Truesight Battle Grid - Design Report

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Abstract
Data visualization is often used in computer gaming to provide feedback to players. However, little research has investigated its potential in hybrid physical/digital tabletop games, nor for tabletop role-playing games. As analysing player activity becomes more and more ubiquitous in games, this study documents the effects of introducing Truesight a tangible battle grid which uses lights to visualize game play possibilities in the role-playing game of Dungeons & Dragons. The tangible tool was developed with the purpose of helping role-players to better understand and communicate the game data of their fantasy world while fostering engagement, playful interaction, and personal learning. The system was evaluated through usability testing and the game experience questionnaire (GEQ). Results indicate a good working system for keeping the immersion of the game. The tool opened new ways of imagination and storytelling and made it possible for all players to really understand the game surroundings.

Author Keywords
tabletop role-playing games; Dungeons and Dragons; tangible data visualisation; immersion.

CCS Concepts
•**Human-centered computing** → **Human computer interaction (HCI);** *Haptic devices;* User studies;

Figure 1: Truesight Battle grid creating atmosphere.

Introduction and Related Work

You are crawling through a dungeon for what feels like days when you finally see a light up ahead. You draw back your bow, aiming for the goblin in the corner of the next room. As you are about to release the arrow, the player sitting next to you at the table doubts your ability to hit your target and a lengthy discussion ensues. The immersive flow of the game is broken and you are forced back to reality to consult rule books and calculate distances and line of sight. In tabletop role-playing games (TRPGs), immersion is essential. Within the Play and Learn squad we often refer to this as keeping players in the magic circle [23], the safe space where the normal rules and reality of the world are suspended and the experience, rules and mechanics of the game world take over.

For the purpose of this project, the definition of psychological immersion by McMahan [26] defined as a player being mentally preoccupied by the world of the game's story, is used [26]. In the popular TRPG, Dungeons & Dragons [19] (D&D), players assume the role of a character while the Dungeon Master (DM) leads them through a story set in a complex fantasy world to complete objectives [38]. D&D players commonly use tabletop maps, or so-called battle grids, to visualize and keep track of what is happening in the game world. These maps range from being simple drawings on grid paper, to lovingly, handcrafted terrain models. Players and DMs report that maps help to collaboratively create and visualize the world they are building both before and during the game [36]. D&D has recently experienced a resurgence in popularity, attributed to the improvement of online tools [34], pop culture references [45] and a renewed interest in analog experiences in general [18]. With the support of the passionate and technologically adept role-playing community [34], work as been done in furthering the available tools to support tabletop

Figure 2: Truesight Battle grid in use.

role-playing games [20] through online character [11, 30, 47] and map [28, 13] builders, custom 3D printed terrain files [33], data and story trackers for both DMs [42, 11] and players [3] and sound effects organizers [41]. Augmenting the tabletop role-playing experience very quickly transitioned from traditional terrain maps and miniature figures, to fully digitized alternatives such as online, teleplay tools Roll20 [43] and Fantasy Grounds [40], fully augmented reality with Tilt 5 [44] and virtual reality with RoleplayU [37]. Some players resented this change, with Kosa and Spronck [22] finding that the lack of tactility and the requirement to stare at a screen to be factors in players lack of interest in augmented reality play [22].

Games which incorporate both physical and digital elements, or Hybrid Games, leave more space for role-playing by speeding up uncaptivating game processes [46]. Relevant hybrid game projects of note include False Prophets [25] which explored the design space of hybrid board/video games, Wizard's Apprentice [31] which implemented sen-

sors into the gameboard, the STARS Platform [24] which introduced a touch screen and RFID tagged miniatures for role-playing games and Tisch [46], a digital tool supporting board games which used the Microsoft Surface as a battle map with support for tagged tokens, while focusing on maintaining spontaneity, house rules and improvisation.

Since role-playing games rely on all players becoming fully invested in the fictional world they are playing in, immersion plays a key role in evaluating whether an addition to the game is successful. To maintain the immersive quality of role-play in D&D we focused on tangibility. Tangible interfaces have been shown to provide a higher level of sensory and imaginative immersion and tangible interfaces increased players desire and curiosity to explore and interact [27]. With the Truesight Battle Grid, we attempt to introduce technology, without compromising the full tangibility and social connectedness of the traditional D&D game. To assess the value of our approach we went through two prototype iterations and for evaluation conducted semi-structured interviews, and two play tests after which we used the Game Experience Questionnaire (GEQ) [32] to investigate immersion, System Usability Scale (SUS) [4] as a simple indication of perceived usability and additional open questions [21]. The Truesight Battle Grid aims to help players quickly understand, and communicate real-time game data, reducing the time spent on technical arguments and therefore maintaining the immersion of the role-playing experience. Truesight also aims to foster imagination and create new ways of storytelling compared to the traditional battle grid. Although more comprehensive research is required to completely validate these requirements, preliminary research has shown promising results.

Dungeons & Dragons

For this project, we were tasked to explore tangible data visualization. At the beginning of our process, we decided to focus on a TRPG as opposed to a video game because we wanted to explore tangible input as well as output. We specifically chose to focus on D&D fifth edition (5e) as it is currently the most played TRPG [1, 9]. This also had the benefit that D&D offered easy access to participants for our user studies.

D&D is an open-ended role-playing game that keeps the players in the magic circle with the help of its extensive rule system [19, 29]. It is typically played with three to six players. Players assume the role of their character and are lead through a fictional storyline by the DM. Together they must solve puzzles, fight monsters, gather treasure, and reach many other objectives. Each character has a unique set of abilities and players must often roll a dice to help the DM determine the outcome of an action. The focus of the game is not to win, but to collaboratively explore and tell stories.

The Dungeon Master

In a D&D game session, the DM must wear many hats, often simultaneously: storyteller, actor, narrator, coordinator and arbiter. They must first choose whether to guide their players through a pre-made campaign, or create their own from scratch (homebrew campaigns). Pre-made campaigns are available from the official D&D franchise, or from other DMs. In homebrew campaigns, DMs are responsible for dreaming up the fictional world that the story is set in, including its history, inhabitants and landscape. For groups that play using a map, the DM often creates a map at this stage. Since D&D is an open-ended game, a DM cannot prepare for every possible scenario, however, they do lay out key moments to incorporate as the game unfolds, such as meeting an inhabitant who needs help or monsters

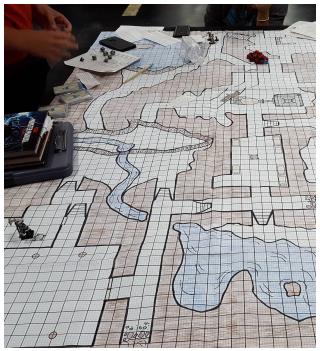

Figure 3: 2d paper grid [17].

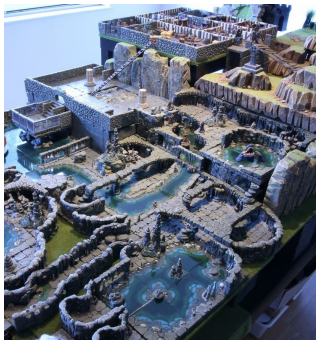

Figure 4: Realistic terrain [15].

which they must fight. When preparing these encounters, DMs take the player's level and abilities into account to make an appropriately challenging experience so they must have the player's character data on hand. During the game, the DM tells the story, keeps track of player activities and decides what is and is not allowed. To decide whether an action is successful, DMs observe the official rules, however they are allowed to use their discretion and ultimately, whatever the DM decides is ultimately taken as rule. To help them in their decision, players are asked to roll various dices with higher numbers usually meaning the action is more successful. At the end of the game, it is usually the DMs responsibility to remember where the players left off to pick the story back up in the next session.

The Players

In D&D, the players have the choice between a variety of races, classes, weapons, spells, and abilities to create their own unique character. They also build the character's unique personality and motivation. Amongst players, there are different player types (Appendix 1). [8] based on their preferences. For example, some players prefer heavy combat while others enjoy in-game social interactions more. This character can then be levelled up throughout one, or multiple, campaigns. This data is stored on an extensive character sheet (Appendix 2) that the players bring with them. Here, they also keep track of variables such as their health, supplies and spells. If a group is using a hand-drawn map in their sessions, it is often the player's responsibility to update the drawing based on discoveries and events (e.g. a secret doorway is discovered or a boulder falls and now blocks a path). Some players use miniature figures to represent their character in the game world, either store-bought, 3d printed and hand-painted, or completely handmade.

Target Users

Within the large D&D community there are many different styles of play. Through online research and initial interviews, we identified a spectrum of players (Appendix 3) ranging from those who play verbally with no visualizations at all, followed by those who play online [43, 40], those who use a 2d battle grid (figure 3), and those who use realistic 3d miniature terrain (figure 4). We specifically targeted D&D players and DMs who already used 2D visuals during their games as their existing playstyle matches the balance between abstraction and realism of our product. These groups use printed or drawn maps (dry erase, paper), large screen based maps, or (wall)projected maps. While the 3D preference seems to fit our product, we chose to not focus on this group because we found that these players found a lot of enjoyment in the creation of the terrain. However, in future scenarios, other styles could be accommodated as further described in future works.

[I2]*"We used matchsticks...plastic...and cardboard. I have nice memories of staying up until 3:30 (making them)."*

First Interviews

For this project, we went through two iterations of the design thinking framework, as proposed by the Hasso-Plattner Institute of Design at Stanford [2]. This iterative framework consists of five stages: Empathize, Define, Ideate, Prototype, and Test. In the first iteration, the empathize stage of the design process, we conducted four in-depth interviews with experienced DMs to gain an understanding of the user needs. Earlier research done by Darrin F. Coe (2017) describes the most common motivators for playing TRPGs, which include Imaginative Creativity, Exploring and Knowing Self, Belonging and Interacting, Relief and Safety, and Learning [10]. Our interviews also confirmed these findings as seen in the quotes below. The Interview outline can be

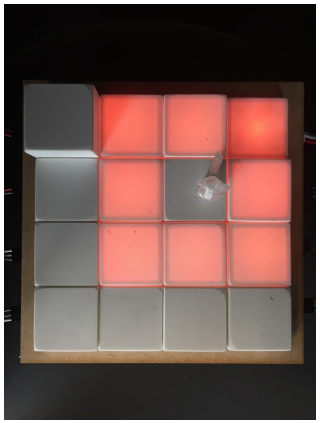

Figure 5: First proof of concept prototype.

found in appendix 4.

Imaginative Creativity
[I3] *"I play D&D mostly for my creative expressions such as imagination and drawing. My mom used to say that I used to live in my own world and now with D&D, we are playing in that world, which is amazing."*

Exploring and Knowing Self
[I1] *"I was also very socially anxious and i liked ignoring the outside world and stepping into a character to become someone else, it helped. It's changed at this point from when I began, but it started as I was very introverted and still can be sometimes but a lot less."*

Belonging and Interacting
[I4] *"But now it's keeping and catching up with friends. It's also just having fun and catching up on life and just talk."* **[I2]** *"there is a shared fiction in which everyone is participating."* subsectionLearning **[I4]** *"For beginners there is so much to learn, although we all have to keep learning"*

Other notable outcomes were their interest in tangibility, being able to more quickly see their possibilities when playing, and the DM's desire to add another interesting layer to their storytelling through dynamic events.

Tangibility
[I4] *"This the downside of only drawing a map. People often forget they can do things: like, they visualize the tree in their head but It's not like "OK I can actually climb that tree." But if you had a 3D tree on the map, you can understand that you can see more with the height difference. "*

[I1] *"I love that physical aspect because then you can immerse yourself in how it feels. I've even ordered a wax sealing kit so I can hand out scrolls with the new spells because I love handing our physical things to my players, and they really like it too. That's why this project intrigues me because i like the cross between physicality and fantasy."*

[I3] *"Physical things are nice for the experience."*

[I2] *"Yeah I'm just really a traditionalist. I prefer working with the tangible and physical, I like things I can move."*

Visualizations
[I4] *"Having the actions you can do visually shown; these are the things you can do this round for example."*

[I4] *"I would like to see quickly if I am hiding, for example, or having the actions you can do visually shown and be able to see how far someone could move."*

[I4] *"It's really hard to determine the different radius' of some things. one of my spells that I always struggle with is a cone, I have no idea of how far away I can use it."*

[I1] *"On paper, it often takes too much time and breaks the flow when you're trying to figure out 'can I move there'. For example, if you could digitize that data and show it or project it while knowing the location of the minis would be so cool."*

Story Telling
[I1] *"I like to switch things up, sometimes I try to change the lighting, or the smell... A friend of mine uses a smoke machine to fill his dungeons to support the story"* **[I3]** *"I love to scare my players by changing things quickly, or telling them they are standing on a trap!"*

Prototype 1

We knew that we wanted to make a new experience for the battle grid by implementing technology, while keeping it tangible. We took the insights collected in our first inter-

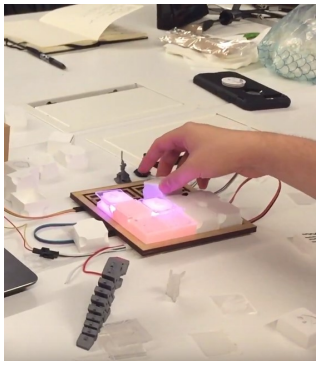

Figure 6: Participant interacting with the first prototype.

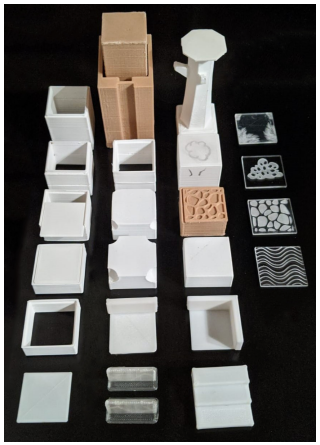

Figure 7: Block and top explorations

views and ideated through quick sketches (Appendix 5) and rapid prototyping to imagine how that could look. We were inspired in particular by MIT's inFORM [14], and imagined ways it could be implemented in a D&D map. It inspired us to make the first prototypes modular, allowing us to not only quickly try new shape explorations, but to make it easily adaptable for the players.

We arrived at a proof of concept prototype (see Figure 5) that consisted of a laser-cut four by four grid which had an individually programmable RGB LED in the center of each square. The squares were 3.3cm wide and long. White, 3d printed 'blocks' of different heights could be placed on top of the squares to create a small, modular battle grid. The blocks were created to accommodate spontaneous changes by being quickly interchangeable, based on the insights from the interviews.

The LED matrix was connected to an Arduino [5], which communicated with a processing sketch on a laptop over serial. that could be used to change the colour of the individual blocks. This was done by drawing on a virtual grid with the mouse. The keyboard keys Q to U were used to select the colour.

We explored the block shapes during this phase. We experimented with various heights, different textures to display terrain such as water and rocks, a height changing mechanism, and different corner shapes to facilitate removing the blocks easier (figure 7).

Ideation Workshops

This proof of concept prototype was tested in two initial ideation sessions. One session with three experienced DMs, and one session with a newer D&D player. The main goal of the Ideation workshop is to validate our first prototype and further explore new ideas. The full workshop outline can be found in Appendix 6. The workshops, therefore, aimed to:

- Engage with our target users in design activities in order to uncover new ideas, priorities, and flows
- Challenge our assumptions about feature development and the value proposition of our products

Participants were asked to bring pictures of their current play set up, as well as their maps as a pre-meeting immersion exercise related to D&D and their play map as asking participants to prepare in advance of a group meeting can enhance the quality of the meeting that takes place [39]. We started with a brief introduction of our concept, and we explained that the goal of the workshop was to generate some new ideas and use scenarios of our prototype. We then explained how the prototype worked and how they could use it. After this, we chose one of the participant's prepared maps and asked them to recreate (part of) it using our prototype (figure 6). They used the various block shapes and heights as well as changing the colour of the lights to represent different things. The participants were asked to think out loud and explain their reasoning for their choices while one of the researchers recorded their answers. The participants were also asked what kind of blocks they would like to see and rank them on importance. The most important being: walls, doors, and stairs.

Next, we asked them to describe their current DM experience, before, during, and after a game, taking particular note of their pain points and together brainstormed how the prototype would fit into their workflow and potentially alleviate some of their difficulties. One of the recurring pain points was when players would want to attempt an action and the group would disagree over whether it was possible

Identified visualizations:

- Hiding
- Spreading fire
- Speed
- Spell shapes (specifically cones)
- Movement ranges
- Room lighting up when entered
- Attack opportunity (flanking)

or not. All participants saw an opportunity to visualize the possible actions available to the players on the board. Together we made a list of possible visualizations that can be seen in the sidebar.

Other features which were considered included the ability to premake and save maps, to look back on the past configurations and load in community maps. With the input from the ideation sessions, the interviews, and by looking at the most popular features in already existing D&D tools such as the online tabletop role-playing platform Roll20 [43], we narrowed down four main visualization opportunities to incorporate into the second prototype. These were: movement range, attack range, spell shapes, and line of sight and chose to incorporate the ability to premake and load maps.

The user journey map with pain points can be found in Appendix 7, the developed requirements can be found in Appendix 8, and the developed personas in Appendix 9.

Prototype 2

In the second iteration, to arrive at a map size which could be play tested in a real D&D game, insights from the first ideation sessions regarding the average map scale (1 square = 5 feet) and size already in use, average character movement range (30 feet or 6 squares) and an interest in portability were taken into account. The second prototype was therefore a 15 by 15 grid, for a total of 225 squares. We chose a wooden exterior for the board which fit the D&D aesthetic since this was strongly valued by the players and DMs we interviewed. The interest in aesthetically pleasing play materials can also be seen when looking at the large selection of luxury D&D products on the market [48, 16, 12]. The board housed an LED matrix, an Arduino Uno[5], and a power supply. The prototype can be seen in figure 8.

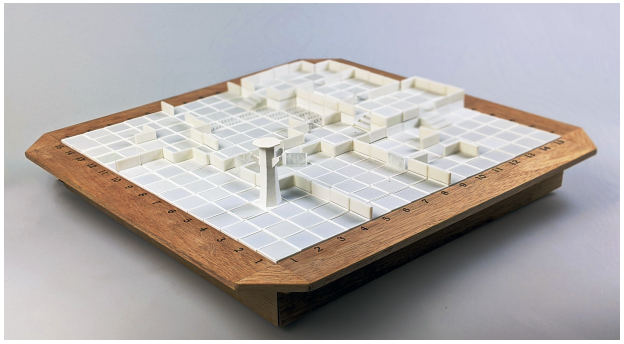

Figure 8: Truesight Battle grid

The blocks were split into two parts; a 15mm high base piece and an interchangeable top. The base pieces could be stacked on top of each other to create taller blocks. Five different tops were created that could be clicked onto a base. These different tops were: a flat piece, a wall piece, a wall corner piece, a wave pattern piece, and a stair piece. Next to this, door pieces were made. These pieces were selected based on the input of the first iteration ideation sessions.

The board was connected to a laptop that ran a processing Sketch. The software showed a two-dimensional representation of the tangible battle map, with three tabs on the right; Draw, Walls, and Visualise. In the draw tab, the user could select a colour with the mouse and then draw on the virtual grid. Changes to the virtual grid were displayed on the physical grid in real-time. This function was primarily used during testing to colour the landscape, e.g., green for grass, blue for water.

Using the walls tab in the interface, virtual boundaries could be placed to indicate the position of the walls on the phys-

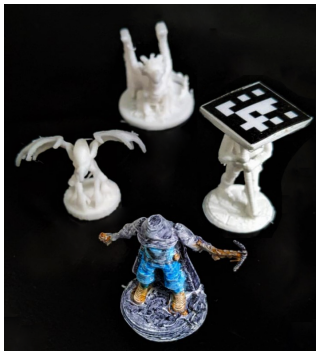

Figure 9: 3d printed minis, Aruco marker on the right.

ical grid. The virtual boundaries were later used for the movement range and attack range calculations. Colouring the terrain and placing the virtual boundaries must only be done once before the start of the game. After a map was created, it could be saved as a CSV file and loaded at a later point in time.

The last tab, Visualise, allows the user to display the movement range, short attack range and long attack range of a character. The character data has to be loaded into the program beforehand as each character has unique stats. This data consists of the name, class, race, speed, and two attack ranges. The movement range of a character can be displayed by selecting the character and movement range type and then clicking on the character's position on the grid. We use the realistic movement approach as specified in the Dungeon Master's handbook [29], where vertical and horizontal movement costs 5 feet per square and diagonal movement costs 7.5 feet. This leads to a more circular movement range than the standard 5 feet per square rule. To calculate the attack range, raycasting is used. When long or short movement range is selected and the user clicks on the grid, 360 rays are cast out from the position of the mouse. The ray is stopped when it either hits a wall or reaches the maximum attack range. Each square then checks if its circular hitbox is hit by a ray, and turns white if it is. This allows the players and DM to immediately see if something is in range, and line of sight, of a character (Figure 10). The full code can be found in Appendix 10.

Tracking

To make the user experience of the board more seamless, we implement automatic tracking of the miniature figure position on the board. The system would then be able to recognize the position and display the chosen visualization for that character with less work needed from the DM. We

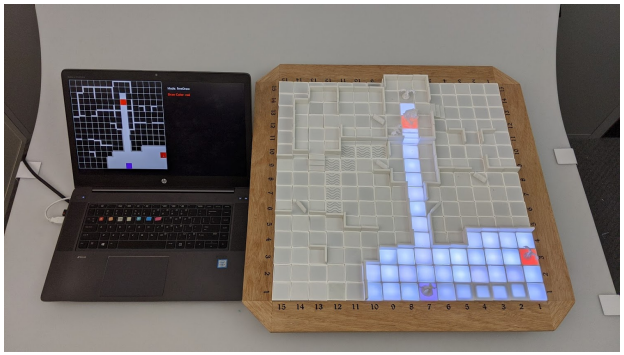

Figure 10: Attack range visualisation

considered various ways of implementing this functionality including computer vision tracking in Python and Processing, YOLO real-time object detection system [35], and introducing RFID chips and antennas directly into the board and miniature figure (minis). The requirement of being able to distinguish between the mini since each character has unique data sheets, and having the block stay easily removable (without electronics integrated into each block) made more simple recognition technologies not a good fit.

Camera Vision

Using the OpenCV library in Python, we tracked the position of Aruco markers mounted on top of the minis (Figure 9). To achieve this, we first set one corner of the board as point 0,0 and measured the distance from that point to the mini. By dividing that distance by the size of the grid square we were able to tell the grid coordinate of the mini. This coordinate was written to a CSV file which was then read by the processing sketch which controlled the board.

We experienced some difficulties with the accuracy of this

method. After devoting a lot of time towards troubleshooting, including calibrating the camera to accommodate for the warp of the lense, experimenting with the size of the Aruco marker and adjusting the sensitivities, it was not accurate enough to provide a fully playable experience in the time frame of our project

RFID
In theory, RFID tracking would the ideal solution to our tracking problem for a number of reasons.This method does not require line of sight, which means that the antenna can be integrated into the board itself and no additional setup, or calibration, is required. Another advantage to the RFID solution is that the RFID stickers could be provided to the user so that they could use their existing minis. However, this method proved too complicated, and expensive, for the scope of this project.

Ultimately, we decided to wizard of oz the tracking for the evaluation sessions, as being even one square off would make the visualisations unusable. This was done by selecting the location of the mini with the mouse and did not affect the player experience.

Evaluation
In order to evaluate our prototype, a mixed-methods approach was taken that involved collecting, analysing and integrating quantitative and qualitative data. In-depth interviews and questionnaires were used to obtain insights from participants. The goals of this research was to validate if the prototype achieved its purpose, namely helping players better understand and communicate game data, foster engagement, playful interaction, and personal learning.

Participants
In total, 8 participants took part in the final evaluation sessions, 7 males and 1 female, split into two groups of three

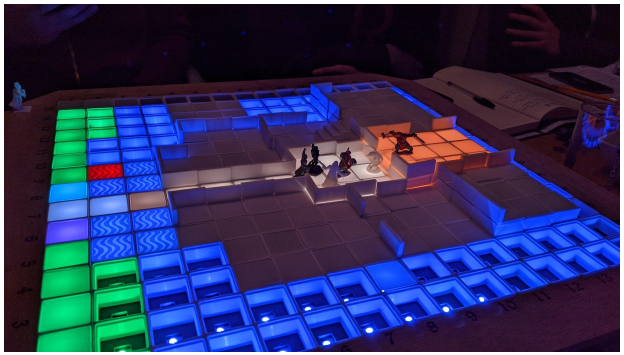

Figure 11: Truesight Battle Grid during the second evaluation session

players and one DM. All participants were above the age of 19. One session tested with an already established D&D group of four intermediate level players, recruited through one of the researchers. The other session tested with four more experienced players who were playing together for the first time, recruited through contacts at the University of Eindhoven. The recruitment poster can be found in Appendix 11. All players were familiar with the fifth edition play system and were used to playing with a battle grid.

Procedure
Before the evaluation sessions, both DMs were acquainted with the possibilities of the board and software as are noted in the sidebar. The DMs then built the map both physically and digitally before the game with our assistance. The players' character data was also preloaded to prepare the game. The experiment started with the participants signing an informed consent form and followed the ethical requirements in place at the time of the study. The evaluation was performed in a typical D&D setting with the prototype re-

Lights were used to visualize:

- Indicating the type of terrain.
- Dynamically lighting up areas of the map as the players discovered them.
- Displaying the movement and attack ranges of the characters when this was not obviously visible.
- Displaying spell shapes.
- Highlighting the square below the character whose turn it was.
- Displaying character conditions.
- Distinguishing similar-looking enemies.
- Indicating fire/chest locations.

placing a normal battle grid in the center of the table(cf. Figure 2). The DM sat at the head of the table behind a DM screen, which obscures their utilities and actions from the players. The players were seated around the table with their dice and character sheets in front of them. One of the researchers was sitting next to the DM controlling the prototype with their laptop in accordance to the DM's wishes. Each session lasted about 3 hours. After the session, the participants were asked to fill in the Game Experience Questionnaire (GEQ) [32](Appendix 12) to measure player experience, the SUS [4](Appendix 13) to assess the usability of the device, and some further additional questions to gather qualitative feedback such as "would you recommend this product to your friends and why?" and "what is the highlight of this product according to you?" (Appendix 14). We used the 2007 version of the GEQ since while the GEQ was initially developed for digital games, research states that the GEQ is also suitable for measuring user experience in board games [6, 7].

Results

Open coding [21] was used to segment the qualitative data into meaningful expressions, describing them in words or short sequences (codes). Two researchers independently open coded the open question responses and then discussed the differences of opinion (Appendix 15). When discrepancies occurred, a third researcher was brought in. By clustering, we identified patterns and categories yielding 4 main codes which are illustrated in Figure 12. These include stimulation of imagination, new opportunities compared to traditional battle maps, communication, and understanding of data and ease of use of the product.

Five participants (N=8) highlighted the benefit of the range integration and the possibility to colour code actions, entities, tiles and enemies. According to them, the tool makes

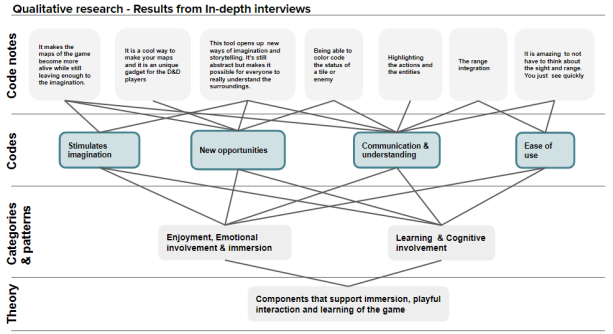

Figure 12: Open coding findings.

it possible for both experienced and beginner players to quickly understand what is going on in the game. They attribute this to the tool reducing interruptions during the game usually caused by recalling rules, character/spell rages and calculations. Three participants (N=8) mentioned that the tool fosters imagination and creates new ways of storytelling compared to the traditional battle grid. They attribute this to features such as secret traps being revealed and other real-time change of environment that support flexible storytelling. P8, for example, mentioned: *It makes the maps of the game come alive while still leaving enough to the imagination.* These aspects play a role in the enjoyment and emotional involvement of the game. All participants also mentioned that they would recommend the Truesight Battle Grid to a friend.

Based on the GEQ results (Table 1), Sensory and Imaginative Immersion scored high with an average score of 3.33 which indicates all participants reported immersion in the game. Five participants (N=8) strongly agreed that they were impressed by the Truesight Battle Grid, while all

Sensory & imaginative immersion	3.33
Tension	1.19
Competence	2.28
Flow	2.73
Negative Affect	1.20
Positive Affect	3.34
Challenge	2.25

Table 1: Scores for the seven subscales of the GEQ ($N = 8$).

ID	Score	ID	Score
1	87.5	5	62.5
2	67.5	6	65.0
3	60.0	7	82.5
4	75.0	8	57.5

Table 2: SUS scores of the eight participants.

participants found it aesthetically pleasing. All participants also reported that they felt imaginative and allowed to explore things while using the Truesight Battle Grid. Only 1 participant disagreed with being interested in the game's story, however that could also be attributed to the DM's storytelling style. Positive Affect scored an average score of 3.34, indicating that all players enjoyed the game and that they experienced an overall positive feeling during the game. Flow scored an average of 2.73 with the results indicating that the participants were fully occupied and concentrated on the game. Although most all participants reported that they felt absorbed in the game only four participants reported a feeling of losing connection with the outside world, which resulted in a flow score lower than 3. This could be connected to the negative effect score, with three participants reporting thinking of things unrelated to the game while playing it. Only one participant reported feeling bored by the story itself and easily distracted, which could again be related to the DM's storytelling style. None of the participants reported a presence of tension during the game.

The system scored in the 69.68 percentile (scores from the individual participants are listed in Table 2). It is important to note that SUS scores are not percentages, but rather percentiles, based on this, a SUS score above 68 is considered above average [4]. As such, the Truesight Battle Grid System scores from 'ok' to 'good' depending on the participant. The large variation between the participant's answers may be attributed to the different individual preferences, skills, and time spent interacting with the prototype.

Discussion

Based on earlier findings the assumption was made that introducing a tangible battle map, with technology-enabled visualizations, would help players to quickly and easily understand game play possibilities. We consider this assumption validated as players reported high immersion. Results also suggest that the system was able to provide a clear overview of the game environment, and was able to clearly communicate the game data.The visualizations and the tangible aspect of the map possibly helped players create a better picture of the situation and by this, they were able to immerse themselves more in an environment or event. The lights and colour also contribute to the structure in the game, such as the player's orders and keeping track of current status. The tool seems to foster learning. This has the potential to be particularly helpful for beginners to understand and learn the rules for long and short distance range, attack range, line of sight and spell casting. These are essential rules to understand, in order to get started with playing D&D. The visualizations reduce the mental load of novices, who can become overwhelmed by the extensive rule system.

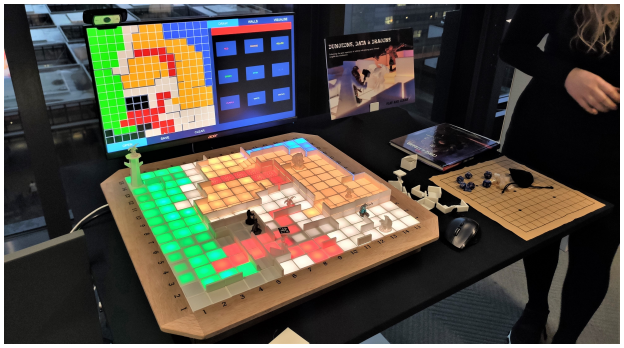

Figure 13: Truesight Battle Grid at Demo Day.

When considering the reliability of the results, the small sample size must be taken into account. A more comprehensive user testing would test with many more D&D

groups. This would also help to account for variation in DM abilities in styles when measuring the success of the tool as the story of the game and the social context play an important role in the immersion and overall game experience. If we were to use the SUS questionnaire again, we think it would be more reliable to seperate the ratings of the DMs and the players since the DMs interacting with the software while the players only interact with the board. Another limitation was that the system could not track the different minis automatically.

Conclusion and Future Work

In this project, we reported on the initial design stages of the Truesight Battle Grid: a three dimensional, modular, tangible battle grid which uses lights to visualize game play possibilities in the role-playing game of Dungeons & Dragons. Our results suggest a high level of immersion when introducing technology to the traditionally analogue game. The tool is reported to help role-players to quickly understand and communicate game data, as well as foster imagination and create new ways of storytelling compared to the traditional battle grid. Next steps will be to enhance this initial prototype in terms of the interaction experience. First by making the user interface more intuitive and faster to use for DMs so that it can be fully integrated into game play. NFC tracking of miniature figures has been investigated during development and could be implemented in a future iteration to provide a more seamless experience. The tangibility of future prototypes is also considered with new tops such as trees or other elements. As we said before, our product is geared towards D&D players who currently play with 2d utilities. However, by offering paintable, more detailed, tops (e.g. textured tops and walls) our product could also be interesting for players who prefer more realism. The online segment could also be targeted by offering a “remote play” function, where players who could not attend the session in person are able to join virtually. These players would be represented by a lit tile.

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