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|  | | | School of Creative and Digital Industries | | | |
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| CW3 |  | | CW3 | 75% |
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| Course: | BSc. (Hons) Software Engineering | | | | | |
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### Plagiarism Statement

I certify that this Project report is my work, based on my study and research and that I have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, or any other kind of document, electronic or personal communication. I also certify that this Project report has not previously been submitted for assessment in any other module or course of study, except where specific permission has been granted from all supervisors involved, and that I have not copied in part or whole or otherwise plagiarised the work of other students and/or persons.

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# Project Title (Approx. 50 Words):

EnviroCare: The eco-friendly environmental monitoring application.

## Acknowledgements (Approx. 50 Words):

Your text here.

## Abstract (Approx. 150 Words):

Your text here.

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## Introduction (Approx. 250 Words):

In today's world, the population is faced with concerns such, as air and water pollution as well as the growing issue of climate change. These do not just affect the environment. Also, it affects human health globally, especially in developing nations. The importance of understanding climate change and water-related challenges is discussed (Ahmed et al., 2020). The urgency for action from the community, organizations and individuals has never been greater. EnviroCare offers solutions that are easy to use and effectively tackle these issues.

Recognizing the significance of monitoring and the role technology plays. EnviroCare takes advantage of this opportunity. With 65.7% of the population having access to smartphones or other devices. Petrosyan (2023) provides insights into internet and social media users worldwide in 2023. Integrating technology into an environmental monitoring application allows users to take real-time action.

The application acts as a bridge between users and their environment by collecting data from agencies, environmental organizations, devices and user reports. EnviroCare provides accounts, with a range of features that enable users to monitor their surroundings stay updated about changes happening around them and actively participate in their community.

This will be done through many methods such as real-time monitoring, allowing users to have access to data in real-time ensuring they can stay informed about air quality, water pollution, weather conditions and many others. EnviroCare will also allow users to participate in user reports, letting the users report things they may encounter. Though all this the focus will be a community-driven project allowing users to interact with each other in forms and share their experiences with others.

EnviroCare will also offer other services such as educational resources about environmental issues, sustainable practices and what can be done to be effective on environmental issues. Throughout all these users must be aware of who is posting the data or where it came from, this project will include a verification so the end user will know what data is accurate and which may be hearsay. The system will also allow users to submit feedback about the application or suggest improvements that they or another user may like to implement, helping with continuous engagement and community-driven development.

Envirocare key features:

* Real-time monitoring where users can have access to environmental data, up to the minute. Reliable agencies, ensure they stay informed.
* User-friendly interface is designed with accessibility and simplicity in mind so users can easily navigate the software.
* Alerts and notifications allow for timely alerts about significant environmental changes.

EnviroCare aims to build a sense of community and raise awareness, about the environment, by using data-driven insights. EnviroCare seeks to revolutionise people’s perspectives on issues. While it can be difficult for individuals to make a significant impact on climate change organizations like EnviroCare take on the responsibility to drive change. Allowing individuals to participate in protecting our planet.

EnviroCare will use a mixture of technology to enhance the user experience, EnviroCare will be a web-based application using React to build a user-friendly experience. With the backend using an intended purpose language for example C# or C++, the data will be stored on a database SQL or Mongo database allowing a seamless scalable approach to data storage.

## Background (Approx.200 Words):

With the ever-growing fears of Global warming, it has never been more desirable to monitor the state of our environment. Fortunately, the dramatic advances made in our technology mean that doing this has never been easier. Envirotech Online (n.d.) provides information on apps for monitoring the environment. Global warming has been such a concern in recent years as a result. Applications monitor the environment more frequently, but each application caters singularly. EnviroCare will be multi-faceted and more multi-functional, allowing EnviroCare to be a perfectly paced product in its intended market.

Throughout recent years the drive to protect plants, animals and species has grown. Allowing a project like this to succeed in the marketplace, where every business makes a profit from a product or service having an environmental application could help everyone. For this application to be a success it would make more sense for it to be charity based also have advertisements based around the environment and other charities in the space. But no Adverts will be allowed to have political leanings, as the app will need to be impartial.

To achieve a charity status the organization would have to be exclusively charitable where the charity’s object falls within one or more of the 13 descriptions provided by the Charities Act. The charity’s trustees must also carry out the charity's purpose for public benefit where the organization must benefit the public or a sufficient section of the public. it must also benefit in a way that is undeniable and not based on personal views. Any harm done for the purpose must not outweigh the benefits based on evidence not personal views.

If EnviroCare chose to go for a charity status it would achieve it as it would fit into many of the charity acts. For example Advancement of education, advancement of health or saving lives, advancement of citizenship or community development, advancement of environmental protection or improvement and advancement of animal welfare. (NCVO, n.d.). If in the future the organization earns over £5,000 it is required to register with the charity commission and must have the charity status.

When going for the charity status EnviroCare will have to have a board of trustees which controls the assets held in trust which cannot be used for debts or commitments. It will also need to follow the charity law and as well as regulatory restrictions. This means it will have to do annual accounts, follow governing documents, trustees reports and annual returns. The board of trustees will be in place to ensure that the charities can run and deliver their charities purpose for the public benefit.

This project is challenging in the sense of the amount of data that is needed while making sure it is only from trusted sources. Getting the correct API to be able to get the data for the databases is critical in ensuring the future of this service. The basis of the application would be a mapping service, Google Maps API geolocation mapping service. Google Maps Platform is highlighted as a valuable resource for developers (Google, n.d.). allowing all events to pop up as a marker on the map, allowing the end user to able to control which events they can see from their location.

The future success of EnviroCare will rely on many aspects of the organisation. EnviroCare can be more than just an environmental monitoring application, it could also be an education platform with interactive quizzes, and it could also be a medical-based application allowing the user to see crucial details that might affect their medical condition.

Following research that has been done people said they found it hard to trust a system from which to take medical advice. Based on this feedback the education resources and medical resources will be more generalised about the planet and global warming rather than medical-based. People also stated that for them to trust the data, it would have to be from a governing body or expert. For this reason, verified accounts and organisations were added to ensure user the data that there seeing is from trusted sources.

## Rationale (Approx. 200 Words):

Today, it is hard to know what issues there are on the planet without looking at the news and seeing fake and biased media trying to manipulate or having an alternate agenda, EnviroCare would be in place to provide clear and accurate data for end users that they can trust.

Providing users with clear and accurate accounts will allow end users to see which accounts are run by organizations, media outlets or individuals. This allows a clear and accurate picture of who and where the data was collected. Users will have distinct roles and responsibilities when a user or organization is deemed to be trusted they can most media as they deem but if there not verified they will only have access to public channels and ones that are read only.

Verifying Users is a challenge but will be done through several methods. Organizations will have to submit their business name, person registration full name, organization email address, website and if they are a business or government body. This is done so an email can be sent to the organization email to finish setting their account up if that email matches the official one registered for that organization, this will have to be checked by an administrator of EnviroCare.

Although global warming is not something that can be changed overnight or something that could even be changed in a decade if everyone knew what they could do from individual to organization, it could be effective. Through this app I want it to appear more like a social media than a news outlet to try and get younger people evolved.

When initially planning the application it was important to do a design that attracted the target audience, though I did a lot of research about design pallets and the overall aesthetics of the application. For this application, I wanted it to be an eco-friendly social media-based platform that trended away from the traditional media approach. For this reason, I went with nature-themed pallet. With the green often being seen in public and often related to environmental and friendly solutions. And orange and browns often being seen as cheerful and warmth.

## Colour Pallet

A screenshot of a chart

Description automatically generatedA screen shot of a chart

Description automatically generatedA screenshot of a yellow chart

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One of the reasons this project could be practical is the variety of data and what could be done with it. Each user will get different results depending on age, an example would be children might get more quizzes and learning resources, but adults may get a messaging service allowing them to talk with people in their community and see the changes other people are making to try and influence others into making better decisions.

When a user registers they will be given a role based on age or other factors. Users will be able to apply for distinct roles for example organization or business accounts. Protecting the user data is critical for the application if someone is under the age of sixteen none of their data will be stored apart from the necessary data. Any advertisements intended for children will have to be verified for deception, inappropriate or unfair and must intend for children to buy or urge parents to buy specific products.

Data integrity is important for ensuring the maintenance of data and accuracy is consistent over the system life cycle. Users will be given this account to ensure that they are in no unauthorized access to the system, data will also have to be secure in a database where sensitive data is encrypted and stored in a correct database free from corrupting interferences such as malware.

This will be done through many tests to ensure that the database is resilient against malware all tests will be done in an isolated environment that will mimic the product model, allowing for easier control and avoiding changing live data(LinkedIn, n.d.). The database will also be tested by anti-virus to scan files for malware infection periodically which will also be able to simulate malware attacks such as performance attacks, penetration testing, recovery and auditing.

## Ethical Considerations (Approx. 200 Words)

Ethical consideration will be at the forefront of the organization (Yu, 2020). When a user registers for an account they will have to sign a term of service, which covers any post or information given that may be used in advertising or promotional material, it may also cover any risks or benefits of participating. When checking user data it is imperative to check the data against information that is around. For this it will use a built-in plagiarism checker to ensure the data given is authentic, there will also be a system in place or report post which can be verified and taken off the platform.

If a user posts data to our service it will be checked by people working within the organization or automated systems. When the data is posted to public space the original authors of the data will be credited, when a user creates a post it will show their organisation name or username, Data or pictures, accreditation of the original author and comments. This will ensure users have a full scope of who posted it and where the data originally came from.

When building the system is critical to ensure that data is not leaked, when a user posts data they will have an option to make the data private which will encrypt the data ensuring that it is not exposed. When protecting users many steps will be taken one of them being the JWT token where user data is stored in a token, only holding set data. If data were to get leaked it would not hold passwords or sensitive data, whilst also ensuring the sensitive data is encrypted throughout.

User data will have to be stored on a secure server removing any identifying information from the database that holds sensitive information (Prolific, n.d.). In the future third party could be used to process the data not keeping records of data longer than needed. To ensure that study data is kept confidential and help protect the users taking part.

Within the application, it is critical to ensure that the user's rights and well-being are considered. Ensuring that users taking part in proving data is voluntary and they do not feel forced or pressured in any way, meaning users will be given a choice to opt out of any research or studies at any time.

## Aim (Approx. 50 Words):

The overall aim of the application is to supply a resource to the public where they can track and check any environmental event that may occur in their area. Throughout the application, it is critical to ensure a high standard of transparency while also focusing on protecting data, security and overall trust.

The project will focus on providing users with information about air pollution, water pollution, current events and many others and allowing users to get real-time updates, allowing them to make an informed decision about what they are doing to help the environment or what could be done.

The application would aim to advance environmental protection or improvement. The application itself may not have an impact on its own, but the community-driven development will allow the public to make slight differences on an individual level, but as a collective, it may be able to be effective.

The application will be run on the web, it will have a responsive design meaning it should be able to run and display correctly on any device without platform restrictions. This approach increases the development speed while also making it accessible to as much of the public as possible.

## Objectives (Approx. 150 Words):

In this project, it is critical to have milestones which are not edited or changed as the project goes forward. Throughout the project, the milestones in place will be tracked against the overall project to ensure that the original aim of the project is meeting the needs of the intended end user.

Splitting the project into subsections makes it easier to keep and manageable. Research and development are where the purpose and scope of the project will be defined allowing the project to meet set aims and allowing the overall project to be able to be possible. During this stage, it is critical to ensure that all project goals are set out and what is wanted to be achieved. The negatives of the project must be laid out.

Based on a survey done users would like a variety of features including personalized profiles, personalized alerts, community engagement and local insights all of these have been taken into consideration within the platform ensuring that the end platform meets the requirements of the end users. Throughout various stages, many surveys will be done to ensure that the system meets the requirements meaning the system should be adopted by users.

Market research was carried out to ensure the product is practical based on research, there are a lot of companies that offer services for example IQAir. IQAir (n.d.). [IQAir](https://www.iqair.com/). (IQAir, n.d.). which allows people to check air pollution in the area by supplying air purifiers and filter replacements. From the research that has taken place, there is not currently a solution that allows people to check distinct types of pollution or climate change events that occur in one place. In a user-friendly manner. A lot of them offer a service to a specific issue and offer a product around that.

1. Research and development
   1. Identifying the Purpose and scope of the EnviroCare project.
   2. Clearly define specific, measurable, and achievable goals.
   3. Document potential challenges and drawbacks of the project.
2. Survey and user requirements
   1. Gather insights on user preferences and expectations.
   2. Based on the survey, outlines features including user-requested ones.
   3. Continuous surveys throughout the project with seamless integration.
3. Market research
   1. Determine how the project can provide solutions addressing gaps in the market.
4. Development
   1. Develop a user-friendly interface with personalized profiles and engagement features.
   2. Implement a secure backend system with a secure user authentication system.
   3. Integrate the feedback to the platform’s development to ensure continuous alignment with user needs.
   4. Create content around user preferences and user needs.
5. Testing
   1. Conduct white box and Blackbox testing, to ensure software reliability.
   2. Implement changes based on feedback.
6. Launch and maintenance plan
   1. public release.
   2. Establish a maintenance plan for scalability and user support.
   3. Conduct periodic servers to gauge user satisfaction.
   4. Review to check if the software meets the aim of the project.

## Risks (Approx. 250 Words):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Challenge | Description | Resolution | Impact on Project Aims | Impact on objectives |
| Technical challenges | High risk of worse or less user-adopted products due to technical challenges. | Implement a risk migration strategy, extensive testing and a flexible development approach. | Not achieving project goals during development. | The project may become too ambitious or not viable. |
| Data sourcing | Moderate risk of insufficient or useable data. | Have robust data collection methods, validate sources and have a backup plan for alternative data. | Hindrance to content creation affecting development. | May not be market ready failing to fulfil user’s needs. |
| User feedback delay | Moderate risk of delayed feedback. | Strategies for feedback collection, clear communication and streamlining the feedback process. | Slowed development due to delay in user input. | Delays in the development stage. |
| Security risks | High Risk of compromising the integrity of user data. | Stay updated on best security practices and robust security measures. | Risk to the integrity of the application. | Threat to application, needing redesigning. |
| Server scalability | Moderate risk due to server limitations. | Optimize server scalability and a plan for server upgrades as needed. | Struggling to manage traffic casing lag and exploits. | If the project does not achieve the desired outcome, the server potentially needs redesigning. |
| Regulatory changes | Moderate risk of regulatory changes affecting data usage. | Monitor and adapt to regulatory changes, maintain compliance and a contingency plan if changes occur. | Potential data changes due to regulatory shifts | Issues causing application changes and increased development time. |
| User adoption | high risk of application does not have the desired impact. | Develop market and user engagement strategy, prioritizing user experience. | Slower than expected growth after deployment. | The potential need for redevelopment decreases the viability of the application. |

## Literature Survey (Approx. 1550 Words):

Survey Introduction

EnviroCare is an application built around data. It provides users with a way to stay informed or gain information about events that are happening. Throughout the planning process, it is imperative to ensure the software is as user-friendly as possible. Well-designed interfaces significantly reduce software complexity and ease maintainability by fostering modularization.

Throughout this project is essential to plan each part of the development cycle, from the databases to the security, each part of the project needs to be well planned and thought out. This survey will cover parts of the application from the first design stages to the development techniques that will be used throughout the project. The application will take into consideration the importance of software design, data management, security, and user experience.

Software Interface Design (UX)

Designing interfaces is not a trivial task. The impact of interface design anomalies on software interfaces is explored (ieeexplore.ieee.org, n.d.). However, software with high usability and user experience can improve users’ effectiveness and satisfaction, as well as user viscosity. (Wang et al. 2022) conduct a comparative research study on the usability and user experience of user interface design software. Interface design is critical to ensuring users can navigate and interface with features in the application, the design of the interface will be user-centred, and understanding the target audience is essential to allowing the application to meet their needs. Designing interfaces is not a trivial task. The impact of interface design anomalies on software interfaces is explored (ieeexplore.ieee.org, n.d.). Allowing time in development for the interface to take shape while getting feedback to make necessary improvements.

Through the software cycle basic design to more advanced design will be illustrated to ensure that the design meets the needs gathered from the user requirements at the start of the project. The application is about the environment so ensuring the application's colour schemes meet the standards is imperative, Throughout the application will have a green and white theme. Green is associated with the environment whilst being friendly. White is associated with health and wellbeing meaning they are perfectly suited for an application of this calibre.

The interface must be responsive and interactive ensuring the end user has no issues switching between devices and ensuring users understand the results of their interactions, throughout the application development the interface will change and develop with more features, better design and responsive allowing the product to be as accessible as possible while meeting the user requirements. user interface design software is proposed from three perspectives: interface design, information quality and interaction design. (Wang et al. 2022) conduct a comparative research study on the usability and user experience of user interface design software.

Based on user feedback the education side of the system was added where users wanted to learn about what was happening in real time and learning about what they could do to be effective. Based on the research end users needed to have a user-friendly design where they could get updates through notifications even if the system were not open. Based on these emails will be sent to ensure the notifications get sent through to their email address.

Initial interface design

A screenshot of a computer screen

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Database Design

Database design is a complex and time-consuming process. When designing the data it is critical to assess the requirements of the application and understand each data type needing to be stored, their relationships and attributes. The database will need data normalization which would minimise data redundancy, organizing data into separate tables.

Throughout the application it is imperative to store data security, making sure the database can cope with increased load with high fault tolerance. The application will have encryption and data hashing ensuring that data is secure when managing environmental data or user information, sensitive data will go through the encryption stage to ensure safety and security. Throughout the lifecycle of the database and application backups will be automated ensuring recovery plans are in place to prevent data loss or corrupted data.

EnviroCare will use a mixture of databases from SQLite for storing basic information and data caching and Mongo DB for storing more complex secure data. The reason for this is SQLite is a single file and is lightweight and embedded and can cache data more often while NoSQL is suited for handling more complex data while having increased scalability and increased security features.

Basic ER Diagram

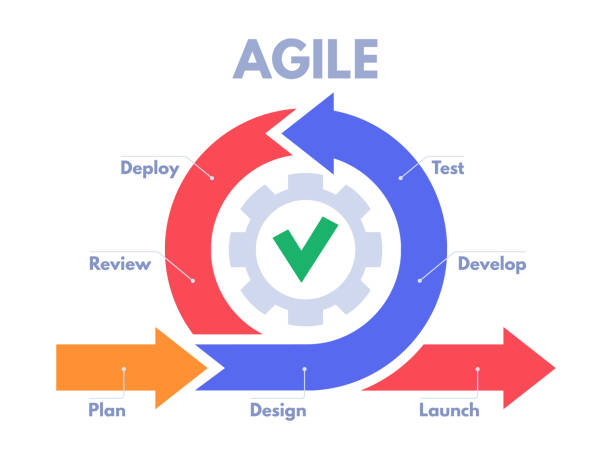
A screenshot of a computer

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Software Development Methodologies.

Agile methodology

For this application, Agile is a lightweight approach that was proposed to overcome the convolutional development methods' limitations and to reduce the overhead and the cost while supplying flexibility to adapt to the changes. Mendeley provides search results related to Agile methodology ([www.mendeley.com](http://www.mendeley.com/), n.d.). It is customer-focused and encourages more frequent and early feedback from end users ensuring the product meets the end users' needs. The agile method splits the project into iterations or sprints, allowing for more frequent reviews of a working product and allowing the project to change and adapt to changes in the requirements.



Waterfall methodology

The waterfall method is named after the fact the development flows like a waterfall. This method requires careful planning and detailed documentation throughout. The waterfall method includes five stages planning, design, implementation, verification and maintenance but a negative to this is that it does not allow for changes in scope and reduces efficiency as it does not allow overlap in stages.

A diagram of a company

Description automatically generated with medium confidence

In this application. Agile methodology was chosen as it uses incremental development over a waterfall's sequential approach. It also allows for a highly flexible and adaptable approach to development over a waterfall being less flexible. Throughout each stage, feedback will be supplied to ensure that the application meets the needs of the end users.

Agile mythologies stages

Stage 1. Planning, planning is critical to ensure that the project is successful it is where the scope of the project, aims and requirements are defined. During this stage, the user stories, features and tasks will be prioritized based on their importance to the project.

Stage 2. Design. This stage is to create high-level designs based on the requirements. This stage decides the overall design of the system, creating wireframes or prototypes of the interface.

Stage 3. Develop. This stage involves designing the code for the software and implementing the features on the user stories. It is also the stage where others can review the code and ensure quality and coding standards are met.

Stage 4. Testing. Testing the system will undergo many different methods of testing from system testing to user acceptance testing ensuring the system meets the requirements of the users.

Stage 5. deployment. This is the stage where the software will be in production. Continuous integration and deployment are used to automate the deployment process.

Stage 6. Maintenance. The start of this stage is where the review will take place ensuring the system meets the aim gathers feedback and indemnifies areas of improvement. A development will also be undertaken to ensure that maintenance of the system is done periodically first year every month then every quarter after that.

Software Development Languages

C# Will be used for the backend of the system as it purposes built for this reason. It is used in Windows-based applications or web-based applications with ASP.NET. It was chosen for this project because of its high-performance framework for building web applications, entity framework for working with databases and middleware for processing requests and responses in ASP.NET.

Throughout the application, it will use an object-oriented approach meaning the system will be built around data and objects rather than functions and logic. C# was chosen as it is a general-purpose object-orientated language that is structured and easy to learn. C# allows the development of web-based and desktop applications, but this application will be used for building the API, allowing an accessible way to extract and share data within the organization.

Typescript is a superset of JavaScript allowing all JavaScript code to still be valid, one of the main reasons for choosing this language is the modularity of the language that allows the mode to be modular and more maintainable especially when building larger applications where JavaScript may struggle. Typescript will be used in condition with a front-end framework Next.js allowing the development to be designed with simplicity and accelerate the development of the web-based application.

CSS will be used as the fundamental technology for styling web content in the web application, working alongside typescript to create responsive and user-friendly interfaces. CSS will be used to enhance menus, images, backgrounds, transitions, and animations all to make the UX enhance user experience.

This was chosen for the front end as it improves productivity when developing complex applications. CSS will be used to style the application, giving the application its unique feel. This application will be built on the next.js framework, this was picked as it allows for fast and easy deployment and easy integration with the backend system speeding up the development process.

Software Security

Authentication for this application is critical in making user data secure and the proper users have the correct permissions to access specific resources. Throughout authorisation, there are protocols in place to ensure the protection of data from multi-factor authentication through to role-based access control. The system will also use encryption from password hashing to ensure the data is unreadable from potential threats.

When it comes to security staying updated is important for keeping the latest security patches, so vulnerabilities do not pop up in the system. Logging and monitoring of the system will also be important to detecting security problems in the system in real-time. If the system fails or runs into any issues it reverts to older deployments or backups. Which will be backed up periodically ensuring minimal data loss.

In software engineering it is critical to assess vulnerability in the system there are already tools out there for doing this allowing the system to be evaluated and find any known vulnerabilities and missing patches. Today there are different testing methods, when it comes to security it is crucial to ensure these methods are in a place where they might be able to detect issues that humans may not realise.

Argon2 hashing will use sue to protect user's accounts through password hashing, due to its robust security features preventing attackers from butte forcing, side channels and memory trade-off attacks. Argon2 used a substantial amount of memory making it resistant to attack. It was chosen for this project to protect users’ sensitive data ensuring data is not leaked or exposed.

Desktop/Mobile Operating system

The reason for choosing a web-based application is it allows the platform to reach a boarder audience without having any platform restrictions. This will allow the platform to be accessed by any user that has access to the World Wide Web from laptops, desktops, mobiles, and even smart TVs.

One of the issues this has is accessing the data offline which is why data caching will be critical for ensuring access even when the user may not be able to access it in real time. Being a web browser application also offers benefits such as updates can be done without needing to update an app, and deployment is easier as it does not need to be built on a variety of platforms. But there are also negative like performance may vary based on the internet on devices' power.

Web services

Webservices are critical for allowing software to exchange data over different software systems. Web serves allow the software to communicate seamlessly even if they are written in different languages and can run on the same platform. This is critical for EnviroCare as it uses different leverages for its front end and the backend having this communication is critical.

The application will use standard data formats like JSON as it is simple and effective, it will also use APIs to access functions or data series, and the application will have more external compatibility by making sure that it does not leave any vulnerability in the software.

EnviroCare will use APIs to access functions or data assets. Api plays an essential in expanding the capability of the software externally. Apis will enable third-party integrations while keeping a focus on security and minimizing vulnerability. These technologies will form the architecture of the application making the overall application more effective and data integrity is persevered.

Project Management Techniques

Project management is one of the most critical aspects of software development, it is critical for planning, executing, and monitoring projects effectively. For this project, it is important to ensure the task gets completed on time to ensure the system and documentation are in the plan for the final system.

The project idea is an environmental monitoring application the individual concept came from the ever-growing issue of climate change, when producing the first consent it was critical to get an idea and planning down as soon as possible to ensure the idea or project concepts did not get lost. This is also where the project will take life and become a reality from Gantt charts to the project schedules.

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Project execution involves putting the project plan into action allowing tasks to be completed and following the method set out from the start of the project. This ensures the project stays on track by allowing access time for unexpected events that may pop up. Monitoring and controlling the project is imperative that the project stays on track throughout, and adjustments can be made as necessary, this is where performance will be measured, and quality control, scope management and risk monitoring will take place.

Having project management in place during the development of EnviroCare is critical to ensure that that project is successful, and the requirements set in the requirements stage are fulfilled. The project management should allow the key stages of the project to be planned out and if they are on target allow the project manager to see if it is not on track and make the necessary changes. While project management is critical during development it is even more critical after it as it may not have developers working on it. So having a place at each stage is critical.

Conclusion

In conclusion, the development of EnviroCare is an environmental monitoring application it is a complex project but splitting it into stages and using a system life cycle model will be followed in a logical order will mean the project should have the desired outcome. Allowing the development of the project to happen in a gradual way that makes it more manageable.

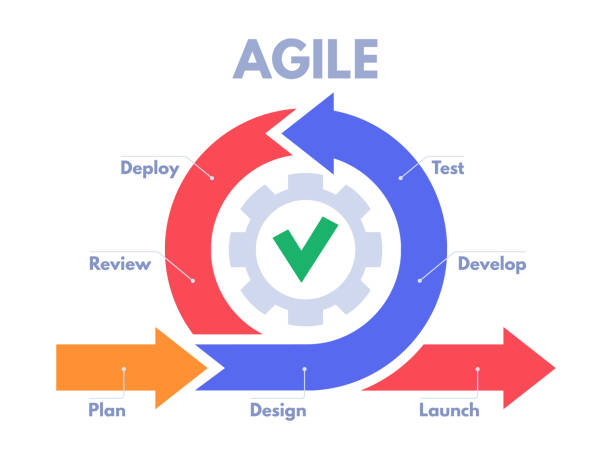
In short, the application will allow the user to have a user-friendly user interface where they can get updates on information on key events that happening around them. The system will use SQLite and Mongo DB to store the data and the next.js framework. To build the application it uses C#, CSS, and typescript programming languages to make the project as effective as possible. Having all of this in place ensures that the project's successful unexpected events are taken care of within the period to ensure the project is a success and that as many people can have access as possible. This survey shows the steps taken to achieve the deserved feasibility of the product.

### Methodology (Approx. 850 Words):

In the lead-up to this project, a well-structured mythology is critical for effective project management and successful software development. Agile seamlessly aligns with the dynamic requirements of this project. The agile methodology is not just an ethos to follow but something that will shape the project, development process and overall management of the project.

Agile methodology adaptability makes it the method of choice. Its principals, emphasize collaboration and flexibility, guiding the entire development process. Agile embraces a detailed approach. Tasks are completed and polished throughout the project, eliminating the revision of work at the end of the project. Agile emphasis on consistent updates and adjustments as the project takes shape. Agile cycles ensure a thoughtful consideration of each step. Meticulous planning allows for ongoing refinement (Soundararajan, Arthur and Osman Balcı, 2012).

Picture from (Asana.biz, 2024)



To collect numerical data on users’ preferences and behaviours, covers will be deployed. These surveys will focus on capturing quantitative insights, allowing for system analysis of user preferences. The survey methodology aims to gather statistical data, providing metrics to contribute to a quantitative understanding of user needs.

In addition to the quantitative data, an understanding of the qualitative aspect of user needs is required. This is gained from interviews. The interview is a critical component of the user-gathering process. This is to ensure the aspects of user requirements are covered which quantitative data might not get alone.

Interviews involve engaging with the user directly. This uses open-ended questions and allows for a more direct approach compared to a survey where there is just a set of questions. The goal is to uncover user preferences and expectations. Understanding the user's needs. Combining both quantitative and qualitative approaches ensures a well-rounded view of user requirements and an in-depth understanding of user preferences and behaviours.

Project management involves breaking down the project into small, manageable increments. The use of tools such as Gantt charts and timelines ensures project planning and management. Throughout the project efficient resource allocation within the agile sprints will ensure a timely completion of each step's goal. Throughout the development implantation of project management practices will be implemented.

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Description automatically generated

The chosen project management methodology is Kanban boards. GitHub is the chosen platform for project management. (GitHub Docs, 2024). Includes projects that allow kanban-styles boards for project management (Ieee.org, 2023). Kanban is used as it shows visualization of work, managing workflows and increased collaboration. This method will allow for easy tracking of tasks and identify bottlenecks. Each collum on the board represents a different stage(Todo, completed, completed).

A screenshot of a computer

Description automatically generated

Continuous integration and deployment practices will be integrated into the development process. This ensures a streamlined a deficient development allowing for rapid and reliable releases. This will be implemented through an automated build process when changes are committed to the version control system(Git). With this, it will also have automated deployment to process new changes leveraging the Vercel platform.

User involvement is critical throughout the application. Collecting the user data will be done through a third-party platform. Google Forms was chosen as it allows the easy creation of surveys, graph data, and analysis of the results with ease. Allowing for a trusted way to gather user data. With easy exporting to Excel to manage the data.

Agiles emphasizes initiative-taking risk management within the methodology. With the continuous inspection of potential risks and their seriousness. An agile ongoing approach to risk management ensures projects are protected against unknown challenges emphasizing adaptability and resilience.

Prototyping is the core of agile development. Agile cycles provide a framework for continuous refinement, allowing for adjustments based on user feedback and changes in requirements. Agile principles ensure the development process remains flexible and responsive to changes. Enhancing the software throughout the project.

Critical evaluation of agile methodology. Agile methodology influences software prototypes and project management. Critical evaluation will take place during each cycle. This ensures that the software will fulfil the objectives of the project and that agile principles will ensure the desired outcome.

Evaluation

Agile is critical to the success of the software. Agile principles include adaptability and collaboration, this aligns with the dynamic nature of the project, where the requirements meet the ever-changing needs of the users. Agile methodology allows for regular feedback and flexibility which caters to the needs of the project.

For the project agile was picked for its swift response to shifting priorities, prioritizing customer feedback. Consistent customer feedback ensures the software will evolve with the user’s needs. Leading to software that does not just meet their needs but exceeds them. Agile also allows for faster times to make and easy identification and solutions to issues.

Agiles' unpredictable nature may lead to changes in the project scope and timeline. The delay in customer feedback may affect the development process. Agile needs comprehensive documentation which could lead to a lack of detailed documentation in the long term which would affect maintenance.

Comparing agile to waterfall

Agile

Agile, its intuitive and flexible approach, allows for consistent adoption of changes in project requirements. It ensures that the software directly aligns with the user’s needs (Staff, 2023).

Benefits of agile

* Allows for changes and adjustments throughout the development process, responding quickly to shifts in priorities and customer feedback.
* Consistent customer involvement ensures the software aligns with the user’s needs.
* Faster time to market allowing for high-quality code and early detection of issues.
* Early identification of risks and issues. Reducing the likeliness of major setbacks.
* Continuous improvement allows for reflection and continuous improvements.
* Allows for flexibility and easier to accommodate changes.

Negatives of agile

* Agile make its mark in predicting the timeline and scope of the final project.
* Customer involvement may be delayed and can slow the development process down.
* Requires comprehensive documentation which can lead to a lack of detailed documentation.
* Constand feedback demands may be an imbalance.

Waterfall

The waterfall methodology is sequential and fixes, it must limit flexibility, with each phase having to be completed before another can start. Leading to challenges in changes to user requirements, meaning less user-adapted software.

Benefits of waterfall

* Clear stages and easy-to-measure progress.
* Easy to manage due to its linear nature.
* Predictable project timeline with clear milestones and easier to plan.

Negatives of waterfall

* Late feedback gathered at the end of the project, making it hard to address changes.
* Long delivery time due to its sequential nature.
* Limited flexibility making it harder to make changes once the project has started.

The agile approach is appropriate for this project as it directly aligns with the project. Agile is an industry-standard approach to development ensuring it aligns with the projects timescale. Agile development not only enhances the project's effectiveness but its relevance to industry expectations. This approach ensures that the project is manageable and maintainable even after the project is concluded. As it is an industry-standard methodology, it ensures other developers can maintain the system if needed.

The agile development plans(Explanation of each stage in the [literature survey](#_Literature_Survey_(Approx.))

1. Planning (2 Weeks)
   1. A clear overview of EnviroCare, aligning with the objects and user needs.
   2. Establishing timeline, defining and prioritising responsibilities.
   3. Breakdown of software features for development.
   4. Planned sprints, outlining specific tasks and goals of each sprint, to deliver in small but functional sections.
2. Design (3 Weeks)
   1. Design phase, focusing on developing an interactive, user-friendly interface with requested features.
   2. Simultaneously, develop the backend system, ensuring secure authentication and robust data protection.
3. Development (8 Weeks)
   1. Begin development of features outlined, meeting with the sprint plans.
   2. Continuous feedback integration, allowing for real-time adjustments based on user feedback.
4. Testing. (2 Weeks)
   1. Conduct regular testing at the end of each sprint, ensuring functionality and indemnifying bugs or issues.
5. Deployment. (1 Week)
   1. Release to the public, efforts make sure it is accessible to as many of the public as possible.
6. Review (2 Weeks)
   1. Monitor user adoption, platform performance and overall satisfaction.
   2. Have a session to reflect on what has been done, analyse the successes and challenges and outline strategies for continuous improvement.

A detailed approach ensures a thorough completion and refinement of all tasks as they are undertaken. This means an easy task is carried out with precision, diligence and commitment to achieve a polished outcome. Throughout the task, there is a focus on completeness and quality ensuring it meets the highest standards and meets the requirements outlined for each task. Contributing to the overall success of the quality of the project.

## Requirements (Approx. 850 Words):

Introduction

For the design of the application to be successful, a thorough understanding of both functional and non-functional user requirements is essential. This section will provide the approaches used, providing transparency in the applied research methodology. The success of the software rides on the quality of the primary research and requirements collections ensuring a viable project.

Design and planning

The first step in primary research is to design and plan the approach. This will be carrying out thorough research techniques such as questionnaires, interviews, simulators and prototypes are all critical for the success of the project. Having poor planning for primary research will overall harm the project. This is why careful thought, research and planning are essential. Using agile methodology allows the data collected to be implanted into the project, as it allows for continuous integration. Understanding the user’s requirements functional and non-function is critical for a successful project.

Primary gathering techniques

Various techniques, such as questionnaires, interviews and prototypes, are outlined. This section covers the key aspects of these primary gathering techniques (Soton.ac.uk, 2024). In our approach to primary gathering techniques. To gather functional requirements the following methods were used, Questionnaires, prototyping and interviews.

Questionnaires

The creation of questionnaires went through a meticulous process to guarantee precise and quantifiable data. The approach used focuses on the following aspects:

A logical design was deployed to ensure quantifiable data collection. The designing was critical to ensure wording was careful and matriculate, eliminating bias and maintaining clarity in responses was of the most concern. Google Forms was chosen as the platform to use to gather this data from a wide variety of users. The questionnaires were tested on a small group of people around three to five. This was to optimize the data collection.

The advantages of questionnaires are:

* Everybody gets the same questions.
* No response effect (willing to divulge more info without face-to-face contact; less likely to try to impress interviewer).
* Can be computer-based.

The disadvantages of questionnaires are

* No control over participant interpretation.
* Low response rates.
* Uncertainty about who filled out the questionnaire.

Structured and unstructured interview

Structured and unstructured approaches to interviews were employed. The structured interview would follow a set of questions like a survey, ensuring consistency. Unstructured interviews provided flexibility, allowing for a more thorough understanding of specific user experiences. All interviews were conducted face to face.

The advantages of structured interviews are:

* Consistency with a pre-returned set of questions.
* Reliability due to expectation of similar results.
* Easy to obtain data from structured interviews.

The disadvantages of structured interviews are:

* Limited flexibility with unexpected results.
* Could be missing context around responses.

The advantages of unstructured interviews are:

* Allows for deeper explanations and can ask follow-up questions.
* Flexible approach based on participants' responses.
* Participants may feel at ease leading to more spontaneous responses.

The disadvantages of unstructured interviews are:

* Lack of scandalization unstructured approach a challenging to replicate.
* Increased bias due to interviewer perspectives.

Simulation/Prototype

The application will have several prototypes and each one will be given to an expected end user, in real-world scenarios. Users will then be taken to participate in questions, interviews or surveys for a thorough understanding. From these prototypes, user data can be integrated into the user requirements. Leading to the end software meeting the needs of the users.

As the project came further along the prototype would develop with continuous refinement on the user feedback gathered. As the project used an agile methodology it allows seamless integration into the design. This was all done to ensure that the software would meet the needs of the end users. Without it, the project would not be viable.

Advantages of simulation:

* Allows for testing in a controlled environment.
* Cost-effective alternative compared to real-world scenarios.
* Can I identify issues and risks before they occur in real work scenarios.

Disadvantages of simulation:

* Might not be realistic based on unpredictable elements.
* Developing high-quality simulations is expensive.

Advantages of prototyping:

* User can interact and encourage feedback allowing user to participate in offering areas of improvement.
* Reduces development risk before full-scale production.
* Allows to identify areas of issues that may occur, saving time and resources.

Disadvantages of prototyping:

* Time-consuming extending the development cycle.
* Misinterpretation could happen leading to the user thinking about the final product.

Non-Functional Requirements:

Nonfunctional requirements consist of performance, security, usability and scalability. Ensuring these requirements are met ensures a well-rounded and reliable software solution.

Performance testing:

Performance tests to simulate and identify the system's response measuring for responsiveness, scalability and overall performance under different conditions. User feedback from these simulations helps refine the nonfunctional requirements.

Usability studies:

These capture the nonfunctional requirements related to the user interface and overall user experience. Using the Agiles approach to consistent feedback integration improves usability and meets user requirements.

Population sampling

This is a critical aspect of primary research, assuring that the data selected is of interest. Understanding the users from the primary research is critical for grouping research findings, based on the sample data it will be used to generalize the entire population. This stage is critical for ensuring the viability of the application.

These project management techniques were chosen and implemented carefully with the chosen methodology, agile. The intuitive nature of agile allowed for continuous integration into the design process. Ensuring it meets the changes in user requirements. The primary research questions include both the functional and nonfunctional requirements giving an understanding of the project scope.

Agile methodology

In line with Agiles methodology, our project's dynamic and interactive approach. Agile, known for its flexibility and responsiveness to changing requirements, aligns with our project objectives (Soundararajan, Arthur and Osman Balcı, 2012).

Alignment with Primary Research Techniques:

The choice of agile methodology was picked deliberately, considering the need for continuous integration of primary research findings into the design process. Each primary research technique contributes to the cycles of agile development.

Design and Implementation:

The agile cycles provided a framework where each piece of primary research is collected and becomes an input for continuous integration into the design process. The agile flexibility allows us to adapt our designs in real time based on user feedback gathered from the primary research methods.

Agile methodology with our primary research makes for a robust foundation. The relationship between agile methodology and primary research methods ensures software meets the dynamic user needs.

Rationale

University was chosen as the primary source offering the advantage of a known group of people, making the sample accessible. Having this in place allows for a streamlined approach to collecting targeted data. The collection of data from individuals who are readily available to the project aims, objects and scope of the project. a well-constructed sampling ensures the characteristics match those of the entire population.

Sampling frames which consist of the registered university students, are constructed with consideration for diversity and accessibility. University provides a wide demographic of students with varied backgrounds and interests. Doing it with the university also allows for the accessibility of data collection, which contributes to the feasibility of the project.

Elements

The emblem is each member of the research study, this allows for representation of the eliminates in the study which is critical for research. In this project probability sampling will be used, this ensures that the research population has an equal chance of being in the sample, where the population is then split into subgroups. The benefits of this are that’s data can be grouped but it can also be resource-intensive and complex to implement.

Population sampling is a vital step in primary research, including the overall quality of research. Understanding the population is critical for a robust research methodology. Considerations of careful planning and accessing the strengths and weaknesses of each approach allow for the research gathered with the project to be dependable and accurate.

Quantitative and Qualitative Research Methods:

Quantitative research methods evolve collections of data in numerical terms, relying on statistical analysis to identify patterns and relationships between data. This approach allows for analysis, and generalization of a larger population and is efficient when dealing with large samples (Verhoef and Casebeer, 1997). But this method also may result in a lack of depth and understanding of context.

The qualitative research method is the non-numerical aspect, which is the principles, attitudes, beliefs and motivations. These methods emphasise descriptive data. This approach allows for flexible, open-ended data collection. This approach is useful as it values the perspectives of the participants. However, the nature of qualitative may limit the generalisation of findings. It also demands more time and resource allocation.

Measuring Results and Ensuring Validity:

In reaching ensuing the credibility and trust of collecting data is critical. Reliability, response rate and validity will all contribute to the research's success. These issues will be addressed to ensure robust and relevant findings.

Readability refers to the consistency over time. Through the projects, the research will have to be dependable even if measured repeatedly. Having high reliability is vital, allowing questionnaires to have strong responses on different questionnaires. This will be achieved by having standardisation across all participants while ensuring questions are clear, concise and unambiguous.

Validity is a critical aspect, ensuring the necessity of the data. Making sure the research has validity involves testing the collected data that aligns with the intended project concepts. This involves the user of containing standardization and techniques for both data collection and analysis. A way to test for this is using the same data, which should raise the same results highlighting consistency.

Data generalization involves whether the finding can be applied to a border population and whether the collected sample data can be used in a wider context. In the research is critical to check for bias within in data. Bias could include sample, non-responses and respondent bias which could comply with the validity and generalization of data.

Conclusion

In conclusion, primary research and requirement collection are critical for the success of software development. By carefully designing, planning and implementing these processes. It ensures a high quality of data and improves project outcomes. This covers the importance of continuous refinement, validation and practises that will be used throughout the project.

## Design (Approx. 1500 Words):

Designing the software is vital to ensure a detailed development plan. covering the process of designing the software artifact, and aligning it with the chosen mythology. Integrated insights form the literature survey and requirements sections above. This section will cover the implementation of UML Techniques, addressing challenges, solutions, and what lessons were learned along the way.

UML design techniques

Unified modelling language(UML) was fundamental in designing the structure of EnviroCare software. Use case diagrams, allow for a visual representation of the interactions between users and the application, while class diagrams design the system architecture. Each Diagram was used to guide development. Linking the design to the goals of the project.

Integrating agile methodology with design and leveraging UML, sets the project foundation ensuring efficient and meaningful development.

The basic design of use case

A black screen with white circles

Description automatically generated

Use case diagram

Benefits:

* Serves as a communication tool between developers and testers.
* High-level view of the system functionality, giving a clear understanding of how users interact.
* Allows clarity of and documents user expectations and development stages.

Disadvantages:

* Maintaining use cases can be complex and difficult to manage.
* Does not provide a detailed understanding leading to potential misunderstanding.

The basic design of the class diagram

A screenshot of a computer

Description automatically generated

Class diagram

Benefits:

* Represents the static structure of the software’s, classes, relationships and attributes.
* Readable and flexible.

Disadvantages:

* Creating class diagrams can be complex.
* Takes longer to manage and maintain.

Integration of Literature and Requirements into Design:

Literature Survey Integration:

Survey introduction:

The literature survey laid the groundwork for the design process. User-friendly interface, significant development cycles, and the consideration for software design, data management, security and user experience. These are all vital for assuring the project meets the needs of the end user. Showing the importance of planning at each development stage.

Software interface design(UX):

The designs show how the impact of the interface design will affect the software usability and user experience. Studies done by Wang et al. (2022) allow for planned decision-making to a user-centred approach. The interface colour scheme will be themed around nature(Greens and whites) and playfulness(purple). The software design interface design process is unsure of continuous nitration from user feedback and a responsive and user-friendly interface.

Database Design:

regards to data security, encryption, and data normalization are all considered in the design process. To ensure security and a decrease in data redundancy. The selection of different databases ensures that basic data can be stored on a lightweight embedded database(SQLite) and MongoDB for more secure, complex data.

Software development methodology:

The software development methodology picked was agile, a flexible customer-driven approach. This was picked as it matched the requirements of the project from the project aims. Agile has a clear focus on incremental development and continuous user feedback. Having the agile methodology ensures the design phase has all the relevant information needed to design and articulate successful software.

Agile key features in the design phase

Incremental Development:

Agile promotes cycles and an iterative development approach (Ikemoto, Tadashi Dohi and Okamura, 2013), where each phase builds upon the last. This ensures expectations and preferences are taken into consideration in the design phase.

Continuous User Feedback:

Agile used regular user involvement throughout the process. Ensuring the software meets the expectations and requirements of the users

Benefits of adopting agile for design

Reduced development risk:

Agile migrates risk associated with larger-scale designs. This risk is minimized by breaking down the development into manageable steps. The risk reduction is critical during the design stage.

Issue Identification:

Agile enables the identification and solution of issues. This approach ensures that design challenges are addressed, Preventing issues in the future.

The Agiles approach achieves a user-centric design. Feedback loops ensure that user expectations are closely met. Agile methodology not only aligns with the project but provides a robust framework creating a flexible, adaptive and user-centric software design.

Software Development Languages:

This section supports the languages and frameworks that are going to be used, such as C#, Typescript, and CSS and their advantages. It also covers the choice of Next.js to allow fast deployment and integration with the backend for an effective deployment process. This ensures designs can be drawn up in related languages. For example, the interface will use typescript and pre-built components can be added to the designs to save time and resources.

Software Security:

## Security is one of the most critical parts of the software ensuring its integrity. Staying updated and ensuring the latest patches is vital. Argon2 hashing will be used to encrypt the password for the authentication page. Ensuring robust security features and protecting user data. When designing the authentication page, it is vital to ensure it is simplistic with clearly defined error messages.

## Desktop/Mobile Operating System and Web Services:

## The decision to make a web page application is critical for user accessibility. This also ensures the goal of reaching a diverse audience. When designing the website it is critical to ensure it user user-friendly and responsive. As it is on the web, it can also be used on mobile devices not just desktops, so collapsible elements and thorough design is essential.

Project Management Techniques:

## The project management supported the design process. EnviroCare chooses to use agile memory complemented will tools such as Kanban and Gantt charts. The agile methodology allows for consistent user feedback integration. This approach allowed for a proven project management strategy and design process. Though its continuous dynamic approach leads to a more refined, user-friendly and user-centric design.

Requirements Integration:

## Introduction:

The design process for the software was linked to the understanding of the functional and non-functional requirements of the software. Recognizing the primary research and requirements collections, the software's success relies on the quality and relevance of the collected data.

Design and planning:

Thorough planning research, and methodologies using questionnaires, interviews and prototypes. To ensure the precise collection of quantifiable data. Agile methodology seamlessly integrates into the design stage, allowing for continuous improvement and dynamic requirements to maintain a user-centric approach.

Primary Gathering Techniques:

Many primary gathering techniques were implemented in the design process. The importance of well-designed questionnaires, structured and unstructured interviews, prototypes and simulations. Ensuring clear, precise, and logical structure and language. It is critical for ensuring reliable and unbiased data. The nature of primary gathering techniques with the constant feedback, aligns with the agile mythology.

Population sampling and rationale:

## University students are the primary source. The targeted approach allows for the design to benefit from a known group of users from different backgrounds and perspectives. This ensures a better understanding of the user’s needs and makes the project feasible because of accessible data. The design can be tailored to meet the requirements and preferences of the users.

Quantitative and Qualitative Research Methods:

Both quantitative and qualitative both influence the design process. Quantitative is the numerical approach, the measurement of user preferences and behaviours. While the qualitative explores the principles of attitudes and motivations that quantitative may not fully capture. This allows the design phase it allow for an understanding of user requirements which ensures well-rounded software.

Measuring Results and Ensuring Validity:

Ensuring and maintaining validity during the design process is vital for creating a robust foundation. Reliability, validity and data generalization impact the quality of the design process. Standardizing data collection and clear questions is critical for ensuring consistency within data. ensuring the validity of the design outcome. Testing for bias is critical during the design stage, this is achieved by using a diverse and broad group. Archiving validity ensures the designs are credible and trustworthy.

Conclusion

This process ensures a well-informed and user-centric approach to the design. Adding the theatrical and practical needs of the user ensures the design quality, rich in features, and overall success of the software. Leading to a robust and meaningful development stage.

Integration of design mythology

Adaptability and Collaboration:

The nature of agile methodology is the foundation for a user-friendly interface. Agile adaptability ensures the project design remains responsive to changes and expectations. Agile is critical in EnviroCare development as it allows the software to adapt to the latest technology changes and changes in user requirements. Resulting in an interface that resonates with end users.

Continuous Refinement through User Feedback:

The well-structured approach of the primary research relates to the design. Agiles continuous refinement and feedback-driven methodology ensure the design evolves with the user’s needs. This allows for the integration of features as needed, modifications based on user needs and a sense of ownership among end users. Continuous refinement ensures the design is developed with the user’s needs (Linkedin.com, 2023).

Collecting, processing and integrating user feedback is a critical aspect of software design that aligns with the user’s needs and expectations. A detailed explanation of the primary research methods can be found in the [Requirements](#_Requirements_(Approx._850).

Kanban Boards for Project Planning:

Kanban visualization of work stages allows for transparent and well-structured project management. Kanban allows the allocation of tasks and identifying issues. Integrating this into the design stage ensured improved planning, execution and refinement. This stage is vital for delivering user-centric designs in each cycle (Ieee.org, 2023).

Flexibility for User-Centric Design:

The largest impact of the agile approach on the design stage is a flexible, user-centric approach. This promotes the user of sensitisation through continuous collaboration. This ensures that the design meets the needs and expectations of the end users. The user-centric focus aligns with the project’s objectives.

Summary

The incorporation of agile methodology into the design. Allows for better adaptability, collaboration, refinement, and a user-centric design. This ensures a design process that is robust and efficient, while also being able to adapt to the ever-changing landscape of technology and user expectations (Man and Chee Weng Khong, 2011).

Design problems and solutions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Design challenges | Description | Solution | Impact on design goals | Impact on design objective |
| Technical challenges | High risk of worse or less user-adopted products due to technical challenges. | Implemented a risk mitigation strategy, extensive testing, and a flexible development approach. | Risk of not achieving design goals during development. | The design may become too ambitious or not viable. |
| Data sourcing | Moderate risk of insufficient | Implemented robust data collection methods, validated sources, and established a backup plan. | Hindrance to content creation affecting design. | May not be design ready, failing to fulfil users' needs. |
| User feedback delay | Moderate risk of delayed feedback. | Implemented strategies for feedback collection, and clear communication, and streamlined the feedback process. | Slowed design due to delays in user input. | Delays in the design stage. |
| Security risks | High risk of compromising the integrity of user data. | Stayed updated on best security practices and implemented. | Risk to the integrity of the design. | Threat to design, potentially requiring redesign. |
| Server Scalability | Moderate risk due to server limitations. | Optimized server scalability and established a plan for server upgrades as needed. | Struggling to manage traffic causing lag and exploits. | If the design does not achieve the desired outcome, the server potentially needs redesigning. |
| Regulatory Changes | Moderate risk of regulatory changes affecting data usage. | Monitored and adapted to regulatory changes, maintained compliance, and established a contingency plan. | Potential data changes due to regulatory shifts. | Issues causing design changes and increased development time. |
| User Adoption | High risk of the application not having the desired impact. | Develop an engagement strategy, prioritizing user experience. | Slower than expected growth after deployment. | The potential need for redesign decreases the viability of the design. |

Summary

Throughout the design process, many key things were learned, and how they are used for the user's benefit. Highlighting the importance of primary research aligning the design choices with the users’ preferences. Additional changes were the importance of a risk migration strategy and took a lot of learning to try and implement them into the development stage when needed. Initiative-taking of measures and transparent planning should ensure the project’s success.

Learning the clear risks involved from design problems, technical challenges, user feedback delay and clear communication, allows for changes in the project to be made to ensure solutions are in place for any unforeseen circumstance. The design stage also allows the reflection on what it was the user wants out of the software rather than the developer's bias towards the software.

## Development (Approx. 1500 Words):

Your text here.

## Testing (Approx. 850 Words):

Your text here.

## Implementation (Approx. 850 Words):

Your text here.

## Conclusions (Approx. 300 Words):

Your text here.

## Recommendations for Further Work (Approx. 200 Words):

Your text here.

## Software Artefact Download

Your text here.

## Glossary (Unlimited words)

EnviroCare – Name of the environmental monitoring application.

Databases – organized collection of data that are stored and managed.

API – allows different software applications to communicate with each other.

environmental monitoring application – an application designed to collect, manage, analyse, and report data.

Geolocation – A way of finding a device's physical location.

user-friendly – A product or service that is easy to use with little to no training.

backend – The backend handles processing, storing, and managing the logic of the application.

front end – The part of the application the users will interact with for showing information and user input.

C# - Used to build Windows applications, web applications are more and is a high-level programming language.

C++- Used in game development and system programming and is a high-level programming language.

SQL – Specialized language for managing querying databases.

Mongo DB – A NoSQL data management system to store data in a document-like format.

Data – facts, statistics, or information.

Encryption – converts data into secure and unreadable data to prevent unauthorised access.

Hashing – Converts data into fixed sizes of strings used for verification and data retrieval.

Black box testing – Focuses on functional and behaviour which is internal knowledge of workings.

Whitebox testing – Testing the internal code and logic of software.

JSON – Lightweight data format

multi-factor authentication – Adds another layer of protection for example a code sent to phone or email also known as 2-factor authentication

role-based access control – managing user's access through a role-based system (users, admins etc...)

UX – User experience

DOB – Date of birth

## References (Unlimited Words):

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## Appendix A: Project Plan (Unlimited Words):

Project Plan

User-friendly interface is the first step in the creation of this software, it will allow users to interact with the application. This section is expected to take around two to four weeks to complete. The interface will use Typescript and CSS to supply a user-friendly and responsive design to ensure it meets the goals of the application.

User authentication and profiles

Users will be able to register and sign up for the application through the front end. The back end will handle hashing and salting passwords encrypted into the database. The backend will be built using C# so it can handle the requests effectively. The backend will also handle verifying login credentials and giving users correct error messages and responses to the frontend, as necessary.

A screenshot of a login screen

Description automatically generatedAuthentication interface

Application Interface

Planning the interface is critical for ensuring that developers can get a visual sense of how the product will look. It also allows changes to be made throughout the project ensuring that content and features fit the app correctly, allowing improvements to be made as they occur. Doing this will ensure a user-friendly interface.

A screenshot of a computer screen

Description automatically generated

Data manipulation

Data is one of the most important considerations in the application. Collecting enough data for the application is critical for ensuring a usable product that would meet the needs of the end user. Data collected will be put into different collections based on the level of security needed, allowing the application to display content for the application and display data in real-time.

The data can come from many sources, but making sure it is verified is critical for this application. The data can come from different APIs, User reports or Verified sources. The system will have a role-based system to ensure that administrators can verify that data is correct and not manipulated in any way, users will be able to view content on the home screen allowing them to view and interact with it.

Users will receive notification from the application by email or phone number allowing them to have daily reviews on what is happening around them. This content will be auto-generated but allowing the user to have quick access is critical, In the user setting, users will be able to disable these notifications or even change how often they get sent.

The main feature in the app will be a mapping service, allowing users to track all events from their geolocation, but it is critical to ensure that their data is protected and it’s up to the user whether they want to allow access to services such as location or just type in a postcode for example.

Planning

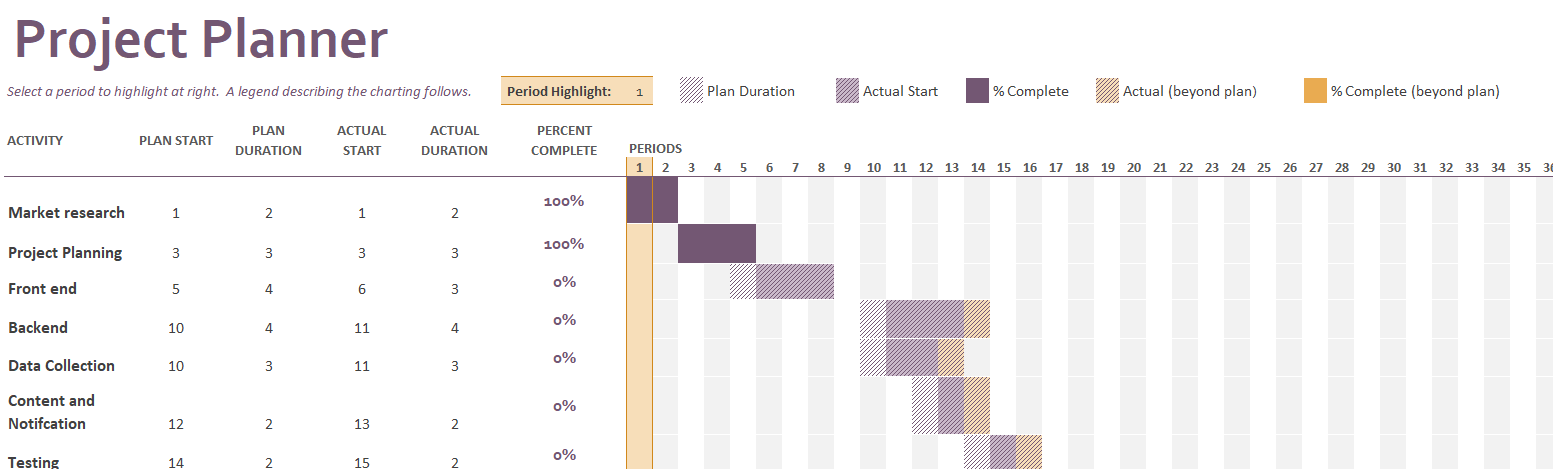
It is critical to ensure that planning is in place to ensure the product meets the needs of the end user. This will need to be covered, anything from task identification, task sequencing, task scheduling, independent tasks, risk assessments and others to ensure the product stays on track and does not exceed the time allowed for the project. These can be achieved by different graphs or project management software tracking each stage allowing adjustments to be made as needed.

Tasks

Each task will be split down into different sections or subsections to make it more manageable. Each task will be done in order based on importance and time frame. Each task will be split into groups from the mythology used, in this case, agile development so the project can ensure it functional and operational product.

Gantt Chart

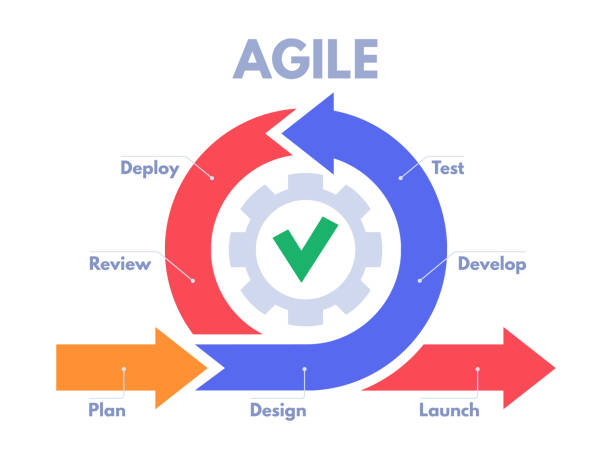
Gantt Charts are useful tools for analysing and planning complex projects. Throughout the cycle of this project, it is imperative to track each stage. In the project, there will be gaps allowing for an unexpected event to be taken care of while also allowing for delays to put back on track. Using Gantt Charts helps to check whether the project is on schedule. Mendeley offers search results for Gantt chart-related content ([www.mendeley.com](http://www.mendeley.com/), n.d.).



Methodology

For this project agile method was picked for its flexibility and adaptability, it allows the project to adapt to changing requirements and priorities. This system allows each task to be done in more manageable sprints lasting around two to four weeks allowing the opportunity for feedback to happen regularly and make the necessary adjustments.

Agile software development is a lightweight approach that was proposed to overcome the convolutional development methods' limitations and to reduce the overhead and the cost while supplying flexibility to adapt to the changes. Mendeley provides search results related to Agile methodology ([www.mendeley.com](http://www.mendeley.com/), n.d.). It is built around customer feedback and values. This is critical for this application as feedback will be essential for meeting the user's needs, making sure that users adopt the product quicker. It also allows for issues to be addressed as they arise, minimizing the chances of the project being late or going over the expected deadlines. However, having a strong emphasis on testing and validation ensures expectations are achieved.



Risk Assessment

Risk assessment was developed to conceptualise, assess and manage risks. Singh et al. (2019) investigates the relationship between environmental ethics, performance, and competitive advantage, emphasizing the role of environmental training. will be done to ensure that risk can be checked and managed throughout the project to minimise the effects and likelihood of they are impacting the project if left undealt with. It allows time to be distributed to address these problems as they may occur.

|  |  |  |  |
| --- | --- | --- | --- |
| Risk | Likelihood | impact | Risk level |
| Privacy concerns | Medium | Medium | Medium |
| Verification challenges | Medium | Medium | Medium |
| Off-topic discussions | Low | Low | Low |
| Development complexity | Medium | Medium | Medium |
| Technical challenges | Low | Medium | Low - Medium |
| Quality | Medium | High | High |
| Information overload | Low | Medium | Low - Medium |

Testing

With the rising complexity and scale of software systems, there is an ever-increasing demand for sophisticated and cost-effective software testing. Mendeley offers search results for Gantt chart-related content ([www.mendeley.com](http://www.mendeley.com/), n.d.). Testing is critical to ensuring the products meet the needs of the end user, but it also ensures that the application can run on low-end devices ensuring these devices do not experience delays or lag. Throughout the project, feedback will be gathered to collect information and make changes to the product.

Testing can be done through many methods but the main ones that will be used in this project are black box and white testing. Ensuring any issue in the product can be found by users and developers. White box testing will allow the code to be perfected and early bug detection, but it is also time-consuming. Black box testing is user-centric and effective as it evaluates from the user’s perspective, but it can take a long time to find issues or cause repetitive testing.

|  |  |  |
| --- | --- | --- |
| Aspects | Black box | White box |
| Registration and profiles | Inputs information testing errors code and successful input | Testing the code to ensure it encrypts correct data and registration is stored correctly on the database |
| Alerts and notifications | Checking if the notifications are working and the data displayed is correctly formatted | Checking to if the notifications are being sent correctly and if there are any issues |
| Geolocation and mapping service | Testing geolocation service and mapping service | Making sure the correct markers are being added and data is correctly displayed |
| Security and privacy measures | N/A | Making sure secure data is encrypted and user’s privacy is kept |
| Content creation | Content is displayed in a user-friendly manner and users can interact with the content | Checking if the correct content is being displayed never showing sensitive information |
| User reports | Users can report events that happen and issues | Can make necessary changes allowing verification of the reports |
| Role-based accesses | User can only see content assigned to their roles | Roles have the correct access checking that no data is leaked |

## Appendix B: Ethics Checklist (Unlimited Words):

A checklist should be completed for every research project. This is used to identify whether a full application for ethics approval needs to be submitted to the University Ethics Panel or one of its sub-committees. Further guidance can be found on the Ethics Blackboard shell.

|  |  |
| --- | --- |
| 1 Applicant details | |
| Name of Lead Researcher (applicant): | Stefan Allen |

|  |
| --- |
| 2 Project details |
| Project title: EnviroCare: The eco-friendly environmental monitoring application. |
| Please provide a brief description of the project:  The project aims to build an application that can help people make better choices about their environmental impact whilst maintaining a high standard of transparency, data integrity, security and trust throughout the application. |

|  |  |  |  |
| --- | --- | --- | --- |
| 3 Research checklist  Please answer each question by checking the appropriate box: | | | |
| Research that may need to be reviewed by an NHS Research Ethics Committee or another external Ethics Committee | | YES | NO |
| 1 | Will the study involve recruitment of patients or staff through the NHS or Social Care, or the use of NHS data or premises and/or equipment? |  |  |
| 2 | Does the study involve participants aged 16 or over who are unable to give informed consent (e.g. people with learning disabilities: see Mental Capacity Act 2005)? NHS |  |  |
| 3 | Will tissue samples (including blood) be obtained from participants? |  |  |
| If you have answered ‘Yes’ to questions 1, 2 or 3 please refer to <http://www.hra.nhs.uk/> for guidance. If external ethical approval is not needed, University ethical approval will still be required. | | | |
| Research participants | | YES | NO |
| 4 | Does the study involve students within the University? |  |  |
| 5 | Does the study involve employees of the University? |  |  |
| 6 | Does the research involve potentially vulnerable groups: children, those with cognitive impairment, or those in unequal relationships? (eg your students) |  |  |
| 7 | Does the research involve members of the public or people worked with in a professional capacity? |  |  |
| 8 | Will the study require the cooperation of a ‘gatekeeper’ for initial access to the groups or individuals to be recruited and/or to give permission for initial contact? (e.g. children, students, members of self-help groups, residents of nursing homes, employees). |  |  |
|  | | | |
| Research methods | | YES | NO |
| 9 | Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people in non-public places) |  |  |
| 10 | Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants? |  |  |
| 11 | Will the study involve discussion of sensitive topics or illegal activity (e.g. sexual activity, drug use)? |  |  |
| 12 | Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind? |  |  |
| 13 | Is physical pain or more than mild discomfort likely to result from the study? |  |  |
| 14 | Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life? |  |  |
| 15 | Will the study involve prolonged or repetitive testing? |  |  |
| 16 | Is there a possibility that the safety of the researcher may be in question? |  |  |
| 17 | Will any of the research take place outside the UK (excluding on-line surveys)? |  |  |
|  | | | |
| Data and confidentiality | |  |  |
| 18 | Will the research involve administrative or secure data that requires permission from the appropriate authorities before use? |  |  |
| 19 | Will the research involve visual/vocal methods where respondents may be identified? |  |  |
| 20 | Will research involve the sharing of data or confidential information beyond the initial consent given? |  |  |
| 21 | Will the research involve security-sensitive data? (eg commissioned by the military or under an EU security call; involves the acquisition of security clearances; concerns terrorist or extremist groups). |  |  |

If any item is checked “YES” you will need to seek advice from your supervisor/course leader regarding the appropriate sub-committee for ethical approval.

4. Declarations

I have read and will abide by the University’s Ethics Policy.

I have read and will abide by the University’s Code Research Practice.

I am aware of, and will abide by the ethical guidelines published by the relevant subject and/or professional associations most appropriate to my topic.

The responses given above are an accurate and true reflection of the nature of my research project.

Applicant:

|  |
| --- |
| Name (please print): Stefan Allen |
| Signed: Stefan Allen |
| Date: 06/11/2023 |

Project supervisor / Line manager

I confirm that the above details are accurate, the proposed methods are appropriate, ethical concerns have been considered and that time and resources are available for the research to take place.

|  |
| --- |
| Name (please print): |
| Signed: |
| Date: |

Note: Electronic approval by above signatories is acceptable

## Appendix C: Participant Consent Form (Unlimited Words):

|  |
| --- |
|  |

**Notes**

1. Black text forms the standard content of a consent form
2. **[**Insert specific information in the highlighted square brackets**]**
3. Text notes in the grey boxes provide guidance only and are to be removed in the final consent form
4. Blue text indicates optional statements to add
5. This form must be accompanied by a participant information sheet.

Informed Consent for [name of study]

|  |  |
| --- | --- |
| Please tick the appropriate boxes |  |
| 1. Taking part in the study |  |
| I have read and understood the study information dated [DD/MM/YYYY], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction. | o |
| I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason. I can withdraw my data up until [DD/MM/YYYY] which is the final date before data is analysed. | o |
| I understand that taking part in the study involves […………………………………………].  Describe in a few words how information is captured, using the same terms as you used in the information sheet, for example: an audio-recorded interview, a video-recorded focus group, a survey questionnaire completed, an experiment, etc.].  For interviews, focus groups and observations, specify how the information is recorded (audio, video, written notes).  For questionnaires, specify whether participant or researcher completes the form.  For audio or video recordings, indicate if these will be transcribed as text, and whether the recording will be destroyed.  If there is a potential risk of participating in the study, then provide an additional statement:  I understand that taking part in the study has [……………………………….] as potential risk. | o  o |
| 1. COVID-19 safety |  |
| I confirm that I have not had any of the following symptoms in the last 14 days: fever, dry, persistent cough or a loss of sense of taste or smell. | o |
| I confirm that I am not in the clinically extremely vulnerable category and therefore advised to shield at home by the government. | o |
| I confirm that to the best of my knowledge, I have not been in close contact with anyone with confirmed COVID-19 in the last 14 days. | o |
| I confirm I am aware of the requirement for social distancing whenever possible, hand decontamination, and use of face-covering during the research and that the researcher may also use further PPE. | o |
| I confirm I have been told about the cleaning of the venue and equipment before/after my attendance. | o |
| It has been confirmed by the researcher that they have not shown any of the above-named symptoms of COVID-19 nor, to the best of their knowledge, been in close contact with anyone with confirmed COVID-19 in the last 14 days. | o |
| 1. Use of the information in the study |  |
| I understand that information I provide will be used for [………………………………….……].  List the planned outputs, e.g. reports, publications, website, video channel etc., using the same terms as you used in the study information sheet. | o |
| I understand that personal information collected about me that can identify me, such as my name or where I live, will not be shared beyond the study team.  Under some circumstances, access to this information should be restricted to the researcher only. | o |
| I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with current UK Data Protection legislation. | o |
| If you want to use quotes in research outputs, add: I agree that my information can be quoted in research outputs. | o |
| If you want to use named quotes, add: I agree that my real name can be used for quotes. | o |
| If written information is provided by the participant (e.g. diary), add: I agree to joint copyright of the [specify the data] to [name of researcher]. | o |
| 1. Future use and reuse of the information by others |  |
| I give permission for the [specify the data] that I provide to be used for future research and learning.  Specify in which form the data will be stored, e.g. de-identified (anonymised) transcripts, audio recording, survey database, etc.. If needed, repeat the statement for each form of data you plan to store.  Specify whether stored data will be de-identified (anonymised), and how. Make sure to describe this in detail in the information sheet.  Specify whether use or access restrictions will apply to the data in future, e.g. exclude commercial use, apply safeguarded access. | o |
| 1. Signatures |  |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_  Name of participant [IN CAPITALS] Signature Date |  |
| For participants unable to sign their name, mark the box instead of signing  I have witnessed the accurate reading of the consent form with the potential participant and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.  \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ \_\_  Name of witness [IN CAPITALS] Signature Date |  |
| I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands what they are freely consenting.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_ \_\_\_\_\_\_ \_\_ Name of researcher [IN CAPITALS] Signature Date |  |
| 1. Study contact details for further information   [Name, phone number, email address] |  |

One copy to be kept by the participant, one to be kept by the researcher

## Other Appendixes (D, E, F etc. as required) (Unlimited Words):