What Did You Eat Today?: Designing a Health Program on Nutritional Poverty

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ABSTRACT

Poverty is a multidimensional phenomenon notably present in developing countries. One of its variants is nutritional poverty, which conducts to chronic diseases and public health problems, affecting the individuals' subjective well-being. In this paper we present our current work at Camino Verde, a neighborhood in Tijuana, Mexico, and amongst those with the highest indexes of nutritional poverty in the city. Working in such environment requires engagement and trust relationships with the community in order to conduct participatory design processes. To address this issue, we created the COCOClub, a workshop for teaching programming skills to Camino Verde kids and conducting our design processes. We describe our proposed contributions to the health program at Camino Verde, including a crowdsourced sensing campaign for collecting photographs and contextual information on nutritional poverty, the usability assessment of a telemedicine kiosk and the design of a community dining hall.

CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile computing design and evaluation methods**; • **Applied computing** → *Consumer health*;

KEYWORDS

Developing countries, participatory sensing, nutritional poverty, subjective well-being, public health interventions

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1 INTRODUCTION

Poverty is a multidimensional social phenomenon widely spread around the world and particularly severe in developing countries. Extreme poverty is commonly characterized as living with less than one US dollar a day. The first objective in the UN millennium goals [8] is to eradicate extreme poverty and hunger by 2030.

In the case of Mexico, according to the National Council for the Assessment of Social Development Policies (Coneval from its acronym in Spanish) [3], 45.5% of the Mexican population live in poverty. Of the 117.3 million inhabitants of Mexico, 41.8 million suffer from moderate poverty and 11.5 million are in extreme poverty. Nutritional poverty demands particular attention in Mexico. According to a recent survey [5], 13.6% of the children under 5 years old suffer from chronic malnutrition (1.5 million), while 33.2% of the children between 5 and 11 years old and 36.3% of the teenagers between 12 and 19 years old also suffer from overweight and obesity, and this increases the risk of developing diabetes and other chronic diseases.

In this paper, we present our current work and experiences with a concrete community suffering of poverty conditions in the city of Tijuana, in the northwest of Mexico, towards the design of a health program. We propose to conduct participatory design sessions with community members and a multi and trans-disciplinary team, composed by dietitians, psychologists, artists, architects, communication and human-computer interaction experts, for designing incentives and

Figure 1: The Transborder FarmLab facilities

visualizations for data collection on nutritional poverty, improve the design of a telemedicine kiosk and menus, as well as activities for social engagement in a community dining hall.

This paper is organized as follows: in the second section, we describe our working context and relate our reflections on participatory design in such situation. In the third section, we present the results of a survey, as motivation for the design of a health program, that includes an exploration of nutritional poverty, continues with the installation of a telemedicine kiosk and finalizes with the design of a community dining hall. Finally, in the fourth section, we conclude presenting some conclusions and outlining our future work.

2 WORKING IN CAMINO VERDE

Camino Verde, a neighborhood in the city of Tijuana, in the northwest of Mexico, is a community of about 48,000 inhabitants, where nearly 70% of the families are headed by single mothers. Camino Verde is ranked as one of the most dangerous neighborhoods of Tijuana, with one of the highest rates of nutritional poverty in the city, and suffers from insecurity and lack of public services.

The Transborder Farmlab was opened in Camino Verde in 2012 as a community space and a social research laboratory, where workshops, artistic events, and sustainability projects take place to empower Camino Verde citizens to create ideas that increase their income and shape a better quality of life [1] (See Figure 1).

We conduct our work at the Transborder Farmlab with elementary school kids (grades 4th to 9th, ages 8 to 14 years old), who are members of the COCOClub (Computing & Coding Club), a workshop for teaching programming skills (See Figure 2), and for involving the Camino Verde community in our studies. Our work, like other programs in the Transborder Farmlab, is predominantly trans-disciplinary, as we collaborate with artists, architects, economists, dietitians, psychologists and members of the community.

Participatory Design with the Community

Working at the Transborder Farmlab made us reflect on the participatory design process and adapt it to the complex reality of the Camino Verde neighbors.

Living in poverty conditions makes people cautious. When people live with so little money, time becomes invaluable, so they need to feel not only comfortable in our process, but also to have a sense of obtaining something valuable in return, for it to be a win-win situation. Working in a traditional participatory design session the role of stakeholders would not be enough, hence we found that a good incentive is providing them with lifelong tools for work and life.

People in such an environment could have dropped out of school early in life. Working with participatory design instruments such as sketches, storyboards, low fidelity prototypes could be difficult to understand for them without a proper introduction. People in that situation feel isolated, worried, and they need to share what is on their mind. We take advantage of this conversation process, where they talk about their families, homes or jobs, showcasing their necessities. This conversation allows us to introduce the participatory design instruments or use the low and high fidelity prototypes as complementary mechanisms of conversation, rather than the main design tool.

To get the community engaged and support our work, we propose and have followed the next principles:

- Working with the community represents a continuous bilateral exchange of skills and knowledge.
- As the community gains skills and knowledge, we expect the process to be oriented not only towards designing, but also towards building together (*i.e.*, from co-designing to co-building).
- We aim to produce social impact in the short and medium term, even if the design process goal is not the main source of impact.
- The process outcomes must remain accountable and visible to the community.
- Community members need a safe place for dialog, where trust relationships must be reinforced, and the Transborder Farmlab aspires to be such a place.

Our experience with the COCOClub kids lead us to think that it was necessary to make the design process become invisible and as enjoyable as possible. Thus, their programming class is also a participatory design session where they can design and play their own games and perform learning activities. When implementing their games, the kids have to co-design through brainstorming and prototyping exercises previous to the implementation. This results in engagement, and they become familiar with the creative process, forming them as stakeholders of our health program.

Figure 2: COCOClub session in the computer classroom

It is true that our potential users have different levels of technology experience. However, with the kids, as we conduct classes and provide them with the opportunity to test different technologies, they become technologically literate and can participate in the design and build processes. When working with adults, the neighbors always have something interesting to share. We encourage all the people to speak and work on conversations pertaining to trivial things of life, sharing experiences and thus strengthening ties while participating in the design process.

The key to building engagement in a complex community such as Camino Verde relies on the visibility of the potential benefit to the inhabitants. Our main allies are the women who are the head of their household, who give us their trust, support and incredibly valuable time. As consequence, these women encourage other community members to get involved in our activities, acting as promoters of our work.

3 THE DESIGN OF THE TRANSBORDER FARMLAB HEALTH PROGRAM

In December 2016, the Transborder Farmlab team conducted a long survey of 117 individuals from Camino Verde, called the 35 mm survey (supplemented in a 45 minutes long interview session). The survey includes questions on family composition, household economics, health and nutrition, leisure and free time, Internet and phone usage, mobility, aspirations, community perception, life satisfaction, and well-being indicators. The survey is supplemented with geotagged pictures of those respondents who allowed us photograph them while they were being interviewed.

The survey outcomes depicted a community where people feel sick, but do not look for a doctor. From the respondents, only 76 of them (65%) visit medical services when feeling ill, contrary to 38 respondents (32%) who manifest doing so regularly. Chronic diseases are also present in the community. 30 of the respondents (25%) reported having someone at home under treatment for diabetes, 19 (16%) hypertension, and 3 (2%) cancer.

On the nutrition aspect, the 35 mm survey included the question *What did you eat yesterday?*, regarding the main meal of the previous day. The 15 top mentioned products allow us to identify the consumption of protein sources, where 31 paticipants indicated eating chicken (26%), 20 beef (17%), and 7 eggs (6%). In the case of legumes and grains, 20 participants indicated beans (17%), 15 rice (15%) and 14 corn related products (e.g., *tacos*, *tortillas* and *sopes*, 12%). However, from the 15 most mentioned items, only 3 participants mentioned the consumption of vegetables (2.6% of the population).

The 35 mm survey outcomes provide a guide for showcasing the Camino Verde needs and outlines the current Transborder Farmlab projects, resulting in the current process of designing a community health program.

In the following section, we relate three components of this health program. It begins with the understanding of what the community is eating using a participatory sensing campaign, and continues to provide Camino Verde inhabitants with tools for improving their health habits using a telemedicine kiosk and finalizes with activities leading towards the design of a community dining hall, aiming to promote a behavioral change from the actual reactive paradigm to a preventive health culture.

What did you eat today?

Poverty measurement usually relies on the design of a basic food basket (BFB), which allows quantifying the minimum income required for obtaining the calories and nutrients essential for subsistence. However, the BFB is an idealized concept that does not reflect how food choices are affected by nutritional poverty and how these choices affect the individual's subjective well-being.

Participatory sensing campaigns enable individuals to reveal and share personal data about their lifestyle or environment status for aiding in the solution of their community's problems. The deployment of sensing campaigns in urban areas enables the collective gathering of data and uses it as a monitoring tool to provide awareness and support decision-making at individual and collective levels [4]. The design and deployment of participatory sensing campaigns requires community involvement and engagement. Community members contribute with objectives, methodologies and participate in information analysis, as they co-own the campaign processes. We use participatory design in order to generate these outcomes with help from the community from the[7].

In light of this argument, we propose to conduct a participatory sensing campaign with kids from Camino Verde for collecting photographs and opinions, using the COCO-Cam application (See Figure 3), that will inform us about the nutritional habits in the community.

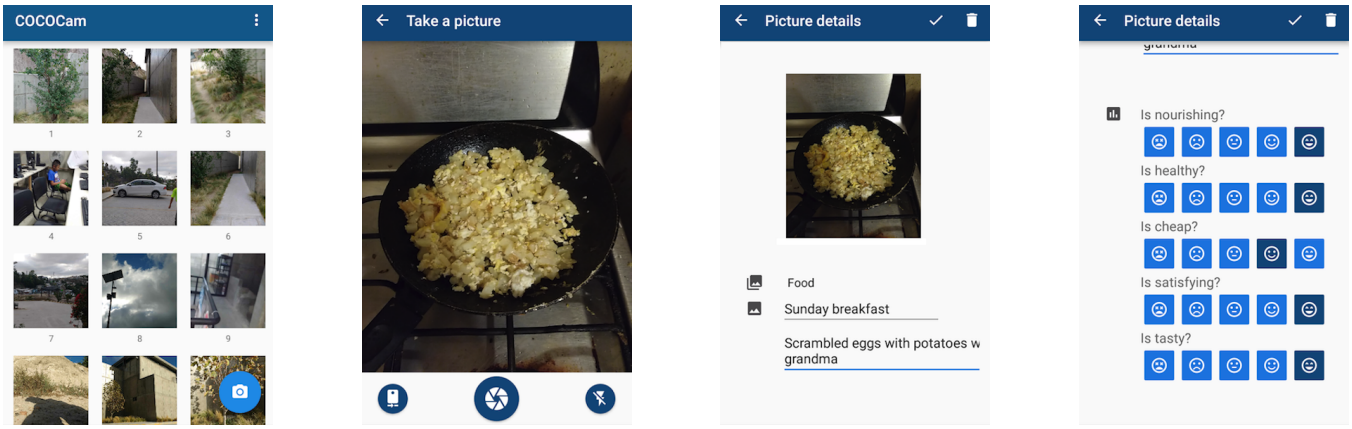

Figure 3: a) The COCOCam main screen, represents an image gallery of the user photos, b) the camera screen, c) the picture details screen, depicting fields for supplying additional information and d) continuation of the picture details screen with the 5 level Likert questionnaire.

The campaign has a threefold purpose: first, to supplement the outcomes of the 35 mm survey, second, to analyze the nutritional poverty situation of the kids participating in the campaign, and third, to measure the community intention of contributing to our upcoming studies and get insights on the design of our health program. The participatory sensing campaign comprises three stages:

Recruitment. From the COCOClub, we will recruit kids between 6th and 9th grade. We will obtain their parents' informed consent to participate in our campaign.

We will survey the kids using the Nutritional Behavior Questionnaire [6] for screening purposes on their eating habits. We will measure and weight kids to calculate their body mass index (BMI). During this stage, we will deploy our application on the kids' smartphones or provide them with tablets as well as provide a short training on their use.

Data Collection. To conduct the campaign we have developed COCOCam, a mobile application for Android smartphones that allows the user to take photographs for use on participatory sensing campaigns (See Figure 3). The COCOCam design process involved a participatory design session with the COCOClub members and an expert on human-computer interaction describing the possible case use scenarios. The application uses GPS for geotagging the photographs and requesting further information on the meal (i.e. a qualitative evaluation, comprised by an optional title and description and an assessment of satisfaction using a 5 level Likert scale indicating if the food is nourishing, healthy, cheap, satisfying and tasty).

During one week, the kids will be using our prototype to take pictures prior to food consumption. The kids will be instructed to use it for all their meals and collations if possible, and their parents will be required to not change their usual nutritional choices, in order to provide them with an accurate nutritional diagnosis. Every time the kids attend the COCOClub sessions, the gathered information will be uploaded to a data repository using the WiFi network available at the Transborder Farmlab.

Withdrawal. At the end of the campaign, we will conduct a semi-structured interview where we will ask questions on technology adoption, self-awareness and potential behavior change on eating.

For the participatory sensing campaign, we will produce three outcomes that will inform us on the nutritional habits and the use and adoption of data gathering technologies in the community. The results will confirm if developing participatory sensing campaigns with kids is viable, and answer our questions under which situations it is feasible to use ubiquitous computing technology from the perspective of the Camino Verde community for gathering collective data. From the gathered data we have envisioned three possible products:

The Food Diary Dataset. The collection of the geotagged pictures, its details and descriptions are part of our dataset for answering the question *What did you eat today?*. The kids' contributions will be analyzed by a nutritionist for a personal assessment to provide parents with recommendations on how to improve their kids' diet and how to make healthier and cheaper choices.

The Food Map. Using the metadata of the pictures, we will supplement a Geographic Information System (GIS) representation for understanding where the kids are eating, and

how they relate to the space around them, answering the question *Where did you eat today?*. These findings will indicate which are the most frequent places for eating, how far they go in a typical day and other information, as school attendance. The food map will also provide us information for estimating how much time they are spending in mobility and the time they stay at home [2].

The Nutritional Clock. Using the metadata of the pictures, we will figure out the kid's average number of meals and collations and their frequency. This information could reveal if there is a hidden pattern in their behavior (e.g., missing meals or having meals previously not reported in the survey). Both, the food map and the nutritional clock could show us consumption coincidences, related to when the kids are having mutual encounters, that will provide us clues on the design and ideas for further exploration.

We have conducted a pilot proof of concept with two COCOClub kids, who captured photographs of their meals for two days. Once the study feasibility was assessed, we decided to complement the design of our campaign with the use of Fitbit devices in order to analyze physical activity and calories consumption.

The next step is to refine the COCOCam application using participatory design to incorporate the appropriate incentives (*e.g.,* gamification) for promoting user engagement with the help of the COCOClub kids. Later, we will conduct our study as we broaden participation to the kids attending other workshops at the Transborder Farmlab. With the gathered data, we will work on the design of the representation and visualizations of our three envisioned products, following a participatory design process with the help of architects, artists, dietitians, experts in human-computer interaction, and members of the community. During the sessions, we will conduct a design workshop, for envisioning representations and prototyping, looking toward the creation of an appealing representation in the form of an art exhibition.

Telemedicine kiosk

The CICESE research center installed a telemedicine kiosk in the Transborder Farmlab facilities (See Figure 4a). This device provides all the tools for performing a remote medical consultation in restricted environments. It is composed by a number of sensors for taking vital signs: an electronic stadiometer, a weight scale, an electronic measuring tape, a thermometer and a blood pressure monitor, besides a camera, microphone, display and keyboard for communication with a physician.

The kiosk installation has already had an impact on our current work, as it attracts the community due to the novelty effect. Today, the COCOClub kids and some of the community members are regular users of the kiosk for tracking corporal measurements.

For our health program, we expect that the telemedicine kiosk will be a strategic asset, working as a complement of the community dining hall, providing Camino Verde neighbors with a tool for improving the community's health habits. In the short term, we plan to conduct an evaluation study on the usability and the quality of the kiosk-mediated patient-physician interaction for informing the kiosk designers with suggestions and, with the help of the neighbors to work on the design of the kiosk next iterations.

The community dining hall

The community dining hall (See Figure 4b), aims to offer a first class quality service. The Transborder Farmlab has a professional kitchen classroom (See Figure 4c). With the help of a local gastronomic school, members of the community will be able to learn, work and get professional certifications as cooks and service personnel, and some of the vegetables and ingredients will be produced in a community garden and a greenhouse located on the Transborder Farmlab facilities.

The trans-disciplinary team conceived the *Coffee Afternoons*, for engaging the community and to open a space for conversation. During one hour every Monday, both experts and the community get together, and while enjoying a hot cup of coffee and pastries, they have an informal chat, in order to inquire on habits, interests, and ideas for designing a better community dining hall, including information for the menu selections and the social activities that promote social engagement.

For the dietitian, the purpose is to know the particular tastes and nutritional deficiencies, (in complement with our *What did you eat today?* campaign), as many of the Camino Verde inhabitants are migrants from diverse places of Mexico, with different preferences. In the case of the psychologists and architects, it represents an opportunity to get in touch with the community and to suggest the best activities in order to provide a comfortable ambiance, where neighbors in conflict could fix differences and improve their coexistence, and for communication experts to design the strategies for promoting the community dining hall activities to the community.

For assessing the impact of the community dining hall on the subjective well-being and the users' health we plan to conduct a study with the help of some Camino Verde families, by exploring their current health status and making a series of observations in order to measure the possible improvement in their quality of life and subjective well-being.

a b c

Figure 4: a) A neighbor using CICESE's telemedicine kiosk, b) pilot test of the community dining hall, and c) the kitchen class.

4 FUTURE WORK AND CONCLUSIONS

We presented our interpretation on how we should use participatory design in the context of a community who suffers of poverty conditions in a developing country such as Mexico. We think that participatory design requires an engaged community, motivated by the desire to solve problems that affect their quality of life and subjective well-being.

Participatory sensing provides a way to empower citizens to reveal information and create solutions from their own perspective. We think that using participatory sensing in the *What did you eat today?* campaign, will allow us to raise awareness on the nutritional poverty situation of the Camino Verde inhabitants and to gather data useful to inform the design and assessment process of the Transborder Farmlab Health Program components.

We have conducted one field test of the COCOCam application, as two kids of the COCOClub collected photographs on their meals during two days using an Android tablet device, proving that it is feasible to deploy our participatory sensing campaign. The next step is to iterate in the COCOCam application design and to incorporate the right incentives for its use, and finally broaden participation for other kids in the Transborder Famlab. This work is also our first approach to develop a participatory sensing campaign in the Camino Verde neighborhood.

The process of assessing the use and adoption of technology will be another way to engage and empower Camino Verde neighbors, as they will be using a novelty in the community represented by the telemedicine kiosk, and this process will provide ideas and understanding on the potential uses of such technology in that context.

Finally, we aim to provide the community with healthy food options, education, tools and a dialogue space, in order to improve their quality of life.

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