

Face2Name: Designing a Dynamic Visual Hospital Directory

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ABSTRACT

In this paper we describe the design and development of a native iOS application aimed at improving inter-professional communication and workflow efficiency in hospitals, by reducing anonymity among staff. A hospital is complex environment with many moving parts; during a hospital stay, a patient is typically cared for by 20 different clinicians with different skills and responsibilities, many of whom are ‘strangers’ to one another.

Recognizing this fundamental problem, hospital staff have asked for a solution to help them know and communicate better with each other. To answer their need, we developed Face2Name, a novel tool based on an approach evaluated in a clinical trial at the Toronto General Hospital.

The Face2Name app helps hospital staff get to know one another by emphasizing visuals along with their names and roles, in a dynamic visual hospital directory; and it improves workflow efficiency by displaying the assignment of physicians to medical teams and of members of care teams around each patient. Among other features, the app uses Bluetooth iBeacon technology to give users access to information they need based on their role and location in the hospital, perfectly complementing hospital workflow.

The application was iteratively designed with input and feedback from over 30 hospital staff through several PDSA cycles. To our knowledge this is the first visual-based smartphone application designed to fulfill this need. During the summer of 2014 the research team will pilot test Face2Name across general internal medicine wards at a large teaching hospital in Toronto, Canada.

Categories and Subject Descriptors

D.3.3 [Programming Languages]: Language Constructs and Features – *abstract data types, polymorphism, control structures*. This is just an example, please use the correct category and subject descriptors for your submission. The ACM Computing Classification Scheme: <http://www.acm.org/class/1998/>

General Terms

Design, Experimentation, Human Factors,

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Keywords

Hospital staff anonymity, visual directory, inter-professional communication, hospital workflow, photographic aids, iOS, smartphone app, iBeacon

1. INTRODUCTION

1.1 Staff anonymity in hospitals

A team of over 20 different clinicians with different skills and responsibilities are typically involved in the care of a hospital patient during one hospital stay. Getting to know each other and communicating effectively is nearly impossible for hospital staff that work in various services and departments, and are located across a number of floors. And yet, all these clinicians must effectively and efficiently communicate and coordinate care for the same patient. Teaching hospitals present an especially challenging situation; nurses change daily and move between three different shifts, while physicians, residents and medical students “rotate” as frequently as every week [1] in addition to on-call assignments and weekend shifts.

Although ineffective communication has been cited as the number one cause of adverse events and staff complaints in hospitals, poor communication continues to be a major problem [2, 3]. Breakdowns in inter-professional communication have been identified in such fundamental aspects as the ability for health professionals to identify their colleagues by face or name. This indicates a high level of anonymity (defined as the degree to which the communicator perceives the sender to be unknown rather than familiar and known by name and/or sight) within the hospital staff [4].

The frequent changes in medical staff and team assignments and the resulting anonymity create an opportunity for designing interventions to reduce the lack of familiarity staff have with each other. At the same time, knowing who is responsible for which aspects of patient care improves teamwork, creates a climate of familiarity, facilitates communication, resulting ultimately in better quality of care for patients.

1.2 Smartphones

Smartphones have the potential to address a variety of communication issues in hospitals, increase team familiarity, and improve inter-professional collaboration. Since their introduction to the market smartphones have been increasingly adopted by medical professionals [5,6] and there is clear evidence that smartphone apps are gaining popularity in hospitals [7]. Furthermore there is emerging evidence to suggest that the development of local, hospital-specific applications has the potential to save time and increase compliance with local guidelines [8].

1.3 Photographic aids

There is substantial literature on the superiority of pictures over other types of stimuli, such as words (names), in memory recall [9]. Research shows that photographic aids can improve communication [10], help people retain information [11], and diminish inaccurate appropriations of facts [9, 11, 12]. Photographs are also shown to increase feelings of sympathy, compassion and understanding about a person or situation [12]. Results from a randomized controlled trial (RCT) evaluating the impact of providing staff photos on recall found a statistically significant increase in the amount of staff names and faces remembered [13]. Hence, applications with a focus on visuals and photographs are expected to be beneficial to hospital workflow and medical staff.

Recognizing the fundamental problem with staff *anonymity* and based on the positive results from the RCT conducted on a hospital ward, of a teaching hospital in Toronto, the staff requested the development of an electronic solution that would be sustainable and scalable, to replace paper-based intervention that was previously evaluated.

2. IDENTIFYING A NEED

In order to collect baseline data to allow for a pre-post intervention evaluation study, and to help inform the design of the app, ethnographic research was conducted for 6 months (Dec 2013-May 201). This consisted of formal and informal stakeholder interviews and over 200 hours of unobtrusive ward observations.

The intent of the observations was to identify situations with staff anonymity (such as difficulty to identify care team members and their roles) and to understand how to design a tool that fits well within staff workflow. Observations revealed such issues at morning “bullet rounds”, which affected inter-professional communication. Bullet rounds are the only daily formal inter-professional meetings where the entire health care team meets to discuss the medical status of their patients. Nursing staff and allied health members often felt underappreciated when the medical team misidentified them by name or professional responsibility. The greatest inefficiencies occurred throughout the day when nurses needed to get a hold of the “most responsible physician” (MRP) associated with a certain patient in order to have them approve a change in the patient’s care plan. Similarly, time was often lost when doctors needed to complete the discharge summary report for a patient but did not know the allied health members that they had to approach in order to get approvals from them. Finally nurses felt frustrated when given referrals by medical students when legally they required an MD (resident or physician) to sign off. Doctors have the same problem when they request that a nurse complete a procedure that only certain nurses have the authority and expertise to fulfill. When staff is unaware of each other’s professional accreditation, time is wasted recounting patient history to the wrong clinician, and then again searching for the appropriate contact on the wards.

The research team conducted semi-structured interviews; a section of the interview asked that participants narrate a situation where they may need to use the Face2Name app. One nurse recounted: *“I’m in a patient’s room and I realize I need to change part of their care regime and to do that I need to consult their physicians. So I walk to the nursing station and look up which team is responsible for my patient on the white board (electronic display*

board). Then I’ve got a team number and maybe a name, but I still have no idea who I am looking for! What do they look like? Especially if the most responsible physician is a resident, they rotate every two weeks”

The reverse situation was also common. One resident said: *“I feel bad, I look at the whiteboard, I know the name of the nurse that I need to talk to, I yell her name out loud, ask around, and she is the person standing two people away from me, it’s embarrassing and cold.”*

Interviews confirmed that there was an issue with staff anonymity and that this was negatively impacting inter-professional relationships and workflow. Staff of all professions and responsibilities in the ward indicated the need to know each other better and be able to identify their colleagues by name, by role and by face. With the support of the staff and research department, the team began designing the “Face2Name” application, bearing the same name as the precursor RCT study conducted at the same location.

3. OVERALL DESIGN

The team had to decide for which operating system (OS) to implement initially the application: the iOS, Android, or Blackberry OS. While the hospital provides support for institutional Blackberry-s to the medical teams (each medical team having one “team device” to communicate securely regarding patients information), the other staff members such as nurses and allied health professionals only have a pager, relying on landlines at the nursing station, or on their personal mobile devices, as means of communication. The surveys showed that the most widely used personal smart phones within the staff are the iPhones; therefore we decided to initiate development for iOS.

Much of the Face2Name’s innovative functionality employed Apple’s new iBeacon technology. The iBeacon feature became available for iOS 7 and added the ability for the smartphone to range other Bluetooth devices (including other phones). While the use case for this technology in a retail setting has been well-established, we believe the iBeacon also has interesting applications within healthcare. Using iBeacon, the Face2Name app can provide staff with information relevant to their location, such as the other staff members associated with a particular patient, or information about nearby staff members. Additionally, the team hoped to further strengthen recollection and familiarity between hospital staff by providing interaction history and offering achievements to the user.

Figure 1 is a block diagram that outlines the various elements the team intended to program into the Face2Name application. In the following section we briefly describe each of these elements.

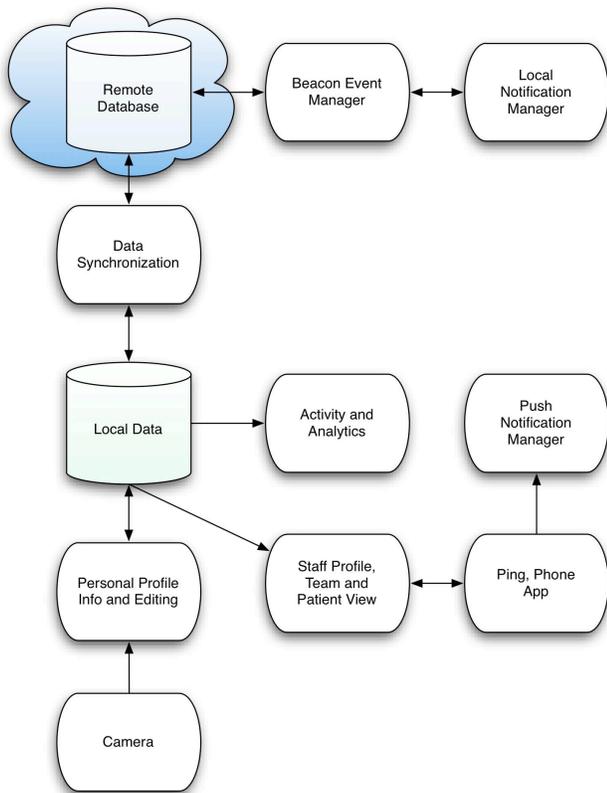


Figure 1: Block diagram, Face2Name app functionality

3.1 Remote Database

A remote MySQL database stores tables with patients' names and locations (hospital room), and pictures, names and team assignments for staff (physicians, nursing, and allied health members), as well as their relationships to one another and to medical teams. This information is collected from different hospital databases. Figure 2 displays the complexity of relationships between staff, medical teams, nursing floors, and patient assignment.

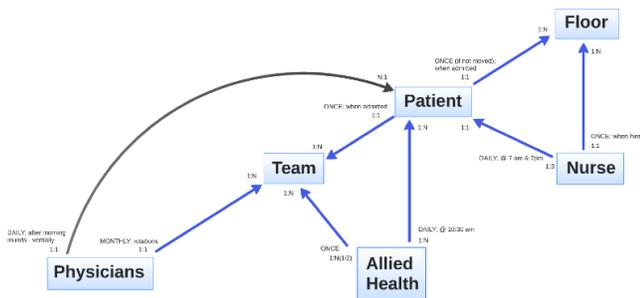


Figure 2: Relational block diagram

The database also stores the iBeacon identifiers and their locations (e.g. which patient or staff member they are assigned to), as well as the iBeacon-triggered events.

3.2 Data Synchronization

The system automatically downloads new data from the server and pushes changes made by the user to the server. This way if a

user uploads a new photograph or a change in patient assignment or schedule, the remaining staff can see the updated information.

3.3 Local Data

The Local data is powered by SQLite and contains all the data maintained by the app and user configurations.

3.4 iBeacon Event Manager

The iBeacon Event Manager sends events to the Local Notification Manager and records data based on nearby beacons, (for example when a user is near a patient or another staff member). As a user enters and leaves another user or beacon's region, we record the start and end date of this "event" and save it to the database.

3.5 Local Notification Manager

The Local notification manager receives events from the iBeacon Event Manager. The app displays relevant banners and lists the local beacons, for example if a user walks into a patient room, the patient's beacon is identified and a banner appears on the user's screen. The user can then click on the banner, to see all the members that are associated with this patient without having to search for them separately.

3.6 Push Notification Manager

The push notification manager manages 'pings' between users, and sends read receipts. The app displays pings as alert.

3.7 Ping, Phone App

The "ping" app initiates pings to other users and creates lists of recently received pings. This allows a user to look up their history of pings. The Phone app affords users the ability to place a call directly after selecting the phone number link from another staff member's profile.

3.8 Activity and Analytics Calculator

The activity and analytics calculator manages interactions between users based on iBeacon event manager data. If the event is longer than a predefined period of time, it is assumed that the two users interacted (as opposed to just pass by each other in the halls). This component is also the basis for calculating and displaying a progress indicator to show how many of the staff members did the current user interact with on daily, weekly and monthly basis.

3.9 Personal Profile Info and Editing

Personal profile information and editing functionality allows the user to input additional information (e.g. languages spoken and professional accreditations) and to change their photo either by uploading an existing one from their device, or by taking a new photo using the device.

3.10 Staff Member or Patient Profile

The profile pages display key information regarding the staff or patient. Staff information can either be manually input, or be drawn from existing scheduling tool. In the future, patient information can be extracted from the hospital's electronic patient record.

3.11 Camera

The iPhone camera application is used for setting profile photos. Alternatively, the user can upload a photo from their device.

4. FUNCTIONALITY AND USER INTERCFACE

The team was able to build an application that satisfied many of the requirements set by the hospital staff. Here we outline how each of the elements of the Face2Name app helps staff to quickly identify colleagues while being well integrated into the hospital workflow.

The main functionality of the Face2Name app is to provide the user with a visual directory of staff working on their ward. This feature can be easily accessed by tapping on the “Staff” or “Patient” tab on the navigation bar.

The “Staff” tab leads to a segmented view where users can choose between viewing members on a medical team (physicians and allied health members) or staff organized by floor or ward (e.g. nurses). We incorporated specific team colours in each heading to provide the users with an additional visual cue. This window is most useful when users are trying to view a team member they know is on a particular team or floor. Users can tap on the respective team or floor to zoom in and view larger photos of all the team members along with their clinical role and name. If more information is desired on a particular individual, users can click on that member’s photo and see their profile page. [Figure 3]

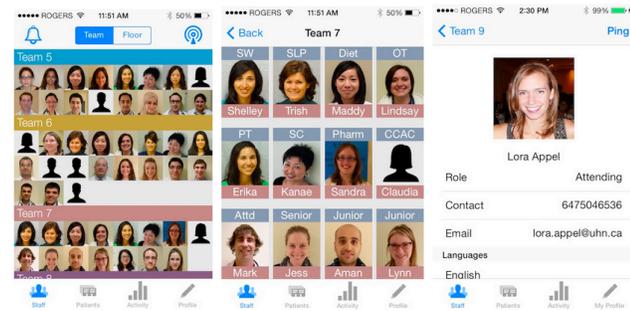


Figure 3. Searching for staff by team association

Similarly, from the “Patient” tab, users have the ability to choose another segmented view that either displays the list of patients assigned to them, or all the patients on the ward. This view is most useful when the only information a user has is the patient’s name. Having selected a patient, the user can see the pictures of staff members assigned to that patient and can “zoom” into a particular staff member’s profile by clicking on their photograph. [Figure 4]

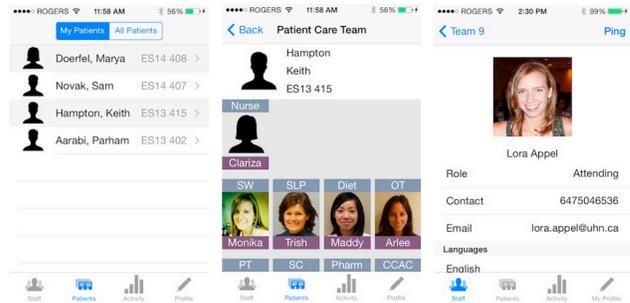


Figure 4. Searching for staff by patient association

The profile page of an individual staff member, mentioned above, includes their full name, role, languages spoken, and contact information. Selecting a phone number in a profile will bring up the phone application and allow for calling the desired staff member. Users can restrict what information is visible to others by going to the “Profile” tab on the navigation bar. [Figure 5]

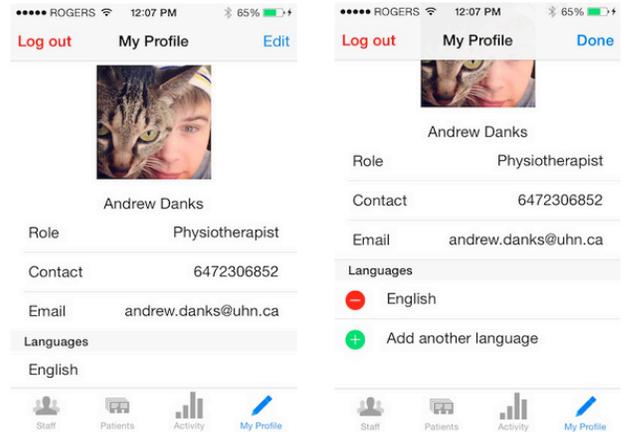


Figure 5. Editing staff profile: initial view & editing mode

Additionally, we implemented another contact method – whereby users may “ping” other users with push notification. “Pinging” a staff member lets them know that they are needed. Read receipts are sent back when the recipient receives the ping, and this mechanism works also when the app is not active. A list of recent pings is available, with timestamps and linking back to the sender’s profile. [Figure 6] The current method of contacting a staff member in urgent situations is through the use of hospital overhead public address (PA) system; this is both disruptive to other staff and patients, and does not provide the paged staff with information as to whom is looking for them. “Pinging” affords the sender to target only the staff member they need (not alert the entire floor), and informs the receiver about who, and perhaps why, they are being called.

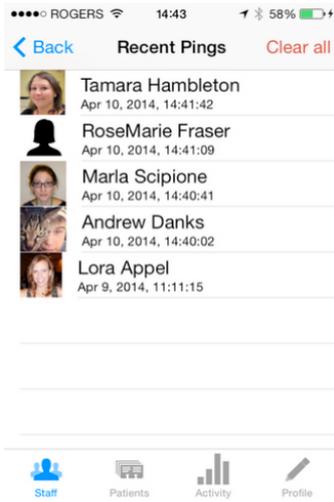


Figure 6. Recent pings, with date and time (items link to user pages)

The “Activity” section provides access to two features meant to strengthen familiarity among staff. The history view allows users to see a list of staff they have interacted with, based on bluetooth iBeacon interactions, and a list of staff profiles that the user has looked up previously. As an incentive for users to get to know more staff members, in order to increase inter-professional communication and decrease anonymity, ‘badges’ are earned by users for interacting with staff of same or other profession. Tapping on a badge shows the users who are the members whom they did not meet yet. This gamifies the activity of meeting new people on the unit, encouraging users to meet others so that they raise their “score”. [Figure 7-8]

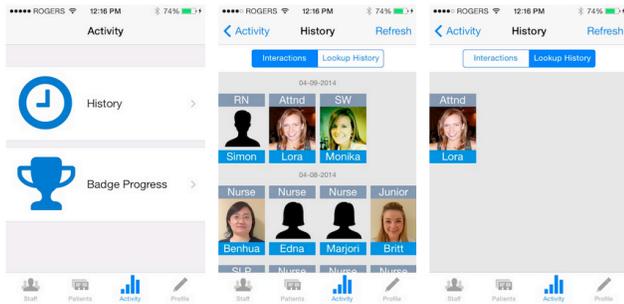


Figure 7. Activity view, History of interactions (separated by date and look-up history)

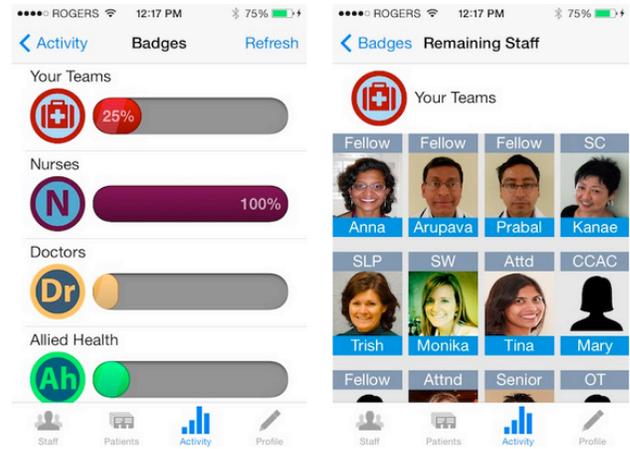


Figure 8. Badge progress, Remaining staff not yet interacted with

The iBeacon detection is reliable, though there are foreseeable issues with noise as the number of beacons is increased. The accuracy allows for the implementation of the approximate distance in the beacon list, which will tell a user if a beacon is Near, Far, or Here. Since the beacon list updates dynamically, users have an efficient way to get information relevant to their location. Users can judge whether it would be more efficient to wait by the nursing station or walk the wards in search for the staff member they have “pinged.” Giving the application some context awareness is a huge benefit to users. [Figure 9]

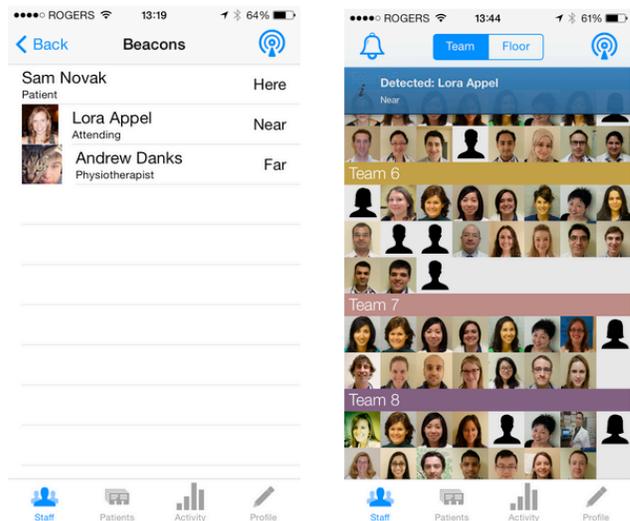


Figure 9. Local beacons list and example of in-app alert when a new beacon is detected

5. KEY LEARNINGS

5.1 Technology

Managing the phone’s database with a remote server and synchronizing the data across all devices was one of the main challenges. We also learned about interfacing with iBeacon and integrating third-party beacon hardware (Qualcomm). Given more time, the developers would have investigated different frameworks for simplifying the data synchronization process, so

that it is more scalable. For example, close to the end of the project we discovered a framework (currently in beta testing) called helios.io, which could be ‘just what the doctor ordered’.

5.2 User Feedback

User feedback was tremendously valuable during the development process, and helped us refine features of the application especially to not interfere with staff workflow. However, some features implemented based on user requests from the interviews ended up not being very popular with staff when deployed. For example, “who has looked up my profile” feature received generally negative feedback, despite some key stakeholder requests.

5.3 Privacy, Security and Ethics

While using the novel iBeacon technology has many advantages, this form of proximity tracking has privacy implications within hospitals, which needed to be addressed. For example, the app could be used, not as intended, as a tracking tool to check if staff are spending time on the wards or elsewhere.

The current version of the app is designed to be installed on personal smartphones, which from the hospital perspective are “unprotected” devices. According to the IT security at the hospital, in order for our prototype to be extended for use across the hospital, it would be advisable to have its own sandbox with its own encrypted data storage. The user would be prompted for a password to unlock to app and a ‘timeout’ feature would be implemented. Logs of the application use would need to be kept for abuse and investigation purposes.

Finally, it is important to maintain a work environment of equal opportunity and, as some staff may not have personal smartphones, or may choose not to use them for work related activities, it would be beneficial to also develop a web-based version of this application to be accessible to everyone from the institutional desktops.

5.4 Value of Design Thinking

Healthcare research is a unique context where stakeholders are equally interested in designing an actual solution as they are in developing a generalizable process by which other researchers can design solutions in similar situations and environments. Researchers and developers creating tools for use in hospitals need a better understanding of the process of involving end-users in the development of tools; who and how many people to involve, and at what point in the process is it most effective to involve users. Our project not only built a tool, but simultaneously described how developers can effectively involve end users in the design, testing, and implementation of such a tool. By gaining trust of the users throughout the design process, developers are more likely to create a tool that satisfies user needs, also creating a feeling of ownership among the end users that impacts their adoption rate and sustainability of the app.

6. FUTURE WORK

The next step is to pilot the app in a proof-of-concept study at the hospital. An experimental study design will test (1) clinician anonymity (2) inter-professional communication, and (3) workflow efficiency, pre and post introducing the app on the hospital wards. The team will continue to conduct observations and collect data on when and how the application is being used (in addition to data collected from the analytics software on the app).

The Face2Name application has already garnered attention; it was a finalist in two pitch competitions, and received interested from two other teaching hospitals in Toronto, Canada.

7. ACKNOWLEDGMENTS

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