Overview

Client

Our client is SCaRF (the Skin Cancer Research Fund), a charity founded in 1979, with the objective of raising money for research into the causes, prevention, and treatment of skin cancer, especially melanoma, and to raise awareness of the condition.

Jon Pleat, a consultant plastic surgeon and chairman of SCaRF, is our main contact for the project. He believes that there are currently not any apps that enable patients to effectively monitor their moles for signs of skin cancer; the apps presently available on the market are expensive, difficult to use and unintuitive.

Domain

The core domain of our project is patients wanting to monitor moles they may be worried about for changes, which could indicate skin cancer, especially melanoma.

There is an ABCDE guide to recognise the warning signs of melanoma:

- A for asymmetry; does one half of the mole not match the other half
- B for border; are the edges of the mole uneven or irregular
- C for colour; does the mole not have a uniform colour
- D for diameter; is the mole larger than normal (i.e. larger than about 6mm)
- E for evolving; is the mole changing in size, shape, colour, etc.

It is important that patients are able to monitor their moles for signs that they are evolving, and have an easy way to contact their doctor if there is anything concerning them about a mole.

The wider domain of our project is anybody who wishes to monitor their moles.

Project

Our project is to develop an app, with a user-friendly interface, to enable users to monitor their moles and provide them with information about skin cancer.

Vision

Our vision for the project is an app, available on both iOS and Android, that will enable users to monitor their moles for signs of skin cancer.

We believe our app should have the following features:

- A body diagram to enable users to identify where on their body a mole is located
- Serial photographs, both near and far, taken over a period of time, to enable users to monitor the appearance of their moles
- A ghost image to be displayed when taking a photograph of a mole, to help users take consistent photographs
- Notifications that users can opt-in or opt-out of, reminding them to take updated photographs of their moles
- A link to the mail app, so users can send photographs of a mole to their GP or other third parties
- Pages of information to educate users on skin cancer, containing text, photographs and videos
- Information pointers to help users navigate the app and use key features
- SCaRF charity logo should be displayed, with a link for anyone to send donations
- User-friendly interface

Requirements

System Stakeholders:

Within our project, we have identified a number of system stakeholders. Stakeholders marked with an asterisk are ones we deem to be user stakeholders.

1. **Client:** The Skin Cancer Research Fund (SCaRF) team based at Southmead Hospital, whose objective is to raise money and awareness about skin cancer. This team is represented by Jonathon Pleat, the Chairman of the charity.
2. **Development team:** The team is comprised of 5 students: Ambika Agarwal, Emily Lopez, Euan Bagguley, George Herbert, Seth Holdcroft, who will be developing, testing and releasing the app for the SCaRF project.
3. ***Young adults:** Skin cancer is the most rapidly increasing killer of young adults. Up to the age of 25, is when moles most commonly develop. Therefore, it is essential young adults are able to track their moles from development to have the best chance of noticing changes over time.
4. ***Adults (25+):** After 25 it is less common for moles to develop. Development of a mole can be the first indication of skin cancer; therefore, it is essential this age group are able to track their moles to have the best chance of noticing changes over time.
5. ***Carers, friends or family:** This group of people involves people who are taking pictures on behalf of someone else. For example, a carer may take a picture for the person they are caring for if they are unable to do so themselves.
6. ***General public:** This group of people are not using the app to take pictures of moles but may instead want to learn about skin cancer or the SCaRF project. They will be able to do this by following the embedded video links or reading the information pages.
7. **Clinicians:** Users who are concerned about a mole they have taken a picture of may want to send the picture to a clinician. The clinician can be emailed from the app itself and are most likely to be GP's who can see the development of the mole and look for any signs of skin cancer.
8. **Researchers:** This is a wide group of people who may be researching into various areas of skin cancer. For example, they may be looking into how a mole develops and in particular what trends they can notice amongst moles that become cancerous. If users have a log of pictures from using our app, they may wish to partake in the researcher's study.
9. **Legislators:** This group of people are stakeholders as we will be using their laws to store data within our app.
10. **Other app owners & app stores:** Other apps on the market which have similar functionality to ours, such as *SkinVision*, may get less interest as consumers have more choices. Additionally, as our app will be available to download from app stores such as Google Play Store, the app stores will get more traction.

User Stories:

For each stakeholder we have deemed to be a user stakeholder, we have provided three of the most important user stories. Some user stories are the same across different users as they have a goal in common.

Young adults:

1. As a young adult who is at greater risk of skin cancer, I want to be able to regularly take pictures of my moles, so that I can compare pictures over time and notice potentially cancerous differences.
2. As a young adult, I want to know that the app is secure, so that I can comfortably and confidently store my photos knowing that they'll remain private.
3. As a busy young adult in full-time work & education, I want to be notified of when to take pictures, so that I do not have to worry about remembering the next due date or missing weeks of pictures.

Adults (25+):

1. As an adult, I want to be able to click on the information tab, so that I can educate myself about skin cancer, by reading the pages and watching the videos.
2. As an adult, I want to be able to send my clinician pictures of my moles, so that they can review the moles that I deem to be potentially cancerous and see how they have developed over time.
3. As an elderly user, I want to be faced with an intuitive and easy-to-use interface, so that I can easily navigate my way around the app and have the option to get help if I come across a page I do not understand how to navigate.

Carers, friends or family:

1. As a carer of a vulnerable person, I want to be able to regularly take pictures of their moles, so that I can monitor them between visits and spot any concerning signs.
2. As an isolated person unable to see some parts of my body, I want to be able to look at previous pictures that have been taken for me, so that I can monitor the development of each mole.
3. As a friend/family member taking pictures on behalf of someone else, I want to be able to see the position of the mole on a previous picture, so that I can ensure consistency across all the pictures of the same mole.

General public:

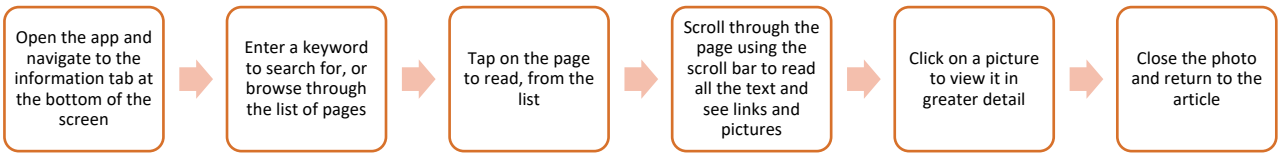
1. As a member of public, I want to be able to click on the information tab, so that I can educate myself about skin cancer, by reading the pages and watching the videos.
2. As a member of public, I want to be able to click on the SCaRF badge which links me to their donation page, so that I can send donations to this worthy cause.
3. As a member of public, I want to be faced with an easy-to-use interface so that I can easily navigate my way around the app and have the option to get help if I come across a page I do not understand how to navigate.

Basic, alternative and exceptional flows

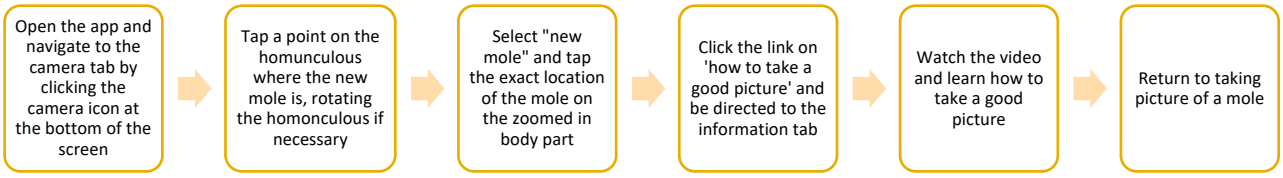
For a subset of user stories, we have created diagrams showing the basic flow, an alternative flow and an exceptional flow. The basic flow shows the typical sequence we expect our users to take to achieve their goal and the alternative flow shows a valid but less common sequence. The exceptional flow, however, shows steps the users may take which may result in an undesired goal.

"I want to be able to educate myself about skin cancer"

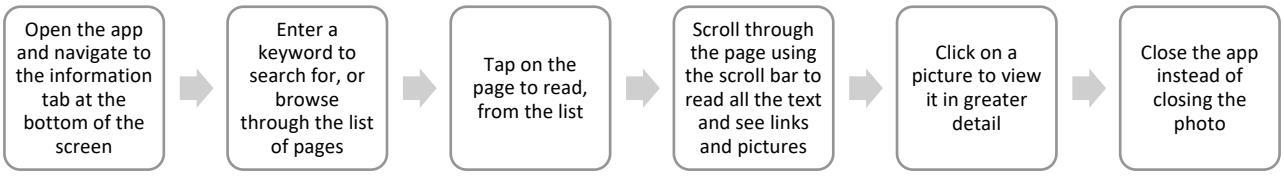
Basic flow:



Alternative flow:



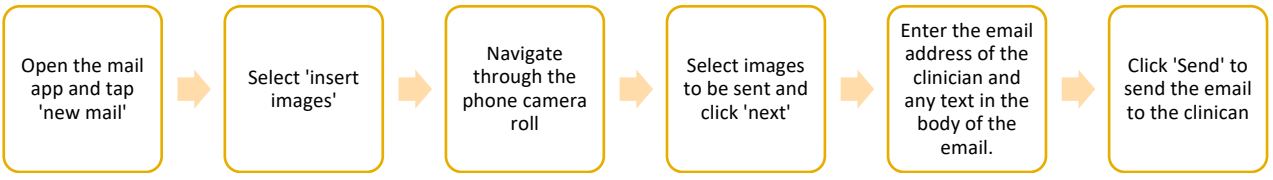
Exceptional flow:



"I want to be able to send my clinician pictures of my moles"

Basic flow:

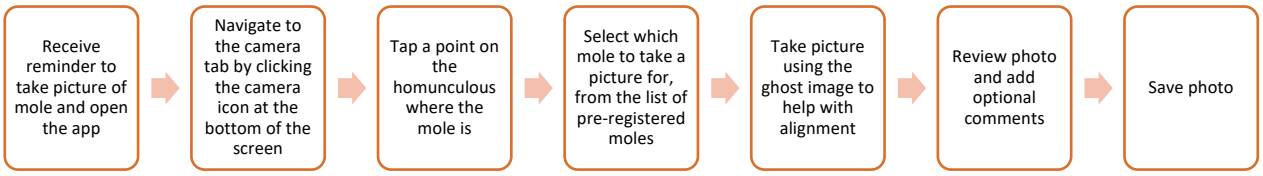
Alternative flow:



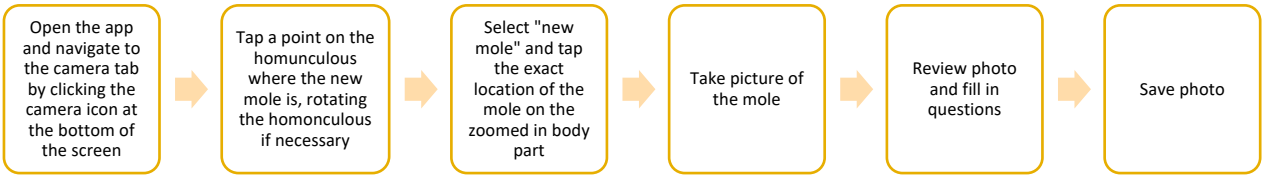
Exceptional flow:

“I want to be able to regularly take pictures of my moles”

Basic flow:



Alternative flow:

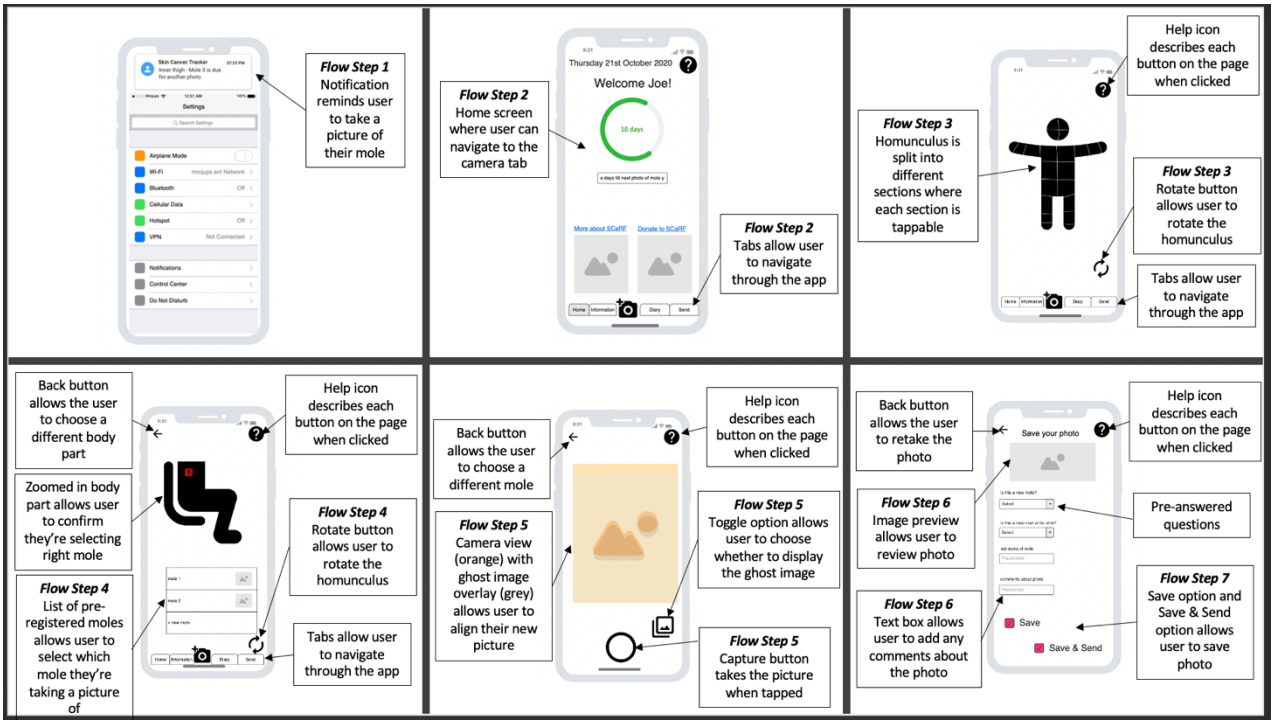


Exceptional flow:

Decomposition of basic flow steps

For a select user story we have decomposed the basic flow steps and identified features that we will need to implement in order for a user to navigate through each flow step.

“I want to be able to regularly take pictures of my moles” – Basic flow steps decomposed:



Personal Data, Privacy, Security and Ethics Management

Personal Data

Types of Personal Data

Our application will be collecting two pieces of personal data about a user:

- Their name
- Photographs of their moles

Collecting User Consent

When the user first opens our application, we will clearly inform them that the application needs to collect their name and images of their moles in order to function. This data will be stored locally on their device, and we will not have access to this data. If they choose to accept these terms, then they will be able to use the application.

Managing Personal Data

We will not be storing any personal data ourselves; all personal data will be stored locally on a user's device.

Cookie Law

Our application will not be using any cookies.

Security

The personal data collected in our application will be stored locally on a user's device. On iOS, each app runs within its own sandbox, so this data will not be visible to other applications on the device. On Android, data within a directory marked as "app-specific storage" is not accessible from other applications either. Therefore the personal data we will be storing will be secure, as it will not be accessible outside of the application itself.

Ethics Management

We are currently in the process of applying for ethics approval.

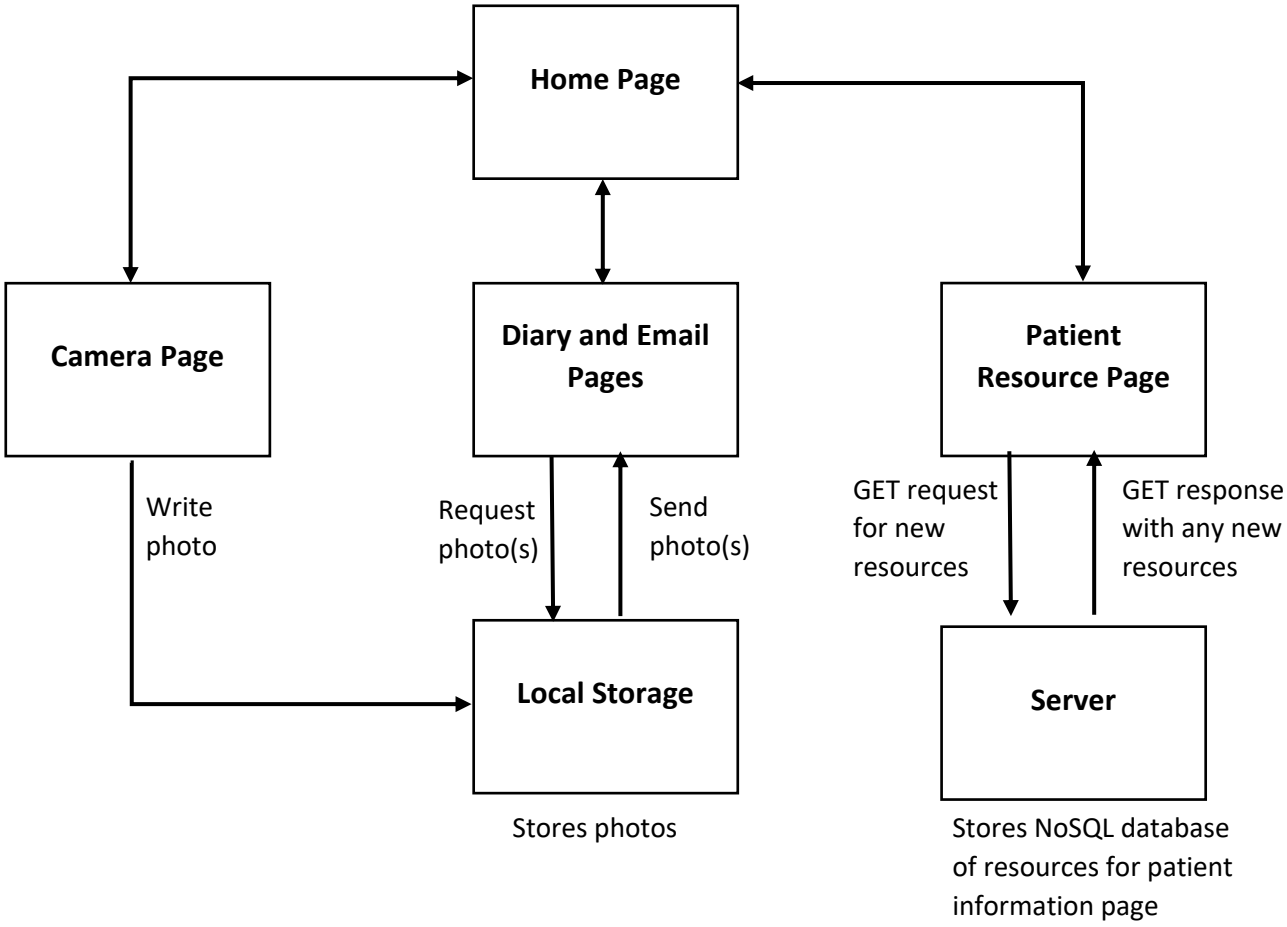
Architecture

Main Architectural Requirements

- **Our fundamental requirement was for our project to be available as a mobile application for both iOS and Android:** We chose to build the front end of this application with React Native due to it providing native cross-platform development for both systems, as well as supported libraries for addressing the following requirements
- **The application must contain the ability to take photos that the user can then view via a "Diary" page:** Upon consultation with our client, **these photos are to be stored locally on the users' phone**. The diary page will therefore read from local storage and display all photos taken in chronological order using the timestamps stored with pictures metadata.
- **The application must contain an email page where the user can select a photo that is then loaded into there email application of choice to be sent to there GP:** Again, this requires reading photos from local storage. There is no sending of emails within the application, the selected photo is simply loaded as an attachment to a new email on the users preferred email service e.g. Gmail
- **The application must contain a patient information page that can be updated dynamically with other resources:** The resources in question will be text, links to webpages etc stored within a database on a server provided by our client. Our application will use HTTP GET requests to request and receive any updates from the server and apply any changes to the page. We have decided to use NodeJS to provide the server-side logic as we require many I/O operations without the need of heavy server-side computing. The resources themselves will be stored on a NoSQL database as we do not require multiple related tables, simply one table storing fields containing text, time stamp of last edit (so we can distribute new changes), and possibly links, images etc.

Overall structure

1) **Front end:** Contains the following: A home page, a patient information page displaying information that is dynamically updated from a server, a camera page that can writes images to local storage, a diary page and email page, both of which will read images from local storage.
2) **Local storage:** Stores all photos taken within the application
3) **Server:** Stores database containing all the resources to be displayed on the patient information page. Sends any resources added to the database after the timestamp of the clients most recent update to said page.


Home Page
Camera Page
Diary and Email Pages
Patient Resource Page
Write photo
Request photo(s)
Send photo(s)
GET request for new resources
GET response with any new resources
Local Storage
Server
Stores photos
Stores NoSQL database of resources for patient information page

Development Testing

Strategy and Approach

Following the test-driven development outline, we will draw from our user stories, client comments and project requirements to create the tests. This will allow us to order the development of the different features of the app, based upon which parts depend on each other. For each of the app features the group has discussed in detail with the client what the feature should achieve and how it should take information from the user. All information should be displayed in a user-friendly format. When dealing with data being input by the user, for example when they add information to a new picture, we will use equivalence partitioning to test the robustness of the app. This ensures that the information we store is valid and that the app will not crash if the user enters unexpected values, for example an abnormally large string for their name field. Other outlier cases will be accounted for, including incorrect data types and empty fields.

Core Component

A core component of our system is the feature that allows the user to take a picture of their skin lesion/mole. They will have diary entries for moles that they have already begun tracking and will have the ability to add new diary entries for new moles. In this test description we will focus on the scenario where the user is adding new images to an existing diary entry. This feature is a key requirement specified by the client. In order to help the user track their moles they must be able to take periodic photos so that a doctor can look for changes.

Test	**Explanation**
The camera page displays a button at the bottom. Used to take a picture.	When this button is pressed a picture is taken and held temporarily. After pressing the button, the user is taken to the review page to check that image and add any additional information.
The camera page has an option to show a ghost photo.	This ghost photo is used to help keep consistency between the images, better allowing the doctor to spot changes in the mole. The ghost photo will be of the first image the user took. They can click the button to display and remove the ghost image. It shows up like a filter would.
The new picture is added to the correct diary entry.	There are two possible options on the review page, ‘save’ and ‘save and send’. Both options will store the image in the entry the user specifies.
The new picture has the attributes the user added in the review page.	These attributes include, whether the image is a near shot or a far shot, any additional comments about the photo from the user and the date the image was taken. The date will not be a user input; we will instead use a date & time module.
The user is encouraged to take pictures routinely. When a new picture is taken, the time until they need to take another set of images, is updated accordingly.	Each diary entry will have the date of the last entry and use this to remind the user of when they next should take a new photo. This date should be updated when a new entry is added.
The user is asked to take both a near shot and a far shot when adding a new entry.	Once the user has taken one of the two shots, they are taken back to the camera page so they can take the other shot.
After taking a picture the user is taken to the diary page.	The user can now see the diary entry has been updated with the two new images.
Back button on each page.	Both the review page and camera page will have a back button in the top left corner. This will bring the user to the previous page they were looking at. If the user does not save an image at the review page and presses the back button instead, the image will not be saved.
Helper button.	Both the review page and the camera page will have a helper button in the top right corner. Pressing this will display more detail about how to use the features of the page.

Release Testing

Strategy Overview

The app is being made for the general public; therefore, it is important that users of all ages and technological understanding can use the app. Throughout the development of our app we will communicate with our client, ensuring that he is happy with the setup. When we have a working app, it will be very beneficial to us to get some additional feedback from other people. To assess the experience of our app from a range of perspectives we aim to get people from a variety of age groups to try the app.

An important use of the app will be to better allow doctors and patients to identify a particular mole on the patient's body. This can be very difficult if a patient suffers with *insert name of condition*. Our client will be able to introduce the app to some of his patients which will allow us to see how our app helps. The format in which we will receive our feedback will be the same for each person. The survey will use number lines and short answer questions which will give us easy to analyse data. From this we can spot areas of the app that need work, as well as what is working well.

Core User Story

The core user story we have chosen for this test table is as follows:

"*As a member of the public, I want to be faced with an easy-to-use interface so that I can easily navigate my way around the app and have the option to get help if I come across a page I do not understand how to navigate."*

We picked this user story because it includes the ease-of-use requirement that is so important to our client. When developing our app, it is important that we remain aware of the range of people's confidence when using apps and mobile phones in general. In summary, we need to create pages that contain all the required functionality in the simplest format.

Test	Explanation
A new user has just downloaded the app. The first time they visit each page the helper feature will be visible.	The helper feature will show small text boxes containing information about each part of the page telling the user how to navigate the page and use its features. We think it will be beneficial to have this information showing when the user opens the app for the first time, as this will enable them to begin to monitor their moles quickly and correctly.
In the top right-hand corner of each page of the app there is a button labelled with a question mark ( ). Pressing this button once will reveal the helper information. Pressing the button again will hide the helper information.	There could be months in-between the user needing to use the app. Therefore, if the user forgets how to use any of the features, they can see the explanations given to them when they first opened the app once more.
The pages of the app should be split up to ensure that none of the pages are overly cluttered. Each page should have a specific function.	Examples of the function of some pages would be: • The home page: this aims to give the user snippets of key information. This includes: the link to the SCaRF charity page and the link to their donation page. It also shows the user the shortest count down (in number of days) until they need to take updated photographs for a mole. • The camera page: the function of this page is to allow the user to take a picture of their mole/lesion. It should have a button that takes a picture, a button to show and hide the ghost photograph, the back button and the helper button.