Reducing Meat Consumption Using A Mobile Application

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Abstract

Animal agriculture has many consequences for our planet, and few are good. An increase in greenhouse gasses, higher use of resources and serious problems with animal welfare. Because of these reasons the current global meat consumption has to decline, but the world population is growing and the per capita meat consumption is also growing. For these reasons consumers nowadays should be motivated to reduce their meat consumption. This is why a mobile application was developed that helps people to reduce their meat consumption. First a literature research is done on why people choose (or don't choose) to reduce their meat consumption. This results in several design guidelines and an eventual design and implementation of the app. Then a brief formative usability evaluation is carried out, followed by a final evaluation to assess the degree in which the app fulfills its goal. The app was deemed easy to use, and the various elements of the app were considered to be be motivating.

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1 Introduction

Agriculture has a big impact on our environment. It causes climate change, animal habitats disappearing, eutrophication of water bodies and water shortages. Agriculture also utilizes pesticides, and animal agriculture plays a role in creating antibiotics resistance (Tilman et al., 2001). Animal agriculture is more resource intensive than plant agriculture. When comparing a meat-based diet against the ovo-lacto vegetarian diet, the meat-based diet requires more energy, land and water (Pimentel & Pimentel, 2003). Reducing meat intake is the most effective measure concerning food that a consumer can take to reduce their greenhouse emissions.(Garnett, 2011). In fact, the only other measures that are more effective are living car-free, avoiding airplane flights and limiting the amount of children. (Wynes & Nicholas, 2017). A diet that contains less meat and more plant foods is not only environmentally better but also has a positive effect on the individual's health. A reduction of meat and increase in vegetables is associated with lower rates of cancers and coronary heart disease (Duchin, 2005). Given these advantages (both globally and individually) convincing people to reduce their meat consumption is an important task.

Technology can be a helpful tool for convincing people to reduce their meat consumption because it can easily be scaled up for limited cost, and is always present in a way humans could never be.

2 State of the Art

2.1 Literature Review: Perceived benefits and barriers of reducing meat consumption

To develop a technological tool it has to be investigated what pathways will work best to convince consumers. This section contains the results of a literature research on the perceived benefits of and barriers to reducing meat consumption, the strongest motivation for reducing meat consumption, and how well informed people are about the benefits.

People seem to be the most aware of the health benefits of reducing meat. Lea, Crawford, and Worsley (2006) showed that health was the most agreed on advantage. 'Prevent disease in general' had a 70% agree rate. However, in Povey, Wellens, and Conner (2001) people seemed much less in agreement. Meat eaters associated a diet containing meat with both 'nutritional or balanced' and 'health scares'. This difference might have to do with a different focus of each article. Povey et al. (2001) asked about people's perceptions towards vegetarianism. This is a diet that completely removes meat and fish. On the other hand Lea et al. (2006) talked about a plant-based diet. This is a diet that puts more emphasis on vegetables, fruits and legumes, and a decrease in consumption of meat, eggs and dairy. Vegetarianism is more extreme than a plant-based diet because it cuts out the entire food group, which is why it might be associated with 'nutritionally unbalanced' - especially given the old adage 'everything in

moderation' . Additionally 'plant-based diet' is mostly used when talking about the health benefits of meat-reduction, while flexitarian/vegetarian is used more when talking about the ethical benefits (especially animal rights). In Povey et al. (2001) The meat eaters didn't have ethical associations towards a vegetarian diet. (The respondents were limited to 8 associations) In Lea et al. (2006) the highest recognized ethical benefit was 'Help the environment', with 35% of people agreeing. 'Animal welfare' was just below that with 30% of agreement.

Health is also the most important motivation for people to reduce their meat intake. In Latvala et al. (2012), and Tobler, Visschers, and Siegrist (2011) health was the biggest motivation for reducing the meat consumption. In Lentz, Connelly, Mirosa, and Jowett (2018) cost savings were ranked higher than health. In de Boer, Schösler, and Aiking (2017) both environment and variation in meals were ranked higher than health. This last difference is probably because that study focused on young people (18-35 years). Most likely health reasons become more important as people grow older. Another motivation that was consistently mentioned across studies was taste and/or variation (Lentz et al., 2018; Latvala et al., 2012; de Boer et al., 2017). The importance of other reasons such as animal welfare and environment differs across the studies. The motivations don't change when only looking at people who already substantively reduced their meat intake. (Lentz et al., 2018; de Boer et al., 2017). However, when looking at vegetarians, animal welfare became the most important motivation. (Lentz et al., 2018; de Boer et al., 2017).

The biggest perceived barrier to reducing meat reduction is the enjoyment of eating meat (Povey et al., 2001; de Boer et al., 2017; Lea & Worsley, 2003; Hoek, Pearson, James, Lawrence, & Friel, 2017; Macdiarmid, Douglas, & Campbell, 2016). The second biggest barrier was having to change eating habits. (Lea et al., 2006; de Boer et al., 2017; Lea & Worsley, 2003; Hoek et al., 2017; Macdiarmid et al., 2016). Other barriers that were often mentioned were lacking information or cooking skills, the belief that regularly eating meat was healthy and having to cook for a meat-loving family or partner. (Povey et al., 2001; Lea et al., 2006; de Boer et al., 2017; Lea & Worsley, 2003; Hoek et al., 2017; Macdiarmid et al., 2016).

The environmental impact of meat is structurally underestimated by consumers. People consistently rate eating less meat as the lowest effective diet measure, thinking that it was less important than: buy organic, avoiding air transport, eating local, eating seasonal, avoiding packaging, and avoiding food waste (Lentz et al., 2018; Hoek et al., 2017; Tobler et al., 2011). It was also rated lowest when compared to general methods to reduce greenhouse emission, such as energy use and waste (Vanhonacker, Van Loo, Gellynck, & Verbeke, 2013). Lea et al. (2006) shows that there is also a lot of uncertainty on the other advantages, such as animal welfare, which had an uncertainty of 43%, increasing efficiency of food production with 51% uncertainty, and have a tasty diet with 37%.

In summary, the biggest recognized advantage of reducing meat consumption is health benefits. It is also the most important motivation for people. The ethical advantages are much less recognized, especially the environmental benefit

is structurally underestimated. Animal welfare seems to be especially important to those who have completely cut out meat of their diet, but less so for those who have only reduced their meat consumption. The biggest barrier for people to reduce their meat consumption is their enjoyment of eating meat and not wanting or being able to change their cooking and eating habits. It seems that the most promising pathways are to inform people about the additional benefits of reducing meat consumption (besides health), help them to gradually create new habits and offer tasty recipes, which are mostly quick and easy.

2.2 How habits can help

When we talk about habits we don't just refer to the frequency of an occurrence. According to Lally, Van Jaarsveld, Potts, and Wardle (2010), drawing on the work of Wood, Tam, and Witt (2005) and Verplanken (2006), "habits are acquired through incremental strengthening of the association between a situation (cue) and an action, i.e. repetition of a behaviour in a consistent context progressively increases the automaticity with which the behaviour is performed when the situation is encountered". Lally et al. (2010) show that the median time to establish a habit is 66 days, although there is a large difference between individuals, resulting in a range of 18 to 254 days. They also show that not performing the behavior one time does not lead to a significant decrease in habit strength.

2.3 Existing Apps

There exist already several apps that have the same purpose as this project: to motivate users to reduce their meat consumption.The most famous one is probably the 'Darwin Challenge'. The Darwin challenge app motivates people to eat less meat by showing the difference that they make. Some of the metrics shown are square meters of forest saved, greenhouse gases avoided (expressed in kms driven by car), marine reserves created, extra lifetime and money saved. The user can decide how many days they want to be meat-free. It has leader boards and people can join groups and compare their group against other groups. The app has won several prices, such as the "Good design Award" (2018), Rebrand100 (2018), AGDA award (2017), Best awards (2017) and W3 (2017). It was created by (among others) Chris Darwin, the grandson of Charles Darwin. Another app that managed to catch a lot of attention was 'the Climatarian Challenge'. It was created by the foundation 'Less meat, less heat.' In this app you are challenged to eat an enviroment-friendly diet for a month. You are given 8000 points at the beginning, and each meal you log will lead to a reduction in your points. The aim is to keep within the allocated 8000 points. (include more specific write up on Less app) There are many other apps out there with similar set-ups. The focus is on either tracking your current diet, or inputting your 'standard' diet into the app and seeing the (predicted) beneficial results your diet has on the earth. There is one app that works quite different. This is Tastyvist, a german app created by the German greenpeace department. You can choose

	Self Monitoring	Goal setting	Feedback behavior outcome	Leader boards	Social
Less	✓	✓	x	x	x
Climatarian Challenge	✓	∽	✓	x	x
Darwin Challenge	✓	✓	✓	✓	✓
TastyVist	x	∽	x	x	x
Quit meat	✓	x	✓	x	x
Veganm8	x	x	∽	x	✓
VeggieApp	x	x	∽	x	x
Eat4Good	x	x	✓	x	x
forGood	x	x	✓	x	✓

Table 1: Behavior change Techniques used by various apps. ∽ in Goal Setting column means that the goal is chosen by the app and cannot be changed by the user. ∽ in Goal setting means that the app sets a default goal that the user can't change.

the reason(s) that you want to reduce your meat consumption. (Climate, health, animal welfare, industrial agriculture, or fight global hunger.) You also select in which situations you have difficulty finding meatless alternatives, the reasons that you find it hard to eat less meat (for example tradition, or taste, or lack of knowledge), and the difficulty rating (easy or expert). The app then offers several possible goals or tasks. Every task has a difficulty rating. It offers the possibility of notifications to remind you of your chosen goal. People can swipe through the tasks untill they find one that they like. When completing a task you earn points, and if enough points have been earned the user 'levels up'.

In tables 1 and 2 an overview is given of all the different techniques used in the apps. In table 3 an overview is given of which advantages the app promotes. It was decided that self monitoring and feedback on behavior outcomes were the most important elements to incorporate in the app. Additionally either a social element or a gamification element could be included.

3 Ideation

3.1 Design guidelines

One aspect that will be important to consider is to create a design that reinforces habits. Firstly, one barrier mentioned by people was that they didn't want to change their habits or found it hard to do so. Our app should help in gradually building new habits. Additionally, strong habits will make it easier to perform the desired behavior (Verplanken & Wood, 2006). A habit is an

	Lev-els	Chal-lenges	Recipes	Tips & Background
Less	x	x	x	x
Climatarian Challenge	x	x	x	x
Darwin Challenge	x	✓	x	x
TastyVist	✓	✓	x	✓
Quit Meat	x	x	✓	x
Veganm8	x	x	✓	x
VeggieApp	x	x	✓	✓
EAt4Good	x	x	x	✓
ForGood	✓	✓	x	x

Table 2: Behavior change Techniques used by various apps. A continutation of table 1.

	Green-house	Animal Welfare	Planet Resources	World Hunger	Health	Money
Less	x	x	x	x	x	x
Climatarian Challenge	✓	x		x	x	x
Darwin Challenge	✓	✓	✓	✓	✓	✓
Tastyvist	✓	✓	✓	✓	x	✓
Quit Meat	✓	✓	x	x	x	x
Veganm8	✓	✓	x	✓	x	✓
Veggie App	✓	✓	x	✓	x	x
EAt4Good	✓	✓	✓	✓	✓	x
ForGood	✓	x	x	x	x	x

Table 3: An overview of which advantages of reducing meat consumption are emphasized in the app.

automated reaction to certain contextual clues. A habit may be formed by repeatedly performing an action. Additionally, implementation intentions can help in establishing a habit. (Verplanken & Wood, 2006).

One barrier mentioned by multiple people is that they really enjoy eating meat. This barrier should be addressed by incorporating recipes without meat that taste good and tips to create appealing meals without needing meat. Additionally, the app should fit unobtrusively into people's life and offer help or advice at the right moment, offer feedback on how well they are doing and if they are meeting their goals. Also, because people seem to be largely unaware of all the benefits of reducing meat consumption, the app should inform them of these benefits in an intuitive and meaningful way.

In summary, the following design guidelines were extracted. The app should:

1. Create new habits and disrupt old ones.
2. Help the user create tasty recipes that don't require additional cooking skills.
3. Clearly inform the user of how they are doing and their progress.
4. Inputting their meat consumption should be quick and easy.
5. The user should feel accomplished when they manage to reduce their meat consumption.
6. Inform users about the advantages of reducing meat consumption.

3.2 Exploratory Sketching

To start of with several initial sketches were made. These sketches were to explore various designs and methods of incorporating the design guidelines. In figure 1 one example of these sketches can be seen. More sketches can be found in appendix A. In figure 3.2 an early prototype can be seen made with prototype design software MarvelApp. For some design elements there were several considerations and options. These elements will be discussed in the following subsections.

3.3 The log screen

The apps all handle the logging in a slightly different ways. In the Less app a plus sign opens a pop-up where you can log the meal. It makes you specify the amount of grams. In 'Quit Your Meat' you click on the picture of the food eaten to open up the logging screen. You log what kind of meat you've eaten. In the Climatarian challenge the log screen is on the home page of the app. You choose the type of meat and portion size. It has three log-in entries: breakfast, lunch and evening meal. The Darwin Challenge app only allows you to record a meat free day, without any further specification.

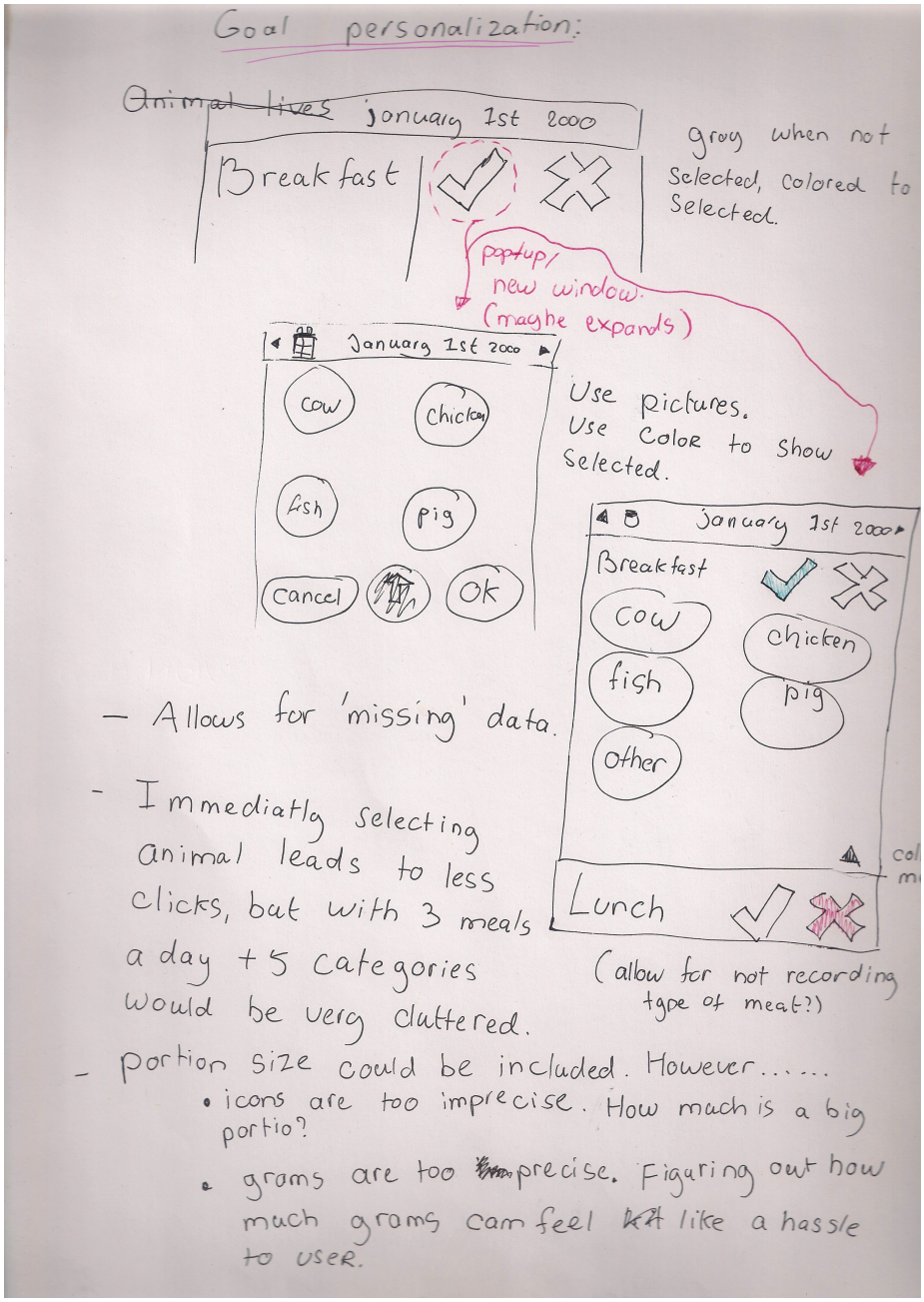

Figure 1: An early sketch of the app

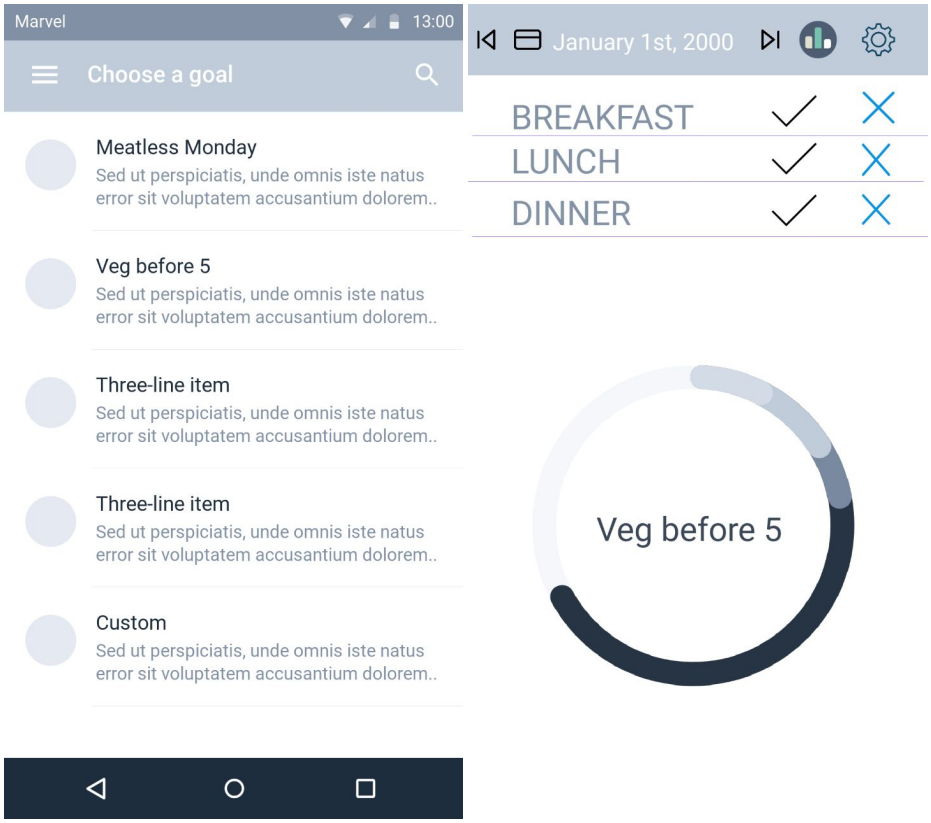

Figure 2: An early mock-up of the app

When choosing how to log the reduction in meat two different guidelines have to be balanced. On the one hand you want to make it as quick and easy as possible for people to log their successes or failures (guideline 5) In this the Darwin Challenge excels, only one button press is needed. However, by leaving out too many details might not feel rewarded for certain actions. (guideline 6) For example, having complete meat-free days might not be practical for some people. (For example those who participate in a cooking group, or where their partner often prepares dinner). For them a 'Vegetarian till 5' approach might be more suitable. However, this approach will not be rewarded by the Darwin app. Another problem is if you want to be more effective in reaching your goal by choosing different kinds of meat. For example, beef is by far the worst meat when it comes to causing climate change. In the 'climatarian challenge' this also means losing more points compared to eating chicken. However, this approach could be problematic because beef is arguably better for saving animal lives since more meat is gathered from one animal life. One workaround would be to let people set their motivation beforehand and use this to personalize which meats are 'good'or 'bad'. The downside of this is that making users aware of all of the positive benefits of meat reduction will help make the user for stronger intentions (guideline 8). By only focusing on one motivation this effect would be lost. Given these considerations it was chosen to not include the type of meat eaten.

Portion size is also problematic. Allowing people to log the amount of meat eaten means they will be rewarded when eating smaller portions. However, if you use icons such as in the climatarian challenge app different people might have very different ideas about how big a big or small portion is. On the other hand, forcing people to input the amount of grams eaten means an extra mental task (and in many situations people might not actually know how much eat they've eaten). Given these considerations, it was chosen to not have a portion option or an option for different kinds of meat. However, the app will allow logging for each meal separately.

3.4 The Goal setting

Another choice that has to be made is whether we use a point-based goal or a rule-based goal. A rule-based goal would look like: 'No meat on Mondays', or 'vegetarian till 5'. A point based system would start every week with a certain amount of points, which are slowly depleted throughout the month based on the meals eaten. The advantage of points is that the goal can slowly be made harder by reducing the amount of points available. Also, the type of animal eaten and/or personal goal can be taken into consideration. For someone who cares about the climate, A hundred grams of beef will cost more points than a hundred grams of chicken. Finally, it fits closely to the techniques of gamification. However, a disadvantage is that it might be harder for people to understand if they are doing good or not without checking the app. The advantages of a rule based goal is that it encourages routine habits (which will

be more likely to maintained). They are easy to remember and people know immediately if they are accomplishing their goal or not. It was chosen to have specific days and meals on each day in order to create strong habits that rely on contextual clues. For example, people might associate not eating meat with laundry day, or the specific time they get home. This effect would be lost if people could simply choose to eat 'x days meatfree'. Additionally, recording the type of animal eaten won't be reflected in the results reached. In the end a hybrid design was chosen. In the beginning a goal is chosen by the user, e.g. 'meatless Mondays'. When the user doesn't eat meat on Monday, they receive 2 points per meal. When the user does eat meat on Monday, they receive negative points. These negative points start at -1, but grow bigger with each subsequent time the user fails their goal. When they succeed at their goal for one meal this streak is broken and the negative points awarded is reset to -1. This is because missing a single instance doesn't hinder the building of a habit, but longer periods of not performing the behavior do impact the habit (source), so when the user does not achieve their goal, they should be encouraged as quickly as possible to start their habit again. If the user has a meat-free meal outside of their set goal they are awarded 1 point.

When the user reaches a certain amount of points they 'level up'. (source) state that the average time to establish a habit is 60 days. Therefore the final level should correspond to 60 days of performing the habit successfully. Ideally the user should then be urged to choose a harder goal and start over again. Of course, this should not be forced and only at the user's volition.

3.5 Progress visualization

Several systems were considered. One such system was a streak system. This would visualize the days that the user succeeded or failed in their goals using colored circles. This idea was rejected for several reasons. Firstly, the system would become quite complicated to interpret because many of the goals are only relevant on one day (i.e. meatless Mondays). This makes it ambiguous what the color should be on those days where there is no set goal. Additionally it would make it harder to see the increase or decrease in progress. Also, after failing a streak the user might be demotivated to start again because they lost their 'progress' or streak length.

For these reasons it was chosen to instead use three different visualizations of progress. One is a simple bar graph showing the percentage of how often they succeeded in their goal. This can be seen every week or every month. In this way a increase or decrease of success is clearly visible. The second visualization is meant to show the habit strength and uses the point system as described in subsection 3.4.It shows the current level, represented by a plant-eating animal. The user starts as a small animal (such as a rabbit) and ends up as a big animal (such as an elephant). The final level is achieved when a strong habit is formed (60 days without any prolonged periods of failure) and is an indicator that the goal difficulty can be increased.The various levels reached can also be seen as achievements, motivating the user to reach a higher level. A donut graph

indicates how far away the user is from levelling up. The third visualization is a detailed break-up of points gained or lost during the last week using various colored circles.

4 design and implementation

Then a more detailed design was made of the various screens. This can be seen in figure 3 and a navigation diagram can be found in 4. The design guidelines come back in the following way in this design:

4.1 Logging of meal

The logging segment is designed as described in section 3.3, including the different meals of the day (breakfast, lunch, and dinner) but excluding the type of animal and amount eaten. The user presses either a check mark or cross which will then change from grey to green/red. The user can also reverse their input. It was placed on the main screen so input was as quick and easy as possible. The date can be changed by pressing the arrow buttons on top of the screen, or by opening a calendar widget by pressing the date itself. This logging segment supports **4: Inputting their meat consumption should be quick and easy.**

4.2 The leveling system

The point system as described in more detail in 3.4 is set up to promote habits. Not eating meat on a day with a goal has a higher reward than not eating meat on a day without a goal. Additionally, a failure streak is punished harsher than one single failure.The leveling up animal and donut chart were placed on the main page. In this way the user can see their current progress with a quick glance when inputting their data. This supports **1: Create new habits and disrupt old ones, 3: Clearly inform the user of how they are doing and their progress** and **5: The user should feel accomplished when they manage to reduce their meat consumption.**

4.3 The inspire and inform buttons

Two orange buttons can be found on the main screen. The 'inspire button' has a lightbulb on it and provides inspiration for a meal without meat through recipes and tips. The 'inform button' has a book on it and provides background information on the effects animal farming has on the world. The inspire button divides into tips for breakfast, lunch and dinner. The appropriate category is chosen based on the time. (For example, if the user views such a tip at 3pm, the dinner category is chosen since that is most likely their next meal).The recipes and tips can be found in appendix B.1.The second button with a book on it, the 'inform button', has a list of strings that describes the impact animal farming

Figure 3: Caption

Figure 4: A diagram showing the navigation through the various pages of the app

has. These can be found in appendix B.2 and the sources for these inform strings can be found in appendix B.3. Both dialogs can show a new string by pressing the refresh button, and for the inspire strings the meal category can be changed with arrow buttons. The recipes and information strings are also presented to the user through the notifications. This supports **2: Help the user create tasty recipes that don't require additional cooking skills.** and **6: Inform users about the advantages of reducing meat consumption**

4.4 The Impact Screen

On the impact screen the user can see how much greenhouse gasses they have saved. This is calculated using the input of the user and expressed in kms driven by car. The user can also see how many chickens, cows and pigs weren't killed because of their diets choices. The calculations can be found in appendix C. This supports **5: The user should feel accomplished when they manage to reduce their meat consumption.** and **6: Inform users about the advantages of reducing meat consumption**.

4.5 The visualization screens

On the visualization page there is a tabbed layout that allows the user to toggle between three different kind of visualizations. The first is a detailed overview of the points lost and gained during the week for each meal. This is done using a colored circle for each meal. The second and third visualizations are bar graphs that show the success percentage of their goal. This second bar graph has a span of one week per bar, while the third bar graph has a span of one month per bar. For all three the visualizations the user can change the data by pressing the arrows on the top of the screen which are next to the date that is currently selected. In this way they can go back or forward in time. This supports **3: Clearly inform the user of how they are doing and their progress**.

4.6 Notifications

The user can choose out of three options for sending notifications. "Never", "before meals" and "before shopping". If the user selects "before meals" they will be asked when they typically eat their meals. A notification will be sent before a meal where they set the goal to not eat meat. If the user selects "before shopping" they will be asked how often each week they shop and at what day and time. Then a notification will be sent before they go shopping. The content of the notification message is the inspire and inform strings as can be found in appendix B. These notifications support **2: Help the user create tasty recipes that don't require additional cooking skills.** and **6: Inform users about the advantages of reducing meat consumption**.

4.7 Implementation

The app was made using Android Studio. To create the barcharts and donut graph the library MPChartLib was used.

5 Evaluation

5.1 Formative Evaluation

A quick user test was done in order to find possible usability issues. A user walked through the app, voicing their thought process out loud. The following usability issues arose.

- During setup the user was first asked to select their desired goal and notification option, then a small tutorial was given about the point system. The test users indicated that this sequence was confusing and it was reversed.
- It was desired to have a symbol indicating on the main screen if a particular meal had the goal of not eating meat. This was implemented by using a leaf icon since this corresponds with the vegetarian option on restaurant menus.
- It was often unclear that the example picture during the small tutorial about the point system was just an example and couldn't be interacted with. This issue wasn't solved.
- The detailed overview of the points gained or lost during the last week is not understandable for people with red-green color blindness. This issue wasn't solved, but a potential solution could be using icons inside the circles, or replacing the circles with check marks and crosses.
- Choosing a goal or notification option could be skipped by simply paging forward. This was not the intention and fixed.
- Several bugs and spelling errors were fixed.

  The final design of the app can be seen in figure 5.1.

5.2 Final Evaluation

A final evaluation was held using an online questionnaire. In the end there were 9 responses. However, only one of the respondents was interested in reducing their meat consumption meaning the majority of respondents didn't belong to the target group. The survey can be found in appendix D. The respondents were asked about the ease with which they could perform certain tasks. The results can be found in table 5.2. The average score of all is above 4 (on a scale of 1-5) which seems to indicate there are no major usability problems left. A second group of questions asked was how motivating they found certain elements

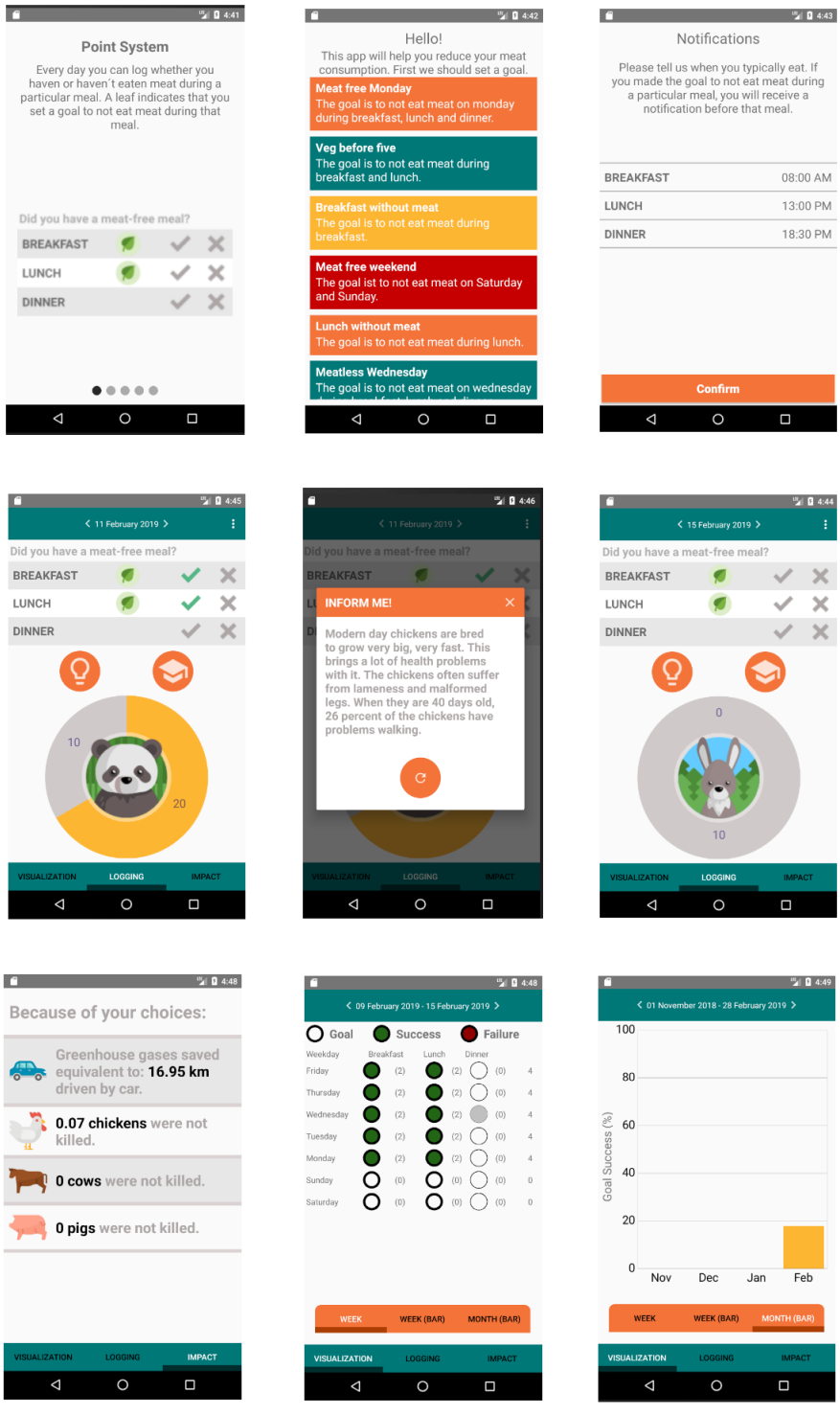

Figure 5: The final design of the app

	How easy is the navigation through the application?	How easy was the first time setup?	How easy is it to view historical information about previous days?	How easy is it to enter whether you have eaten meat or not?
Average	4.33	4.22	4.50	4.78
Standard Deviation	0.50	0.67	0.53	0.44
95% CI interval	[3.95, 4.72]	[3.71, 4.73]	[4.09, 4.91]	[4.44, 5.12]

Table 4: The results of questions regarding the ease of a certain actions. The scale was from 1 to 5. 1 had the label "very hard". 5 had the label "very easy"

of the app. Most score on average above 3 and below 4. This means that most elements in the app were found to be motivating.

When asked about missing features, 3 out of 7 respondents wanted a more freedom when it comes to setting a goal. A custom goal option that allows choosing specific meals during the week would accommodate this. Additionally 3 out of 7 respondents had some problems with certain buttons being too small. The following improvements were also suggested once:

- *"Individual goals (say I want to not eat meat tomorrow evening, but I do this evening)".*
- *"Next to CO2, the amount of water and (animal) food saved would be very interesting to me."*
- *"A clearer overview of your progress."*
- *"More pictures/icons would be nice"*
- *"In the visualization part, the icons that represent goal, success and failure could be improved. Maybe adding an extra help screen could work, where you also explain what the grey circle means."*
- *"Perhaps add an option that challenges you to go vegan on certain meals."*

	How motivating was the point system?	How motivating is the "inspire me" (lightbulb) button?	How motivating is the "inform me" (book) button?
Average	3.22	3.44	3.56
Standard Deviation	1.20	0.88	0.88
95% CI interval	[2.30, 4.15]	[2.77, 4.12]	[2.88, 4.23]

Table 5: How motivating several components of the app are. The scale was from 1 to 5. 1 had the label "Not motivating at all". 5 had the label "Very motivating"

	How motivating was the leveling system?	How motivating were the notifications?	How motivating was the impact screen which showed you the impact of your actions?
Average	3.22	3.33	3.89
Standard Deviation	1.30	0.50	0.93
95% CI interval	[2.22, 4.22]	[2.95, 3.72]	[3.18, 4.60]

Table 6: How motivating several components of the app are. The scale was from 1 to 5. 1 had the label "Not motivating at all". 5 had the label "Very motivating"

6 Conclusion

The aim of this project was to design a mobile application that motivates people to reduce their meat consumption. Animal agriculture has many negative effects on the world around us. It increases global warming, increases eutrophication, and requires more resources than plant agriculture. Additionally, animal welfare in animal agriculture is often of a low standard, and some people might have ethical problems with the slaughtering of animals. During the initial literature research it was found that people often underestimate the environmental problems of meat, and/or have trouble changing their cooking habits. Additionally many people had a personal reason for wanting to reduce their meat consumption: they wanted to improve their health. Based on these findings an app was designed that informed people about the disadvantages of meat, inspired them with vegetarian recipes, promoted concrete goal setting, motivated them with points and a levelling system, and helped to create new habits. Based on the final evaluation it seems the app is easy to use. Most elements were seen as moderately motivating. Based on the final evaluation it seems that the app is suited for the intended purpose: help people lower their meat consumption. However, the final evaluation was only filled in by 9 people, of which exactly only one was part of the intended target group. Additionally most respondents only used the app for a few minutes. Another limitation is that although users were asked how motivating they found each component, this does not necessarily translate to these components actually helping people to reduce their meat consumption.

7 Future Work

Several features could be added to the app. During the final evaluation the desire to have a more flexible 'custom' goal option was mentioned multiple times. Therefore it makes sense that such an option should also be implemented. Additionally, another feature that was mentioned multiple times would be a 'challenge system' which allows the user to set a challenge for one specific day. This would tie in naturally with the gamification system already in place. This gamification system could also be extended with an achievement system. During the ideation phase one possible idea was to include social elements in the app. Because of time constraints it was decided to focus on either social or gamification elements, the final choice being the latter. Therefore, a logical step for future work would to investigate how social elements could be incorporated into the app. Another possible addition could be to broaden to app to focus on an ethical diet in general, instead of just reducing meat consumption. Finally, the app currently targets people who already have a desire to reduce their meat consumption. Therefore, it might be interesting to investigate if the app could be extended in such a way to also convince people who have never thought about their meat consumption before. This could happen in-app (by laying more of an emphasis on discovery instead of behavior change) but one could also think

of an out-app idea. For example, maybe one could design an artwork that is displayed in a public place, which visualizes the impacts of meat consumption. Then through a QR-code the spectators could download the currently designed app as direct call-to-action.

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Appendices

A Sketches

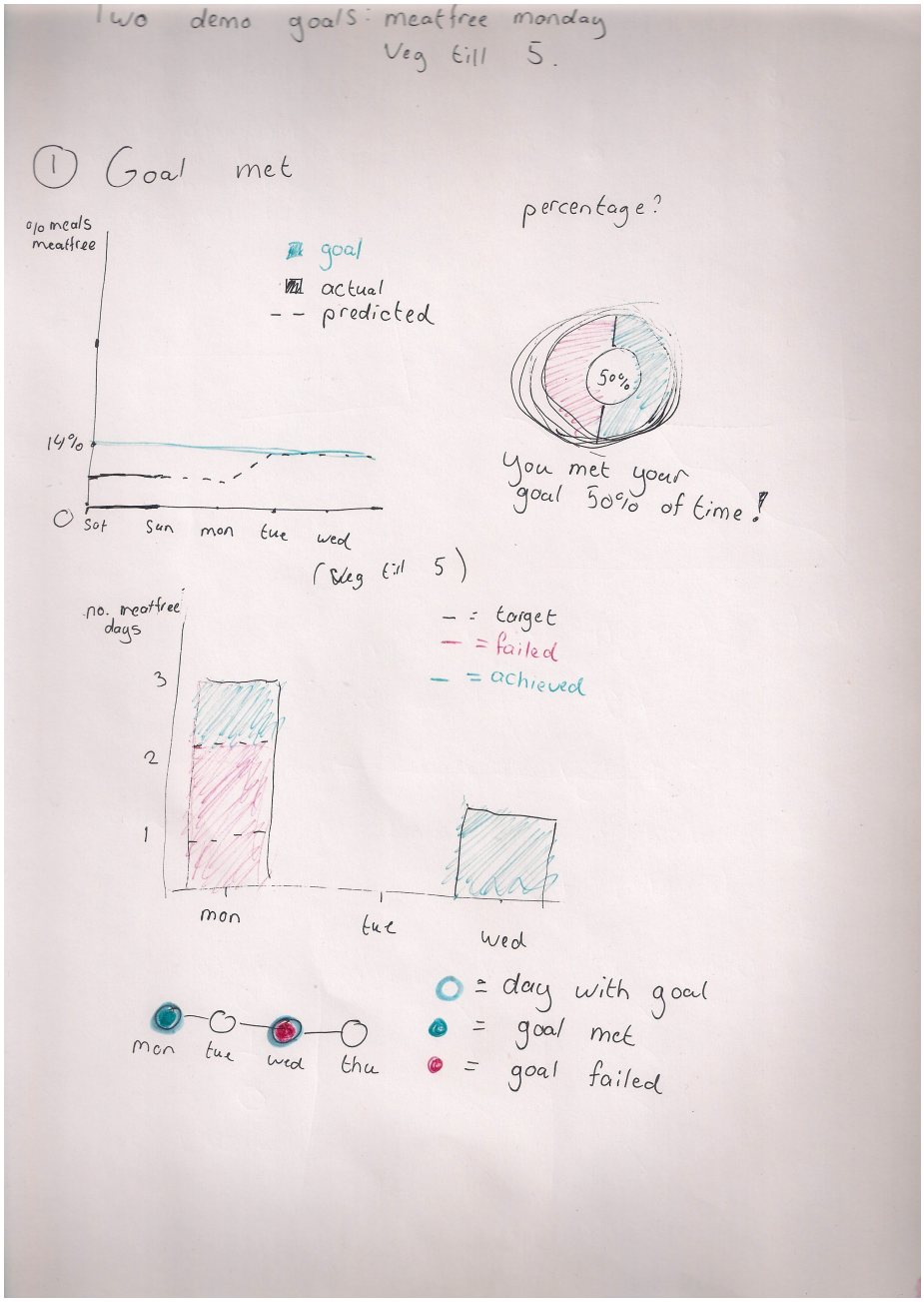

Figure 6: An early sketch of the app

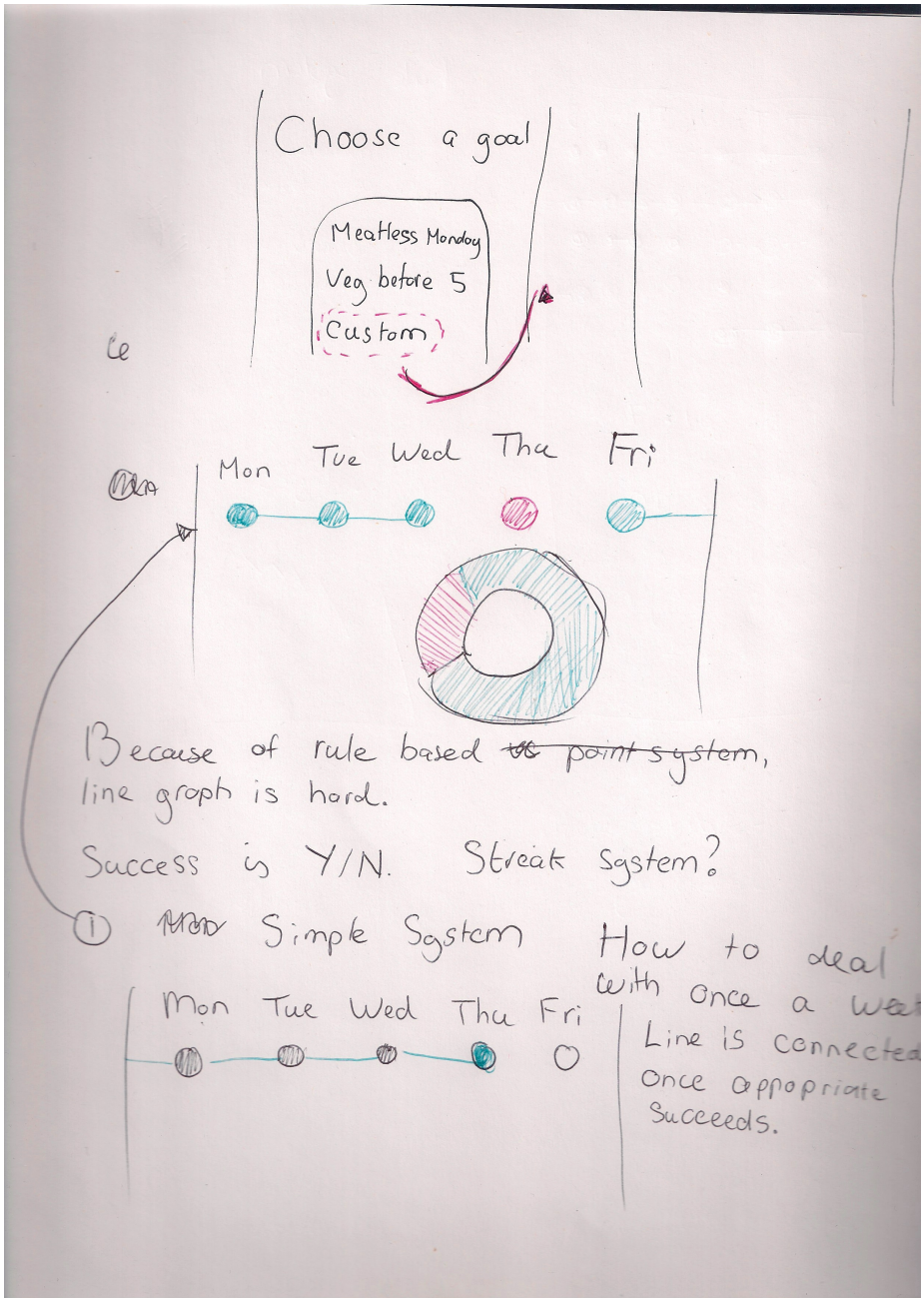

Figure 7: An early sketch of the app

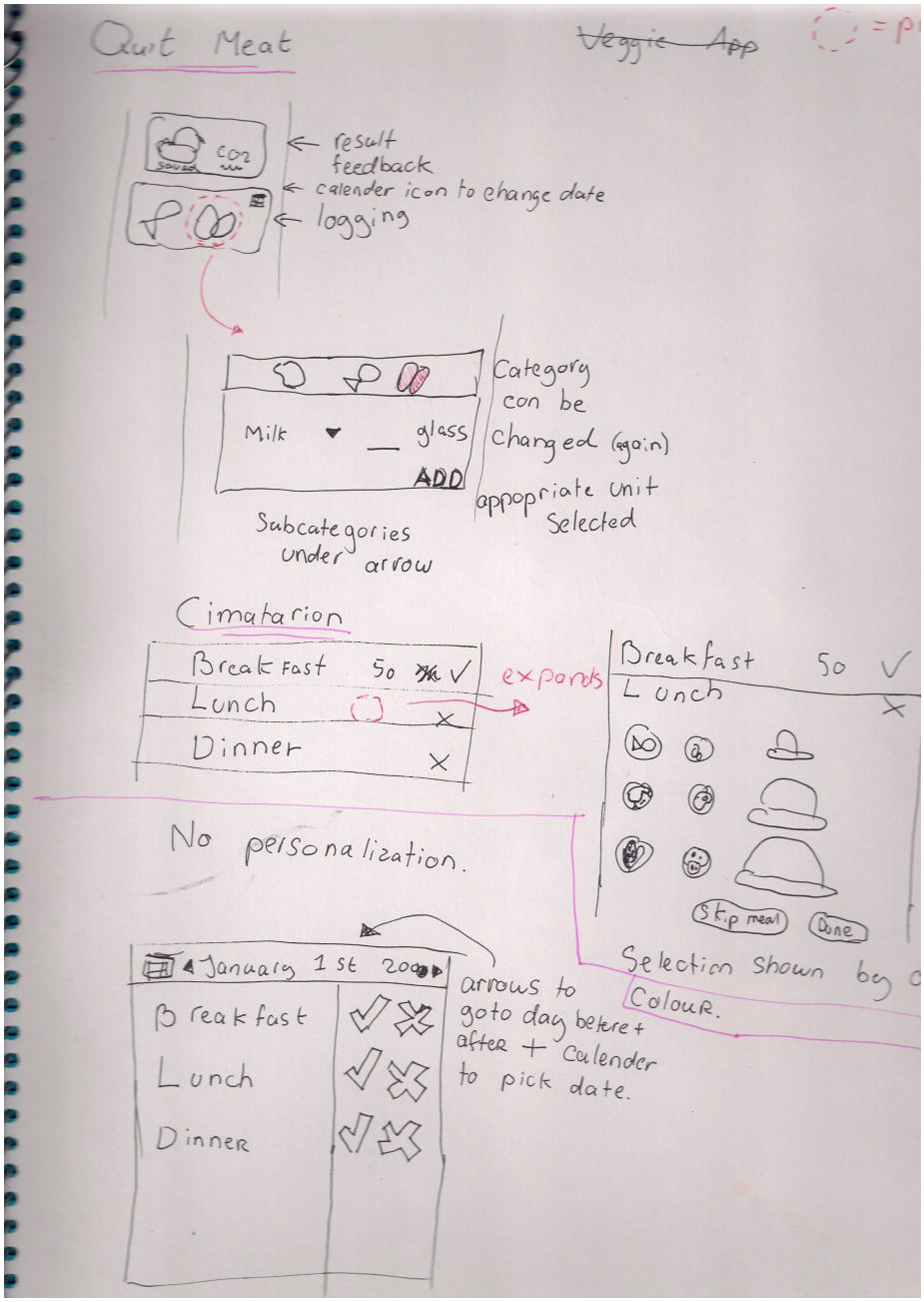

Figure 8: An early sketch of the app

B Inspire and inform strings

B.1 Inspire strings

dinner

- •Peanuts are a great meat substitute in almost all asian dishes.
- •You can turn a chili con carne recipe into a chili sin carne by simply replacing the ground beef with lentils.
- •You probably know tofu, but have you tried tempeh (fermented soybeans) or seitan (wheat-protein) yet?
- •If you want to give tofu a lot of taste you should press out the water. Wrap the tofu in a dishtowel and place heavy books on top. Let this sit for 1.5 hours. Then you should marinate the tofu in a sauce that is water-based. In this way the tofu sucks up the sauce as much as possible.
- •Legumes contain a lot of protein and make for great meat substitutes. Legumes include beans, peanuts, peas, lentils and green beans. You can for example add 100 gram peas per person to a vegetable dish and just leave out the meat.
- •Cooked eggs taste delicious with spinach. Add some mashed potatoes for a hearty winter meal, or mix with cream and use it as filling for a delicious quiche!

lunch

- •Peanut Butter is filled with protein. It is the perfect vegetarian spread.¡/item¿
- •You can make a delicious omelet! An omelet can for example be filled with bell pepper, onion, spinach and a little bit of cheese. Omelets are great for using leftovers.
- •A classic cheese sandwich is of course always great, but if you want something extra you can add some harissa (Tunisian hot pepper sauce) to it.
- •For a mediterranean take on the sandwich you can use some tomato slices, balsamic vinegar and goat cheese.
- •Buy some tortilla wraps and fill them with your favourite veggies (e.g. carrots, onion, beans, spinach etc.), add some cottage cheese or greek yogurt, and then just fold and enjoy!

breakfast

- You can have a bowl with some delicious fruits!
- Some yogurt with muesli is a common breakfast meal and completely vegetarian!
- Try having some toast with hüttenkäse and fresh strawberries for a refreshing morning meal.
- Toast with scrambled eggs is a delicious standard. Try adding in some fresh herbs if you want to pimp it a bit.
- Start experimenting with overnight oats! The basis is milk (600ml) and oats (200g). Then you can add a wide range of toppings. Examples are fruit, cinnamon, or honey.

B.2 Inform strings

- The livestock sector is responsible for 18
- The average US consumer requires more than 1.08 hectare (over two football fields) of land each year to sustain his or her current diet. In contrast, a vegetarian diet only requires less than 0.14 hectare of land per person per year.
- It takes (on average) about 1789 liters of water to grow a kg of soybeans, and 3340 L for a kg of eggs. In contrast 4856 L are used to produce 1 kg of pork and 15497 liters to produce 1 kg of beef.
- Habitable land is the total land on the globe without glaciers or barren land. If the whole world adopted the current diet of the Netherlands we would need to use 99.99 of habitable land available. If we adopted the diet of the USA we would need 137.65% of habitable land available. A vegetarian diet greatly reduces the land use.
- Of all antibiotics sold in the USA around 80% are sold for use in animal agriculture. This could contribute to antibiotics resistance.
- Modern day chickens are bred to grow very big, very fast. This brings a lot of health problems with it. The chickens often suffer from lameness and malformed legs. When they are 40 days old, 26 percent of the chickens have problems walking.
- 18% of pigs die before they get to slaughter. This is because pigs are bred to have a very high amount of piglets. This causes a lower birthweight and riskier pregnancy.
- The World Health Organisation has classified red meat as 'probably carcinogenic to humans', and processed meat was classified as 'carcinogenic to humans'

- •Chickens are usually kept at 18 chickens per m$\hat{2}$. The small amount of space means restricted movement and an increase in disease.
- •A meal without meat is often cheaper than a meal with meat. This is because peas, beans, peanuts and cheese are often cheaper than meat.
- •Eating a plant-based diet is a great way to reduce greenhouse gasses! The only actions that are more effective are avoiding air travel, living car free, buying green energy and having fewer children.
- •Agriculture is the second biggest driver of biodiversity decline.
- •Animal agriculture is the biggest reason for excess nitrogen in the environment. This can contribute to global warming, ozone depletion, and eutrophication.

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C Calculations for the Impact Screen

A medium meat eater emits 5,93 kg CO2e per day, a pescetarian 3,94 kg CO2e per day (Scarborough et al., 2014). This means that when a medium meat eater eats pescetarian for one day they save 1,99 kg CO2e per day.
Percentages of meat per meal based on dutch numbers. (Doesn't add to 100 because snacks are left out). Dutch people have famously sad breakfast and lunch so by using international numbers a more equal distribution might be found.
Breakfast 5% - 0.1 kg Co2 saved LUnch 17% - 0.3 kg Co2 saved Dinner 72% - 1.4 kg CO2 saved
New cars sold in the EU emit 118 gCO2/km. (Source: https://www.eea.europa.eu/publications/co2-emissions-new-cars-and-vans-2016)

——————————————————— Animals saved

According to (http://www.countinganimals.com/how-many-animals-does-a-vegetarian-save/) In a year a vegetarian saves
23.685 chickens 0.119 (cows+calfs) 0.376 pigs
So per day a vegetarian saves: 0.0649 chickens 0.000326 cows 0.00103 pigs
Again using the meat distribution per meal
Breakfast 5
0.00324 chickens 0.0000163 cows 0.0000515 pigs
LUnch 17
0.011 chicken 0.000456 cows 0.000175
Dinner 72
0.0467 chickens 0.000235 cows 0.000742 pigs

D Questionaire

Meat Tracker

For my graduation project of the study Creative Technology at University of Twente I am creating an app that encourages people to reduce their meat consumption. The download for the app can be found at . If you want to help us improve the app you can download it and use it for a while. Afterwards you should fill in this questionnaire.

Since the app isn't offered through the official Play Store you have to give permission to install apps from unknown sources. A detailed guide on how to do this can be found here: https://android.gadgethacks.com/how-to/android-basics-enable-unknown-sources-sideload-apps-0161947/

How long did you use the app
Mark only one oval.
- ◦ Just once
- ◦ 1 day
- ◦ 2 days
- ◦ 3 days
- ◦ 4-7 days
- ◦ 1-2 weeks
- ◦ Longer

This is a required question
Are you interested in reducing your meat consumption?
Mark only one oval.
- ◦ No, I don't want to reduce my meat consumption
- ◦ I've already reduced my meat consumption to a level I'm satisfied with
- ◦ I've already reduced my meat consumption but I would like to reduce it even more.
- ◦ Yes, I am interested in reducing my meat consumption
- ◦ I'm vegetarian

This is a required question
What is your motivation for wanting to eat less meat?
Check all that apply.
- ◦ I don't want to eat less meat
- ◦ To combat global warning
- ◦ To fight global hunger
- ◦ To become healthier
- ◦ Animal welfare
- ◦ To use less resources
- ◦ Help nature and wildlife
- ◦ To save money
- ◦ Other:

This is a required question
Have you ever tried to reduce your meat consumption in the past, and how successful were you?

This is a required question
How easy is the navigation through the application?
Mark only one oval.

	1	2	3	4	5	
Very hard	◦	◦	◦	◦	◦	Very easy

This is a required question
How easy was the first time setup?
Mark only one oval.

	1	2	3	4	5	
Very hard	◦	◦	◦	◦	◦	Very easy

This is a required question
How easy is it to view historical information about previous days?
Mark only one oval.

	1	2	3	4	5	
Very hard	◦	◦	◦	◦	◦	Very easy

This is a required question
How easy is it to enter whether you have eaten meat or not?

Figure 9: The questionnaire used for the final evaluation

Mark only one oval.

	1	2	3	4	5	
Very hard	○	○	○	○	○	Very easy

This is a required question
Do you think this app can help you reduce your meat consumption, and how?

This is a required question

Section 2

What were your expectations before downloading the app?

This is a required question
Have your expectations been fulfilled?

This is a required question
How motivating was the point system?
Mark only one oval.

	1	2	3	4	5	
Not motivating at all	○	○	○	○	○	Very motivating

This is a required question
How motivating is the "inspire me" (lightbulb) button?
Mark only one oval.

	1	2	3	4	5	
Not motivating at all	○	○	○	○	○	Very motivating

This is a required question
How motivating is the "inform me" (book) button?
Mark only one oval.

	1	2	3	4	5	
Not motivating at all	○	○	○	○	○	Very motivating

This is a required question
How motivating was the leveling system?
Mark only one oval.

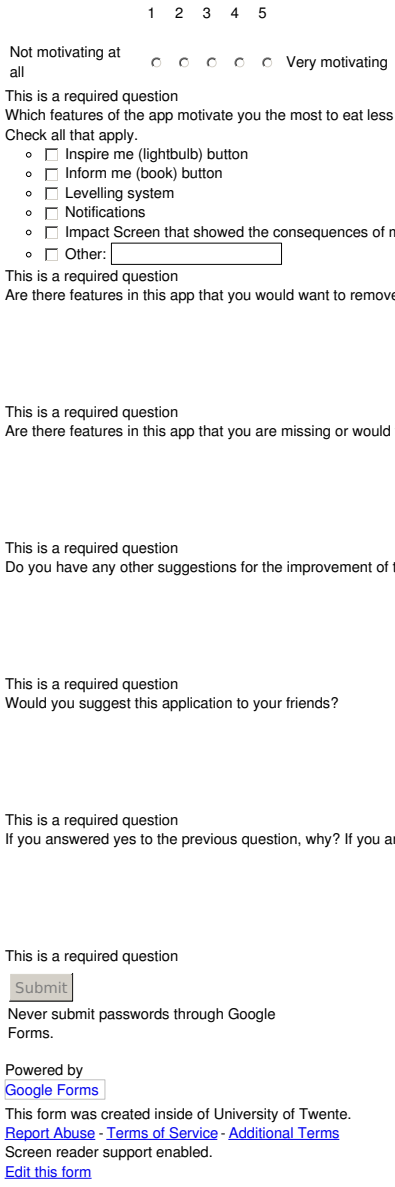
	1	2	3	4	5	
Not motivating at all	○	○	○	○	○	Very motivating

This is a required question
How motivating were the notifications?
Mark only one oval.

	1	2	3	4	5	
Not motivating at all	○	○	○	○	○	Very motivating

This is a required question
How motivating was the impact screen which showed you the impact of your actions?
Mark only one oval.

Figure 10: The questionnaire used for the final evaluation


1 2 3 4 5

Not motivating at all ○ ○ ○ ○ ○ Very motivating

This is a required question
Which features of the app motivate you the most to eat less meat?
Check all that apply.

- ☐ Inspire me (lightbulb) button
- ☐ Inform me (book) button
- ☐ Levelling system
- ☐ Notifications
- ☐ Impact Screen that showed the consequences of my choices
- ☐ Other:

This is a required question
Are there features in this app that you would want to remove?

This is a required question
Are there features in this app that you are missing or would want to add?

This is a required question
Do you have any other suggestions for the improvement of this app?

This is a required question
Would you suggest this application to your friends?

This is a required question
If you answered yes to the previous question, why? If you answered no, why not?

This is a required question

Submit

Never submit passwords through Google Forms.

Powered by
Google Forms

This form was created inside of University of Twente.
Report Abuse - Terms of Service - Additional Terms
Screen reader support enabled.
Edit this form

Figure 11: The questionnaire used for the final evaluation