Coach: Utilising environmental data to help people choose the optimal time to exercise outdoors

Marian Vijverberg, Koen Wijbrands, Jan Teunissen, Mike den Hertog

Communication & Multimedia Design, Rotterdam University of Applied Sciences
hi@marianvijverberg.nl

ABSTRACT

This paper explains how a big pool of environmental data can be made relevant for a general public. The process clarified in this paper covers the question of how to use environmental data to create an innovative, data-driven experience for people in the urban environment. This process resulted in an application called Coach. With the help of a personal intake, the user can point out which triggers are most crucial to their health. The combination of these triggers and environmental data gives users the opportunity to sport during their most optimal days and times regarding their health issues.

Author Keywords

Environmental data, open data, smart cities, asthma, running, user centered design

ACM Classification Keywords

H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces.

INTRODUCTION

Cities are constantly challenged by today's global industrial development to maintain a balance between sustainable economic development and a livable urban environment that ensures the quality of life for its inhabitants. This comes down to the transformation 'smart cities' entail, inter alia, the implementation of innovative solutions to better manage mobility, energy, healthcare and housing, improving governance and involving residents.

Smart cities are putting forward initiatives that are focussed on collecting data. Sensor networks continuously monitor the quality of the environment. These sensor networks collect real-world urban data that can be analysed [9].

The challenge this gathered data brings, is to make it meaningful for the general public. The data gathered by smart cities often means nothing to a resident, if even made public at all. To solve this problem, smart cities need to be viewed from another perspective as well: as a 'social city'. A social smart city can not be seen as just a sensor network that collects a lot of data, but instead: as a community where people with different backgrounds can live together. Due to transparent usage of a combination of information and communication, a higher quality of life can be achieved. A key point is that residents can also be part of this and could take some ownership of the data that is generated.

By making this connection between abstract, raw data and residents, the collected data can be more meaningful to both city and residents. This way they can profit from using data to, for example, reflect on their behavior. This paper describes the process of how environmental data collected by sensor networks can help people to choose the best time for their outdoor activities.

Initially, this project was focused on a group of people that practice outdoor sports. Soon after we started the development of our concept, we noticed that our target group was too big to have the impact we intended to have, which was to encourage a behaviour change. This is why we spoke to different user groups to get a better understanding of their needs. Based on these interviews we chose to design our concept for asthma patients. For this user group we could make a more meaningful and user centered design.

BACKGROUND

By focussing on asthmatic patients, we found an audience that has an estimated size of 235 million people worldwide [13]. The Dutch National Institute for Public Health and the Environment states that, in 20 years the group of asthmatics in the Netherlands will grow with 28%. According to the Dutch Lung fund, the size of this group in the Netherlands is around 565.000 people, consisting of 250.000 men and 315.000 women [10]. Care for asthmatic people costs the Netherlands approximately €287 million a year. It is estimated that this will increase by 150% over the next 20 years, due to the fact that increasing pollution has more impact on asthmatic patients and new medicines tend to become more expensive. Asthma is a disease that is mainly mitigated by medication. However, this is not the only way patients can control their asthma. By avoiding certain asthma triggers that affect the airways in a negative way, such as a high pollution level, asthma can partially be controlled [13]. Next to that, multiple studies have shown that that exercise will help improve the condition of the lungs, which will result in fewer problems for asthmatic patients [3]. Therefore, asthma patients can benefit from knowing more about environmental data in combination with sports.

Within the Quantified Self movement, people are constantly generating data from which they can extract information that is relevant to themselves [8]. This way they are able to discover patterns, appoint incidents and draw conclusions from their own data, which leads to an awareness that could result in behavioural change. The Quantified Self movement is an example of how relevant data can benefit human beings. People are able to change their behaviour based on individually relevant data [6]. However, people participating in the Quantified Self movement are highly skilled in terms of technology and do the gathering, as well as the interpretation of the data, all by themselves. One of the conclusions we can draw from our interviews is that people are not capable of making the gathered data relevant for themselves. The connection between them and the data needs to be made. People require a tool that will help them by making the data meaningful for them.

There are examples that make that connection between self-tracking and the regular audience. Next to devices such as FitBit, Jawbone, Apple Health and Polar, there are apps that make self-tracking available. For example, through sleep trackers such as SleepBot [4], users are able to track their sleep, motion and sounds.

SleepBot gives users an overview of their sleeping pattern and shows trends and graphics. Users are stimulated to sleep more by learning about their sleeping pattern.

These examples are cases of the connection between self-generated data and the value for the user. But, when keeping smart cities in mind, there need to be opportunities for environmental data instead of only self-generated data.

CONCEPT

Coach is a mobile application that uses environmental data to provide asthmatic users with an advice on when are the best circumstances to run. Based on an intake where triggers are translated into a personal index, a personal advice can be shown for any moment in the upcoming two days.

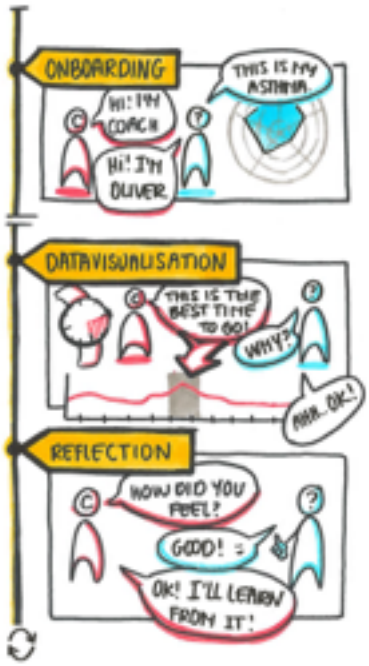

Figure 1. Overview of Coach

As a result, users also gain knowledge about the effects of the environment and air quality on their health and in particular, their asthma.

Intake

To enable interactions between a virtual Coach and the user with the goal to start a personal connection, a more personal approach in user onboarding was needed. To generate recommendations, specific information about the user must be collected. We introduced an approach where the collection of data is a conversation instead of a traditional form. In this manner, users will feel more involved in their personal connection with Coach.

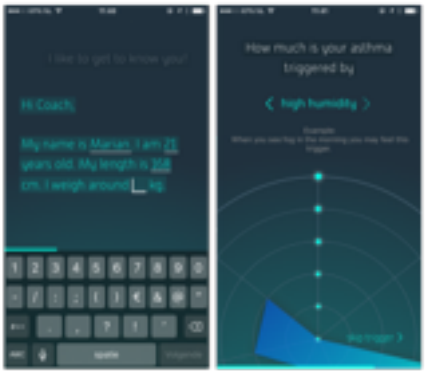

Figure 2. Screenshot of the intake

This interaction was designed following the three dimensions 'interpersonal relations in conversation' model developed by Svennevig [2].

The first dimension of the model is labeled as power, which is the feeling of the ones who are in control. Coach will show that given information changes the way the app itself works, so that the user feels the importance of giving adequate answers. Familiarity is the second dimension of this model. This dimension describes the evolution of relationships during a conversation about non-intimate topics that gradually progresses to more personal and private topics. In the interaction design of Coach this dimension is used by asking for more general data first and moving into a deeper

layer of information after the conversation has evolved. The third dimension is solidarity. This like-minded behaviour can be achieved by small talk in, for example, greetings. We are using a personal approach in returning data to the user. For example; when a user enters his name he will be greeted by his name. Next to that, Coach is partially based upon an individual index, where general data gets personalised. We will explain this index further in this paper.

By creating this connection between Coach and the user we allow ourselves to ask more personal questions. To get to know more about the type of asthma the user copes with, we ask users to state how much the different variables influence their asthma. There are six different types of asthma [1]. The most common asthma triggers are pollution, pollen, temperature and humidity. We found out that the majority of patients does not know the specifics of their asthma, besides the general diagnosis. The challenge was to get a more specific profile considering the triggers without the asthmatics knowing their own type of asthma, while at the same time, we should be careful not to formulate a diagnosis. So the requirement is that it should not feel like a definite judgement.

To find out which way of asking is the best, we set up a multivariate test. By asking 32 asthmatics in different ways about their triggers, we could see how users could define their triggers most accurately. After selecting their triggers, we asked the participants to match their triggers with a type of asthma. There was one specific way of asking in which they could appoint their type of asthma best, in comparison to their triggers. So eventually, we came up with an asthma intake in which the user grades the different variables on how much they think it could trigger an asthma peak. This way the user does not have to know the exact extent of influence, but an educated estimation will suffice. Thereafter, Coach will reflect on completed runs to sharpen the perception of asthma triggers, which will lead to more accurate future suggestions. We will discuss this more extensively later in this paper.

Not every asthma patient knows the specific influence of all triggers. Therefore, we introduced the "skip trigger" button. The trigger will be processed as one of an average user and as said, it can become more personalised.

Communication data

Since normally it is all about what asthmatics can not do, we wanted to strive for a positive tone of voice. That is why we decided to focus on the best moments to run instead of telling when not to run. After all, our goal is to coach our user in running frequently to enhance the condition of their lungs. To motivate the user to run in good circumstances we notify them when the variables are favourable.

One of the design challenges was how to communicate the data in a way that is relevant at the moment of usage and stimulates behavioural change. During the user interviews, we noticed that it is important to look carefully into the information level you communicate at a certain moment. Not every user is interested in each complex level of data. Research in the use-flow of the app was very important in determining what and how to communicate. There are three different levels of information we wanted to communicate. The first level is a simple cue on whether or not it is advisable to go for a run based on environmental data. Second, there is the more personal and explanatory level at which the user could see a

index exists of the current state of environmental data combined with the personal trigger-score, which was filled in by the user during the intake. While, within a bad moment, three out of four variables are within healthy range, Coach still advises not to run on account of the user's pollen allergy. The last and most detailed level consists of accumulated information on the different variables, showing the progress of the different variables over time. This could be useful in the process of creating more awareness (and providing more insight into data).

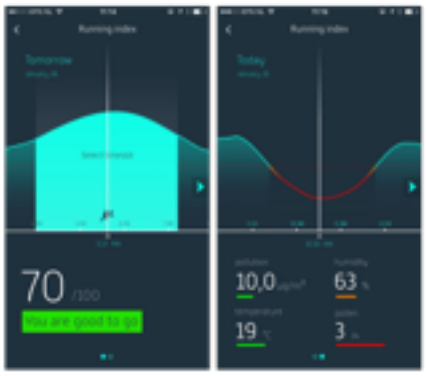

Figure 3. Screenshot of the second layer of data

Reflection

As mentioned before we constantly refine the user's asthma profile to enhance the suitability of Coach's suggestions, such as the suggested times to run. Coach will do this by asking specific questions about the experience, focussing on a relevant variable during that particular activity. For instance, when a user with high sensitivity to pollen goes for a run despite the presence of pollen in the air, we will ask them "Did you find the pollen troubling?". This way the app is able to continuously improve its own accuracy, based on user input.

The method of using user generated data to get accurate information could be compared to the way Wikipedia works. Viseur argues why Wikipedia is actually a reliable platform [12]. The possibility to freely edit every subject means that every time an article contains an error, it is very likely to be correctly adjusted very soon. For Coach this means the asthma profile will improve with every completed activity. Sometimes there will be a result that can be considered as an exception, this will not be taken into account for the average results. This way the asthma profile will become more reliable over time if intensively used.

Next to giving the user concrete and personal information on when to run an important aspect of the app is to create awareness about the influence environmental data could have on their asthma and more importantly, how negative aspects can be avoided for a healthy run. As mentioned before, we provide an opportunity to reflect on the run (and circumstances) by asking a user questions about the run after it has been completed. The answer to the reflective question will be documented so that users can review their experiences. Users can find general information, such as speed, route and time, as well as the values of the environmental data during the completed run. Coach also provides tips to make the next activity healthier, such as standing away from a traffic light while waiting, where pollution levels are lower.

All these assets combined will give a summary of all the completed runs and allows the user to reflect and learn. The more experience the user gets, the more he learns to interpret the data. This will eventually create awareness, not only about the local circumstances with regards to environmental data, but also about their own asthma triggers.

DISCUSSION

As pointed out in the introduction of this paper, the technology used in this concept contains sensor networks. With the rise of initiatives like Smart Data City Assen [11], this data becomes more and more available for daily use. However, the possibility to create a forecast based on the gathered data needs to evolve. In all probability, this will be possible in the near future. Nevertheless, questions need to be asked when applying these predictions to health-related concepts, because of the negative consequences a false prediction can entail. When the time is right, the reliability of a system like this should be checked by experts.

As explained in the beginning, it can be hard for asthmatic patients to define their specific asthma triggers. Coach now takes a role in helping users understand the effect of environmental data on their asthma, but lets data be open to interpretation while giving suggestions. The question is, can Coach help users with understanding their specific asthma, thus allowing users to make these judgements of data themselves?

During our design process, we used the open data provided by the Royal Netherlands Meteorological Institute [5]. No financial obligations were connected to the usage of this data. Nevertheless, it needs to be contemplated whether the more advanced and real time data will be distributed complimentary as well, since sensor networks require new investments.

CONCLUSION

This paper presents the design process and features of 'Coach', a concept that helps people choose what time they go for their outdoor activities. Based on the users' needs, such as asthma triggers, personal running moments will be generated. During our research phase we discovered that different factors which enhance air quality differ much during the day. We can conclude that it is possible to give an hour-to-hour advice based on air quality, provided that users give in their specific needs in an intake.

We evaluated our work by conducting user tests with the target group, to examine if our assumptions were correct and our designs were understood. Users pointed out that the way of entering information allowed them to fill in all their asthma specifics, without missing important details. Users also noted that the intake felt like a conversation instead of a form, which contributed to building their trust. The partitioning of data enabled the user to fulfill his need of getting a certain amount of information needed at that moment.

Within this project we experienced that we are able to show data to asthmatic patients that is relevant to their individual kind of asthma. By doing this, we could make a connection between environmental data and the end user, which could make them more motivated and confident in starting to run.

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