Minetest Mods for 5G and Beyond Wireless Systems and Rural Broadband

Design Document

sddec22-03
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Executive Summary

Development Standards & Practices Used

List all standard circuit, hardware, software practices used in this project. List all the Engineering standards that apply to this project that were considered.

29119-1-2021 - ISO/IEC/IEEE International Standard - Software and systems engineering --Software testing --Part 1:General concepts

P802.11bc/D2.0, Oct 2021 - Telecommunications and information exchange between systems Local and metropolitan area networks – Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications - Amendment: Enhanced Broadcast Service

211-2018 - IEEE Standard Definitions of Terms for Radio Wave Propagation

Summary of Requirements

List all requirements as bullet points in brief.

- Project must keep costs down by building upon an open-source base game.

- Some parts of the simulation won't match 1:1 like reality, but they must get as close as reasonably possible.

- Project must be able to be distributed to every FFA and 4H student in IA

- Project must be easy to install and set up

- Each object must have communication between players, as well as environment

- Must not violate any copyright.

- Must use a local server, designed specifically for a classroom

- Must provide a smooth gameplay experience on a variety of hardware.

Applicable Courses from Iowa State University Curriculum

List all Iowa State University courses whose contents were applicable to your project.

COM S 309

COM S 227

ENGL 314

Maybe COM S 352

New Skills/Knowledge acquired that was not taught in courses

List all new skills/knowledge that your team acquired which was not part of your Iowa State curriculum in order to complete this project.

LUA

Modifying pre-existing software

Potential building a mod loader

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List of figures/tables/symbols/definitions (This should be the similar to the project plan)

1 Team

Minecraft mods for 5G and beyond wireless systems

1.1 Team Member

William Lavelle

Nicaela Rose

Eric Kirch

Zhihao Liu

Jacob Kelderman

1.2 Required Skill Sets for Your Project

- Communication - For figuring out what our client and users would like from our product
- Coding - To create the mod
- Problem solving - For solving the coding issues

1.3 Skill Sets covered by the Team

*Problem solving - All of us

*Coding - All of us

1.4 Project Management Style Adopted by the team

We will be adapting an agile project management style, we are planning on meeting with the client weekly to discuss the progress that has been made and talk about any problems we have faced.

1.5 Initial Project Management Roles

1.) William - Leader
2.) Nicaela - Research
3.) Jacob - Meeting Minutes
4.) Zhihao - Networking research
5.) Eric - Legal/Licensing

2 Introduction

2.1 Problem Statement

What problem is your project trying to solve? Use non-technical jargon as much as possible.

Our project is trying to solve faster wireless communication which is not easy to use in rural areas compared to other areas. Our program will simulate rural wireless infrastructure in order to educate students as to how it works, as well as let them play around with it.

2.2 Requirements & Constraints

List all requirements for your project . This includes functional requirements (specification), resource requirements, qualitative aesthetics requirements, economic/market requirements, environmental requirements, UI requirements, and any others relevant to your project. When a requirement is also a quantitative constraint, either separate it into a list of constraints, or annotate at the end of requirement as "**(constraint)**". Other requirements can be a single list or can be broken out into multiple lists based on the category.

- Project must keep costs down by building upon an open-source base game.

- Some parts of the simulation won't match 1:1 like reality, but they must get as close as reasonably possible.

- Project must be able to be distributed to every FFA and 4H student in IA

- Project must be easy to install and set up

- Each object must have communication between players, as well as environment

- Must not violate any copyright.

- Must use a local server, designed specifically for a classroom

- Must provide a smooth gameplay experience on a variety of hardware.

2.3 Engineering Standards

What Engineering standards are likely to apply to your project? Some standards might be built into your requirements (Use 802.11 ac wifi standard) and many others might fall out of design. For each standard listed, also provide a brief justification.

29119-1-2021 - ISO/IEC/IEEE International Standard - Software and systems engineering --Software testing --Part 1:General concepts

https://ieeexplore.ieee.org/document/9698145

-This standard is useful to us because it breaks down the standard concepts and policies for software testing. Once we have started development of our software then we will need to begin testing it and this should help us with that.

P802.11bc/D2.0, Oct 2021 - Telecommunications and information exchange between systems Local and metropolitan area networks – Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications - Amendment: Enhanced Broadcast Service

https://ieeexplore.ieee.org/document/9650686

The scope of this standard is defining a medium access control and several physical layer specifications for wireless connectivity for fixed, portable, and moving stations within a local area. This standard applies because our project requires wireless communication to enable a simulation experience through Minetest in Iowa.

211-2018 - IEEE Standard Definitions of Terms for Radio Wave Propagation

https://ieeexplore.ieee.org/servlet/opac?punumber=8657411

This standard provides terms and definitions used in the context of electromagnetic wave propagation relating to the fields of telecommunications. Once we've built the system, we will need it to describe our project.

2.4 Intended Users and Uses

Who benefits from the results of your project? Who cares that it exists? How will they use it? Enumerating as many "use cases" as possible also helps you make sure that your requirements are complete (each use case may give rise to its own set of requirements).

- Students will enjoy a fun and educational experience about rural 5G broadband connections
- Farmers will enjoy it for seeing how a 5G Broadband connection can help them with their farm
- Teachers can give their students a fun and educational experience
- 4H and FFA students can enjoy getting experience with the future of farming

3 Project Plan

3.1 Project Management/Tracking Procedures

Which of agile, waterfall or waterfall+agile project management style are you adopting? Justify it with respect to the project goals.

We will use a hybrid management style. After some research, we came to the conclusion that waterfall development is better for a single, large project like ours. So, we are going to use mostly waterfall, with some key changes. We are going to meet with our client once a week - more often than is normal for waterfall development. We are also not going to provide a deliverable to the client at each phase. After some phases, the product will not appear much different to an average consumer because that phase was for more back-end details that are not fully functional because they take several phases to complete. We will be using the waterfall method of "the next phase cannot start until the current phase is finished."

What will your group use to track progress throughout the course of this and the next semester. This could include Git, Github, Trello, Slack or any other tools helpful in project management.

We will use Github to store our code, Github Issues to keep track of which tasks are assigned to which people, Discord for team meetings, and instant messaging for communication.

3.2 Task Decomposition

In order to solve the problem at hand, it helps to decompose it into multiple tasks and subtasks and to understand interdependence among tasks. This step might be useful even if you adopt agile methodology. If you are agile, you can also provide a linear progression of completed requirements aligned with your sprints for the entire project.

Task 1- Design Research:
- Cell Tower
    - Height? Dimensions
    - Construction cost?
    - Range?
    - Speed/bandwidth?
- Electricity
    - Research Mesecon's mod and how it can interact with other features
- Obstacles
    - How much do different materials block 5G signals? (dirt, stone, metal, etc)

Task 2- Implement features:
- Cell Tower
    - Model Design
    - GUI
    - Functionality
- Electricity
    - Design changes
    - Implement functionality
- Satellites
    - Model Design
    - Research
    - Resource cost
    - Functionality

- Obstacles
    - Signal transmission
    - Environment
    - Power supply
- Fiber-Optic
    - Functionality
    - Wavelength/Bandwidth
    - Cost

Task 3- Test Features
- Test each of the features implemented in Task 2 as they are finished

Task 4 - Build Installer
- Make sure it is easy to use

- GUI development

3.3 Project Proposed Milestones, Metrics, and Evaluation Criteria

What are some key milestones in your proposed project? It may be helpful to develop these milestones for each task and subtask from 2.2. How do you measure progress on a given task? These metrics, preferably quantifiable, should be developed for each task. The milestones should be stated in terms of these metrics: Machine learning algorithm XYZ will classify with 80% accuracy; the pattern recognition logic on FPGA will recognize a pattern every 1 ms (at 1K patterns/sec throughput). ML accuracy target might go up to 90% from 80%.

In an agile development process, these milestones can be refined with successive iterations/sprints (perhaps a subset of your requirements applicable to those sprints).

Milestone 1: Finish Research and Begin Development

Milestone 2: Implement first feature

Milestone 3: Connect 2 features

Milestone 4: Finish all features and begin testing

Milestone 5: Finish testing and confirm the mod works

Milestone 6: Finish Installer

Metric: How many features are implemented

How to determine progress made for each feature:

Can you interact with it in the game?

Is it designed well and is it aesthetically pleasing?

Does it function correctly 100% of the time?

3.4 Project Timeline/Schedule

• A realistic, well-planned schedule is an essential component of every well-planned project

• Most scheduling errors occur as the result of either not properly identifying all of the necessary activities (tasks and/or subtasks) or not properly estimating the amount of effort required to correctly complete the activity

• A detailed schedule is needed as a part of the plan:

– Start with a Gantt chart showing the tasks (that you developed in 2.2) and associated subtasks versus the proposed project calendar. The Gantt chart shall be referenced and summarized in the text.

– Annotate the Gantt chart with when each project deliverable will be delivered

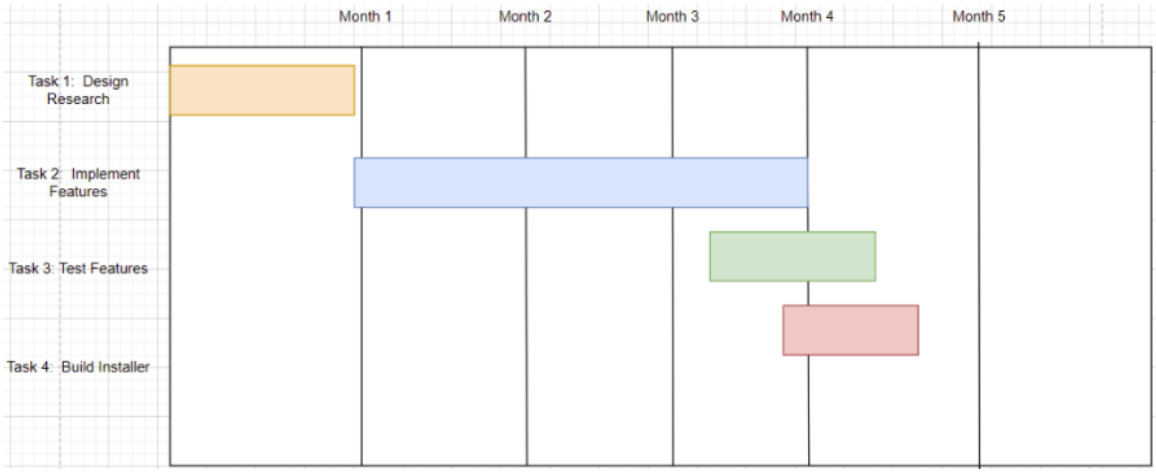
• Project schedule/Gantt chart can be adapted to Agile or Waterfall development models. For agile, a sprint schedule with specific technical milestones/requirements/targets will work.

We want to have the first Task done and begin development by the end of the first month

Developing the features will be the longest task we hope to have that done by the end of the fourth month so 3 months to complete the 5 features

Testing can start before developing the features is completely finished it should only take about 3 weeks less

We will start working on the mod installer before testing is complete it should only take about 3 weeks as well



3.5 Risks And Risk Management/Mitigation

Consider for each task what risks exist (certain performance targets may not be met; certain tools may not work as expected) and assign an educated guess of probability for that risk. For any risk factor with a probability exceeding 0.5, develop a risk mitigation plan. Can you eliminate that task and add another task or set of tasks that might cost more? Can you buy something off-the-shelf from the market to achieve that functionality? Can you try an alternative tool, technology, algorithm, or board?

Agile projects can associate risks and risk mitigation with each sprint.

Possible risks:

-Project not done in time: 20%
-Pre-made mods do not work as expected: 60% Risk Mitigation plan: Ask the rest of the team for help figuring out the mod, or use a different mod. This risk would be possibly occur in task 2

-Security vulnerability discovered after final deadline: 65% Risk Mitigation plan: Implement new and improved security protocols. This risk would possibly occur in task 3
-Issues with wireless connectivity: 60% Risk Mitigation plan: Communicate within the team to find the most stable method. This risk would possibly occur in task 2

3.6 Personnel Effort Requirements

Include a detailed estimate in the form of a table accompanied by a textual reference and explanation. This estimate shall be done on a task-by-task basis and should be the projected effort in the total number of person-hours required to perform the task.

Task #	Hours needed	Explanation
Task 1: Design Research	10 hours per team member	Answering questions will lead to even more questions, but this should be enough to account for that.
Task 2: Implement features	50 hours per team member	Implementing features will be the single greatest time sink, so we want to give it plenty of time.
Task 3: Test Features	20 hours total	We estimated this amount of hours due to having to test all features to confirm functionality
Task 4: Build Installer	10 hours per team member	Building the installer will basically be connecting all of our features with the software and see if it is overall compatible

3.7 Other Resource Requirements

Identify the other resources aside from financial (such as parts and materials) required to complete the project

We will need to network to reach out to the clubs and organizations using the mod

We will need fiber optic cables - this includes hardware components

We will need software to design the models and code the mod.

4 Design

4.1 Design Context

4.1.1 Broader Context

Describe the broader context in which your design problem is situated. What communities are you designing for? What communities are affected by your design? What societal needs does your project address?

List relevant considerations related to your project in each of the following areas:

Area	Description	Examples
Public health, safety, and welfare	How does your project affect the general well-being of various stakeholder groups? These groups may be direct users or may be indirectly affected (e.g., solution is implemented in their communities) How does your project affect the general well-being of various stakeholder groups? These groups may be direct users or may be indirectly affected (e.g., solution is implemented in their communities) Our project will help inform club members and students on how 5G works and how it can be applied to farming. A better understanding of 5G can lead to smarter farming which can improve food production.	Increasing/reducing exposure to pollutants and other harmful substances, increasing/reducing safety risks, increasing/reducing job opportunities Increase in food production, Increase in knowledge. More overall success in farming.
Global, cultural, and social	How well does your project reflect the values, practices, and aims of the cultural groups it affects? Groups may include but are not limited to specific communities, nations, professions, workplaces, and ethnic cultures. Our project is accurate to the wants and views of affected groups. The project is written by students, for students. Since the project is a mod for a videogame, it also reflects what many students enjoy and use frequently.	Development or operation of the solution would violate a profession's code of ethics, implementation of the solution would require an undesired change in community practices. Instead of filling out a worksheet, students will now be able to play a game over the same topic.
Environmental	What environmental impact might your project have? This can include indirect effects, such as deforestation or unsustainable practices related to materials manufacture or procurement.	Increasing/decreasing energy usage from nonrenewable sources, increasing/decreasing usage/production of non-recyclable materials.

	Our product does not have any environmental impacts since our product is an open-source game so no materials are required for this.	N/A. This is software, and not resource intensive software at all.
Economic	What economic impact might your project have? This can include the financial viability of your product within your team or company, cost to consumers, or broader economic effects on communities, markets, nations, and other groups. An economic impact our product can have is the financial viability of our product and its costs to our consumers. We had a budget in mind and we have been making decisions towards our product in order to stay consistent with our budget goal for both the team and the users.	Product needs to remain affordable for target users, product creates or diminishes opportunities for economic advancement, high development cost creates risk for organization. Our product needs to be affordable for our users since we want our product to be easily accessible for students and teachers who want to utilize it.

4.1.2 User Needs

List each of your user groups. For each user group, list a needs statement in the form of:

User group needs (a way to) to do something (i.e., a task to accomplish, a practice to implement, a way to be) because of some insight or detail about the user group.

- **Students** need a fun and interactive way to learn about 5G broadband in rural areas
- **Teachers** need a simple, fun tool for introducing students to the next generation of farming
- **Farmers** need a way to see how a 5G broadband connection can increase the quality of their work
- **Wireless Companies** can use the simulator to see where a wireless tower could improve general signals
- **Investors** can use the simulator to understand the impact the scale of the next generation of farming

4.1.3 Prior Work/Solutions

Include relevant background/literature review for the project

– If similar products exist in the market, describe what has already been done

– If you are following previous work, cite that and discuss the **advantages/shortcomings**

– Note that while you are not expected to "compete" with other existing products / research groups, you should be able to differentiate your project from what is available. Thus, provide a list of pros and cons of your target solution compared to all other related products/systems.

Detail any similar products or research done on this topic previously. Please cite your sources and include them in your references. All figures must be captioned and referenced in your text.

There is no similar product in the market. Although there are many other mods in the market such as farming tools, the field we are trying is completely new.

The advantage of our project is the ability to combine agriculture with STEM for education.

The disadvantage of our project is that we are simulating in a game. It is not exactly the same as reality.

4.1.4 Technical Complexity

Provide evidence that your project is of sufficient technical complexity. Use the following metric or argue for one of your own. Justify your statements (e.g., list the components/subsystems and describe the applicable scientific, mathematical, or engineering principles)

1. The design consists of multiple components/subsystems that each utilize distinct scientific, mathematical, or engineering principles –AND–
    a. We will build mods for cell towers, satellites, and cell phones. All these components will build a communication system. The fields involved are programming, graphic design, and signal transmission.
2. The problem scope contains multiple challenging requirements that match or exceed current solutions or industry standards.

    a. Since we are exploring new areas, there's no current solution or industry standard.

4.2 Design Exploration

4.2.1 Design Decisions

List key design decisions (at least three) that you have made or will need to make in relation to your proposed solution. These can include, but are not limited to, materials, subsystems, physical components, sensors/chips/devices, physical layout, features, etc.

We have decided to use Minetest as the game we will be modding.

The main 5G features we want to implement are Cell towers, Satellites, and Cell Phones.

We are going to be combining other mods with our own for farming and animals.

Obstacles and weather will be the main setbacks for the player that they have to work around.

4.2.2 Ideation

For one design decision, describe how you ideated or identified potential options (e.g., lotus blossom technique). List at least five options that you considered.

For one of the design decisions - using Minetest as the game we will mod, we identified potential options based on budgeting. We wanted our product to be easily accessible for its users so finding an open source game where they did not have to pay in order to download the game was important. Minetest is a free open-source game.

Five options we considered were:

1. Minecraft
2. Terasology

3. Roblox
4. TrueCraft
5. Terraria
6. Minetest

4.2.3 Decision-Making and Trade-Off

Demonstrate the process you used to identify the pros and cons or trade-offs between each of your ideated options. You may wish you include a weighted decision matrix or other relevant tool. Describe the option you chose and why you chose it.

Pros:

- We will generally try to add as much detail as possible into each part of the mod, because that will increase realism. This applies except in the case of the following con.

Cons:

- Some things that happen in real life would not make any sense in a game. We will have to intentionally leave out some functionality in order to prevent user frustration. For example, the chance of random component failure. In real life, you may get unlucky and be shipped a dud or defective product, but if we were to implement that in the game, players would think the mod is not working right or that the failure is the programmer's fault, not an intended feature.

4.3 Proposed Design

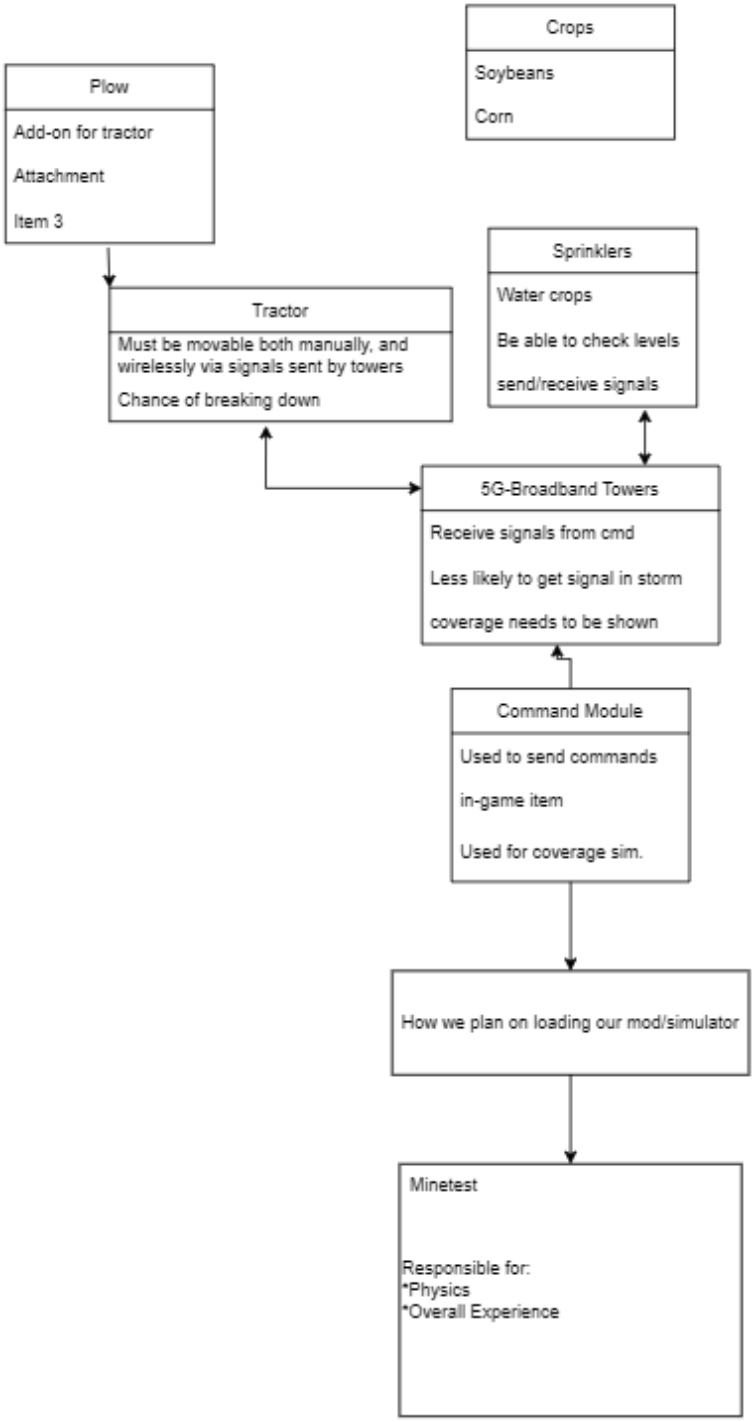
Discuss what you have done so far – what have you tried/implemented/tested?

We have tried several different videogames to see which would be best to use as a foundation. Minecraft was tested and discarded because it would cost a large sum, and the source code is obfuscated. All the other games except for Minetest were tested and discarded due to lack of features.

4.3.1 Design Visual and Description

Include a visual depiction of your current design. Different visual types may be relevant to different types of projects. You may include: a block diagram of individual components or subsystems and their interconnections, a circuit diagram, a sketch of physical components and their operation, etc.

Describe your current design, referencing the visual. This design description should be in sufficient detail that another team of engineers can look through it and implement it.



This is our current design of what we want to implement, we will likely add to it as we continue working on the project. Each item will have some interaction with another. All the farming equipment will have some 5G tied to it like with the Tractor and sprinklers.

4.3.2 Functionality

Describe how your design is intended to operate in its user and/or real-world context. This description can be supplemented by a visual, such as a timeline, storyboard, or sketch.

How well does the current design satisfy functional and non-functional requirements?

In the real world, our project will run on a person or school's personal computer, by launching an .exe file. This satisfies the requirements very well, since it will be easy to set up, easy to transport to clients, and requires no physical products.

4.3.3 Areas of Concern and Development

Based on your current design, what are your primary concerns for delivering a product/system that addresses requirements and meets user and client needs?

What are your immediate plans for developing the solution to address those concerns? What questions do you have for clients, TAs, and faculty advisers?

Some concerns we have when delivering our product based on our requirements and needs of both users and clients is the overall functionality of the game. We want the game to be working at full functionality and also have all the components needed in order to provide the best learning experience for our users. We also have concerns about issues with our 5G connectivity for rural broadband. If this is not working, then the game would not be useful.

Our plans for developing the solution to address these concerns is to make sure we create and utilize all current mods that are relevant towards our project. This includes farming since our target users are 4H students. If our game for some reason is not functioning properly, the solution to this is to know how to troubleshoot any issues for Minetest. A solution for 5G connectivity would also be to gain the knowledge of troubleshooting in this area, although any connectivity issues can be out of our reach since it is for rural broadband.

4.4 Technology Considerations

Highlight the strengths, weaknesses, and trade-offs made in technology available.

The nice thing about using minetest is that it is free and easy to use, the downside is that it might not be as powerful as other programming languages, which could be a problem if we decide to make out mod more complex

Discuss possible solutions and design alternatives

An alternative would be making our own game or using minecraft, minecraft isn't really an option for the cost and making our own open world game would add to the time it would take to complete the project

4.5 Design Analysis

– Did your proposed design from 3.3 work? Why or why not?

Since we were planning on starting work in the second semester it is still not certain whether the proposed design from 3.3 will work or not

– What are your observations, thoughts, and ideas to modify or iterate over the design?

We will probably have many changes over the course of the semester, that is just the nature of software planning, we hope the core plan will stay true though.

4.6 Design Plan

Describe a design plan with respect to use-cases within the context of requirements, modules in your design (dependency/concurrency of modules through a module diagram, interfaces, architectural overview), module constraints tied to requirements.

Since the requirements to this project are to have users enjoy the mod and learn from the mod, what we could do is to continuously test the gameplay of the mod to see how fun it is. We could have other people who either don't know much about 5G or who are young play test the mod also.

5 Testing

Testing is an **extremely** important component of most projects, whether it involves a circuit, a process, power system, or software.

The testing plan should connect the requirements and the design to the adopting test strategy and instruments. In this overarching introduction, given an overview of the testing strategy. Emphasize any unique challenges to testing for your system/design.

5.1 Unit Testing

What units are being tested? How? Tools?

> For Towers, the range can be tested to see if it is numerically correct. For the devices, we could test to make sure it has the right signal strength given a set of conditions. We could make sure specific weather conditions affect the specific connection strength variables per device.

5.2 Interface Testing

What are the interfaces in your design? Discuss how the composition of two or more units (interfaces) are being tested. Tools?

> The biggest point of interface in our simulator would be the control panel. The control panel will be an in-game tablet where you can check on your devices, the signal strength, and see things that could affect it (ex. weather). We could make sure each device shows up on the list, they have the correct signal strength found through the unit testing, and make sure the current and upcoming weather conditions shown are correct.

5.3 Integration Testing

What are the critical integration paths in your design? Justification for criticality may come from your requirements. How will they be tested? Tools?

> We need to make sure that the mod/simulator can be properly integrated into Minetest. For this, we will need Minetest, as well as some sort of mod loader or plugin manager. Since we

want to add functionality to a preexisting piece of software, a simulator is much like a plugin, where the original source code stays intact, however there is no code added to it.

5.4 System Testing

Describe system level testing strategy. What set of unit tests, interface tests, and integration tests suffice for system level testing? This should be closely tied to the requirements. Tools?

This will be testing our new objects and additions that work well within Minetest. This can be just ensuring that everything loads in and has correct functionality.

5.5 Regression Testing

How are you ensuring that any new additions do not break the old functionality? What implemented critical features do you need to ensure they do not break? Is it driven by requirements? Tools?

In order to make sure one addition doesn't break a bunch of things, we will have to work on adding one object at a time. There will be certain priorities, with the control panel and the cell tower being the first two, as everything else will have to have some degree of functionality with those two things.

5.6 Acceptance Testing

How will you demonstrate that the design requirements, both functional and non-functional are being met? How would you involve your client in the acceptance testing?

We'll show that our simulator is working as intended through the control panel, as well as some other tests. The control panel should have a lot of useful information pertaining to the connection statuses, as well as the final coverage simulation button.

5.7 Security Testing (if applicable)

Making sure we don't modify any of the preexisting code, and that our new files don't cause any drastic software or OS violations.

5.8 Results

What are the results of your testing? How do they ensure compliance with the requirements? Include figures and tables to explain your testing process better. A summary narrative concluding that your design is as intended is useful.

We can get numerical data, and examples in order to understand how our software operates in order to proceed with development. If everything works as intended, onto the next thing, if not, back to Minetest to understand why things aren't working as intended.

6 Implementation

Describe any (preliminary) implementation plan for the next semester for your proposed design in 3.3. If your project has inseparable activities between design and implementation, you can list them either in the Design section or this section.

7 Professionalism

This discussion is with respect to the paper titled " Contextualizing Professionalism in Capstone Projects Using the IDEALS Professional Responsibility Assessment", *International Journal of Engineering Education* Vol. 28, No. 2, pp. 416–424, 2012

7.1 Areas of Responsibility

Pick one of IEEE, ACM, or SE code of ethics. Add a column to Table 1 from the paper corresponding to the society-specific code of ethics selected above. State how it addresses each of the areas of seven professional responsibilities in the table. Briefly describe each entry added to the table in your own words. How does the IEEE, ACM, or SE code of ethics differ from the NSPE version for each area?

Will be choosing IEEE code of ethics.

Area of responsibility	How IEEE addresses each area	How does the IEEE differ from NSPE
Work Competence	erform with the goal to maintain and mprove technical competence and tasks ne proper qualification/experience	NSPE states that engineers should only perform services that are in their area of expertise. This is similar to IEEE as they both encourage only taking tasks that they are qualified in
Financial Responsibility	Reject any bribery in all possible forms	NSPE encourages to be faithful towards all employees and clients. This differs from IEEE as they specify money that could be obtained "the easy way"
Communication Honesty	Be honest and realistic in all claims/estimates based on data	NSPE encourages public statements to be objective and truthful. This is different from IEEE as they want claims that are backed up by evidence
Health, Safety, Well-being	Accept the responsibility to make decisions that provide safety, health, and welfare to the public. Anything that can endanger the public/environment must be communicated immediately	NSPE prioritizes the safety, health, and welfare of the public. This is similar to IEEE code of ethics
Property Ownership	Avoid injuring others and their property, reputation, and employment	NSPE encourages to be faithful towards all employees and clients. The difference is that NSPE's description for Property Ownership is the same for Financial Responsibility. For IEEE, both are different and more descriptive as to what they expect
Sustainability	Disclose factors that can endanger the environment immediately	NSPE does not have a description towards this area. However, IEEE does – the NSPE glances over it by generally stating to "prioritize the safety, health, and welfare of the public"

Social Responsibility	Assist your colleagues in their own professional development and support/encourage them to follow the IEEE code of ethics as well	NSPE states that those who believe an individual are unethical or participating in illegal practices must present this information to a higher up

7.2 Project Specific Professional Responsibility Areas

For each of the professional responsibility areas in Table 1, discuss whether it applies in your project's professional context. Why yes or why not? How well is your team performing (High, Medium, Low, N/A) in each of the seven areas of professional responsibility, again in the context of your project. Justify.

Yes, all 7 professional responsibilities from Table 1 apply to the project's professional context. This is because in order to successfully complete our project (and any other project in the future), all members must have knowledge and consider all issues of ethics and professional responsibility. If not, then we can provide solutions that can impact the environment in a bad way. Engineers have several responsibilities and when they are performed irresponsibly/outside the code of ethics, more problems will arise.

Currently, our team is performing high in all 7 areas of professional responsibility. We have avoided several conflicts by communicating and being respectful towards one another. We also communicated any conflicts/concerns towards each other and also our client as well. Our team also created an environment that encourages criticism, questions, correcting errors, while also crediting those who deserve it. Although so far our team has been using this time to get to know each other and perform individual research to share for our project, there is no question that we as a team created a professional environment where we encourage each other to perform our best to create a successful Senior Design Project in the end.

7.3 Most Applicable Professional Responsibility Area

Identify one area of professional responsibility that is both important to your project, and for which your team has demonstrated a moderate or high level of proficiency in the context of your project. Briefly describe what this responsibility means to your project, the ways in which your team has demonstrated the responsibility in the project, and specific impacts to the project that you have observed.

One of the areas of professional responsibility that is important towards our project and that our team has demonstrated a high level of proficiency for is financial responsibility. This responsibility means to "deliver products and services of realizable value and at reasonable costs". What this means towards our project is that our product (pending but currently is Minecraft) will be utilized by FFA students. However, this product does have a cost – not only to design it but also provide this product to the students as well. This is something that we have been discussing/researching the past two weeks. This is important and vital towards our overall project because not only do we want to create a product to the best of its ability, but it is also budget friendly when it comes to actually being used. What we as a team observed from this is that not only do we need to think about ourselves and working on this project, but we also have to think about our targeted users.

8 Closing Material

8.1 Discussion

Discuss the main results of your project – for a product, discuss if the requirements are met, for experiments oriented project – what are the results of the experiment, if you were validating a hypothesis – did it work?

Since the requirements of our project are pretty abstract we are not able to say whether they are met or not exactly. We do have a solid plan for how we want to accomplish the project but we won't know for certain if it will be fun, educational, and easy to use until we do more work on it.

8.2 Conclusion

Summarize the work you have done so far. Briefly reiterate your goals. Then, reiterate the best plan of action (or solution) to achieving your goals. What constrained you from achieving these goals (if something did)? What could be done differently in a future design/implementation iteration to achieve these goals?

Our goals for this semester was to plan out how the mod was going to work, this goal has been met mostly. We do not have everything planned but we have a basic idea of what we are going to do. The work that led up to this point were multiple meetings with the client and individual research on lua and minetest. We have also completed all the assignments that were required for this class which has helped with the planning process.

8.3 References

List technical references and related work / market survey references. Do professional citation style (ex. IEEE).

Minetest Modding Book:

rubenwardy, "Minetest Modding Book," Minetest modding book. [Online]. Available: https://rubenwardy.com/minetest_modding_book/en/index.html. [Accessed: 24-Apr-2022].

Lua Docs:

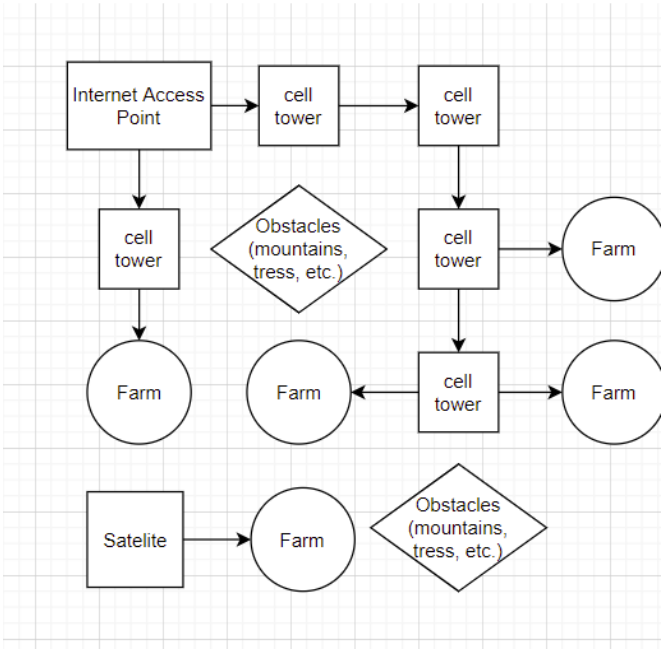
"Documentation," *Lua*. [Online]. Available: https://www.lua.org/docs.html. [Accessed: 24-Apr-2022].

8.4 Appendices

Any additional information that would be helpful to the evaluation of your design document.

If you have any large graphs, tables, or similar data that does not directly pertain to the problem but helps support it, include it here. This would also be a good area to include hardware/software manuals used. May include CAD files, circuit schematics, layout etc,. PCB testing issues etc., Software bugs etc.

network diagram:



8.4.1 Team Contract

Team Members:

1) Nicaela Rose

2) William Lavelle

3) Zhihao Liu

4) Jacob Kelderman

5) Eric Kirch

Team Procedures

1. Day, time, and location (face-to-face or virtual) for regular team meetings:

With Client: 3:15 Thursday, Team meetings without client will vary weekly depending on everyone's availability that week.

2. Preferred method of communication updates, reminders, issues, and scheduling (e.g., e-mail, phone, app, face-to-face):

Snapchat group chat for discussion, Discord for sharing of resources

3. Decision-making policy (e.g., consensus, majority vote):

Majority vote

4. Procedures for record keeping (i.e., who will keep meeting minutes, how will minutes be shared/archived):

Minutes will be shared on Discord. Jacob Kelderman will keep meeting minutes.

Participation Expectations

1. Expected individual attendance, punctuality, and participation at all team meetings:

Everyone shows up to all meetings on time. Eric is excused from client meetings, as he has a class conflict at that time.

2. Expected level of responsibility for fulfilling team assignments, timelines, and deadlines:

Everyone is expected to split team assignments equally and complete all individual assignments on the designated deadline. If for any reason a deadline cannot be met, this must be communicated to the team as soon as possible.

3. Expected level of communication with other team members:

Respond to all messages ASAP, within 24 hours maximum.

4. Expected level of commitment to team decisions and tasks:

High level of commitment. Tasks should be completed on time

Leadership

1. Leadership roles for each team member (e.g., team organization, client interaction, individual component design, testing, etc.):

William is the Team Lead. Other roles are currently pending as we are still doing research towards the project with Dr. Daniels to determine what can and can't be done.

2. Strategies for supporting and guiding the work of all team members:

We can provide support and guidance within our group during team meetings. Creating an environment where everyone feels comfortable asking questions or for help when needed.

3. Strategies for recognizing the contributions of all team members:

Verbal gratitude towards one another. As to keeping track of contributions, we can do this by looking at our teams weekly reports to view one another's contribution towards the project.

Collaboration and Inclusion

1. Describe the skills, expertise, and unique perspectives each team member brings to the team.

Jacob: Programming experience in java, c/c++, most experience in web development. Have made some games in the past. Including multiplayer games in coms 309.

William: Java & C knowledge, experience with rural living and rural internet.

Nicaela: Programming experience in Java and C, some experience in game development from COM S 309, and communication skills from past group projects

Eric: Extensive Java knowledge and a decent amount of C experience. I bring unique ideas to the table, while trying to make a fun learning environment for everyone

Zhihao: Programming experience in C/C++ and matlab, general knowledge of electrical engineering, and interpersonal communication skills.

2. Strategies for encouraging and support contributions and ideas from all team members:

No judgment for new ideas. All questions are encouraged.

3. Procedures for identifying and resolving collaboration or inclusion issues (e.g., how will a team member inform the team that the team environment is obstructing their opportunity or ability to contribute?)

We will have the entire team listen to the issue and make a collective decision. We will do our best to make sure both parties are satisfied, and that the issue is settled in a neat and timely manner.

Goal-Setting, Planning, and Execution

1. Team goals for this semester:

-Understand the design process better

-Work on communicating with the team, and growing ideas

- Develop a comprehensive plan for the details and boundaries of our project.

2. Strategies for planning and assigning individual and team work:

We will use Trello for dividing up tasks and assigning them to team members.

3. Strategies for keeping on task:

Weekly meetings, Trello, reminders from teammates

Consequences for Not Adhering to Team Contract

1. How will you handle infractions of any of the obligations of this team contract?

Kindly talk to the infracting team members and see what is going wrong or what is causing them to fall behind, then help fix it if possible.

2. What will your team do if the infractions continue?

Talk to the instructor

****

a) I participated in formulating the standards, roles, and procedures as stated in this contract.

b) I understand that I am obligated to abide by these terms and conditions.

c) I understand that if I do not abide by these terms and conditions, I will suffer the consequences as stated in this contract.

1) Nicaela Rose DATE: 4/22/22

2) Eric Kirch DATE: 4/24/22

3) Zhihao Liu DATE: 4/24/22

4)Jacob Kelderman DATE:4/24/22

5) William Lavelle DATE: 4/24/22