NightWalk Safety: A night-time security system for people walking home.

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1 ABSTRACT

In the UK, the night life and the night-time economy are heavily impacted by various dangers. Violent crime is one, and the results have been under scrutiny for a number of years. The issue of individuals' safety is the main concern of both the government as well as the police. Various implementations have been created in order to tackle the issue though various mediums, and further improvement can still be made. The central focal point are the individuals and how there's a particular need of a way to ensure their safety and make access to help quicker and more effective for people walking. Unfortunately, in the likelihood of sudden events, even the slightest guidance would affect decision making and could reduce the possibilities of a person falling as a victim to various crimes. Five stakeholders were identified, that live in a medium to high-risk district and enrolled in a five-month study. A pre and a post prototype testing was conducted to reassure on the validity of the application and an evaluation revealed enough results. The results have shown how people lay their trust in technology and how it can be lifesaving when danger is unpredictable. Further, the data reveals how usable and efficient the application can be in the end of the study. After detailed analysis on these results, the provided insights have shown how the overall application is well ordered but, they have also shown signs where improvements could be made based on user behavior.

2 INTRODUCTION

Each year in Cardiff, approximately 51 crimes happen per 1,000 people on the streets where general population exists. This is also held accountable for 25% of the total injuries that happen each year. According to the Cardiff Crime Overview, violence and sexual offences are the most common crimes in Cardiff, with 5,816 reported in 2020. (CCO, 2022). Other crimes include anti-social behavior such as stalking, burglary and different other crimes of opportunity. What is saddening is that most of the victims are aged 18-25 and are most usually university students. The NightWalk Safety system, a night-time security system that navigates pedestrians' home after a night out, will be the topic of this article. Our preliminary research investigated how means of technology can be able to ensure safety and how when users can use these means, crime-rates are affected during night-times. A rigorous literature review of previous similar programmes was conducted as part of the development and implementation of NightWalk Safety and this aided in reviewing the focal problem, its causes, and inputs from different socio-cultural dimensions. Different measures were assessed to act when the problem it is unpredictable. The primary aim of this research was to ensure people can walk safely home at nights without

having to face any sudden incidences. The comprehensive characterization of the problem was compiled through these studies and resulted as the foundation for the community-based approach of this solution.

3 LITERATURE REVIEW

The night-time economy is consisted by increased levels of drunkenness, disorderly behavior, and assault related injury. Recently, in many different ways, attempts have been made to reduce occurrences of crime and ensure people can walk safely home at nights without having to face any sudden incidences. Since smartphones include features such as internet connectivity and quick communication technology allowed pedestrians to be connected to “a social network community, family, and police to know, track, and help users in dangerous situations.” (Kurni, 2020). My Guardian is a mobile application that assists users in notifying their collection of specified contacts when they believe they are in a dangerous situation. It features an “I’m safe” button that works in such a way that if it is not pressed in the given amount of time, close contacts will be notified, allowing user to share details on their whereabouts. (My Guardian: A Personal Safety Mobile Application, 2018). Another similar application is bSafe. “The bSafe app works as a guardian that sends an emergency message to the chosen contacts with a push of one button” (N. Prathibha Bharath, 2018). This application also allows voice commands to activate functions if the user is in distress. On activation, the application shares a stream with selected contacts so that the contacts will not only be able to see the location, but also see and hear everything that is happening in real-time.

In a study it was revealed that some Irish public transportation customers were eager to download and use a personal safety app. (Margaret O’Mahony, 2016). Their attempt to approach the goal is correct as it focuses on the problem, and uses a panic button, but they don’t utilize specific situations or look into other possible safety app features. Our research takes a look at the problem through a different path, as a UX Designer’s role and three personal safety scenarios are considered, as well as how technology is utilized to further see into the situation.

4 METHODS AND ANALYSIS

To begin with, the first task that needed to be done, was to plan different stages that would follow the design and thinking process which were the empathize, define, ideate, prototype, test and reflect stages. For further reference, look at the Portfolio’s different section names.

4.1 Empathize Stage

Firstly, at the first stage, a summary was created to identify the project’s description, topic, scope, and problem. Following, the project’s aim, research question, title and main objectives were identified to enable a complete and total understanding of the topic and its rationale. The key was to try to understand beforehand, the perspective of the target users, the severity of the problem and how useful would it be to solve such a problem. The overall process allowed deep questioning for the outcome as it needed to be meaningful and worthy. To find out more about this instance, look at the statements at the Empathy Stage, Section Project/Research Description, and Iteration.

Subsequently, after deep investigation and research, the most relevant paper was discovered and that related to the problem and its strengths, limitations, motivation, methods, results and main takeaway message have been noticed and noted down. It is located at the Empathy Stage, Section Reviewing The Most Relevant Paper.

A problem tree analysis was drawn, to help in identifying the focal problem and causes, and with the help of our project stakeholders we identified the main problem, its causes, and its effects on economic, political, and socio-cultural elements. Moreover, the effects and consequences have been brainstormed and exploited including a realistic image that could be viewed as a strategic element towards its solution. In the same way, a solution tree analysis was also drawn to help in identifying potential solutions and to also brainstorm and propose the desired outcome. Possible solutions and actions were suggested in order to be of service alongside the project's objectives. For further reference, see the trees analysis at the Empathy Stage, under the sections of Problem and Solution Tree Analysis, on the Portfolio.

To carry on with the project, a rigorous study of research integrity online training course was undergoing by the investigators so that the responsibilities would be understandable as researchers and finally ensure that the research would be conducted to the highest professional standards. After completion, the ethics application to CM3116-Design Thinking and Prototyping for User Experience Research Ethics Committee was planned and three templates needed to be concluded. The first document was the Application Form for Ethics Committee reviewed and it was comprised of different sections such as general information, screening questions, a project summary, review criteria, information on participation, procedures, and management on data. The second document was the template of the Participant Information Sheet which is a document with information for participants that gives them the knowledge and comprehension of the study's motivation and overall procedure, as well as further information on their rights if they choose to undergo the investigation. Lastly, the third document was the Participant Informed Consent which is a document that gives brief information regarding the research and is given to participants and requires them to give their consent on participating in the particular research. The documents of the ethics application can be found under the Empathy Stage, Section Preparing Ethics Application, on the Portfolio.

At the same time the documents were planned, the research process for user experience was needed to be thought of as well. The research objectives were recognized, the participant recruitment was selected to be participants of Group 4 Team of Cardiff University's CM3116 Module, Design Thinking and Prototyping for User Experience and the research was planned out. The data collection methods that were selected were through an Online Microsoft Teams Survey and through an in-person Interview. The outcome of these methods would give both quantitative and qualitative data. To further examine the process, look under the Empathy Stage, Section User Experience Research Process, on the Portfolio.

Following, the results of the data collection were summarized, interpreted, analyzed statistically, and presented. To conclude, an empathy map was drawn to present the participants insights, and user attributes with needs were written down. The analysis and the results can be found under the Empathy Stage, Section Data Analysis and Results of the User Studies while the insights are under the Section Presenting Insights, on the Portfolio.

4.2 Define Stage

Moving on to the second, the define stage, the data needed to be turned into meaningful and actionable problem statements. Therefore, three personas were created in which their raw background was reflected through the empathy phase. The personas presented, shared a realistic story about them including a problem and then their unique personal goals against the problem were collected. Further reference is available at the Define Stage, Section Point of View, on the Portfolio.

Following the collection of their goals, three sailboat exercises were conducted to fully harness necessities and support on the persona's requirements, goals, desires, drawbacks, and frustrations. After this technique the engagement continued with the stakeholders. With the stakeholders then each individual persona's design visions and goals were listed on top of each Sailboat and what could help, motivate, hold back the user achieve their goal, and their obstacles were then annotated. Then, the stakeholders would then on place three voting dots each on the problems they would prioritize as the challenges to the user from achieving the goal. The sailboats can be found under the Define Stage, Section 1st, 2nd and 3rd POV GOAL, on the Portfolio

Ideas were generated to help us find ways to achieve the main design goals by constructing "how might we" diagrams regarding the top voted challenges from before. A number of 18 different questions were raised and then each stakeholder had to prioritize the statements and vote between the three questions they considered to be the most crucial challenges. The diagrams can also be found under the Define Stage, Section How Might We?, on the Portfolio.

4.3 Ideate Stage

Furthermore, since the key main design objectives where then defined, it was time to start ideating for potential solutions and this was the beginning of the third stage. The three most voted "How might we" questions were put on top and the stakeholders then on proposed different solutions for achieving the goal onto the three predefined challenges. After many solution ideas were posted, the stakeholders again had three votes to choose which suggestion had the most impact on solving the problem. To examine the ideas posted, have a look under Ideate Stage, Section Identifying Opportunities for Technology, on the Portfolio. Since there were many ideas on board, an impact feasibility matrix was used to assist in prioritizing the best solution and then jointly assert the ones that could actually be implemented based on their impact and feasibility. The matrix also had featured comments as feedback from the stakeholders that reflected topics such as equality, accessibility, and sustainability. For the impact matrix in need finding, see Ideate Stage, Section Impact – Feasibility Matrix, on the Portfolio.

Lastly, after the three solutions were advanced, they had to be made actionable therefore, they were selected as they were the most important and noted down on top. As a team four action steps were brainstormed for the three solutions with regards to their requirements, risk, resources, and tools. For further reference, see the brainstorm at the Ideate Stage, under the section Make Actionable Solutions, on the Portfolio.

4.4 Prototype Stage

With this coming to an end, the prototype stage was up, therefore inspiration was needed from relevant other feasible solutions to these problems. Three ideas were gathered as demos to support and stimulate numerous

motives and recommendations for our solutions. For the ideas have a look under Prototype Stage, Section Lightning Demos, on the Portfolio.

After being inspired, three sketches were made to materialise and visualise the solutions. Feedback was gathered from the project team for each sketch and each member of the team voted on the initial design they believed would have a greater impact and thus our design was selected. For further see at the sketches, find them on the Portfolio under Prototype Stage, Section Sketching.

The idea of the particular initial design was then wireframed to focus on materialise it again and focus on its key elements. User feedback was provided by the team to assist in re-designing across modalities. Thus, based on the feedback, a new iteration of the wireframe was created but this time, input and output modalities were considered beyond vision. To find out more about these instances, look at Prototype Stage, Sections Wireframing the Selected Initial Design and, Re-designing across modalities, on the portfolio.

With this being done, a storyboard was then created to feature how the re-designed wireframed concept would be used in a real-life situation which was more helpful to relate with the user needs. The storyboard is on the Portfolio under the Prototype Stage, Section Storyboard.

Finally, one last re-design with middle to high fidelity was designed that included some additional features in addition to the second re-design. All of the iterations were documented along with the series of actions the user could do. It is documented under Prototype Stage, Section Middle to Hi-fidelity Prototype on the Portfolio

4.5 Test and Reflect

The final stage entailed was to test and reflect on the prototype. An evaluation scheme was planned that included the objectives of the evaluation, the plan, its user evaluation methods, and the recruitment of participants. One quantitative method through a survey from a Microsoft Form was enacted and a qualitative method through an interview was arranged. The participants were again the the members of Group 4 Team of Cardiff University's CM3116 Module, Design Thinking and Prototyping for User Experience. An ethics application again took place and the CM3116-Design Thinking and Prototyping for User Experience Research Ethics Committee approved it. For referencing, look at Test and Reflect Stage, Section Evaluation of the Final Prototype, on the Portfolio.

The documents and the survey were then shared with the applicants again and after they completed it, they underwent through the interview. Results were obtained from almost all of the participants, they were noted down and analyzed one by one. For the questions, answers, and analysis of data in need finding, see under Test and Reflect Stage, Section Analysis and Lessons Learned, on the portfolio.

5 RESULTS

In this section, the initial results from the evaluation of the NighWalk Safety prototype application are discussed. The Design of the NightWalk Safety application was designed using Figma which is a web-based vector graphics editor. Based on users' opinions after testing, on a Likert Scale survey and through interview, the app's overall functionality, usability, graphical interface, drawbacks, features, and feel were evaluated.

Table 1: Quantitative survey results from evaluating the final prototype

Participant ID | Survey Question	1	2	3	4	5
Font is easy to read, and size is appropriate	Strongly Agree	Neither agree, nor disagree	Agree	Agree	Agree
Easy to navigate	Agree	Agree	Agree	Strongly Agree	Agree
User friendly	Agree	Strongly Agree	Agree	Agree	Strongly Agree
Easy to use and understand	Agree	Agree	Agree	Strongly Agree	Agree
Uses common words and icons that are intelligible	Strongly Agree	Neither agree, nor disagree	Neither agree, nor disagree	Strongly Agree	Neither agree, nor disagree
Good graphical interface	Strongly Agree	Strongly Agree	Disagree	Agree	Agree
Provides logical order along with the actions	Strongly Agree	Agree	Neither agree, nor disagree	Strongly Agree	Agree
Minimizes user error	Agree	Strongly Agree	Strongly Agree	Agree	Neither agree, nor disagree
It is confusing at some point	Strongly Agree	Disagree	Agree	Strongly Agree	Neither agree, nor disagree
Buttons are easy to click	Strongly Agree	Disagree	Agree	Strongly Agree	Neither agree, nor disagree
Provides good features	Agree	Agree	Agree	Agree	Agree
How long did it take for you to walk through the prototype?	30 seconds	30 seconds	3 minutes	45 secs	1:35 minutes

After the completion of the survey, 20% of the participants responded that they strongly agree that the font is easy to read and the size is appropriate, while 60% responded that they agree and the rest 20% neither agree nor disagree. 20% of the participants responded that they strongly agree that the application is Easy to navigate, while 80% responded that they agree. On the User friendliness, 40% of the participants responded that they strongly agree, while 60% responded that they agree. 80% of the participants responded that they are strongly agreeing the app is easy to use and understand, agree, while 20% responded that they agree. When asked if the app uses common words and icons that are intelligible 60% of the participants responded that they neither agree nor disagree, while 40% responded that they strongly agree. On the graphical interface 40% of the participants responded that they strongly agree it's good, while 40% responded that they agree it's good and the rest 20% that they disagree. When asked if the application provides logical order along with the actions, 40% of the participants responded that they strongly agree, while 40% responded that they agree and the rest 20% are neutral. Also when asked if the app minimizes user error, 40% of the participants responded that they strongly agree, while 40% responded that they agree and the rest 20% are neutral. 40% of the participants responded that they strongly disagree that the app is confusing at some point, while 40% responded that they disagree and the rest 20% are neutral. Regarding if buttons are easy to click, 40% of the participants responded that they strongly agree, while 20% responded that they agree, 20% are neutral and the rest 20% disagree. Moreover, on the question if the application provides good features, 100% of the participants responded that they strongly agree. Lastly, it took all of the participants around 30s to 3 minutes to walk through the prototype which provides an average walkthrough time of 88 seconds.

Table 2: Qualitative interview results from evaluating the final prototype

Participant ID Interview Questions	**1**	**2**	**3**	**4**	**5**
How does it feel to use NightWalk Safety?	I think it's a very useful application. Its core functionality could help me a lot with my night out.	It feels really good, I am positive it will have a great impact and it could change a lot of things	I'm not entirely sure. I'm relatively neutral. The navigation is nice, but the graphical design part doesn't fit my preferences.	It feels like using any other application, which means it's nice	It feels nice
Were you confused at any point while using the application?	I'm not entirely sure if it's confusion but I needed 2-3 minutes to walkthrough the entire application so that I would fully understand its features.	Not at all, it has a very useable interface and I could understand the functionality of every button easily	The pop-up could be a bit more clear and maybe reduce the opacity of the things going on in the background, but it's no confusion	Nope, I was able to walkthrough the entire application in a short period of time.	Not at all
Can you identify any drawbacks for the application?	Interactions (such as buttons, etc.) should be distinguished by more prominent colors or labels.	No	I would prefer it if the graphic interface was improved a little bit	Again nope, I had no issues while testing the application at all.	No everything works fine
Which feature were you impressed with the most?	The fact that it is so easy to share the location and to also select contacts excited me and I was truly impressed.	I was impressed with the timer. I could understand how the application could foresee unpredictable events and take action.	The way the SOS button works. It could save people from a lot of trouble and its just one tap of a button.	The way you can select pre-set messages to sent to selected contacts. Even the option to write a custom message feels nice to use and saves some time.	The way the navigation was overally set.
Any additional comments you may have?	Yes, please make the font a bit bigger and use more common words which would be understood globally in a future update.	No	Not at all.	Nope, I'm satisfied	No

After completion, the overall feel of the app's use was really good and nice for 80% of the users. There was also no confusion for the 80% of the participants and some small confusion for the other 20%. On the application's drawbacks, 40% managed to identify some drawbacks and the other 60% could not. 100% of the participants were impressed with divergent features of the application. Lastly, 20% had additional comments which will be used as feedback.

6 DISCUSSION

In the end, the users' experience was really positive, and many were impressed. The majority of the participants noted that it feels nice and easy to use the application and the navigation was understandable and useable. In addition, the features featured in the application pleased every user and it manifested the functionality of the application as well as the simplicity of the design. On the other hand, it was recognized that some confusion was caused by some users while testing the application. It was appreciated that they recommended to enlarge some links and buttons to emphasize their functionality more and add more labels to outline their utility.

A limitation of the results is that there could be more participants to test the application so that a greater scale of results would be obtain and a better statistical analysis could be performed.

Therefore, there are always opportunities to improve it. To improve the application, more iterations should be designed to achieve a better outcome. Some minor changes were also suggested by the participants which should also be considered, and another greater evaluation could take place with more participants.

7 CONCLUSSION AND FEATURE WORK

In this paper, the design and initial prototyping and evaluation of the NighWalk Safety, a night-time security system for people walking home was presented. It operates at the intersection of safety and mobile computing - attempting to solve a number of real-world problems. As an application it is presented by the mobility of the user and different lightening conditions. The study evaluated the effectiveness of this pedestrian application with the primary component being safety. However, in order to decrease the number of victims and crimes respectively for pedestrians, a combination of efforts by every individual is clearly needed. Our future work includes different directions. Although it is an effective strategy to attempt to decrease numbers of crime and raise more awareness, more research is needed to implement more features and designs as well as ways in which the system may expand and improve. In conclusion, the final design can have a huge impact on various societal implications. Every user may contact and share location to their selected target and ensure on their safety with a few taps and without any tap at all (when time is elapsed). This may aid in reducing crime rates and ensure on the user's safety and wellbeing. Significantly, the technological application can take measures in case a user encounters danger and also navigate him while also notifying contacts. This could result in people feeling more confident and safer while using the application and walking at night and unmotivated criminals from different crimes thus reducing street dangers.

8 REFERENCES

[1] Crimerate, 2022. [online] Available at: <https://crimerate.co.uk/south-glamorgan/cardiff> [Accessed 10 January 2022].

[2] Kurni, M., 202. A "Simple-to-Use" Personal Safety System through Smart phones. [online] Academia.edu. Available at: <https://www.academia.edu/12265749/A_Simple_to_Use_Personal_Safety_System_through_Smart_phones> [Accessed 10 January 2022].

[3] IEE 2018. My Guardian: A Personal Safety Mobile Application. [online] Available at: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8632808> [Accessed 10 January 2022].

[4] N. Prathibha Bharath, K., 2018. A "Simple-to-Use" Personal Safety System through Smart phones. [online] Available at: <https://d1wqtxts1xzle7.cloudfront.net/37561525/IC-IMPETUS_2014-with-cover-page-v2.pdf?Expires=1642859073&Signature=L6xTQ1iW-

wIHzz2MynAT5L4ING8NXXZ5~gKEu8AfqTSz77vOa9OYySxexXnhM9iw~G2ejzwu6apLqY-Wvs4ZtpEy~lkT3RY1hVtrlLiy6dKlttDwzkb7QaOO0aJcNOXKaWLqg15rI48dv8AB7zd7CDTXJ8-7FdqEsePZMNrCBiRomeVUAfhUqHysQZ6A7eIk2FfiWsUDxMbdEUE-3JeHbdCnoCuXIqg9Q9rCg-jV9rWOr6VHjwWF3bARZtvK-NtyCaqNqoITxOyVhlvkpHcqW2iWOyZKf~nhMdvmRoPFkVL01s3vB5D6xQUtu6kW8kELO7C7tHkSwvdw32bDHfsOYA__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA> [Accessed 10 January 2022].

[5] Margaret O'Mahony, O., 2026. How transport users perceive personal safety apps. [online] Available at: <https://pdf.sciencedirectassets.com/271994/1-s2.0-S1369847816X00071/1-s2.0-S1369847816304107/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEB0aCXVzLWVhc3QtMSJIMEYCIQDMfpT1vqCYwhJNyMOoh5nu9Ce%2Bn%2Ba3MUXUrTT8G1xcBwIhAJfCrP1Gqm%2Bh4xWb9kJz%2FYYxziAVRhGZbwnd%2BoJyNhUAKvoDCEYQBBoMMDU5MDAzNTQ2ODY1Igz9cjAXg4Wgl6nEMOEq1wN5OZ70G%2BrYnpyFSWNjyUXtP8VVLClwvRFdc9Gi9EgSe9MesLN7w0Ho%2BFBXLyyrmlnsGLEYD0RfuU9cf9v7SBdambRfrgE7SQ32zVbBfi8zXm6Go2%2B1dRpZn5F3y2s1GQQNJ3ZJziR9JsKN31EZ%2FCmX90Z%2FPbjIJ4i%2BZiGe2O96qsPFh7sCMXP3rkug3XUZvufgMXEPfQXvKUrzizAvxvxWwc%2F8ODof4txPh4gjpuHiAQiZ%2FTwdiYDtA%2BuvfrwpAaEJvGQzKl%2BxkdUqYNUj9mfs2lwvuX534yvsFttoonfriDRQVaDyW2svN14lsAZXm4kehqRy5n0LnsMJJHgVmkLAAJV2pTXHzu60l3OFBJduRo2a7dqKTOUn5nHpoEywCtKwQhTuDNCYl8jlELlmbpz5y%2F7aDBPdeF072RHEzIRHw7%2FNf1Hteyy6FGWjriwp5lp2u2RO2ICFcA6Y5sp7vdVwJzlxd4LK2pGcK%2Fm27EuOy%2BLe6RiVc2Skw7nYTbUWRX54iYHKUZuaO7uBdNnYqP%2F9GxuOhXp93wTNbJ4rCXTCMAKTG3VowJf4TiP8i1PICG2jry0C2n6ka0NiY47fbNGPSUDsodjvnPx1EGUmRpl%2FNpS%2BOh53iJQwzfKvjwY6pAE5kF0e%2BsIEEqF8BsMbGky2gGxRlZeWyC%2BqXcb65ZsilSwGhY3GErS0A3B4V6ecaA6yZfE%2Buwh1hNcaWVfMB%2FdFZ3vwmUMO7Djbrmw0TfO%2FIBWdTMqMdiy0N1jVsAWCqdUaayXSTAmx9xe7ii3J1h8v2MNCO51j9PV7n95RsberLaBMboVXK%2FQ3VFF2pGEb7U5z9lJwyel88M8cTkXulM1nNKhyGA%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20220122T133002Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY43PUNP7Q%2F20220122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=34e5905b9fb4c0cb22fb6cec903f86ddd1e386ebaac4d953cf1377186d7eedd0&hash=75dc53fd36dbe15d3969ebab862e09aa93224de8b7ac3abeb5861d381c6d177a&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1369847816304107&tid=spdf-76ab3100-060d-40f8-9d64-3e46a42e2b5c&sid=75ea20e21da3d748364ad836d6e6783d8a93gxrqb&type=client> [Accessed 11 January 2022].