UpShot

Archery Tournaments Anytime!

System Design Document

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MOBILE APPLICATIONS MODULE

UFCF7H-15-3

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GitHub

11/05/2022

1. SYSTEM OVERVIEW.

UPShot is a new iOS app intended to promote the sport of archery and expand its appeal to a wider audience. The app is designed to achieve this goal by making archery practice and training much more engaging and enjoyable and adding 'gamification' to the process of training for archery with virtual, app-based archery matches.

The app user will select a fun virtual opponent to shoot an archery match against, with different difficulty levels available to choose from, then, enter their own arrow scores into the app as they shoot their practice arrows at a real archery range. The app will then record their score against the virtual opponent and provide rewards and encouragement for beating each opponent as the user moves up in difficulty levels.

2. USER STORIES

The following user activities represent an idea of what each type of end user may wish to use the app for. Each user activity, and the associated acceptance criteria, will then be used to develop the user story map and, subsequently, to outline the flow of the user experience throughout the app's design and define the specific requirements for each function of the app. These user stories were sourced from informal talks and interviews with potential users at a local archery club, asking them how they would most likely make use of an app such as this and what they would like to see in the app once complete, alongside use of a general questionnaire (appendix 1) handed out at a second archery club. This survey was taken anonymously by 32 respondents covering two archery clubs located in the southwest of England and by 12 anonymous respondents who were present at a national archery tournament in the east midlands, representing 46 total respondents. The respondents characterised archers of a wide range of ages, genders, experience levels and bow style.

2.1 USER STORY # 1

As an app user I should be able to select from a range of fun opponents with a varying degree of difficulty so that I can feel like the simulated tournament match between myself and my opponent is both fair and challenging, no matter what my real life archery skill level is.

ACCEPTANCE CRITERA:

At least 3 opponents are available to select.

At least 3 difficulty levels are available (easy, medium, hard).

2.2 USER STORY #2

As a user I should be able to enter my score quickly and easily into the app. Ideally this will be possible using one hand as most archers will have their bow tied to their hand via a finger sling (see figure 1) whilst shooting, meaning that we only have one free hand. Whilst not shooting I may or may not remove the finger sling, briefly allowing two handed operation of the app, but as most archers probably do not regularly remove their finger sling during training the entire app should be useable with a single finger if possible.

Figure 1: An archery finger sling.

ACCEPTANCE CRITERIA

All vital operations for the virtual tournament in the app can be performed one handed.

Non-essential operations such as changing settings or creating a profile may require two handed operations of the app.

2.3 USER STORY #3

As a user I should be rewarded for beating an opponent and possibly for setting a personal best score. Ideally I would like to keep track of how my scores have improved over time and maybe earn badges and trophies so that I can compete with my friends to be the first to beat a level/opponent or earn a specific achievement and feel a real sense of progression when using the app.

ACCEPTANCE CRITERIA

Users recieve a congratulatory message when they have won a match against an opponent.

Users receive a silver trophy for setting a new personal best score.

Users receive a gold trophy for beating a new opponent for the first time.

Figure 2: Achievement!

Extracting and understanding the use cases of potential user activities, such as those above, has been shown to be avery important part of and software development and the associated design phase (Patton et al., 2014). This type of insight ensures that the design process detailed within this document maintains a core focus on the end user and ensures that the final app is one which the users will be keen to install and use.

3. USER STORY MAP

User story mapping is a highly beneficial aspect of software development and can be used to better understand how each type of external user will interact with, and possible ways they will move through, the app so that their needs can be understood and catered to fully (Patton, 2014).

With this in mind the following user story map was created to visualise the typical user flow through the app, what they might want to do at each stage of the app flow, and why they would like to use the app this way.

In parts of the user story map there are lateral return tasks, these represent functions of the app which some users may find useful but not all potential end users expressed a desire to have this functionality present in the app.

This kind of user story modelling helps to make sure that the requirements abstraction is well tailored to a typical user's needs, based on real world evidence of how potential end users might use the app.

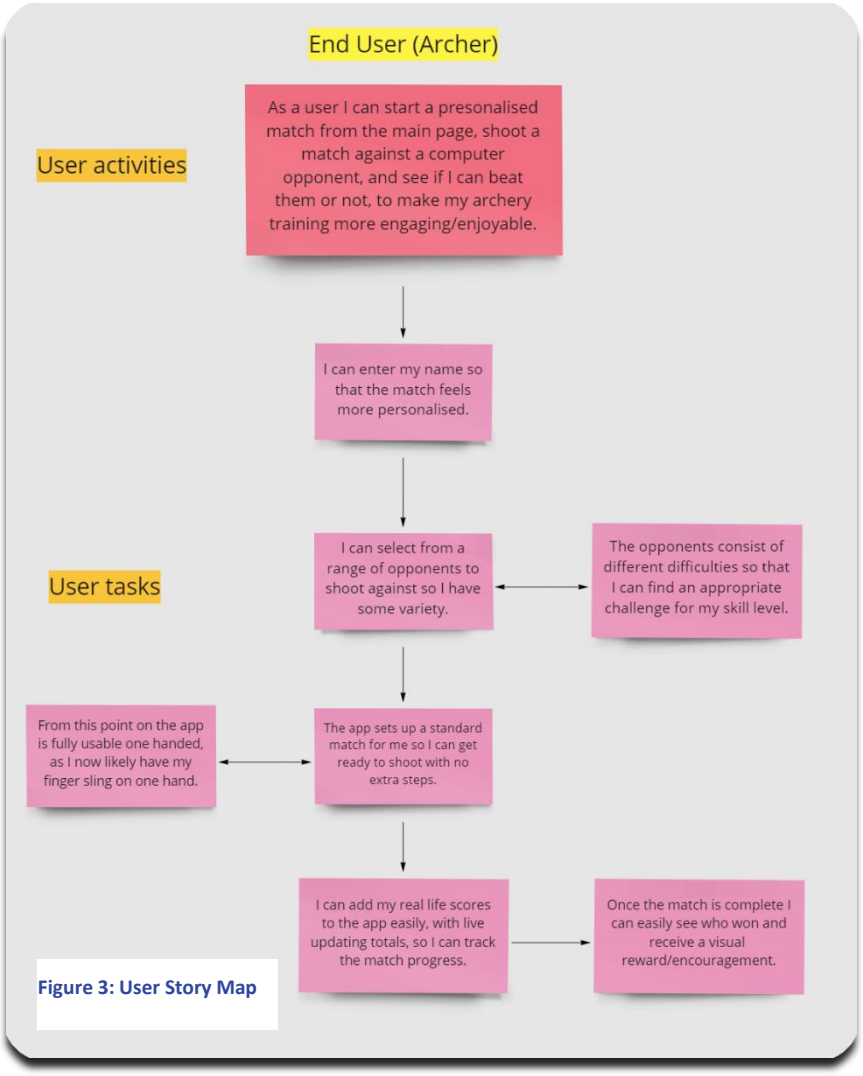

Figure 3: User Story Map

4. REQUIREMENTS CAPTURE

The requirements were then extracted from this user study and are prioritised by using the MoSCoW (Must have, Should have, Could have, Won't have) prioritisation system (Clegg and Barker, 1994). Meeting these requirements will form the basis for the future design of the system.

4.1 FUNCTIONAL REQUIREMENTS:

4.2.1 MUST HAVE

Requirement	Input	System Behaviour	Output	ID
The system must have a selection of opponents.	The user can swipe through opponents and select one they want.	The system stores the opponent for use in the match.	A match is created against this opponent.	1
The system must be useable with just one hand.	Inputs such as buttons and actions should be located at the bottom of the screen so that they can be pressed with the thumb.	The system shouldn't put any inputs critical to a match above the halfway point of the screen.	The system can be used from the start of a match to the end with just one hand.	2
The system must reward the player for beating an opponent.	The player wins a match against any opponent.	System generates a reward such as a congratulations message or a trophy graphic.	The message or trophy is displayed on the screen in a pleasing/rewarding manner.	3

4.2.2 SHOULD HAVE

Requirement	Input	System Behaviour	Output	ID
The system should have different difficulty levels to choose from.	User selects a difficulty level.	System adjusts the virtual opponent's level to match the difficulty selected.	The virtual opponent scores a higher or lower score in the match depending on current difficulty setting.	4
There should be at least three different characters to compete against.	User navigates to the opponent select view.	System accesses the saved characters.	System displays at least three characters for the user to select from.	5

4.2.3 COULD HAVE

Requirement	Input	System Behaviour	Output	ID
The system could have interesting characters to add excitement.	Extra characters such as future archer with a laser bow is added to the opponents list.	System treats these like other archers but perhaps with more interesting or extra graphical features.	The opponent roster is expanded with more interesting choices.	6
The system could have an animated congratulations/trophy display on match win.	User score exceeds that needed to win match.	System calculated that the user has won and ends the match.	System displays an animated trophy/congratulations message.	7

The system could have an animated archery target to show the computer opponent taking their shots.	User has entered their own score and it is now time for the system to calculate the opponent's semi random (weighted by difficulty) score.	System calculates the opponents score and selects an appropriate animation file for this.	Score is displayed to the user by showing a pre-rendered animation of the arrow hitting the appropriate part in the archery target.	8

4.2.3 WONT HAVE (AT THIS TIME)

Requirement	Reason fo not Including
The system won't have a complete multi-user login system and support.	It is likely that this app will be used by a single archer. There are no multi-user features and the vast majority of people who were interviewed said they would just install and use it on their own personal phone.
The system won't track progression or personal best scores.	This is a scope issue. Although this was a very popular feature in the user interviews/questionnaires, it will likely be too complex to implement, given the limited scope of the module's development time. It is an unfortunate but likely necessary exclusion but understanding of this requirement gives great scope for future expandability of the app.

4.2 NON-FUNCITONAL REQUIREMENTS

4.2.1 MUST HAVE

Requirement	Input	System Behaviour	Output	ID
The app must load in < 2 seconds.	App is opened	App is started and the system is initialised.	App main page is displayed and ready to use.	9
Each view change in the app must take < 1 second.	View is changed via a button press or other user input.	System changes to the next view.	Next view is displayed and ready to use.	10
All input controls to complete a match must be located in the bottom half of the screen.	Any view after the match is set up is opened.	System loads the appropriate view and user input controls in the correct places.	System displays the desired views with all inputs at the bottom of the screen.	11
The user score in the match must be returned in less than 1 second.	User inputs their next arrow's score.	System adds this arrow score to their running total in less than 1 second.	Running total for the user score is displayed quickly and correctly.	12
The computer opponent's score must be calculated and updated within 2 seconds of the user inputting their score.	User inputs their next arrow's score.	System calculates a semi random (weighted by difficulty setting) score for the computer opponent.	Computer opponents score (and running total) is calculated and displayed quickly and correctly.	

4. REQUIREMENTS ANALYSIS (DESIGN PRINCIPLES)

Analysis of the user stories/map and the extracted requirements can give some overall guiding principles for the design and ongoing development of the app. Following these principles, based on the user sourced requirements, will ensure that the overall design of the app will meet as many user desires as possible, even when they have not been explicitly defined within the requirements section.

Overall, the app will endeavour to have the following design principles:

- **Simple but powerful:** Shooting archery can be mentally and physically taxing. The app should be very simple to use, with simple single digit button press inputs, so that the app doesn't become a strain or overly strenuous to use during a training session.
- **Encouraging to the end user:** The app is intended to add enjoyment and fun to the otherwise sometimes rather monotonous activity of archery training. Therefore, it should be upbeat and encouraging, never discouraging the user.
- **The presentation should be fun and engaging:** Archery can be a very technical and analytical sport. To counter that and keep training exciting the app should have a fun interface and graphical style. This may also have the benefit of keeping children and junior archers more engaged during their training sessions.
- **The app should be fast and highly responsive:** Archery shot cycles are very rhythmic in nature. So as not to break this rhythm during training the app should react quickly and responsively, to ensure it is not distracting or frustrating an archer during their training sessions.

5. WIREFRAMES

The app will be designed to run across all modern apple smartphones, specifically targeting the iPhone 12 pro for development but with good support for all other iOS devices. Following Apple's iOS Human Interface Guidelines (HIG), specifically the design themes of clarity, deference and depth, the following initial wireframes of the apps potential views have been created.Based on the iPhone 12's 6.1-inch 2532 x 1170-pixel display, these wireframes aim to meet as many of Apple's design principles as possible. For example, the above 'choose your opponent' view is designed with both metaphors and direct manipulation in mind. The opponent selection gallery is a metaphor for flicking through the pages of a magazine, to select an item, by using swipe gestures. This will be instantly familiar to users and will give a natural and intuitive flow to the app.

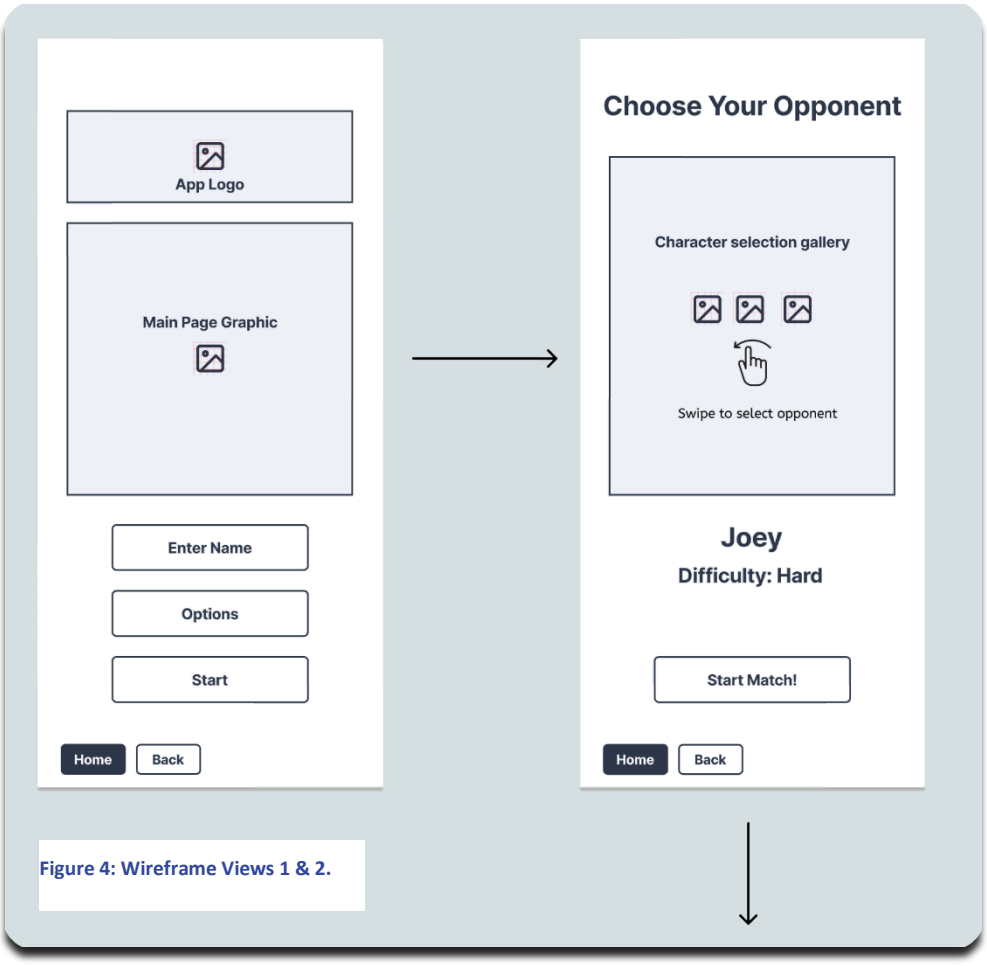

Figure 4: Wireframe Views 1 & 2.

In addition, the navigation bar present at the bottom of these views will be a familiar and easy to use aspect of the app to any user. Ascribing to the Apple HIG principle of user control, this bar allows the user to exit any view, either back to the previous view or back to the home scree. This navigation bar is placed at the bottom of the screen as a direct result of requirement 2 (app must be usable with one hand).

Figure 5: Wireframe Views 3 & 4.

The match progress view wireframe involves some complex design decisions. This view must display a lot of information and have a lot of options for user inputs to allow for a full virtual archery match to take place within this view. Consideration of splitting this view into two (or more) separate views was made, however, with the apps first guiding principle in mind (**simple but powerful**) the decision was made to keep it as a single view, but to simplify each element of that view as much as possible. Navigation of more than one view being required during a match would be complicated and likely over-taxing, considering the concentration required to also shoot a real-life bow at the same time. This will likely lead to a view which may end up a little over-complex and mean a small compromised on the Apple design theme of clarity, however, it was assessed (with the help of some live user feedback during design) that this would be the preferrable compromise of the two solutions to this problem.

The final wireframe view (right) was designed to be visually simple with a clear reward (trophy) as the main focus. This should give the user a clear and prominent reward for winning a match, encouraging engagement, and keeping the user coming back for more.

Finally, there is the option to either return to the main menu or to start a new match. It is thought that users will likely shoot multiple matches during a training session as archery matches tend to be rather short and training sessions can be on the longer side. The option to go straight into another match without returning to the main menu keeps the flow of the app smooth and allows the typical user to cycle through a number of matches seamlessly with as little steps as possible, keeping them engaged and reducing frustrations by eliminating unnecessary steps.

If the user does not win the match and is defeated by the virtual opponent an alternative match end view will be displayed. Again, sticking to the app design principle **encouraging to the end user** the match lost screen does not use negative terminology such as ‘defeat’ or ‘lost’. Discouraging the end user in such a way has been shown to negatively affect moods and emotions (Dewaele, 2016), and is not something which users have reported a desire to see in a fun, encouraging and upbeat app such as UpShot.

Here again, quick access to a new match is imperative, so that the user can quickly leave the match ending screen and regain engagement with the app in a positive way.

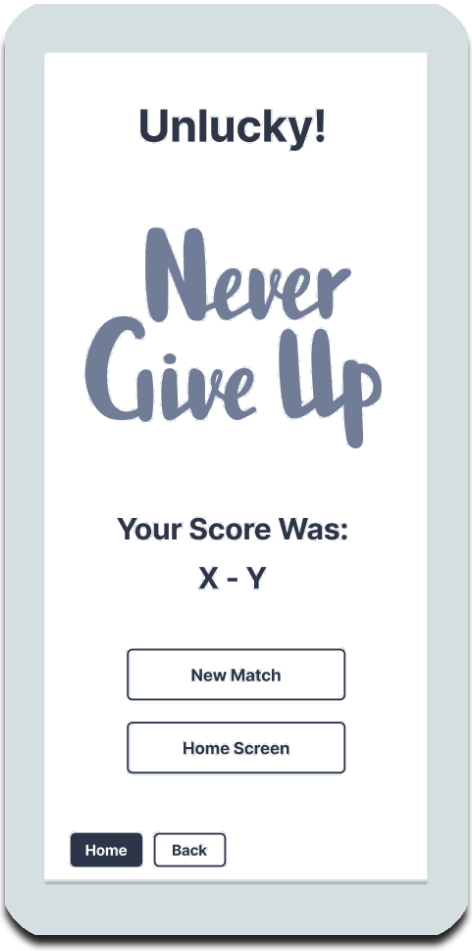

Figure 6: Wireframe View 5.

6. COMPOSITS

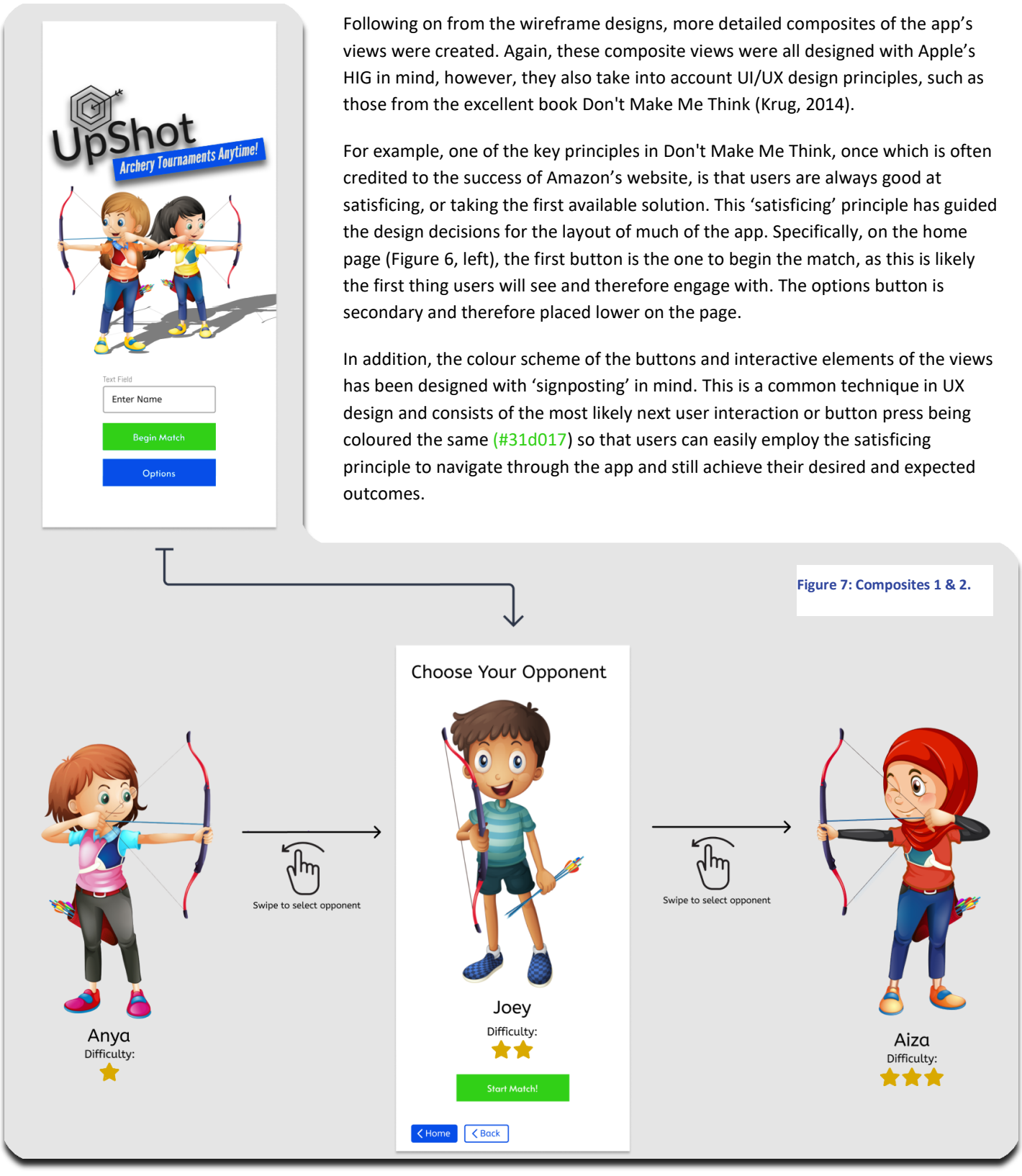

Figure 7: Composites 1 & 2.

Following on from the wireframe designs, more detailed composites of the app's views were created. Again, these composite views were all designed with Apple's HIG in mind, however, they also take into account UI/UX design principles, such as those from the excellent book Don't Make Me Think (Krug, 2014).

For example, one of the key principles in Don't Make Me Think, once which is often credited to the success of Amazon's website, is that users are always good at satisficing, or taking the first available solution. This 'satisficing' principle has guided the design decisions for the layout of much of the app. Specifically, on the home page (Figure 6, left), the first button is the one to begin the match, as this is likely the first thing users will see and therefore engage with. The options button is secondary and therefore placed lower on the page.

In addition, the colour scheme of the buttons and interactive elements of the views has been designed with 'signposting' in mind. This is a common technique in UX design and consists of the most likely next user interaction or button press being coloured the same (#31d017) so that users can easily employ the satisficing principle to navigate through the app and still achieve their desired and expected outcomes.

Other considerations when creating these composites were the fun and exiting graphics. Caricatures of archers were sourced to give the app an engaging and colourful look, which fits well with the bold colour palate of the UI design. Early user feedback when presented with these composites was positive towards this look with adults enjoying the aesthetic but specific positive feedback was given that this style would also be very engaging for children and junior archers, whom, according to user feedback, would benefit greatly from an app such as this to increase their engagement with archery training and practice.

The initial composite design of the match in progress screen (figure 8, left) had all of the arrow scoring colours the same, to match the overall apps colour palette. This created a nice looking aesthetic and adhered well to Apple's HIG principles of clarity and consistency, however, user feedback about the initial composite was that it was very difficult to tell the input buttons apart, as well as see what was happening in the recorded score. Therefore, a second composite was created, this time with the arrow scores and input buttons colour coded to their matching colours on a target face (Figure 7).

Figure 8: Archery Target Colours with Scores.

Although this may cause the screen to look a little, colour-wise, to most people, these are colours which are very familiar to archers. This change in colour scheme, just for this single view, enabled end users to much more confidently locate and use the scoring inputs, with much less distraction from their shooting, adhering to the apps design principle of not being too mentally taxing on the end user.

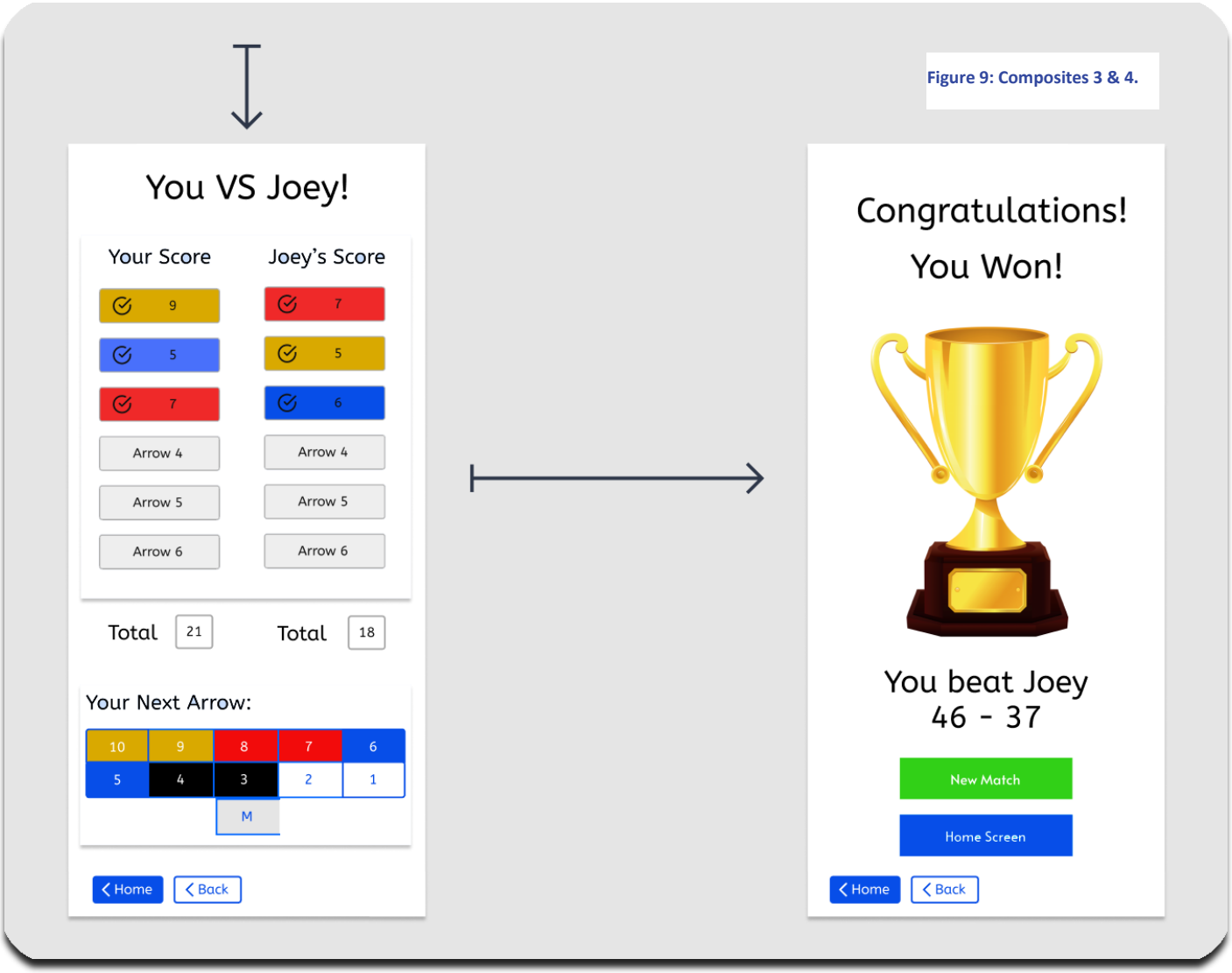

Figure 9: Composites 3 & 4.

The final match results screen is very similar to the blueprint design. A large golden trophy was chosen, which, does not conform to the apps usual colour palette. This was a purposeful choice made with the intention of enlightening the user that this is something special, something out of the ordinary and a great achievement! Studies have shown that this sudden departure from the expected colour scheme can cause users to pay attention to the graphic and treat it as something special (Wen, 2021)!

COLOUR PALLETE

The following colour palette was selected for use in the app after informal discussions with potential end users:

# 074ee8	# c9deff	# 31d017

Figure 10: The Colour Palette Used in the App

Studies have shown that similar colour combinations involving bright blues and greens have been associated with both energized and alert emotions in test subjects (figure 10). Potential end users responded to these emotions as being the most likely emotions to experience during an archery training session. Specifically, the birght and bold blues and greens were selected as bright colours have been shown to elicit positive emotions in users (Hemphill, 1996). Finally, green and blue have ben shown not to have any connections to negative emotions, whereas reds, oranges and yellows do (Ou *et al.,* 2004).

Figure 11: Colours Associated with Energized and Alert Emotions (Gilbert, Fridlund and Lucchina, 2016).

Finally, adequate amounts of whitespace were encouraged throughout the composites to promote a clean and clear look and feel for the app's views.

7. DEVELOPMENT METHODOLOGY

The app will be developed using an agile methodology. Although this project will be developed by a solo developer, this development methodology still enables an iterative design process and continuing development strategy. The requirements abstraction and design phase of the project, documented here, will follow the COMET process (Concurrent Object Modeling and Architectural Design Method), which is a method designed and explained in more detail by Gomaa (2011). Utilising the COMET software design method will directly ensure a strong app design which is highly user focused.

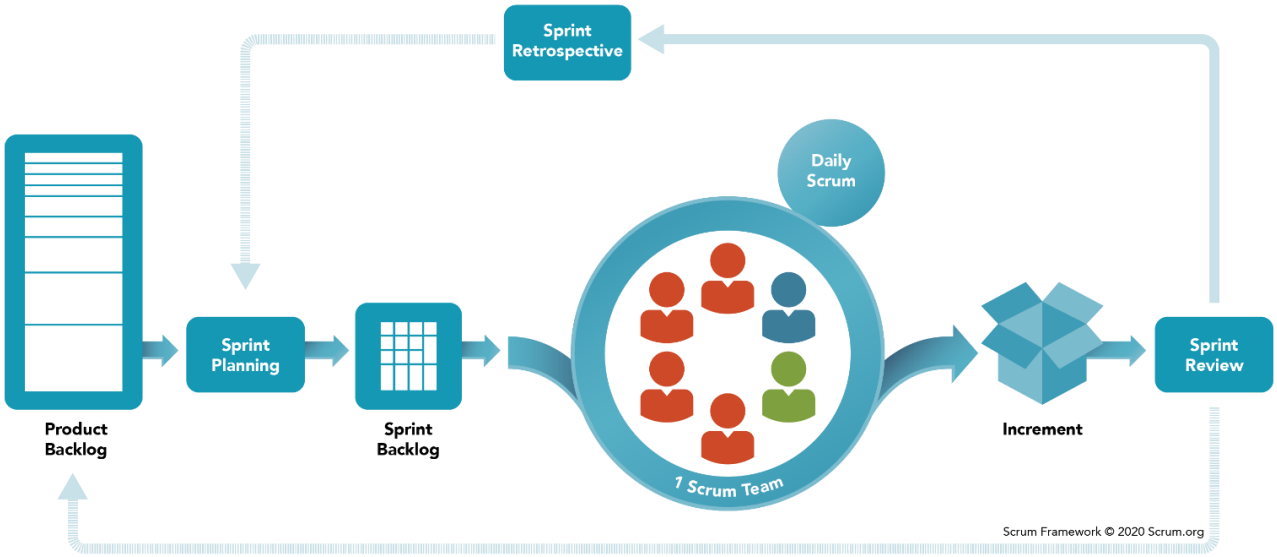

Figure 12: Development Methodology Model.

The development will utilise a product backlog, generated from the requirements list and user stories. This backlog will be broken up into 3 individual sprints, consisting of two weeks development time. The overall development cycle will resemble the diagram above (figure 11) however, the 7-person scrum team will be replaced with a single developer.

The app will be developed in X-Code version 13.2.1 with iOS Deployment Target as 15.2. The app will use no external services or APIs as they are not necessary for this development.

8. REFERENCES

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UpShot App Potential User Questionnaire

Please answer the following questions as truthfully as possible. Imagine you are a potential user of the new UpShot archery app.

The app is designed to give you a virtual opponent to shoot against in training sessions. Allowing you to have some fun battling against various opponents and gain a sense of achievement by winning matches and progressing your scores.

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1. Please indicate if you are currently a member of an archery club who shoots regularly.

    Yes / No - (skip to question 4)

2. Have you ever used an archery app before?

    Yes / No

If yes, please specify which app: .....

3. Do you agree that you would benefit by more guidance in your training, such as a virtual opponent, tracking your scores and receiving rewards/achievements?

    Definitely Agree / Somewhat Agree / Somewhat Disagree / Definitely Disagree

4. Have you ever shot in a real-life archery tournament?

    Yes / No

5. Do you currently keep track of your personal best scores?

    Yes / No

6. Please use the space below to write any suggestions for the app, such as ways in which you might like to use it, anything you would like to see in the app and anything that you think might spoil the experience of using the app:

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