacles and focusing on enhancing the knowledge, which the elderly already possess, namely the skill of writing using pen and paper.

## 4.3 Store Analysis

In order to know how to integrate GOA (Grocery Order Application) in the home delivery scene, there was a need to evaluate the existing market. Looking at all the larger grocery store chains in the region as well as an Internet based store, gave a well-rounded picture of what was being offered regarding home delivery of groceries. Comparing GOA to other methods of ordering was also of interest from a competition-based perspective.

### 4.3.1 *The extent of home delivery*

The home delivery market segment in Lund was considerably smaller than we expected with only 50% of the stores investigated that actually offered the service at all, namely Malmborgs and Konsum Örnvägen. The results of the investigation can be seen in 4.3.4 *An overview of stores investigated.*

Today, the market is very segmented with almost exclusively elderly and handicapped people using the service since they have no possibility of actually going to the store. There is also a small segment of career families where there is no time to do the shopping. In future however, home deliveries have a possibility to broaden its target market.

By increasing the volume of sales, the delivery cost of the groceries will decrease. Combining this with a hassle free method of placing an order and more frequent high-consistency deliveries, the whole concept of having groceries delivered to the doorstep will attract a wider spectrum of the market.

### 4.3.2 *Services offered*

The services that were offered varied slightly. The main interest areas from our point of view were how an order was received and followed up by the grocery store, what cost and payment methods were employed, and what delivery time and personal relation to the customer that could be expected. Orders received by Konsum and Malmborgs were mainly placed by phone but also occasionally by fax. The order receiving process by phone was tedious and interruptive. It however gave direct positive feedback to the customer, which came to light in the interviews with the store managers and is described later in the paper.

MatoMera, the Internet based store, requires the customers to follow a relatively complex order process, which includes far too much information for an elderly person to grasp. MatoMera is hence not an alternative for this target group. When seeking a specific item, it doesn't seem to exist where it's expected to be found. For example, when searching for "Toalettpapper", which is a submenu of "Papper" which in turn is a submenu of "Städa & Tvätta", the whole chain of submenus has to be known to find the desired "Toalettpapper". If it's not found through the submenus, there is a possibility to search directly by typing the name in a search box. Searching for "Toalettpapper" only gives the items named "Toalettpapper" and search results for "Toapapper", for instance, only includes items named "Toapapper" which can cause confusion since the whole range is of interest. Speaking to MatoMera's advantage however is the direct feedback given via a display of the whole order placed and a confirmation of when these groceries will be delivered.

Malmborgs, being the most expensive food store by 33% at 80 SEK for delivery, offered the best service in total. Both Konsum and MatoMera charged a considerably less amount of 59 SEK and 60 SEK respectively. MatoMera only accepted credit/debit cards, Konsum only accepted cash on delivery while Malmborgs on the other hand accepted all methods of payment. Since the majority of elderly people prefer to pay in cash, MatoMera's payment method was not a very attractive option.

Malmborgs and MatoMera both offer next day deliveries while Konsum only deliver once a week. It can be mentioned that Konsum had a much smaller organisation and customer base compared to the other two stores. Malmborgs and to some extent Konsum had a close relation to the customer, which is important since elderly want to feel secure and trust whoever delivers the groceries.

There was also a service element where Malmborgs and Konsum would accept recyclable goods, vouchers, and help putting perishable goods in the fridge. This was a level of commitment, which MatoMera couldn't live up to.

### *4.3.3 Competition and integration*

GOA can be seen as an alternative to ordering over the Internet, thus being positioned as a competitor to MatoMera. Integration with MatoMera would be virtually impossible without making any changes in their system since it has a very rigid, fully automated ordering mechanism. Every product is specified exactly and can be added to the shopping list using a menu system, while GOA is based on the user adding the specifics to predefined main words such as milk and bread. These details are then interpreted by the store. There was no interest of integration with MatoMera since GOA's concept is based on simplicity and total freedom for the user. There is of course one possibility for MatoMera to integrate GOA in order to reach a larger target group. The best way of connecting them would be if GOA used ICR (Intelligent Character Recognition) to be able to let the system understand exactly what the user orders. Today, the technique for ICR hasn't matured enough this purpose requires.

There is a possibility for the user to order exactly what he/she wants, and to describe it with own words, not having to go through several steps to try to find it. If you never go to a grocery store, there is a risk that you forget what range of groceries the store has. Therefore it's recommended to use the weekly advertising flyer from the stores combined with GOA when ordering.

When MatoMera receives an order it goes straight into their database. When an "ordinary" grocery store uses home delivery, the cashier registers the order, which will be stored in their system. This means that even if ordering by GOA, the order will still be registered in a database. In both cases it's a human being who reads the order when the groceries are being picked.

GOA can integrate well with both Konsum and Malmborgs who operate on a manual basis today by taking orders over the phone. GOA automatically rearranges the ordered items according to the items location in the specific store and puts together the order form consisting of the customer's handwritten order information. It relieves the store from time-consuming telephone orders and increases the accuracy level of the order. The customer gets a chance to stay home in a relaxed environment to write the order without having to feel stressed.

One drawback is the lack of direct feedback. It can be solved by either a confirmation message on the mobile phone screen or a phone call from the store to confirm that the order has been received.

The latter is to be preferred in order to keep the process as low-tech as possible for the elderly user. GOA can be seen as a tool for the store to use to improve their home delivery order system, making it more attractive to use, as well as reclaiming parts of the grocery market lost to the online stores. *See also 4.5 Pros and cons of the application.*

#### 4.3.4 An overview of stores investigated

Stores:	Malmborgs Clemenstorget	Konsum Mårtenstorget	MatoMera	ICA Kvantum	AG Favör	Konsum Örnvägen
<b>Contacted on:</b>	Wed 13/9	Wed13/9	Tue 12/9	Mon 11/9	Tue 12/9	Fri 15/9
<b>Home Delivery:</b>	Yes	No	Yes	No	No	Yes
<b>HD in the future?</b>	Yes	Not considered	Yes	Maybe	No	Yes
<b>Order by Phone/Fax/ E-mail/Internet:</b>	P/F/E/I	N.A.	I	N.A.	N.A.	P 98%/F 2%
<b>Ordering time:</b>	5-10 min	N.A.	5-10 min	N.A.	N.A.	4-5 min
<b>Delivery time:</b>	Next day, within a 2 hour interval	N.A.	Next day 20-22	N.A.	N.A.	Wed 16:00-18:00, order on Tue
<b>Cost:</b>	80SEK if order <1000SEK, else free of charge	N.A.	59SEK if order<500SEK, else free of charge	N.A.	N.A.	60SEK
<b>Payment method:</b>	Credit Card, Account, Direct Debit Card, ICA	N.A.	Credit Card, Account, Direct Debit Card	N.A.	N.A.	Cash, member card for bonus only
<b>Order Confirmation:</b>	No	N.A.	No	N.A.	N.A.	Not unless stated
<b>Delays Communicated:</b>	No	N.A.	No	N.A.	N.A.	No

Table 1 Overview of stores in Lund

## 4.4 Contacts

### 4.4.1 Meeting with Konsum Örnvägen

We established a contact with the store manager Willis Dovrén of Konsum Örnvägen in Lund since this is the single Konsum store in Lund already having a system for home delivery of groceries. He was enthusiastic towards the idea. He received orders by phone, which was quite time consuming and he appreciated the advantage of receiving them on paper directly, preferably by fax. He was prepared to be a part of the test.

The store manager had a young student employed for the delivery of the groceries once a week. He collected the groceries in the store and then got the receipt from the cashier. Upon delivery, the goods were paid for in cash. Sometimes he helped them to put the groceries in the fridge. He delivered everywhere in Lund and fulfilled a social link as well as helped with easier questions such as how to pay bills.

The store manager realized that he had to change the system if the order intake increased and seemed like something he was willing to do if necessary. If the order intake increased then there would be a need for deliveries more frequent than once a week, which would mean a greater freedom of choice for the customer. Orders from Konsum had to be placed on a Tuesday afternoon, but with the GOA system they could be placed at anytime.

The store manager had received mail from the Social Services and the Council concerning a larger need for home delivery, which he had forwarded to the office of Konsum South.

### 4.4.2 Meeting with Malmborgs

The meeting with Johnny, who was the man handling home deliveries for Malmborgs, gave us an insight into how home delivery works in practice. We got a copy of the order form he used when receiving phone orders, to use as input for the development of our order form. There are two people receiving the orders, picking the groceries in the store for each order, paying for it by ICA debit card at the tills and then delivering it to the customer. Placing orders by phone is possible between 8am and 12pm. The delivery was made the next day between 1pm and 9pm. They accepted coupons and recyclable goods and would phone the customer if there were any ambiguity regarding replacement of an item out of stock. They also put perishable goods in the fridge of the elderly, but above all they filled a social function.

#### ***4.4.3 Meeting with Social Services Assistant Chief***

The reason for meeting Yvonne Bliander was to establish a contact with her group of Social Services Assistants in the southern area of Lund for further cooperation.

We wanted to sort out how grocery ordering worked today for those elderly who used Social Services, both when the assistants bought the food and when a grocery store delivered. We were interested in what problems existed, how payment was performed, how the synchronization worked between Social Services and the grocery store that delivered, and what the political decision concerning these matters would result in. We received a copy of the letter from the government to the Social Services. There was an agreement prompting that Social Services wouldn't be allowed to handle the money of the elderly in the future. This meant that there would be a problem for them to deal with buying groceries for the elderly. Yvonne Bliander referred to Hildegun Vollert who was controller at Vård- och Omsorgsförvaltningen for further information.

#### ***4.4.4 Meeting with Vård- och Omsorgsförvaltningen***

Hildegun Vollert who is a controller at Vård- och Omsorgsförvaltningen gave us information that made us change the focus from the grocery stores to Samhall (a company where most of the employees have one or more work disabilities). She explained that the government had come to an agreement with Samhall that they and not the grocery stores would deliver all groceries ordered by people using Social Services, from the first of October year 2000. The agreement included services such as accepting vouchers, recyclable goods, synchronization with Social Services when delivering the groceries and the possibility for the customer to choose which store to order from.

The ordering process would start with a Social Service Assistant writing an order in the shape of a fax consisting of the groceries wanted by the elderly who would then fax it to Samhall. When Samhall had received all faxes for the day, a team would go to the store selected, buy the groceries, and deliver them to the elderly.

Hildegun referred to Kay Kristiansson at Samhall for more information about this agreement.

#### **4.4.5 Meeting with Samhall**

##### **4.4.5.1 Purpose**

Since Samhall were commissioned by the government to deliver the groceries to all elderly people in need of home delivery, the focus of the project turned from the grocery stores to Samhall. The reason for the interview with Kay Kristiansson at Samhall was to get an insight into how future deliveries to elderly would be made and to evaluate the possibilities of cooperation.

##### **4.4.5.2 Samhall's organization**

Samhall receives the delivery orders by fax from the Social Services who write the order together with the elder and then collects all the orders at the head office ready for faxing. There is one fax page for each order. Samhall has designed the layout of this order form and uses it when the groceries are collected. They have three delivery teams; each consisting of three people who pick up the groceries in one of the two stores namely Malmborgs at Clemenstorget and Konsum at Mårtenstorget. When all of the orders have been collected, all the groceries are paid for by Samhall's credit card at the cashier's desk.

The person placing an order can choose to have the goods delivered in the morning or afternoon. When the delivery is made, the groceries are paid for by the elderly in cash.

##### **4.4.5.3 What we offered and the agreement**

We suggested to Kay that we could, if our forms were used for placing an order, rearrange the order before it reached his fax to accommodate the way the groceries were collected in each store respectively. Samhall wanted the order form to have two additional columns, one for marking if the product was a coupon offer and one for marking if Samhall were allowed to replace a grocery out of stock with one similar to it.

Being a pilot project, only two to three people would actually use it during the test. At the beginning of the meeting he wasn't interested, mainly due to the possible negative feedback Samhall could receive in case something went wrong but also since they didn't want to introduce too many new changes for the elderly.

After our intense and persuasive marketing, Kay was however positive to the ideas and could see the many advantages of our system compared to the current. The project would only concern two or three test persons, being easy to monitor and would ensure that no deliveries were missed. This set Samhall at ease and they agreed to accept participation in the project.

#### 4.4.6 *Meeting with Telemedicine Region Skåne*

We contacted Olof Jarlman, Chief Regional Officer Telemedicine in Region Skåne. The reason for this was to find out what interest there was for a project like this in the triad Medical Service, University and Ideon in Lund. He gave very positive feedback and was interested in a future collaboration.

#### 4.4.7 *Other contacts*

To be able to meet elderly people in a natural way without having to trespass in their homes, several meetings were held with Bo Persson, the manager of a day-care centre in Lund. He was very positive towards the idea and asked us to write a brief summary of the project to be posted on the notice board at the centre.

There was an interest of meeting approximately five people, which we also did, *see 5.2 User test at day-care centre.*

Through Gunilla Knall we established a contact with Britt Östlund, PhD, Telematics at the Swedish Transport & Communications Research Board (KFB) in Stockholm. Britt has a wide experience of the relationships between elderly and IT. Discussions with her and reflections from her books are found in *4.2 Elderly and IT.*

To learn more about usability, which was a corner stone in our application, we met two people from the institution of work sciences and ergonomics in Ronneby, *see 5.3 Meeting in Ronneby regarding usability.*

## 4.5 Pros and cons of the application

### 4.5.1 Pros

- GOA can reach target groups such as elderly, handicapped and career people with limited spare time.
- It appeals to those who can't use the Internet and those who can't physically go to a store.
- No monetary exchange is required. Money could be charged directly from an account.
- There is no need to know a store in order to find the desired products.
- The supplier of the food saves time due to: order already being printed, money can be charged directly from an account, no order by phone (phone orders are very time-consuming and can be unclear).
- No cashier for this service is required by the store.
- The user saves time due to: No need to physically visit the store, it's quicker and easier to write an order on paper than to use a computerized order system over the Internet. No need to both write the shopping list and place the order by phone, fax, email or Internet.
- The user doesn't need to carry the groceries.
- There is a possibility for feedback by phone if a particular item is out of stock (unusual). This can be seen as a drawback compared to Matomera (Internet site for buying food), where you have the direct response. In relation to the carers who don't consult with the elderly if something is out of stock it is a good service.
- Direct confirmation by phone (if possible) of order and of the delivery time makes the elderly rely on the system and maintains a social contact in the beginning of the order process.
- Internet ordering is too complex for elderly, who usually know how to write but have no computer experience.
- The carers can spend their time with the elderly rather than spending it going to the supermarket.
- GOA means more freedom for elderly to choose where and when to shop and to use coupons.
- The application offers a possibility for elderly to order the food by themselves not having to use help from carers or relatives. This gives the elderly a feeling of still being a part of the society and also a feeling of being able to do something on their own.

- Future pros: lower costs for Social Services, focus of careers of delivery people and carers, specialist grocers could increase such as butcher, baker etc.

#### **4.5.2 Cons**

- Social contact with the grocery store is lost in general, but not applicable in the elderly services since the elderly wouldn't go to the shops themselves anyway.
- If there were another payment method than using cash, the elderly people would be forced to trust it.
- The customer has to rely on the delivery being accurate.
- A person having major writing disorders cannot use this application.
- Small orders can be expensive since there is always a fixed price for delivery.
- The customer has to be precise when placing the order so that the exact product can be delivered i.e. different brands and quantities.
- Feedback is not necessarily an obvious occurrence.

## **4.6 Structuring the application**

### **4.6.1 The Ordering Process**

1. The user writes a shopping list on a designed interface; decides what store to buy from, fills in details of desired products, chooses delivery time, and check marks the send button.
2. Information is collected in the pen and transferred to the Bluetooth compatible phone.
3. The phone establishes a connection and relays address-information to the ANS-server, which in turn tells the phone to send remaining information to a particular application server.
4. The application server manipulates the data received and performs desired tasks, in our case sends the order to the chosen store (Samhall) in form of a graphical e-mail or fax. A copy is sent to the social services in those cases when the delivery has to be received by the social services at the home of the elderly.
5. The store (Samhall) receives the order and collects the groceries.
6. The order is confirmed by phone to the client.
7. Delivery of groceries is performed.

# 5 Graphical design

## 5.1 Introduction

This section illustrates the design development of the GOA order form. The three first models were designed to extract the most common ways to fill out an order form.

An important question for Anoto has been the design of the send button, therefore different designs were tested. From the beginning PowerPoint was used as a design environment but later changed to PageMaker. Illustrator files containing our part of the Anoto pattern were created in Matlab and pasted into PageMaker. Photoshop was used for creating background images. There was also a research of human-computer interaction [10].

## 5.2 User test at day-care centre

### 5.2.1 Description

The three first models of the order form were tested, *see appendix*. These were accompanied by a questionnaire for each one.

Finally we gave the test persons a general questionnaire in order to collect information about their behavioural aspects. Five elderly and the carer at the day-care centre participated in the test.

### 5.2.2 Aim

The aim of this test was to give a general insight into elderly peoples reaction to new technology, how well they grasp a new tool and how well they function physically. This gave us firm ground from which to build our application.

### 5.2.3 Apparatus

- Three different models on paper to be tested
- A questionnaire to accompany each model
- A questionnaire regarding usability
- Anoto pads, marketing material and a dummy pen for visualization of the product
- Video camera to record the test
- Digital camera to document the test
- Cakes for the coffee to create a friendly and relaxed atmosphere and to try to build a relation with the elderly

### 5.2.4 Method

All the tests were in a pad to simulate how the final product will be printed. Each order process was performed one at a time, accompanied straight afterwards by a questionnaire.

When all three models had been tested, the usability questionnaire was handed out. The whole test was recorded on video in order to be able to go back and analyse occurrences that could be missed on the day. How the forms are to be filled out was kept to a minimum to get a true picture of their understanding of the forms.

### 5.2.5 Order form version 1

#### 5.2.5.1 Description

This model was the most simplified of the three. It consisted of a number-column, a grocery-column, a general notes area, a possibility to choose between two different stores and a send button. The grocery-store buttons and send button were in the shape of arrows with the text inside the arrow. The idea was that the user would strike through the word in the direction of the arrow.

#### 5.2.5.2 Test evaluation

All members of the test-group filled in both the number and the grocery columns correctly.

Due to the simplicity, they found problems when deciding on the number of groceries. Since it wasn't specified, they didn't know what column to put the number in.

The section for writing general notes was appreciated but it wasn't clear how to use it, for instance it could be used for special coupon offers and delivery time. It's possible however that if this test was done in a more lifelike situation, then the general notes area would probably have been used naturally.

The last part of the model, where arrows were used to symbolize grocery-store buttons and send-buttons, showed that they weren't intuitive at all. We expected to see people put a line through the word in the direction of the arrow but instead almost everyone put a cross at the tip of the arrow or just next to it. This shows that even though the choices weren't made the way we wanted them, there was a pattern of how this kind of symbol was interpreted. To mark using a cross seemed to be the preferred method for all participants. One of the five test persons forgot to send the order, which shows that at this stage he hadn't quite grasped the overall concept of the ordering system.

The image shows a form titled "MATBESTÄLLNING 1". At the top, there are two columns: "ANTAL" and "VARA". Below these is a table with 10 rows and 2 columns. Underneath the table is a section labeled "ÖVRIGA UPPLYSNINGAR" with a large empty box for text. At the bottom, there are three arrow-shaped buttons: "KÖRUT", "MALMÖBUD", and "STICKA".

Figure 10 Order form version 1

There was also the problem of forgetting certain items, which were added to the shopping list after the order had been sent. If items were added afterwards and the send button crossed again, only the added items would be sent but as a completely new order. With extensive development, it may be possible to automatically put the two orders into one before it reaches the store. This however lies beyond the scope of this project. One advantage with this model was that the ordering process was more sequentially intuitive than the other two but it still caused test persons to add items after the order was sent. If items were added, the send box wasn't re-marked to send the updated order to the store. This can cause a problem since it shows that the test persons didn't grasp the order process completely.

It must be added however, that these tests were done without any initial information of how to place the order apart from how the pen worked.

When it comes to the size of the text, which lies between 10 to 12 p, all the test persons were satisfied.

## **5.2.6 Order form version 2**

### **5.2.6.1 Description**

This model was the most detailed of the three models. It first contained a part with two boxes and the name of the grocery stores beside them, Text After Box (TAB)-method. It consisted of a column where the 60 most common groceries were predefined. In addition to this, there were three additional columns where you could fill in the number of groceries, the quantity and a further specification for the predefined grocery.

The user also had the ability to fill in his/her own groceries that weren't listed. The last part of the order form consisted of a send button again using the TAB-method.



## 5.2.7 Order form version 3

### 5.2.7.1 Description

This model was divided into seven different categories of groceries; bread and grain, beverages, butchers counter, frozen foods, dairy products, fruit and vegetables, and finally a various category. These categories were derived from existing order forms, the balanced diet chart, and the grocery sections in the actual stores.

Every category had a few words describing the type of groceries it encompassed. Within each category, there were rows for writing the number of, quantity and description of the grocery.

Last part of the order form consisted of a choice of store, delivery day and delivery time. They were all in the form of a box with the describing text inside it. Finally the send button was shaped as the Anoto symbol with text above it.

MÅTBESTÄLLNING 3			
	ANTAL	EG/L	VARA
BROD OCH SPANNMÅL: (mjöl, bröd, ris osv)			
DRYCKER: (juice, saft, läsk osv)			
CHARK: (kött, fisk, ägg osv)			
FRYSVAROR:			

	ANTAL	EG/L	VARA
MEJERI: (mjölk, sl, ost, smör, margarin osv)			
FRUKT & ORÖNT: (grönsaker, frukter, bär, potatis, rotfrukter osv)			
ÖVRIGT:			

AFFÄR:  KONSUM  MALMÖRGS

LEVDAO:  MÅ  TI  ON  TO  FR  LO  SO

LEV TID:  13-14  14-15  15-16  16-17

SEKULA 

Figure 12 Order form version 3

### 5.2.7.2 Test results and evaluation

There were a few test persons who found that there weren't enough rows to write on in each category. This was a conscious decision on our part to see if the extra space on each line would be preferred compared to having several narrow lines. The narrow lines didn't prove to be a problem. There was also a wish for more categories than the seven we specified, for instance cleaning and hygiene articles.

Since we had written the store names, delivery date, and delivery time inside the boxes, only two of the six test people actually put a cross in the box. It can be mentioned that the same test group were used when testing the first three versions of the order form. A drawback with this is that they gain knowledge from the first test, which can be of use in the other tests. This was taken into account when evaluating the results.

Other ways of marking that appeared in this model were ticks and crosses next to the boxes and also circles around them. This never happened when we used the Text After Box-method in previous models.

There was also some confusion regarding the send button in shape of the Anoto logo. Since they couldn't see what it was supposed to represent (a pen marking a box), they didn't realize that they were supposed to mark it at first. There were test persons who even thought that it was marked already. Again, the lack of the TAB method could have been a factor for users not intuitively marking the box.

### **5.2.8 General usability test**

The general usability test was designed to give us information about how the elderly marked boxes, their cognitive skills, what limits have to be taken into account and what kind of order form they preferred.

We found that when it came to the size of the font, most test persons found that font size eight (8) was sufficient. This was a relatively small font size and it was a surprising observation that the test persons could read it. The size of boxes didn't pose a problem either.

The elderly were asked to put crosses in a variety of boxes with different size. The smallest boxes were crossed very accurately. This can vary geographically since the way crosses and ticks are made varies with country and culture. In the Nordic countries for instance, crosses are made very accurately while in more southern countries a hasty tick is more common, according to Micco Grönholm (VP Corporate Strategy Anoto). Therefore the order form was designed to accommodate most types of marking methods. One way to increase the reliability of interpreting the mark correctly was to make the boxes larger in order to gain acceptance by a larger target group. If the box was larger, it's easier to mark when in a hurry, the sight is poor or you're just being a careless person.

It can also be said that the computer literacy varied from none to experienced computer users. However, this didn't affect how well the test persons placed their food orders. This showed that even if the user didn't have any computer experience, which was a criterion we worked by, the form could still be used to place an order.

### 5.2.9 Conclusions

Taking a step back and looking at the three models in general, several important results were discovered when the test persons filled out the order forms. Errors made that were both expected and completely unexpected led us to conclusions of how to shape a suitable order form. There was an instant liking by the test persons of the second model since a lot of the items were pre-printed.

There was also positive feedback regarding the third model such as the grouping in categories of different foods. The Anoto symbol was found confusing by the test persons as a send box since it differed from the other cross-boxes and some thought it had already been crossed. The first model, being purposely basic and insufficient, showed not so much items that had supposedly been missed out as the fact that the test persons were alert and observant at possible problems. It gave us assurance that the other test results would be reliable. Having said that, it did give a few useful results too.

To conclude the outcome of the tests, it was clear that the fourth order form would be based mainly on the second version with several parts of the third version incorporated into it. The font size would be a minimum of ten pixels in order to accommodate most people. To separate into different steps was to be preferred since elderly people read a form first and fill it out afterwards, *see 4.2.4 Adaptation of technology*. The sequence of the order process would be changed in the final form. Choosing the store first, better simulates how shopping is done. We wanted to specify products but group them in categories to make the form easier to fill out.

In addition to the findings from these tests, there was an interest of discussing with Blekinge Institute of Technology in Ronneby. Since they have one of the leading institutions in the field of work sciences and ergonomics they could provide us with the intellectual angle of the appearance of the order form.

## *5.3 Meeting in Ronneby regarding usability*

### *5.3.1 Purpose*

The reason for contacting Blekinge Institute of Technology in Ronneby was their expertise in work sciences and ergonomics. We were hoping to learn new methods for determining a good design and also to get some feedback on our test results and our updated order form nr 4.

### *5.3.2 Theory*

They showed great interest in the project after our brief presentation and began giving us a lecture on how to approach the area of work sciences.

There is a distinct difference between user friendliness, which is a term that shouldn't be used, and the correct definition namely usability. The reason for this distinction is that there is no way to define user friendliness since it doesn't pinpoint the problems of a design. Usability however can be seen as how well a product performs. There is no "friendly" interface, but you can on the other hand talk about efficiency and how effective a design is i.e. its usability.

The concept of user worthiness was also discussed. A design mustn't be overworked and "intelligent" since this too can confuse the user, for instance a parking meter that accepts credit cards but doesn't give you acknowledgement that you have paid. The aim with the parking meter was to make it "easier" for the user but instead caused a dilemma whether the payment had been made or not and could lead to a second payment being made. Therefore care was taken not to underestimate the users intelligence at the same time as creating an intuitive design.

### *5.3.3 Design improvements*

The discussion progressed and the focus turned to our specific design of the order form. Several points brought up concerned the flow of the order process. An empty space in each category would be better than a large various box at the end since this would cause the user to jump back and forth while placing the order instead of for instance writing the unspecified dairy product directly in that category.

This gives a more natural order process. By having the predefined products to the far left and everything the user has to write to the right of it, it makes the order process easier to follow for the user.

Another aspect was the visual appearance of the order form. We wanted to create more space and somehow visually define the four steps of the order process namely 1. Choose store, 2. Select groceries, 3. Choose delivery date and time and finally 4. Send the order. The first comment concerned the rounded corners of each section, which gave a symmetrical appearance causing the user to miss the fact that there are two columns in each category.

By numbering each part of the order process as well as pointing it out in text i.e. “step 4”, the user would comprehend the requirement of filling out each part in turn more clearly.

The third aspect discussed was the wording of the order form. It is better to write one or two words describing what the user is required to do rather than using abbreviations, which sometimes can be confusing. We needed to change kg/L to quantity (“Mängd”) and delivery time (“Lev. tid”) to what time? (“Hur dags”) to make it easier to understand. By choosing words carefully and having the text “talk” to the user, for instance by stating “I want to shop from:” followed by a choice of stores, the form communicates directly with the user. The word “Various” (“Övrigt”) was used but is a bit too vague. Since no alternative was found, it had to remain. The Anoto send-button was given quite positive feedback from Ronneby as a logo and they thought that it was good that it looked different from other buttons to indicate that the user had finished placing the order. They didn't find putting a cross inside it very intuitive though. An opinion from Gunilla Knall was that it looked like you were supposed to put a dot and not a cross inside the box.

Other suggestions they made were the use of other order forms from various sources to compare solutions with our order form such as the mail-order company Ellos. For improved comprehension when the store receives the order, the number of each grocery should be listed first, as in a recipe. We also discussed different fonts to use but finally decided to continue using Times New Roman. This was because its small extensions on many of its letters, which had the benefit of making the text easier to read. Since we try to include as much information as possible on a small space, there is a risk that the user could feel that the order form is a bit messy. One idea was to use several pages for the order form. This was something preferably avoided since it could exaggerate the risk for misunderstanding. A better solution would be to enlarge the format of the pad.

#### 5.3.4 *Testing methods*

The ethnographic method, which we partly used in previous testing, is basically when you don't ask any questions but instead you write down all observations in real-time during a test. A video recording of a test is a good way of being able to study people's reactions in more depth after the actual test. This method was used in the first GOA user test and was found very helpful. One example they gave us was when they watched a recording of an SAS terminal that needed improvement. All the people working in the booking desk kept turning their head and this strange behaviour was due to the calendar being on the back wall, which came to light on the video. A very simple solution, a calendar at each desk when taking a booking, was implemented and improved their working environment and order process significantly. According to Gunilla Knall and to our own experiences, it's very hard to get the answers that you want in a test; the test person often tries to please the interviewer instead of being critical. When testing a person there has to be something concrete to test and not just ask what that person would want. Another method when developing a product is to gather a test group where everyone has a specific fictive hat to represent a character; one person could be the optimist, another could be a person just thinking of human factors etc. By using this method there is a possibility that it will generate a lot of creative ideas since for example the positive person isn't blocked by limits.

The experts in Ronneby also suggested a quantitative analysis with hundreds of test persons but since we didn't have the capacity for such an operation, a more relational approach was opted for. Only a few users were involved, but instead a close relation to these people was built up. There was also a need to possibly test it with other people who might come in contact with the order form. This would primarily be carers and possible grandchildren who visit. Finally a test reference that was used was a friend to us who gave valuable input to the project.

#### 5.3.5 *The pen*

The last part of our discussion concerned border factors, namely the pen itself. Even though it's beyond the scope of this project, it is of great interest to analyse all the parts of the user side of the process.

What they found the pen lacking was a direct feedback for the user to know if something was sent, apart from the LED (Light Emitting Diode), which may be implemented in the near future. The shape of the pen is required to force the user to hold it

correctly and also give feedback if it was held in the wrong way, for instance not holding it upside down.

Using a reservoir pen solution instead of the usual ballpoint pen could give this feedback. The pen-lid didn't "click" to confirm that it was securely fastened and the fact that the "pocket-clip" was, according to them, on the wrong side. There were detailed observations they made yet quite important for future pen development. There was also the problem of putting the lid upside down on the pen. This could cause a problem for example if there is any functionality in the lid. To charge the pen they suggested using a cone-shaped stand to drop the pen into, for ease of use.

### *5.3.6 Summary*

To summarise it can be said that the meeting in Ronneby was very valuable to us and we left with a lot of new knowledge. All problem areas had now been highlighted and there was a new methodology to be incorporated in the development of the appearance of the order form and the testing models.

## 5.4 Changes from the 4<sup>th</sup> to the 5<sup>th</sup> version of GOA

Changes made from the 4<sup>th</sup> to the 5<sup>th</sup> version of the GOA order form were mainly based on the meetings with Samhall (see 4.4.5 Meeting with Samhall) and Ronneby (see 5.3 Meeting in Ronneby regarding usability).

The name “GOA” was removed from the top of the order form, as it would just confuse the user.

A possibility for the user to fill in today’s date (“Dagens Datum”) was added to give the user backward reference to orders made previous weeks in the order pad.

The marking of the steps was changed from for example 1 to Step 1 (“Steg 1”), to make it clearer that you’re supposed to follow the correct flow in the order process.

At least one additional space in each category was added and the large diverse box became smaller. We kept the same order flow as in the earlier version but changed from three to four steps and divided them by borders. In this version every other step was in red and blue respectively in order to differentiate each step as much as possible. By using red and blue, the problem with colour blindness was avoided. The rounded corners in each section were replaced with sharp corners because of the reasons mentioned in 5.3 Meeting in Ronneby regarding usability.

① **GOA**  
 KRYSSA I VILKEN BUTIK DU VILL HANDLA FRÅN:  MALMBORGS  KONSUM

②

**MEJERI**

ANTAL KOD	VÅRA	SPECIFIKATION	ANTAL KOD	VÅRA	SPECIFIKATION
		Mjök			Kaffgrädd
		Mozzari			Färsrik
		Smör			Yoghurt
		Vägggrädd			Jäst

**CHARK**

ANTAL KOD	VÅRA	SPECIFIKATION	ANTAL KOD	VÅRA	SPECIFIKATION
		Bacon			Korvlägg
		Korv			Kött
		Fäskkorv			Fisk
		Pastaj			Kyckling
		Skinkalägg			Ägg

**DEYCKER**

ANTAL KOD	VÅRA	SPECIFIKATION	ANTAL KOD	VÅRA	SPECIFIKATION
33 CL		Välby Noorman			Ölklass I
33 CL		Rambösa			Ölklass II
		Övrigt vatten			Juice
33 CL		Blått öl			Saff

**FRUKT & GRÖNT**

ANTAL KOD	VÅRA	SPECIFIKATION	ANTAL KOD	VÅRA	SPECIFIKATION
		Tomater			Challahbröd
		Gulka			Övrigt rått
		Gul lök			Paprika
		Övrig lök			Apelsiner
		Morötter			Citrus
		Parsnär			Bananer
		DL			Kavi
		Gulbete			Pisens
		Potatis			Äpple
		Lökspis			Vindruvor

**BRÖD & SPANNMÅL**

ANTAL KOD	VÅRA	SPECIFIKATION	ANTAL KOD	VÅRA	SPECIFIKATION
		Statsocker			Kex
		Bäcker			Käsebröd
		Övrigt rocker			Brot, fet
		Vattnmjöl			Brot, grovt
		Övrigt mjöl			Sk
		Salt			Pasta

**FRYSVAROR**

ANTAL KOD	VÅRA	SPECIFIKATION	ANTAL KOD	VÅRA	SPECIFIKATION
		Glass			Fisk
		Pommes fräs			Kyckling
		Grisar			Färdig mat

**HYGIEN & RENGÖRING**

ANTAL KOD	VÅRA	SPECIFIKATION	ANTAL KOD	VÅRA	SPECIFIKATION
		Dishapp			Tvättmedel
		Hushållsrengöring			Dishmedel
		Tvål			Dishvatten
		Schampoo			Rengöringsmedel

**ÖVRIGAVAROR**

ANTAL KOD	VÅRA	SPECIFIKATION	ANTAL KOD	VÅRA	SPECIFIKATION
		Kaffe			
		Té			
		Marmelad			

③

LEVDAG  MÅ  TI  ON  TO  FR  LO  SO

LEV. TID  12-14  14-16  16-18  18-20

KLAR

Figure 13 Order form version 4

The width of the sections was increased to the full width of the paper. The wording of the order form was changed to more complete sentences, describing what the user was supposed to do.

Each grocery was now listed first and the columns “Antal” (“Number”) and “Kg/L” are concatenated to one wider column with the description “Quantity” (“Mängd”). Two new columns were added, one for marking if there was a special offer for that specific grocery and one for marking if the customer allowed the supplier to replace the wanted grocery if it was out of stock. Due to the supplier’s delivery limitations, it was only possible to choose either a morning or afternoon delivery on a weekday.

<b>STEG 1</b>		JAG VILL HANDLA FRÅN: <input type="checkbox"/> MALMBORGS <input type="checkbox"/> KONSUM	
DAGENS DATUM:			
<b>STEG 2</b>			
<b>MJÖLJ</b>			
VARA	KURSENY	MÄNGD	SPECIFIKATION
Mjöl			Färdmjöl
Muggmjöl			Vegetar
Socker			Panna
Grödd			
<b>CHARK &amp; DELKATES</b>			
VARA	KURSENY	MÄNGD	SPECIFIKATION
Bacon			Korv
Korv			Fisk
Panng			Krydding
Pålägg			Äst
Färd			
<b>BRÖD &amp; SPANNMÅL</b>			
VARA	KURSENY	MÄNGD	SPECIFIKATION
Bröd, vit			Bröd, rött
Bröd, grönt			Örgröt socker
Vitbröd			Äst
Örgröt mjöl			Äst
Brödsocker			Matkalkulid
<b>DRYCKER</b>			
VARA	KURSENY	MÄNGD	SPECIFIKATION
Kaffe			Skåns II
Panna			Mjölk
Örgröt mjöl			Äst
Bländad mjöl			Äst
<b>FRUKT &amp; GRÖNT</b>			
VARA	KURSENY	MÄNGD	SPECIFIKATION
Tomater			Äppl
Gulka			Paprika
Gul kik			Aprikos
Örgröt kik			C-mat
Morötter			Bananer
Panna			Äst
Äst			Äppel
Panna			
<b>FRYSVAROR</b>			
VARA	KURSENY	MÄNGD	SPECIFIKATION
Glass			Fisk
Garnkorv			Krydding
<b>HYGIEN &amp; RENGÖRING</b>			
VARA	KURSENY	MÄNGD	SPECIFIKATION
Papper			Tvättmedel
Tvål			Äst
Förlösning			Reparering
Balsam			
<b>ÖVRIGT</b>			
VARA	KURSENY	MÄNGD	SPECIFIKATION
<b>STEG 3</b>			
JAG VILL HA MINA VAROR: <input type="checkbox"/> MÅ <input type="checkbox"/> PÅ <input type="checkbox"/> ON <input type="checkbox"/> TO <input type="checkbox"/> FR			
PÅ: <input type="checkbox"/> FÖRMDAGEN <input type="checkbox"/> EFTERMIDDAGEN			
<b>STEG 4</b>			
<input type="checkbox"/> NU ÄR JAG KLAR			

Figure 14 Order form version 5

## 5.5 User test Social Services

### 5.5.1 Description

Order form number 5 was tested. Two different test persons using Social Services for such as house cleaning and grocery delivery participated in the test. They had both physical as well as cognitive limitations. A realistic test situation was set up in their homes one at a time. For testing we used the ethnographic method; *see 5.3 Meeting in Ronneby regarding usability.*

A dummy model of the Anoto pen was used which also gave us feedback about the pen itself.

Changes we had planned to implement in order form nr 6 were discussed with the elderly.

### 5.5.2 Aim

The aim of this test was to reach the existing target group who has grocery delivery already, to be able to see their reactions and understand their needs. We set up a contact with two people from this group. In the test phase of the project we wanted to use these two people as test persons in a real situation. The aim was also to get feedback regarding the ergonomics of the Anoto pen, to secure that the font-sizes and row-/cell-sizes being used weren't too small and to get important feedback concerning order form nr 5 and its usability.

### 5.5.3 Apparatus

- GOA order form nr 5 in colour to be tested
- A questionnaire for our own support
- Anoto pads and dummy pen for writing the order
- A digital camera to document the test

### 5.5.4 Method

The order form was pasted into a pad to simulate what the final product will look like. The test was made with one test person at a time in their respective homes.

The test persons were asked to place an order the same way they normally do, except for the fact that they were supposed to use the GOA order form. We minimized the instructions of how to fill out the order form and during the ordering process we kept a distance and wrote down all observations we made.



*Figure 15 Elderly testing order application version 5*

Afterwards we discussed the advantages and disadvantages of the concept and the order form with the test persons.

### **5.5.5 Test**

#### **5.5.5.1 Description**

This model nr 5 was a further development of nr 4 (*see 5.4 Changes from the 4th to the 5th version of GOA*), which was a combination of models 2 and 3.

It consisted of four steps. In the first step you were supposed to choose grocery store and write down today's date. The second step was where you chose the groceries and specified information about them. In the third step you marked when you wanted to receive your order and in the fourth you crossed or ticked the send box to send the order to the supplier.

#### **5.5.5.2 Test evaluation**

We noticed that test person nr 2 felt a bit stressed and she wasn't as relaxed as test person nr 1 during the test. This could be due to her feeling stressed to show that she understood what she was supposed to do.

Test person nr 1 filled in both the choice of store and today's date in the end of the ordering process instead of doing it as the first step. Test person nr 2 totally missed Step 1. A reason for this could be the above mentioned or just that Step 1 wasn't marked clearly enough.

When it comes to Step 2, both test persons managed really well. One problem, which was hard to discover, was that certain columns could have been missed, especially the column "Replace if out of stock" ("Ersätt om slut"). The main reason for this was that when filling out details of a specific grocery, the next grocery was seen in the corner of the eye and was easy just to jump right to it without going through all columns. The best solution for avoiding this problem was to separate each row from another but then other problems would arise. Other reasons were that almost no instructions were given at all, the test person wasn't alone to be able to feel totally relaxed and the knowing that this was just a test and that the pen didn't actually work. It was obvious that it was more common that a person wanted the supplier (especially when there is a personal relationship between the customer and the supplier) to replace the item being out of stock with a similar item. This showed that it was better to have a column to mark if the customer didn't want the supplier to replace.

It was also obvious that we made the right decision when it came to how the application was supposed to work, especially regarding the product rows. Sometimes there were crosses made in a column that afterwards was regretted. By saving the whole row as a picture instead of having an algorithm that checked what was written, there was a possibility to change the choice made. Some groceries common for the elderly to order were also missing in this order form.

In step 3 there were no problems, both test persons filled in day and time for the delivery correctly.

Step 4 consisted of sending the order and this was at first missed by test person nr 1. Test person nr 2 made Step 4 before Step 3, which in a real situation had led to an order without any delivery-time being sent.

The appearance of the Anoto send-button didn't cause any problem but one of them thought it looked like a box with the letter "A" in it, representing the "A" in Anoto and not a pen tip.

The overall feeling was that they liked this order form because of the advantage that there was no need for writing everything by hand, the size of the order form and the size and font of the text. They also found the order form easy to fill out and easy to read. When it comes to the ergonomics of the pen, it was sometimes held upside down. The positive feedback given on the pen was that it's pretty thick which is a benefit when you have rheumatism as one of the test persons had.

## *5.6 Meeting with graphic designer*

Discussions were held with a graphics designer, Stefan Wennerström, regarding order form number 5. The reason for this was to put the visual aspect of the form through its paces and have a trained eye look at it. There were several details that needed changing such as making borders thinner (0.5 points), inserting images of products, and making the column headings fit above each column. Many of the alterations were to do with the messy appearance of the sheet, trying to fit too much information into a small space. Making the order sheet larger by either using four A4 sheets that fold out or alternatively two A3 sheets would solve all of the above-mentioned problems. It would give a better and easier-to-follow order form but at the price of having a large and clumsy piece of paper. The use of the A3 alternative would probably be easier to use since it would only have two sides instead having to fiddle around folding pages as in the expanded A4 version.

Images of products would fit on the sheet as well as all column headings. The use of product images has both positive and negative sides to it, namely it helps to identify a product but at the same time the user might assume that exactly the type depicted will be ordered. There was also a suggestion of further use of colour-coordinated boxes where each category had a different colour to the adjacent categories and not just a colour variation between the four steps of the order process.

Changes actually made based on the meeting with the graphic designer are discussed in *5.7 Changes from the 5<sup>th</sup> to the 6<sup>th</sup> version of GOA*.

## ***5.7 Changes from the 5<sup>th</sup> to the 6<sup>th</sup> version of GOA***

Changes from the 5<sup>th</sup> to the 6<sup>th</sup> version of the GOA order form were based mainly on the user test with Social Services (*see 5.5 User Test Social Services*), a meeting with Micco Grönholm and a meeting with a graphic designer, *see 5.6 Meeting with graphic designer*. The size of the 6<sup>th</sup> version of the order pad was enlarged to a format of 240 \* 330 mm.

The font was changed from Times New Roman to Gill Sans since it was in line with Anoto's other products but mainly because it was much clearer even if Times New Roman had its small extensions. All text was left aligned and headings were made with the first letter upper-case and the rest made as lower-case letters because it was easier to read than lower-case according to Micco Grönholm and [14].

The ovals marking the steps were now filled to make it even more obvious that you were supposed to follow the correct flow. The borders between the steps were removed to make a more spacious order form and also because we believed that it wasn't necessary to have borders since the steps were made so distinct. Today's date now had an underline and two slashes.

All borders in the sections were thinner since we realized that it wasn't a problem for the elderly to see them and it looked much better design wise. The colours were inverted since after a comparison, it seemed like the blue colour was the one to prefer for larger areas. The order of the columns was changed to a more logic order with the specification field as the last.

Figure 16 Order form version 6

The column “Replace if out of stock” (“Ersätt om slut”) was changed to “Don’t replace” (“Ersätt ej”). This was due to it being more common for the customer wanting the supplier to replace the product rather than discard it from the order list. The name of the large "various" box was changed to “Textbox” (“Textruta”).

The subheadings were angled 40 degrees to make it more spacious and also because it was an improvement of the visual aspects of the design. By making the extended dividing border in each section thicker, it became more obvious that the halves were separated from each other. Some important items such as coffee were added and some were discarded.

After placing the Anoto pattern only at those positions where choices were supposed to be made, it was more intuitive where to write.

# 6 Programming development

## *6.1 Introduction*

The chosen structure for GOA meant that the programming of it was extensive. First we took a look at what tools were available to fulfil all the tasks required. Then a strategy and specification were put together in order to have a guideline when programming. There were several obstacles that had to be worked around in both the programming and testing phases of the development.

## *6.2 Investigation of tools*

In order to know what tools to use, the requirements of the programming part of the project were analysed. There were three main areas to be looked at, namely interpretation of input data, database communication and control, and lastly the creation of an email/fax order to be sent. In this situation, it's always important to start off by looking at what has actually been implemented already.

The methods for parsing the incoming coordinates from the pen were available and had been programmed in Java. This is an object-orientated language that is easy and powerful to work with. Since the parsing methods were written in Java, it seemed natural for it to be the language of choice. We also looked at Visual Basic, but this seemed more geared towards creating user interactive applications.

The programming environments used were JDK (Java Development Kit) 1.2 (JDK is a set of building blocks that includes development tools, a set of class libraries and a virtual machine), and Forte 1.0 for Java. The reason for using Forte was the fact that it was designed purely for Java, contained several built-in functions pre-configured for Java, and was used by the software development team at Anoto. Both compilation and running the programs was done through Forte.

The next area looked at was the database choice and how the communication with it worked. Since Java was the chosen language, JDBC (Java Database Connection) [19] was used to connect java to the database. JDBC is an API (Application

Programming Interface), which is part of the Java 2 Standard Edition.

It should also be mentioned that JDBC connects to virtually any tabular data source. JDBC is very similar to ODBC (Open Database Connectivity) and with a small “bridge” program it’s possible to use the JDBC interface to access databases through the ODBC interface. SQL (Structured Query Language) statements [15] were used to communicate with the database, which is a widely used standard for this purpose.

The question remaining was which database engine to use. There were several options and the possibilities were Microsoft Access, MySQL, and Oracle. Microsoft Access was much preferred due to its hands-on simplicity and basic creations of reports and forms, which was why we started off with this as our platform. An external consultant recommended MySQL, while the Server developers at Anoto in Stockholm preferred the Oracle database. Due to image storing difficulties, to the advantage of having experts of Oracle in the company, and due to Oracle having several applications that helped with this complex process, the Oracle database replaced our original Microsoft Access platform.

The final area requiring attention was the report writing and sending. If Microsoft Access were used as was originally planned, then the report writing would have been simple and faxing solutions straightforward to implement. There was one hurdle though, which was the control of these events. This wasn't possible through the JDBC-ODBC Bridge used to communicate with Microsoft Access. There was no other obvious way of triggering these actions from Java. The only other option was to code a MIME-message directly in the java program (Multi-purpose Internet Mail Extensions-message. MIME is an extension of the original Internet mail-protocol and lets people use the protocol to exchange different kinds of data files over the Internet). This MIME-message was built up of the GIF (Graphics Interchange Format)/PNG (Portable Networks Graphics) images representing the products ordered. The images concatenated with the HTML (Hypertext Mark-up Language) document were encapsulated in the MIME-message and then emailed directly from the java program, incorporating order data from the database. By implementing an email function, faxing was possible through an email-to-fax service available commercially on the Internet such as [18]. Thereby support for both methods of communication in a very efficient way was achieved. Faxing was the preferred method of reception for the grocery stores (in this case Samhall) involved in the project.

## ***6.3 Strategy – the chosen approach in short***

Applications used: Forte for Java CE 1.0, Oracle 8.1, Photoshop, Outlook, Microsoft Visual SourceSafe 6.0, Internet Explorer 5.5, and an email-to-fax service.

Languages used: Java, SQL, and HTML.

### ***6.3.1 Chain of events***

1. Coordinates from the pen are analysed as images or “tick”-selections using existing and modified Anoto methods written in Java.
2. Images and order details are stored in an Oracle database using SQL statements [17].
3. HTML document [12], [13] is put together in a Java method, consisting of order details and the product GIF/PNG images in a predefined order, dependent on which store chosen, that looks like a purchase order from the client.
4. The HTML file is emailed to the predefined destination, be it an email or fax recipient.

## ***6.4 Programming Specification***

### ***6.4.1 Aim***

The aim was to precisely define the implementation strategy in order to have a guideline when programming the application.

### ***6.4.2 Description***

The application consisted of several conceptual parts that each fulfilled a task in the ordering chain. The three parts were 1. Interpreter, 2. Database Controller, and 3. Order Dispatcher. The Interpreter received a string of coordinates sent from a pen/user that had placed a grocery order and converted the coordinates into the specified data and images. The Database Controller then entered this data in the database that stored customer details, products images, predefined product information and order details. This also gave the possibility for creating valuable statistics concerning the system. The Order Dispatcher collected all the information for a particular order from the database. An order

report was created and then sent to the store by fax or email. The whole process was fully automated.

<b>Matbeställning</b>				
<b>Butik:</b>				
Malmborgs				
<b>Ordernummer:</b>				
1647				
<b>Leveranstid:</b>				
<input type="checkbox"/> MA	<input type="checkbox"/> TI	<input checked="" type="checkbox"/> ON	<input checked="" type="checkbox"/> TO	
<input type="checkbox"/> PA	<input type="checkbox"/> FORMIDDAGEN	<input checked="" type="checkbox"/> EFTERMIDDAGEN		
<b>Leverans till:</b>				
Namn: Fredrik Ivarson		Telefon: 046 396737		
Gatuadress: Ulrikeådalv. 6		Kundnummer: 10001		
Postadress: 224 58 Lund				
Våning: M202				
Portkod: null				
<b>Produkter:</b>				
Vara	K/A	EE	Mängd	Specifikation
Juice			1L	Apelsin
Vetemjöl			2kg	
Ris			2kg	Jasmin
Pålägg			2kg	Rökst skinka
Mjolk			1L	Ekologisk, l8H

Mjolk			1L	Ekologisk, l8H
Provvä	X		3L	Nypon
Kyckling		X	1	kron
Kiw.			6st	
Tvål		X	1	Djfrfr
Mapp			1	Vileda
Lim			1kub	Super-

**Text ruta:**

Knädes hårt!

K/A = Kupong/Annons  
 EE = Ersätt Ej  
 Vid problem kontakta GOA

Figure 17 A fax/email at the recipients end

### 6.4.3 Sections and Methods

#### 1. The Interpreter

- A connection is opened
- The stream of coordinates is read into a buffer
- The document is analysed as to where strokes have been made with the pen on the order form
- Predefined Anoto methods are used for converting coordinates into GIF/PNG images or, if appropriate, check if a box has been marked
- The pen's ID is extracted from the buffered coordinates
- The store stroke is read to determine which grocery store is to be used and is stored as a variable
- Each product slot is stored as an image
- The area of selecting day/time of the delivery is stored as an image

#### 2. The Database Controller

- Pull customer ID for the pen ID
- Enter the new order (store, day/time image, customer, etc)
- Pull the new order number (automatically generated in the database as new order is created)
- Enter order details (each product and its description)

### 3. The Order Dispatcher

- Collects images and data related to a particular order number.
- Prints the information in a report and lists the groceries in a predefined way.
- The report is emailed or faxed depending on the preference of the particular store

## *6.5 Programming – advances, problems, solutions*

There were several obstacles in the programming process. In the beginning we had a lot of trouble with imported classes [7]. Either they couldn't be found when the program was run or we didn't realize that they were to be added separately to the standard Java class collection [11]. The Anoto methods, which we were supposed to use, were quite complex and came with only brief documentation. Thanks to good explanations and guidance from the technical support group, the functionality of the methods and how they fit together was comprehended. The database connection to the Oracle database set up at Anoto in Stockholm was complicated. The physical distance was one obstacle since we had no direct control over all the parameters of the database. Name changes of the database and its fields weren't possible to change from our location due to the limiting Oracle client software we were using to access data. This caused unexpected errors when performing the first database information exchanges. Once the database connection was properly configured however, it performed with high levels of consistency. Dealing with the images is an advanced process in terms database storage and generation. The BLOB (Binary Large Object) [5], [16] database type puts a locator in the database to a large binary file containing the information for all stored images. That way, the image-storing problem was solved but before this procedure took place, the image rendering had to be performed. Generating the final image to be stored in the database consisted of two steps. In the first step a predefined background image combined with a particular area of the pattern from the order form (typically a product or text box) are rendered together. Then they are encoded into the PNG file format, before being stored in the database.

The final stage of the order, consisting of email creation and sending, required further research. Literature covering Java [6], [7], HTML and Oracle were used as well as an extensive Internet search. The two possibilities stood between building the mail

manually and then sending it or using an existing report creating tool that contained certain functions to be used directly. It was found that by using parts of existing code for sending a MIME-messages and building an html document directly in the code was the better solution.

## *6.6 Testing – simulation environment, pen tests*

Each part of the program was tested in small scale on its own before it was added to the main program. There was a small test program written for the database connection for instance, in order make sure it was stable and to experiment with different SQL commands.

For simplicity reasons and since there were no Bluetooth cards available for PC computers, a so-called pen client developed by Anoto was used for testing different parts of the pattern with the program. The pen client consisted of a drawing space with a background representing a part of the GOA pattern (such as a product slot) on which strokes could be made using the mouse. These were sent to a local web server on the PC. A so-called Skin, being a control panel for switching on and off various servers, was started and the required servers turned on. The servers used are: 1 Sniffer, 2 Live2Post, 3 Dispatcher, 4 Bogus, and 5 GOA. The sniffer writes all executions to a log file, the Live2Post posts strokes to the web server, which adds them to the correct bean. The Bogus server is a static ANS (Anoto Name Server) without a database that decides what application a message from a pen is to be sent to while the Dispatcher directs the message to the right port (host). In the case of GOA it directed the grocery order messages to the GOA server port. By using the pen client combined with the above-mentioned servers, we tested all logic and image slots in the program separately. In order to test creating a whole order in the same instance required the offset print of the order form, an Anoto pen, and a laptop with a Bluetooth PC-card.

When these items were obtained, the final testing moved to a more physical level where actual orders were placed using pen and paper and then sent through the laptop to local email boxes. In order for the Anoto pen to pair up with the Bluetooth card it had to be programmed with unique address of the card. Once this was done an additional application had to be started in the skin called bt2socket. This created a connection from the Bluetooth card to a specific socket on the server. By testing using the whole order form instead of just parts of it as with the pen client, gave several errors

that couldn't have been found or easily been missed otherwise. Problems such as the fact that the order is on two pages and oversensitive borders between product slots, caused changes in GOA and other related Anoto programs. A major problem noticed when testing with the print was the absence of a bleed of the pattern at the edges of some slots. Since the pen's camera eye reads the pattern 4 mm below the tip of the pen and then calculates the correct position of the tip, the pen couldn't read the areas close to the edge of a slot due to the missing bleed. This was valuable information for improving the application and for future updates of the actual print.

## *6.7 Analysis – pros and cons, further development*

Several strengths and weaknesses emerged after the programming stage. Some of these were pre-planned for simplicity reasons. Since this was the first offset printed edition of the form and the first actual pen and paper test, problems such as the missing bleed and misalignment between slots was inevitable. The email-to-fax solution, which was outsourced, gave unfortunately a poor result. The company Tellustalk, which corresponded this service with, had problems incorporating the attached PNG images in the fax. The reasons for this was the fact that the PNG format is quite new and that the graphical faxes are complex to create compared to typed text. Samhall, who wanted the order as a fax, were only to be involved if the pen and paper were to be tested from the home of an elderly over a period of time. The fax problem was to be solved in the future but the situation of the project, where deliveries weren't to be tested live due to pen restrictions, a faxed version wasn't vital.

The database was created with flexibility in mind for easy future improvements and growth. One area discussed was the possibility of statistic facilities so that intelligent functionality could be built into the system. This means that by analysing the ordering patterns of all users, the items on the order form can be adjusted thereafter such that products never ordered can be replaced by other more attractive products. It can also be of interest to look at frequency and size of orders to optimise the whole order process both in the virtual and particularly in the physical world. There was a possibility to easily add a table from which the program picks the store closest to the home of the elderly. This was a great advantage when the system is run nationwide. On a larger scale and when the pen is commonplace, it

wouldn't be impossible for one user to have several pens. This wasn't incorporated due to two reasons namely needs to restrict the project to the core functionality and the fact that our target group would probably only be issued with one pen. The penID was statically associated with the user in a table. Due to the nature of the database design, there would be no problem incorporating a dynamic pen to user relation with a separate penID list. The program used a fixed email address to send the completed order to since there was only supposed to be one receiver, Samhall. This was done in such a way that a database lookup could enter the email address of the receiving store.

The order sent to the store contained products in a predefined order unique to the store. The products were listed on the order in the same sequence, as they were located in the store. Eliminating the need to go back and forth in the store, would speed up the gathering process of the groceries. Starting with the groceries by the entrance at the top of the list and finishing with the last products by the tills and exit of the store at the bottom of the list.

The program was kept relatively minimalist in total, in order to focus on the desired tasks specified. Despite some shortcomings and problems, the program was stable, flexible, and fulfilled the requirements set-up for GOA.

# 7 Testing

## 7.1 Description

In the later stages of the developing phase, the system had reached a point where enough requirements were fulfilled for the testing phase to begin.

Two of the five test persons from the day-care centre participated in the test. Due to limitations in the infrastructure of the Anoto system in this phase, the test had to be performed at Anoto.

As in earlier tests the ethnographic method was used, even though full instructions were given in this test.

A prototype of the pen was used which also was a limitation.

## 7.2 Aim

The aim of this test was to see the reactions of the elderly and to find out limitations and possibilities of GOA and the Anoto pen, when actually ordering groceries using GOA.

## 7.3 Apparatus

- A questionnaire for our own support
- Anoto pen (prototype)
- Laptop with Bluetooth card and network connection
- A digital camera
- A digital video camera
- Rolls and cookies for the coffee break
- GOA order pad (version 6) with instructions attached (see below in Swedish)

### Instruktioner för matbeställning

#### Steg 1: Välj butik

- Välj butik att handla från genom att sätta ett kryss i en av rutorna
- Fyll därefter i dagens datum

### Steg 2: För önskade varor

- Sätt ett kryss i ”Kupong/Annons” - fältet om varan finns som kupong- eller annonsvara
- Sätt ett kryss i ”Ersätt Ej” - fältet om Du ej önskar att leverantören ska ersätta med likvärdig vara om önskad vara är slut
- I ”Mängd” - fältet anges antal exempelvis kg, liter, styck
- I ”Specifikation” - fältet specificerar man exakt vilken vara som önskas
- I tomma ”Vara” - fält ges möjlighet att själv fylla i önskad varutyp
- Under ”Övrigt” kan ”Textruta” användas för valfri text till leverantören

### Steg 3: Leverans

- Sätt ett kryss för önskad leveransdag, tidigast nästföljande dag
- Sätt därefter ett kryss för leverans på förmiddagen eller eftermiddagen

### Steg 4: Skicka order

- När alla önskade fält är korrekt ifyllda, skicka iväg hela ordern genom att sätta en bock eller kryss i Skicka-rutan till höger om ”Nu är jag klar”

## 7.4 Method

An introduction of Anoto and of the GOA application was held. This was followed by a discussion of limitations of the pen. Customer information such as for example name and address were written down by the test persons and then inserted into the database. The test persons were asked to make a typical weekly grocery order. Instructions were given of the ordering process followed by a demonstration.

A break with coffee and rolls took the focus from the test for a moment for the elderly to be able to feel relaxed.

One test person at a time filled out the order form under close observation of the technical aspects such as the pen functioning properly.

After the grocery order was placed, the test persons received a printed version of the order created for the grocery store. We discussed limitations of GOA in order to explain why the result wasn't faultless. To declare these in the beginning would put the test persons' focus on something unessential.

When the test was finished there was a retrospective interview with the test persons together. The objective was to help them

express their feelings by asking them precise questions. The reason for interviewing both persons at the same time was to create a discussion where we all had different views, to maximize the outcome from the tests.

## 7.5 Test

### 7.5.1 Description

The flow in the GOA order form is the same as in order form version 5, *see 5.5.1 Description*.

### 7.5.2 Test evaluation

After having read the instructions and watched the demonstration, it appeared as if both test persons had understood the whole process flawlessly. The reason they gave this impression was because the order form took on a very simple appearance and to a certain extent “fooled” whomever it was demonstrated. This was a phenomenon, which we were aware of [4].

In the test, it seemed like the first test person had grasped how to fill out the order form very well. Basically she made only one thing that she wasn't expected to do. When ordering a bunch of tulips, she wrote it in the textbox (“Textruta”). This wouldn't cause a problem except for the risk that the supplier could miss the item since that space is supposed to contain other information. Apparently it wasn't totally clear where to write items that weren't pre-printed.

The order created for the grocery store looked OK except for some specifications being hard to read, due to problems with the pressure-sensor of the pen.

Test person nr 2 forgot step 1 at first, according to her it was just a careless mistake. It was clear to her that items missing could be ordered on the last row in every category. She wanted frozen cod but ordered just “cod” where it's supposed to be fresh food. This is a mistake that probably just would be made once.

For both test persons it seemed like there was enough space to write in and that the visual appearance of the text was clear.

The send button was a slightly misplaced; it had been easier to draw a big and clear send-stroke if it was placed further in towards the centre of the page.

They discovered that two important items namely cheese and toothbrush were not pre-printed on the order form. The pre-printed quantities (33 cl) could be confusing and would preferably be printed in the description of the beverage rather than in the quantity column.

When discussing the concept of ordering food from home with GOA, they were very positive. One opinion was that for example people with neurological disabilities could have great use for this.

One thing that could be added was a picture of the groceries. This is something that was discussed earlier in 5.6 *Meeting with graphic designer*. To know what groceries there are and what they are named was considered as a problem. A positive response was the fact that it was easy to just write specifics such as wanting the tail part of the fish. To be able to choose store and exactly what you want in a simple way was very appreciated. The “Don’t replace” (“Ersätt ej”) column was considered as very important even though they assumed that most groceries existed. We also discussed the possibility of being able to fold out the instructions when filling out the order form. Concerning the feedback, there was a satisfaction with the feedback given from the pen (LED). All social contact such as a phone call for confirmation of the order would be appreciated. There was a worry for the supplier not to choose the best of for example the fresh groceries. This is a general problem when using home delivery of food, hopefully the supplier is interested in keeping the customer happy and sees this as a natural service. A solution could be to have video cameras filming all fresh groceries in the store which could be looked at on a screen at home in real-time over the Internet.

The pen received positive criticism, especially for the low weight and the thickness. A summation is that the test worked out very well and that the concept of GOA received very positive criticism.



*Figure 18 Test person evaluating the GOA system*

# 8 Analysis and Conclusions

This project focused on elderly peoples' interaction with a new technology. It was of great interest to observe how the application concept was perceived and then mould the whole ordering system around these users. Apart from a few misunderstandings concerning the order process of the first forms tested, the cognition level was quite high. The last tests, when the whole system was working, convinced the test persons that this could be a great aid for elderly requiring help with their grocery shopping from the Social Services. Obviously the test group was small, but it still gave a good indication of both requirements in the initial stages and confirmation of the finished application functionality. A great advantage with this system of ordering was in fact the simple tool base of pen and paper, which is a key to the good results achieved with the user tests. The reason for this was that elderly tend to write their shopping lists using pen and paper anyway and GOA was just that but in a structured format.

Due to several factors but mainly the development stage of the pen itself, which is a factor beyond our control, external user tests were impossible to perform. Such a test would mean that a group of elderly people would order groceries from their home using GOA, an Anoto pen, and a Bluetooth compatible mobile phone over a period of several weeks. This would be very interesting further research because the whole system would be tested in a real environment. There would be no direct help available for the elderly, and our role would be purely observational. It would pinpoint the weaknesses that could be missed in an assisted test environment.

Since this project was so multi faceted with a diverse selection of knowledge from programming to behavioural studies, each subject has received a limited but sufficient amount of attention. Even though the pre-study was extensive, further research concerning Human and Machine Interaction combined with larger user tests could have perfected the usability of the system. More functionality in the database and program would have been a great help if not a necessity if the system was to be run live on a larger scale. Feedback and automatic synchronisation to the stores and the Social Services of Samhall's deliveries is an important function for a live scenario to run smoothly.

Statistics of order volumes, product types, and frequency would be of interest to automatically create user targeted ordering forms that change according to what products are ordered and how often orders are placed. An example to illustrate this could be if a group of users never order frozen vegetables, then these would be removed from the next order booklet and replaced with a product that might be used more often. The use of ICR is an area of development that could add unprecedented power to the system. It would allow total digitalisation of the whole order. Statistics could then be analysed regarding quantities and habits of users. Since this technology isn't perfected yet, the use of images of the handwriting for this particular project was the best solution in order to leave the user as unaffected as possible of the technology.

There are other paths that could have been taken in order to use the technology to place orders. One method would have been to have a tick box on all groceries at home such as on a milk carton or loaf of bread. When placing an order the desired item would be crossed and ordered automatically. The forte with this is the simplicity of ordering the goods, getting the correct items without having to specify them exactly. The typical weekly order tends to follow a certain pattern and be fairly constant, which means that most of the groceries wanted, would already exist in the home of the elderly. There would be no need to be able to find the exact grocery from the huge assortment a local store keeps. The drawback with this method however is when items, which are not on the list, are required. Either a large reference book containing all groceries in which ticks could be made to order the desired grocery or a simplified version of GOA would be required. Either way, two methods of ordering rather than one would be required which would most probably confuse the elderly user rather than aid. The other disadvantage would be receipt of the order, which with GOA is the actual paper where the order was written. If items are ordered asynchronously to each other, then they are difficult to keep track of unless a system is created where they are printed. This however would require more technological gadgets in the home of the elderly, which is not desirable.

Taking a step back, looking at the project as a whole it can be concluded that the goals set up have been achieved and although more research can be done within the areas relating to this system, the results have been both satisfying, interesting and sometimes unexpected. GOA combined with slight refinements has, according to the implications of this thesis, potential to reach a commercial status for elderly to use.

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# 10 Glossary

ALS	Anoto Lookup Service
ANS	Anoto Name Server
API	Application Programming Interface
BLOB	Binary Large Object
Bluetooth	Wireless technology that eliminates the need for devices to be connected by cable in order to send and receive information
Certec	Centre for Rehabilitation Engineering Research
HD	Home Delivery
GIF	Graphics Interchange Format
G-MAIL	Graphical E-mail
GOA	Grocery Order Application
HTML	Hypertext Mark-Up Language
ICR	Intelligent Character Recognition
Ideon	The research park of Lund where Anoto is a part
IP	Internet Protocol
IT	Information Technology
JDBC	Java Database Connectivity
JDK	Java Development Kit
KFB	Swedish Transport & Communications Research Board
LED	Light Emitting Diode
MatoMera	Store on the Internet with a virtual warehouse
MIME	Multi-purpose Internet Mail Extensions
N.A.	Not Available
ODBC	Open Database Connectivity
PNG	Portable Networks Graphics
SMS	Short Message Service is text that can be sent between mobile phones. It is a service provided by GSM technology
SQL	Structured Query Language
TAB	Text After Box
Telematics	Information and Telecommunications technology
Telemedicine	All kinds of transmission of medical information by telemedia
VP	Vice President



## MATBESTÄLLNING 2

AFFÄR:       KONSUM  
                   MALMBORGS

ANTAL	KG/L	VARA	KOMMENTAR	ANTAL	KG/L	VARA	KOMMENTAR
		Strösocker				Juice	
		Bitsocker				Yoghurt	
		Övrigt socker				Nyponsoppa	
		Vetenmjöl				Kaffebrädd	
		Övrigt mjöl				Vispbrädd	
		Salt				Fibrmjölk	
33	CL	Virky Nouveau				Toalettpapper	
33	CL	Ramlösa				Hushållspapper	
33	CL	Blandad läsk				Mjölk	
		Övrig läsk				Smör	
		Ölklass II				Margarin	
		Marmelad				Kräm	
		Syrt				Ägg	
		Knäckebröd				Tomater	
		Bröd, fritt				Gurka	
		Bröd, grovt				Gul lök	
		Bacon				Övrig lök	
		Falkorv				Potatis	
		Ost				Isbergssallad	
		Pastej				Salladshuvud	
		Skinkpålägg				Övrig sallad	
		Korvpålägg				Morötter	
		Kött				Paprika	
		Fisk				Dill	
		Fågel				Gräslök	

Figure 20 Order form version 2 page 1





	ANTAL	KG/L	VARA
MEJERI:			
(mjölk, fil, ost, smör,			
margarin osv)			
FRUKT & GRÖNT:			
(grönsaker, frukter,			
bär, potatis,			
rotfrukter osv)			
ÖVRIGT:			

AFFÄR

KONSUM

MALMBORGS

LEVDAG

MÅ

TI

ON

TO

FR

LÖ

SÖ

LEV.TID

12-14

14-16

16-18

18-20

SKICKA



Figure 23 Order form version 3 page 2

GOA

①

KRYSSA I VILKEN BUTIK

DU VILL HANDLA FRÅN:  MALMBORGS  KONSUM

②

**MEJERI**

ANTAL KG/L	VARA	SPECIFIKATION	ANTAL KG/L	VARA	SPECIFIKATION
	Mjök			Kaffegrädde	
	Margarin			Filmjök	
	Smör			Yoghurt	
	Vispgrädde			Jäst	

**CHARK**

ANTAL KG/L	VARA	SPECIFIKATION	ANTAL KG/L	VARA	SPECIFIKATION
	Bacon			Korvpålägg	
	Korv			Kött	
	Falkorv			Fisk	
	Pastej			Kyckling	
	Skinkpålägg			Ägg	

**DRYCKER**

ANTAL KG/L	VARA	SPECIFIKATION	ANTAL KG/L	VARA	SPECIFIKATION
33 CL	Vichy Nouveau			Ölklass I	
33 CL	Ranbäsa			Ölklass II	
	Övrigt vatten			Jucie	
33 CL	Bladdad läsk			Saff	

**FRUKT & GRÖNT**

ANTAL KG/L	VARA	SPECIFIKATION	ANTAL KG/L	VARA	SPECIFIKATION
	Tomater			Salladshuvud	
	Gurka			Övrig sallad	
	Gul bök			Paprika	
	Övrig bök			Apelsiner	
	Morötter			Citron	
	Persilja			Bananer	
	Dill			Kivi	
	Gräsbök			Päron	
	Potatis			Äpple	
	Isbergssallad			Vindruvor	

Figure 24 Order form version 4 page 1

### BRÖD & SPANNMÅL

ANTAL	KG/L	VARA	SPECIFIKATION	ANTAL	KG/L	VARA	SPECIFIKATION
		Stösocker				Kex	
		Bissocker				Knäckebröd	
		Övrigt socker				Bröd, firt	
		Vetengöl				Bröd, grovt	
		Övrigt mjöl				Ris	
		Salt				Pasta	

### FRYSVAROR

ANTAL	KG/L	VARA	SPECIFIKATION	ANTAL	KG/L	VARA	SPECIFIKATION
		Glass				Fisk	
		Pommes frites				Kyckling	
		Grönsaker				Färdig mat	

### HYGIEN & RENGÖRING

ANTAL	KG/L	VARA	SPECIFIKATION	ANTAL	KG/L	VARA	SPECIFIKATION
		Toalettpapper				Tvättmedel	
		Hushållspapper				Diskmedel	
		Tvål				Disktrasa	
		Schampoo				Rengöringsmedel	

### ÖVRIGAVAROR

### ÖVRIGT

ANTAL KG/L VARA SPECIFIKATION

		Kaffe					
		Té					
		Marmelad					

③

LEV.DAG     MÅ     TI     ON     TO     FR     LÖ     SÖ

LEV. TID     12-14     14-16     16-18     18-20

KLAR

Figure 25 Order form version 4 page 2

**STEG 1**JAG VILL HANDLA FRÅN:  MALMBORGS  KONSUM

DAGENS DATUM:

**STEG 2****MEJERI**

VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT	VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT
Mjolk				Filmjolk			
Margarin				Yoghurt			
Smör				Proviva			
Grädde							

**CHARK & DELIKATESS**

VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT	VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT
Bacon				Köttfärs			
Korv				Fisk			
Pastej				Kyckling			
Pålägg				Ägg			
Kött							

**BRÖD & SPANMÅL**

VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT EJ	VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT EJ
Bröd, fit				Bissocker			
Bröd, grovt				Övrigt socker			
Vetemjöl				Salt			
Övrigt mjöl				Ris			
Strösocker				Knäckebröd			

**DRYCKER**

VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT	VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT
Kaffe				Öl klass II			
Ranlösa	33 CL			Juice			
Övrigt vatten				Saff			
Bländad läsk	33 CL						

Figure 26 Order form version 5 page 1

### FRUKT & GRÖNT

VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT	VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT
Tomater				Sallad			
Gurka				Paprika			
Gul bök				Apeksiner			
Övrig bök				Citron			
Morötter				Bananer			
Persilja				Päron			
Dill				Äpple			
Potatis							

### FRYSVAROR

VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT	VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT
Glass				Fisk			
Grönsaker				Kyckling			

### HYGIEN & RENGÖRING

VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT	VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT
Papper				Tvättmedel			
Tvål				Disk			
Shampoo				Rengöring			
Balsam							

### ÖVRIGT

VARA	KUPONG/ ANNONS MÄNGD	SPECIFIKATION	ERSÄTT OMSLUT

**STEG 3**

JAG VILL HA MINA VAROR:  MÅ  TI  ON  TO  FR

PÅ:  FÖRMIDDAGEN  EFTERMIDDAGEN

**STEG 4**

NU ÄR JAG KLAR

Figure 27 Order form version 5 page 2

**STEG 1**JAG VILL HANDLA FRÅN:  Malmborgs  KonsumDAGENS DATUM:    /    /   **STEG 2****Mejeri**

VARA	KUPONG	ANVÄNING	EBENT	MÄNGD	SPECIFIKATION	VARA	KUPONG	ANVÄNING	EBENT	MÄNGD	SPECIFIKATION
Mjök						Filmjök					
Margarin						Yoghurt					
Smör						Prova					
Gräde											

**Chark & Delikatess**

VARA	KUPONG	ANVÄNING	EBENT	MÄNGD	SPECIFIKATION	VARA	KUPONG	ANVÄNING	EBENT	MÄNGD	SPECIFIKATION
Bacon						Köttfärs					
Korv						Fisk					
Pastej						Kyckling					
Pålägg						Ägg					
Kött											

**Bröd & Spannmål**

VARA	KUPONG	ANVÄNING	EBENT	MÄNGD	SPECIFIKATION	VARA	KUPONG	ANVÄNING	EBENT	MÄNGD	SPECIFIKATION
Bröd, fint						Bitsocker					
Bröd, grovt						Övrigt socker					
Vetermjöl						Salt					
Övrigt mjöl						Ris					
Strösocker						Knäckebröd					

**Drycker**

VARA	KUPONG	ANVÄNING	EBENT	MÄNGD	SPECIFIKATION	VARA	KUPONG	ANVÄNING	EBENT	MÄNGD	SPECIFIKATION
Kaffe						Öl klass II					
Ramlösa				33 CL		Juice					
Övrigt vatten						Saft					
Blandad läsk				33 CL							

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### Frukt & Grönt

VAR	KLEDDIG ANVÄNDIG EJ MÅNGD	SPECIFIKATION	VAR	KLEDDIG ANVÄNDIG EJ MÅNGD	SPECIFIKATION
Tomater			Sallad		
Gurka			Paprika		
Gul lök			Äpelsiner		
Övrig lök			Citron		
Morötter			Baraner		
Persilja			Päron		
Dill			Äpple		
Potatis					

### Frysvaror

VAR	KLEDDIG ANVÄNDIG EJ MÅNGD	SPECIFIKATION	VAR	KLEDDIG ANVÄNDIG EJ MÅNGD	SPECIFIKATION
Glass			Fisk		
Grönsaker			Kyckling		

### Hygien & Rengöring

VAR	KLEDDIG ANVÄNDIG EJ MÅNGD	SPECIFIKATION	VAR	KLEDDIG ANVÄNDIG EJ MÅNGD	SPECIFIKATION
Papper			Tvättmedel		
Tvål			Disk		
Schampoo			Rengöring		
Balsam					

### Övrigt

VAR	KLEDDIG ANVÄNDIG EJ MÅNGD	SPECIFIKATION	TEXTFÄLT

**STEG 3**

JAG VILL HA MINA VAROR:

MÅ  TI  ON  TO  FR

PÅ:  FÖRMIDDAGEN  EFTERMIDDAGEN

**STEG 4**

NU ÄR JAG KLAR →



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*The aim of this Master's Thesis was to create a system for elderly to independently order groceries from their home using the Anoto pen and paper technology. This required an extensive pre-study into elderly behavioural patterns through research and user tests. A graphical interface was deigned and the supporting technology behind it implemented. The system was tested with a small group of elderly, which gave positive results. The conclusion is that elderly understand this method of ordering and it can be of great benefit to them.*

*This document is also available on the Internet:  
<http://www.certec.lth.se/doc/groceryorder/>*



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*Certec is a division of the Department of Design Sciences at Lund University.*

*The aim of our research and courses is to contribute to improved opportunities for people with disabilities by developing more usable technical devices, new design concepts, and new individual methods of learning and searching.*

*Certec employs about 20 people. Our annual budget is approximately 12 million Swedish kronor.*

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**Grocery Order Application for Elderly**