



OFF-GRID

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Executive summary

Highlights

- Off-Grid was founded by: Tswai K (student no:41942140), Malesa SD (student no:39212017), Molopi NB (student no:37275135), Nyirenda TR (student no:40707822), Tsetetsi KS (student no:41544986), Singo B (student no:42618045), Khalishwayo NK (student no:40454142), Mabuza TG (student no:39166287), Maboea TK (student no:40583295) and Minyuku TR (36456926)
- Off-Grid was established in 2023 because of an educational initiative focused on loadshedding within the ITSP113 module.
- The game was given the name “Off-Grid” to offer an engaging and enjoyable platform for the users interested in understanding the impact loadshedding has on our everyday life. Its aim is to provide educational foundations through a gaming system, catering to individuals who can personally relate to load shedding and seek an intriguing and entertaining experience.
- Determining the users:
 - Off-Grid involves two parties, town counsellor and the system.
 - The town counsellor will be our system user.
 - The system is going to be the municipality that the user must work for in their community. [\(Model of interaction\)](#)

Overview

Off-Grid has a primary objective of raising awareness among individuals regarding loadshedding and the impact it has on the economy.

We also aim to impart knowledge about alternative power solutions that can be implemented during loadshedding period.

Furthermore, we highlight the significant role our town counsellors can play in bringing positive change to the community.

Introduction

Loadshedding has become a norm to the point where we ourselves do not recognise the impact it has on us. Loadshedding has a great impact on the county's economy as well as its safety, and our safety in our communities.

Off-Grid is a game that is programmed using Scratch, to teach users about the impact loadshedding has on the economy, the affect it has on the community and how to reduce it. Our goal is to make the user aware of the changes loadshedding has made to their daily lives. In this document, more information about loadshedding is included, what exactly loadshedding is and how it can be reduced. Different power supplies that businesses can invest in, for their businesses to continue operating. There will be an explanation on how each stage of the game is played, the different difficulty levels in each stage, the Human and Computer Interaction behind the game will also be included.

Loadshedding

What is loadshedding?

Loadshedding has been and continues to be a great problem in South Africa, the effects making it nearly impossible to lead a normal life for the many South Africans. Loadshedding is when there is a reduction of electricity consumption, because the power supply is endangered. It might occur because of shortage of electricity and the demand of electricity surpassed the supply. Its purpose is to prevent the entire national grid from collapsing, due to the power stations that have already been built are not enough to sustain the country at large, with enough electricity, 'power cuts' are then made to ensure that the system does not experience an overload, narrowly escaping a system collapse.

Stages of loadshedding

Currently, South Africa has implemented a loadshedding schedule with different stages, depending on the level of electricity supply challenges. According to (Kahla, 2021), the different stages are explained as follows:

Stage 1: At this stage, up to 1,000 MW of the national electricity load can be cut off. The purpose is to reduce the overall demand on the power grid during peak periods.

Stage 2: This stage allows for up to 2,000 MW of the national load to be shed. Power outages happens six times over a four-day period for two hours.

Stage 3: In this stage, up to 3,000 MW of the national load can be shed. Outages will occur nine times over a four-day period for two hours each time.

Stage 4: Up to 4,000 MW of the national load can be shed at this stage.

Stage 6 & 7: These stages represent higher levels of load shedding, with Eskom shedding 6,000 MW and 7,000 MW respectively. Power cuts will be scheduled over a four-day period for four hours each time.

Impact of loadshedding on the economy in SA

Reduced productivity

Companies that need power supply, for example, mining, agriculture, and manufacturing industries. Business cannot continue operating at their full productiveness; therefore, they fail to meet their production objective, which then leads to a decrease to the economy.

Technological disruptions

Nowadays companies are modern and therefore rely on digital infrastructure to support their operations. Loadshedding not only interrupts their digits, but also the internet connectivity making it difficult for companies to keep communication with their customers and employees. Many systems shutdown, as well as the firewalls, when there's no power, making business vulnerable to attacks.

Incremental costs

Because of loadshedding, companies are now forced to rely on alternative power supply and invest in generators, which are expensive to use. This causes strain to businesses that are already struggling. And this might lead businesses to increase the prices of their products/goods and services, and that also affects the consumers.

How does loadshedding affect the community?

Safety & security

During loadshedding, streetlights, traffic lights and security systems may not operate. When streetlights and security systems aren't working for that period then it increases crime; when traffic lights aren't working there is an increase in accidents and traffic congestion.

Daily life

Loadshedding disrupts people's daily routines as well as their activities. This causes people to adapt new schedules, change their cooking schedules and find ways to heat up their food, find other ways to find light during loadshedding.

How to put an end to loadshedding

Renewable Energy

It is time that South Africa enhances its energy production capability by building power facilities, by embracing both traditional and sustainable sources (such as wind turbines, solar panels, and hydropower) (Finance101, 2023).

Wind energy

- Renewable and Sustainable: Wind energy is constantly renewed by nature and will not run out or deplete. (Han, 2019). It also does not contribute to air pollution or greenhouse gas emission.
- Wind is abundant and limitless (Han, 2019), and is an excellent choice for different communities, it can be installed onshore or offshore.
- Cost Effective

Solar energy

- Clean and environmentally friendly: Solar power produces no air or water pollution, and by using it, we can reduce carbon emissions.
- Versatile and cost effective. (Wigness, 2023)
- Renewable and sustainable: Solar energy is obtained from the sun, and we can capture its energy to produce electricity in our homes.

Public awareness and Education

By informing and educating people in our communities about utilizing energy efficiently and the consequences of load shedding, we can encourage and motivate them to change their behaviours. There should be educational campaigns that can inform community members about reducing energy consumption, reliable power supply as well the advantages of renewable energy.

Storing energy

Communities could invest into systems, like batteries or inverters, which can help store extra energy when it's not needed and use it when there's high demand.

Hybrid inverter

- Cost Savings: Can help reduce electricity bills; you can store any excess energy you produce when you do not need it and use it later when electricity prices are more expensive (Wenli, 2022)
- Backups power
- Eco-friendly
- Flexibility and Efficiency: Give you the ability to be flexible in how you use and control your energy.

Game design

Difficulty Level

The user will have to choose which difficulty level they want (Beginner, Intermediate and Expert). The difficulty levels will affect each stage depending on these factors:

Stage 1 – The quiz/interview

- Beginner: 3 questions with 10 second timer
- Intermediate: 5 questions with 15 second timer
- Expert: 7 questions with 20 second timer

Stage 2 – Coin collector

The difficulties in this stage are set different to the others where the difficulty would be depends on what option you choose that would stop or reduce the rate of load shedding and the more expensive the option the harder the difficulty.

- Generator: Target amount to be collected of R80 000 and a 15 second timer
- Solar Panel: Target amount to be collected of R100 000 and a 20 second timer.
- Wind Turbines: Target amount to be collected R120 000 and a 25 second timer.

Stage 3 – The intruder

- Beginner: simple floor plan with a target of 7 evidence files to be collected in 45 seconds
- Intermediate: simple floor plan with a target of 7 evidence files to be collected in 40 seconds

- Expert: Different and complicated floor plan which some have dead ends, target of 11 evidence files to be collected in 80 seconds

Stages

Introduction – Storyline

For the user to progress through this scene, the user is required to play the entire game from the beginning. The user will be welcomed by an email stating that they must make it to an interview on time. While the user is on the way to the interview, there is loadshedding, and the user must make it to the interview on time.

Stage 1 – The interview

Stage 1 will feature a series of multiple-choice questions that the user must answer. The user's performance in the interview is crucial for them to advance to the next stage of the game. They need to perform well in the interview in order to progress further.

- Beginner – 3 questions asked.
- Intermediate – 5 questions asked.
- Expert – 7 questions asked.

Stage 2 – Coin collector

The user will be asked a question on which power supply they think will be beneficial for their community. Once the user has chosen the power supply, he will then be required to accumulate enough money for him to buy that power supply.

We have introduced three new elements: a bomb, a coin, and paper money. When the user catches a bomb, their total amount will be reduced by R2 000. If they catch a coin, their total amount will increase by R5 000. Similarly, if they catch paper money, their total amount will increase by R10 000.

- Generator – A target amount of R8 000
- Solar Panel -A target amount of R100 000
- Wind Turbine -A target amount of R120 000

Stage 3- Investigator

The funds that the user collected in the previous stage will now need to be transferred to their account. However, the player discovers that a portion of the accumulated money has been stolen. Therefore, they must determine the culprit responsible for the theft of the power supply funds. During the investigation, they must be cautious not to get caught and complete their task before the time runs out.

- Beginner - simple floor plan – easier to get all 7 evidence files needed, 45 seconds timer.
- Intermediate – 40 second timer and similar to beginner
- Expert – different and complicated floor plan with a lot of dead ends which makes it difficult to collect all 11 evidence files, 80 seconds.

Outro – End of Storyline

As a result of successfully identifying and exposing the culprits, the stolen money is retrieved and the loadshedding project can continue where the option selected in the Coin Collecting game which now can be implemented and can finally reduce/stop the rate of Loadshedding.

Research purposes

Aim of the game

Off-Grid seeks to educate users about the consequences of loadshedding and the various power supplies they can consider minimizing power-outrages.

Off-Grid focus on individuals who belong to small communities as the target audience. Our game aims to capture their interest and assist those who are unaware of alternative power supply options and those who receive incorrect information.

According to (Head, 2021), loadshedding began in 2007, and there has been a new system of load shedding schedules that has been introduced. Our game will be educating fellow community members. In our game, we will ensure that the user understands the history of loadshedding and the alternatives there are to reduce it. We will also dedicate our efforts to educating the user about the benefits of various renewable energy sources.

Human-Computer Interaction

According to (Kiefer, 2023), Human-Computer Interaction (HCI) components utilized in the project are described as follows:

The human component

- **Auditory system** - the user can effortlessly distinguish and identify when different characters in the game speak.
- **Use of non-speech sound** – In Stage 3 of the game, there is a notable visual change which occurs in the background as the time is nearing its end. This change is designed to alert and capture the user's attention, indicating the urgency and impending deadline.

The computer component

- **Health issues** – The noise level is maintained at a comfortable and enjoyable level for the user.
- **Use of color** – By aligning the colors with the theme of loadshedding, the game aims to create a balanced and engaging experience for users. The colors used in the instruction backdrop(s) are intended to convey the atmosphere and context of loadshedding, allowing users to better understand and connect with the game's narrative.

The interaction component

- **Model of interaction** – Interaction involves both the user and the system, and the interface must effectively translate between the user and the system for interaction to be successful. It provides us with an understanding of what is going on in the interaction and identifies the root of difficulties.
- **Interactive styles** – Command line interface
 - Menu-driven interface
 - Natural language
 - Point-and-click interfaces.
- **WIMP interface** – Buttons
- **Experience, engagement, fun** – Aesthetic
- **Ergonomic** – buttons are made larger in size and spaced appropriately to enable the user to click on the buttons accurately and comfortably.

Basics of interaction

- **Screen design & layout** – Decorations
 - Alignment
- **User action & control** – Entering information.
 - Affordance
- **Iteration and Prototyping**
 - **Throwaway** – Initially, we developed a prototype for the project and conducted testing, which involved feedback from users (Lecture & Supplementary instructor (SI)). Based on the feedback received, we decided to discard Stage 1 of the project, into something different.
 - **Evolutionary** – The iterative nature of the development process enabled the game to evolve and grow from its initial limited version to the finalized release.

Conclusion

In conclusion, our project has been designed to prioritize user interaction, ensuring that the users interact with the system effortlessly and without encountering obstacles. The user-friendly design provides clear and logical pathways for navigation.

We have also emphasized the focus on making the game visually and audibly appealing. We have paid close attention to details like colors, animation, and sound effects to create an engaging environment. We have implemented ergonomic design principles, making sure that the game controls and interactions are comfortable and natural.

The educational aspect of the game was carefully created to align with the educational goal. Through the quiz, the user can acquire knowledge about loadshedding and develop essential skills. It reflects our dedication to providing a game that educates community members about loadshedding and alternative power sources.

We passionately believe that our game will capture the attention, entertain, and educate users, delivering an unforgettable gaming adventure.

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