

# User Oriented Design Speculation and Implications for an Arm-Worn Wearable Device for Table-Top Role-Playing Games

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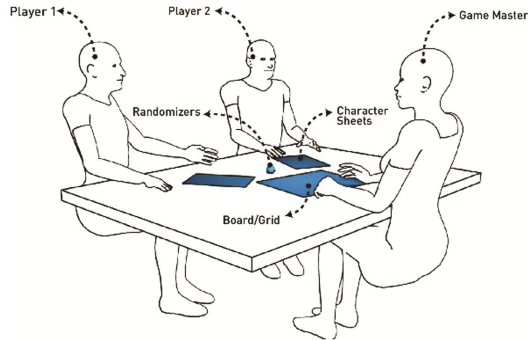
**Abstract.** Augmenting table-top role-playing games (TTRPG) with computers is an extensive research area. Nevertheless, wearable devices were not considered a part of TTRPG before. Previous studies speculate that wearables may be valuable additions for games by altering many aspects some of which can address TTRPG such as character identification. Still, we did not encounter a player oriented exploratory study which suggests possible utilization ways for these devices. Therefore, we organized a participatory design workshop with 25 participants aiming at eliciting ideas from users to produce design knowledge about the interaction techniques, actions, visual properties and the GM's role. We also wanted to understand users' overall reactions to the idea of wearables in TTRPG. The workshop resulted in 5 conceptual device designs which led to design implications that can guide designers in this unexplored area. Moreover, we proposed a speculative arm-worn device drawing upon these implications.

**Keywords:** Wearables · Role-playing · Games · Game research · Game design · Movement-based game-play · Participatory design · Design workshop · User centered design · Design speculation

## 1 Introduction

Table-top Role Playing Games (TTRPG) are games in which players assume the role of their fictional characters. Game consists two types of actors which are players and the game master (GM). Players role-play their characters in an imaginary world written and moderated by the GM. TTRPG can have ancillary objects such as dice, character sheets, boards or figures. Conventional setting of TTRPG (Fig. 1), however, does not include digital artifacts. Nevertheless, recent studies integrate computer assisted devices such as notebook computers, interactive boards or surrounding systems like interactive rooms into role-playing games for altering especially narrative, ludic and functional properties [6, 14, 21]. However, previous studies did not consider wearable devices as a part of TTRPG. Thus, design knowledge regarding to user preferences for wearable devices do not exist in the field.

There are many studies aiming at augmenting the table-top games. [5, 14, 21, 23]. These studies aimed to enhance the table-top gaming experience by speeding up the



**Fig. 1.** Setting of conventional PnPRPG

calculation processes, improving communication abilities, bolstering sensory experiences and adding novel mechanics. In case of TTRPG, these additions left more space for role-playing by debilitating the conditions interfering with acting process. Drawing upon the previous studies, we believe that exploration of these devices in TTRPG context is valuable since wearable devices are claimed to enhance game experience with introduction of new interfaces and modalities [1], utilization of body as a controller [1, 2] and strengthen the feeling of character identification [3]. Still, we did not encounter a player oriented exploratory study which suggests possible utilization ways for these devices.

In the direction of these arguments, we believe that an arm-worn device may enhance the TTRPG experience. However, providing the ideal experience to players can only be possible with a ready-to hand device and such device can be designed with user-oriented design knowledge which was not covered by previous studies. In order produce this design knowledge, we organized a participatory design workshop with 25 participants including TTRPG players, game masters, cosplayers, jewelry designers and interaction designers. In this workshop, we asked participants to design non-working arm-worn device prototypes and “role-play” using them in a game scenario. Our expectations from the workshop were to (1) see users’ reactions on positive and hindering parts of the wearable idea, (2) learn their preferences about the game actions to perform with this device, (3) understand their desires about the interaction techniques which refers to input and output methods (4) see their visual design decisions and (5) understand GM’s role in controlling these devices. We especially focus on arm-worn devices, since they are easy to reach and control, attached to the upper part of the body which is visible in a table-top setting. Moreover, we wanted to narrow down to scope to have a more fertile workshop process. Upon the workshop, we discussed the design implications and proposed a speculative design with the design knowledge gained from the workshop.

## 2 Related Work

Augmenting table-top games with computers is a well-adopted practice in game design field [4–8]. However, we did not encounter any example which specifically proposes

augmenting the TTRPG with arm-worn devices. Nevertheless, utilization of wearable devices is common in games which have similar characteristics [9–14]. Pervasive games, physical games and live-action role playing games (LARP) were considered suitable environments for the integration of the wearable devices.

Before referring to wearables, we should examine the work on computer augmented games (CAG). STARS Platform [7] is a remarkable example which was designed to be adaptable for different kinds of games with a room-sized interactive environment. This is one of the first and noteworthy examples of a working CAG system. Other than implemented systems, a recent work by Bergström and Björk pointed out 6 different CAG cases and extracted 8 dimensions which define the game design space for CAG [4]. These dimensions form constructive insights and define the design space of CAG in a convenient way. A similar study puts the primary aim of the CAG to decrease uncaptivating game processes, integrate game mechanics which can only work with computational power and maintain the social interaction level [6]. Another project, Undercurrents is a software which will remove undesired gaming processes like complex calculations and add enhanced properties like private communication by also emphasizing the importance of calm technology [5].

Another domain which is more related with TTRPG is Live-Action Role Playing Games (LARP). Lindley and Eladhari coined the Trans-Reality RPG concept which combines LARP, TTRPG and computer RPG (CRPG) using the advantages of each game modalities [15]. Proposed design does not include wearables, yet the concept of bringing together CRPG, TTRPG and LARP also corroborates with our concept of creating sensory experiences and costuming properties which is essential for LARP [16]. We may exemplify usage of wearables in LARP with the projects of Thumin Glove [13] and Gauntlet [12]. Both of these devices were developed for enhancing the game experience with new game mechanics generated by the computational power. Both studies draw conclusions from the user remarks.

Previous studies also suggest that wearables can strengthen the bond between player and the imaginary world which is an essential quality for TTRPG. Lightning Bug [3] examines wearables as costumes and question how they can foster the connectedness to imaginary worlds. Tanenbaum et al. also claimed that wearable devices can mediate one to feel as another character [2]. Supported by these projects we believe that connectedness to fictional world and characters in TTRPG can be bolstered by wearables.

The studies are indicators of how computers may be sources that can foster the tabletop games by shortening undesired processes, introducing new game mechanics and fostering the sensory aspects. Moreover, previous studies indicate that wearable devices can bolster the game experience by increasing the connectedness to imaginary worlds. Wearables also were speculated to support calm technology which has been coined as an important aspect for CAG [5]. However, these projects did not investigate wearable devices for TTRPG. Moreover, they do not focus on presenting user-oriented design knowledge which can inspire designers. Therefore, in our study we aimed at exploring this unvisited field by involving users in the design process, understanding their reactions and eliciting ideas.

### 3 Method

For examining the use of wearables in TTRPG, we integrated users in the design process from the very beginning with a participatory design (PD) workshop. PD is a widely adopted method for eliciting design ideas from the users, understanding them and producing design knowledge which will serve to the broad-range of fields [17–19].

#### 3.1 Participants

25 participants which are *TTRPG players, game masters, cosplayers, interaction designers and jewelry designers* took part in the workshop. TTRPG players and GMs were our main users. We included cosplayers due to their knowledge in making costumes of fictional characters. Interaction designers were to assist projects in terms of interaction techniques while the jewelry designers helped in the visual design. We included jewelry designers since the wearable device design were mostly related also with smart jewelry. Table 1 demonstrates users' backgrounds, experiences and relation with the field. For acquiring participants, we posted a call to social media pages and e-mail groups related to RPG, cosplay, games and design. This call included a brief explanation of the workshop and a visual prepared by us to attract attention. We chose participants among 143 applicants according to their backgrounds and experience in related fields. We provided breakfast, lunch and transportation for the participants, yet we did not offer a payment. We believe that the TTRPG players, GMs and cosplayers wanted to participated in the workshop since they are usually enthusiastic for alternative culture events. Jewelry and interaction designers may also be motivated by the novel topic (wearable devices) of the workshop.

#### 3.2 Procedure

We motivated the workshop by stating that we investigate the usage of wearable devices in TTRPG and did not disclose the arguments of previous work about costume properties, embodiment of characters and unobstructed interaction in order not to direct participants towards our opinions and to elicit objective ideas which are not affected by a certain point of view. The workshop lasted two consecutive days, in total 16 h.

The first day of the workshop focused on creating use case scenarios for devices. It started with a brief presentation about the utilization of wearables in HCI, in role-playing games and the schedule of the workshop. After the presentation, participants were divided into five groups. Each group incorporated one participant from all audiences. Then, in a brainstorming session which lasted about two hours, each group generated several ideas about the employment of the arm-worn device in the game. Jewelry and interaction designers led this brainstorming process. Each group presented their ideas with sketches, notes and mind-maps after the brainstorming session. All the participants watched the presentations and made their comments on the ideas. After presentations, we wanted each group to choose one of the alternatives and prepare detailed use case scenarios for the wearables. First day of the workshop concluded with final PowerPoint presentations which explains the preliminary use cases.

**Table 1.** Breakdown of participants (CP: Cosplayer, IxD: Interaction Designer, JD: Jewelry Designer, RP: RPG Player, GM: Game Master, XP: Experience in Years)

Part.	Age	Sex	XP	Notes
CP1	28	F	5–10	Masqueraded more than 10 characters
CP2	24	F	2–5	Masqueraded more than 10 characters
CP3	21	F	2–5	Masqueraded more than 10 characters
CP4	31	F	2–5	Masqueraded more than 10 characters
CP5	20	M	0–2	Masqueraded 3 characters
IxD1	24	F	3	Designer in a web-design company
IxD2	30	M	2	Musician working on wearable devices
IxD3	22	M	2–5	IxD student worked in prof. projects
IxD4	25	M	2–5	Industrial designer working on electronic devices and interfaces
IxD4	26	F	5–10	IxD in a game studio
JD1	27	F	0–2	Industrial designer with the fashion accessories master degree
JD2	29	F	>10	Jewelry designer and seller
JD3	34	F	5–10	Fashion design researcher with a master degree in fashion in game design
JD4	25	F	2–5	Industrial designer who designs and sells jewelry
JD5	24	F	0–2	Industrial designer with a jewelry design related work background
RP1	23	F	4–6	Knowledgeable D&D and custom RPG systems
RP2	24	M	4–6	More than 5 different RPG systems
RP3	21	F	4–6	More than 5 different RPG systems
RP4	21	M	>6	4 different RPG systems
RP5	21	M	0–2	More than 5 different RPG systems
GM1	27	M	>6	Knowledgeable in moderating 5 different RPG systems
GM2	33	M	>6	3 different RPG systems
GM3	25	M	>6	More than 5 different RPG systems
GM4	26	M	4–6	3 different RPG systems
GM5	25	M	>6	More than 5 different RPG systems and the co-founder of a RPG community

The second day of the workshop aimed at defining the form factor, visual properties, making the visual (non-working) prototypes and “role-playing” the use cases, which were designed in the first day, in a real game scenario. First, participants designed and produced visual prototypes with the materials we provided such as leather strips, beads, jewelry accessories, model clay, cardboard and cloth pieces. Groups also used the materials which the cosplayers and jewelry designers brought along to the workshop. After the visual prototypes were created, they wore them and played a short (about an hour and half) session of TTRPG by “role-playing” as if the devices were working (Fig. 2). Forming user scenarios with role playing and making users explore the design space by creating prototypes was claimed to be effective also by previous research [20]. The game systems and the scenarios in these sessions were decided by GMs in each group. We also wanted participants to document this process with photos. These photos were turned into video sketches [21] to be presented at the end of the second day. We specifically facilitated

video sketches, as they are useful expressing the ideas quickly and finding hindering parts of the use cases. After the presentations, we made a semi-structured group interview to understand participants' opinions on the possible contribution of the device. Questions were about the main contribution of the device, effects on the game, visual properties, ways of integration, GM's Role and the possible interaction techniques.



**Fig. 2.** Gameplay session in the second part of the workshop

We analyzed the workshop results drawing upon the visual prototypes, video sketches, video records of presentations and voice record of the group interview.

## 4 Device Concepts

In this section, we explained all projects in detail by commentating the concepts, interaction techniques, game actions, visual factors and GM's Role since a product is comprised of form, material, function, cultural aspects, interaction and environmental design dealing with the mental models of users [22]. We encapsulate the form (visual aspects), function (actions), interaction (interaction technique). We also examine the



**Fig. 3.** Some of the visual non-working prototypes from the workshop

GM’s role as a separate entity, since it is a special case for TTRPG. Material, cultural aspects and mental models of players can only be examined in production level and upon long-term engagement with the product. Figure 3 shows visual non-working prototypes and Table 2 demonstrates the main properties of designs.

**Table 2.** The properties of the device concepts – C (Combat), NC (Non-Combat), PC (Private Communication), DR (Dice-Rolling), MF (Move Figure), FC (Fully Customizable), PDC (Pre-designed Customizable)

	Interaction techniques		Game actions		Visual styles		GM Control
	Input	Output	In-game	Out-of-game	Feature	Appearance	
Group1	Tangible, auxiliary	Visual, haptic	C, NC, PC	–	FC	–	Separate console
Group2	Gestures, body sensors, touch	Visual	C, NC, PC	–	FC	–	Separate console
Group3	Gestures, voice, touch	Audial, visual, haptic	PC	DR, MF	PDC	Daily Use	Enhanced wearable
Group4	Tangible, touch	Visual, haptic	C, PC	DR	PDC	Character	Enhanced wearable
Group5	Voice, auxiliary, tangible	Audial	C, NC, PC	DR	PDC	Character	Enhanced wearable

**4.1 Group 1 – RPGear (Fig. 4)**

RPGear is focused on increasing the spatial awareness of the player about the fictional world. The concept adapts a gameplay similar to role-playing games which includes boards and figures. RPGear has auxiliary parts, called “beacons”, which are used for defining the game area/map as if there is a board. Moreover, beacons are also used for defining the character figures, their locations and their connection with the wearable device. As the game progress, the information about the environment is transferred to the device and the players can react to the events according to their skills. For examples, if a player come across with a cliff, she/he can use Climb command if she/he has the ability. Similarly, during the combat, players can select the skills they had when the turn is theirs. The success of the moves is shown with LEDs which are visible to all players. Private information like private messages, character properties, intractable objects or available skills are demonstrated with a private display which remains under the front-arm.

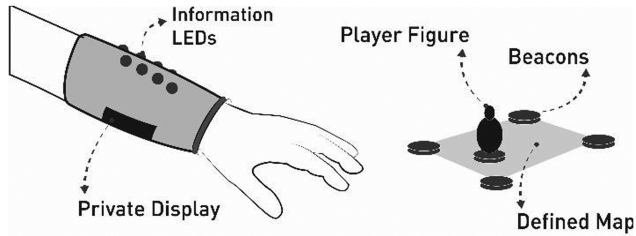


Fig. 4. Group 1 - RPGear device instructions

#### 4.2 Group 2 – Nameless One (Fig. 5)

Nameless one focused on encouraging players enact their characters by making use of gestures and body conditions. Mid-air arm gestures and player's body conditions detected by body sensors like galvanic skin sensors are the primary inputs. Instead of expressing the command verbally and rolling the dice for calculating the outcome, players perform mid-air gestures. For example, when encountered to foes, one should swing her/his arm for performing a sword attack. After the gesture is performed, body conditions detected by sensors also affect the outcome.

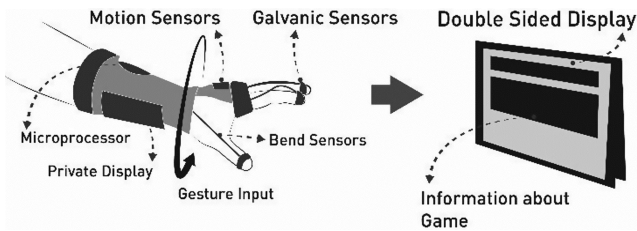


Fig. 5. Group 2 - the nameless one device instructions

Different than other projects, primary output is provided via a separate double sided display one side of which is visible to all players. Game events are to be monitored from this display. Information which should not be available to public is shown by small displays on wearables. The group also added a small device which emits scents to the environment in order to increase sensory experiences.

Other side of the double-sided display was faced to GM and functions as GM console. GM can manipulate the environment, alter the difficulty of the game and decide the outcomes of the moves.

#### 4.3 Group 3 – RProp (Fig. 6)

The primary goal of the RProp is to provide private communication capability to players by using directional speakers. The device is consisted of two parts. One part includes



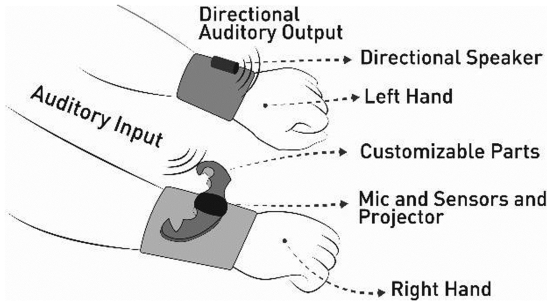


Fig. 6. Group 3 – RProp device instructions

the main module comprised of a projector and a microphone. Other part hosts the directional speaker. Players speak the messages directly to microphone and point their arms to the player who should hear the message.

As a secondary function, RProp simulates dice-rolling when a player performs the dice-rolling gesture. When the dice is rolled, device calculates the outcome by the virtue of character information loaded in its memory. The outcome can be seen from the projected display which is formed via the projector embedded the main module. This display can also be used as an alternative for getting private messages. Moreover, figures on the grid can be controlled through this display.

RProp provides a playful engagement for GM. GM device can be linked with the objects in the gaming environment. For example, when GM says “It’s getting dark” while telling the story, the lights of the room dim.

Both parts of RProp are customizable and players can customize them with pre-designed parts. Group 3 expressed that, they aimed at designing a minimal device which can be worn also in their daily life.

#### 4.4 Group 4 – RPGear (Fig. 7)

RPGear aims at speeding up the dice rolling process and encouraging players to express their character’s progress with visual cues. Group 4’s prototype stores the character information and lets players attach badges to device which shows their character achievements and history.

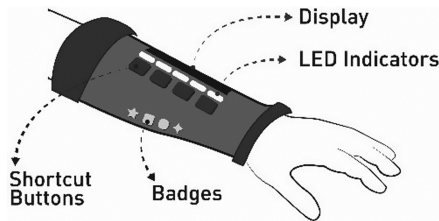


Fig. 7. Group 4 – RPGear device instructions

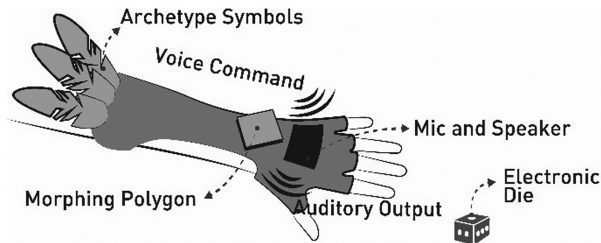
RPGear has buttons, a display, LED indicators and badge sockets. Buttons are for performing various dice-rolls and specific attacks. The LED indicators show the mana or health level of the players. When the move type is chosen and the dice are rolled by the device, the display shows a solid color depending on the success of this move. Although device can manage all kind of dice-rolling, Group 4 decided to keep dice in the game. They are not functional but they expressed that dice should not be removed completely as they were a symbolic part of TTRPG.

GM device differentiates from other players by its size and look. Its design is more flamboyant compared to the player devices. RPGear adds physical interaction to game. GM should touch other players' devices to make the outcome affect them when s/he performs a move.

Players can add badges to the device which reflects the characters' properties and achievements. These badges also activate the achievements in an online platform which functions as a social network between players who has a RPGear.

#### 4.5 Group 5 – Gauntlet of Fate (Fig. 8)

The main purpose of Gauntlet of Fate (GoF) is reflecting the fictional character by using nano-technological clothes which can morph into different shapes. Therefore, every player may turn their devices into something which is related to their character properties.



**Fig. 8.** Group 5 - gauntlet of fate device instructions

As a primary input, Group 5 used voice commands. For example, when a player says “Fireball”, the device executes that move. Dice is also a part of the input system. When the dice is rolled, the outcome is transferred to the device for calculating the value of the move. The output of the move is also announced by device via speech. Group 5 indicated that this interaction technique provides non-distracting gameplay. Additionally, device has a part which has a shape of a polygon. The edge number of the polygon is determined according to the number of players. If there are 4 players, this polygon-shaped part morphs into a square and each corner represents a player. GM can select specific players by touching the specific corners.

GM device, different from the players' devices, is two part and worn to both arms. Therefore, it is more radiant than others. The device of the GM has several enhanced properties. For example, GM can attach some figures to the devices which show the number of the fictional characters who passed away during the games that he moderated.

Moreover, GM can send a “whisper of GM” which includes private information by talking towards his palm. Players can listen these messages via speakers of the device. Furthermore, device is able to change the voice of the GM during the storytelling according to characters she/he enacted.

GoF can also be upgraded with new parts as the fictional character levels up. Therefore, players can represent their fictional characters with their device’s appearance.

## 5 Discussion

We evaluated the visual prototypes, presentation videos, workshop notes and the voice record of the semi-structured group interview for analyzing the outcomes of the workshop. According to the evaluation, players’ opinions indicate that arm-worn devices may contribute to the RPG environment by (1) adding new game play styles, (2) automatizing the undesired game process, (3) enhancing the sensory experiences. Apart from these positive additions, participants expressed their concerns about the distraction possibility which may be caused by the interaction with the device. In this section, we commented on how the results corroborate with previous studies and how our implications may hint to design of wearables for TTRPG. We believe that these implications are important since they provide the design knowledge which is open to interpretation [23] that can lead to many different designs.

### 5.1 New Gameplay Styles

Previous research on CAG indicates that integration of new game play styles as a result of the computational power is an expected result [6]. Our study also shows that this also reflects the TTRPG players’ mind as four of the groups proposed changing the game play style slightly or radically.

The most radical change was proposed by Group 2 with the introduction of movement-based play and the effects of body conditions. Previous research in games indicates that movement is a phenomenon which may result in an increased engagement [24–26]. Yet, movement-based play was not investigated in the context of long-term games with rich narrative. As RPGs may have limitless in-game actions, assigning different movement patterns to each action can be mentally or physically fatiguing. Substantiated with this statement, Group2 assigned gestures only to main actions like attack, defense or spell-casting instead of all actions. This way, players do not have to memorize different gestures, for different spells. To exemplify, they can use the same gesture for all ranged attack spells, yet imagine different results. In this way, the system becomes more scalable and usable for players. This new addition to game, turned the game into a real-time game where players need to react events in real time instead of the turn-based structure of conventional RPGs. For instance, players may have to attack to a certain enemy by swinging their arms for attacking with a sword. In the conventional structure, dice should be rolled for the player and for the enemy to conclude this encounter. However, new structure proposes players to swing their arms in a right timing and reduces the process into just one move. If player can have a good timing, than she/he

can take out the enemy successfully. Still, each player performs their moves in the turn-based system and rest until the turn is theirs which bypasses the physical fatigue.

Group1 also radically changed game play style by removing dice and the board completely. They used beacons for digitally defining the map and instead of using dice, implemented CRPG-like system in which players can choose skills to perform on the wearable device's display. Moreover, device can provide sensory feedback like visual and haptic easing the spatial comprehension for the imaginary environment. The approach of this group put the game into a space between CRPG and TTRPG by adopting sensory and scripted nature of CRPG and social, limitless and imaginary environment of TTRPG. Other groups also made slight additions to gameplay like tangible inventory system (Group5), global achievement system (Group4).

Although changes in game-mechanics were acceptable, players expressed that RPG elements like character properties should not be overwhelmed by new additions. For example, during our discussion in the group interview, challenge-based game mechanics were taken skeptically. One of the players said that "I am a tiny person, however I always role-play a barbarian character. How will I overcome the physical challenges which will be faced by my character with my tiny body?" This indicates that imaginary characters' properties and similar role playing elements always should be the primary concern and their emphasis should not be reduced by new additions.

Players preferences and opinions indicate that wearable devices can conceive new game play styles, interactions and mechanics which may bring the TTRPG closer to CRPG and LARP. Still, new game mechanics should be implemented carefully by not overwhelming the RPG elements like character skills.

## 5.2 Transforming the Undesired Game Properties

RPGs are based on impersonating a character and acting it. However, most of the RPG systems have game rules which require long and complex calculation processes. These calculation processes can be considered uncaptivating [6]. Participants showed an inevitable consensus on automatizing these processes. Similar features also were introduced in previous CAG [5].

First, the common point for all groups was assigning character information and dice calculation to devices. However, they followed different approaches. Group1 and Group2 replaced the conventional dice rolling system with new game mechanics, whereas other groups decided to keep the conventional game play. Group4 and Group5 kept the dice physically in the game while the Group3 replaced it with a dice-rolling gesture. Moreover except for Group2, all groups kept the tangible props like figures or a game board in the game. Previous research also suggests that the tangible props, and especially dice [27], have an important effect in table-top gaming experience. The moment when the dice is rolled, the excitement occurred until the result is revealed and the materiality [28] of it stand as important properties of TTRPG experience. Even, one of the players said "Dice is like the treasure for role playing gamers and I am attentive not to lose any of them".

Another common point was the private communication feature. In a conventional TTRPG setting, private communication is only possible with note papers or whispering

to the ear of players. However, this process does not create the ideal experience since all the players are aware that a secret message is delivered to a specific player. With wearable devices, participants emphasized the opportunity which improves transmitting secret and private messages.

Our observations showed that removing and automatizing the processes which intervenes with role-playing process and entertainment such as calculating dice outcomes should be done by devices. Still, we saw that, as also previous work suggests [27, 28], player may keep the dices or other tangible props in the game system even if their functionality are replaced by devices. Therefore, how these kinds of props will be integrated to the game system supported by wearable devices should be scrutinized by designers. Other than this, wearables can transform and enhance the communication between players by providing features such as secret or private messaging.

### 5.3 Sensory Experiences and Character Identification

TTRPG is built on the imagination of players and visual support is usually provided by miniature figures and boards. However, players took the opportunity of using more dynamic visual, audial and haptic feedback to foster the sensory aspects of the TTRPG with wearables. Previous studies also remark the advantages of computers in enhancing the sensory experiences [29]. Group1 used LED and Haptic indicators, Group2 coined the idea of a scent emitter, Group3 gave the proposal of GM's ability to manipulate environmental conditions, Group4 and Group5 came up with visually customizable devices enhancing the identification experience with fictional characters.

Still, participants also expressed the worry for the distraction that can be caused by the excessive visual feedback. Therefore, peripheral interaction methods were proposed which are not visually distracting and captivating like gestures, voice commands, tangible buttons, haptic and audial feedback. Moreover, visual feedback is mostly used as sole colors, simplified information and mostly for calculation results and character information. At group interview, one of the participants also said "If we are stuck to the device, this may break our concentration to game."

Designers should acknowledge that although players consider that an arm-worn device may enhance the game, the interaction techniques should not be distracting and prevent social communication. Wearables can more advantageous than other types of devices in that sense, since they are speculated to support "calm technology" by remaining at the periphery of users [30]. The maintenance of social aspects was also asserted as an important property by previous research [6]. Moreover, especially haptic feedback come forward as specific to wearables as they are attached to the body. Similarly, identification with characters through customization, as also indicated by previous research [2, 3, 14], is wearable specific.

### 5.4 GM's Role

Previous studies in augmenting TTRPG explored the possible functions for GM's in CAG which also corroborates with many of the features proposed by participants like immediate control availability, map and story preparation [5]. However, different from

the previous work, our study put forth interaction, game-play, visual style and feature preferences of GMs for arm-worn devices in TTRPG.

First of all, while two groups proposed a separate console, other groups preferred a wearable device for GM. A separate console is advantageous in administering a detailed interface which may let GM control the players' wearables and the game with much force. On the other hand, a wearable for GM can be more desirable as it can include GM in the game not only as a moderator but a player. One of the GMs expressed that "Game Masters should also be considered as a "player", as moderation and story-telling get boring if you cannot participate in the game."

The enhanced features for GMs were environment control, voice changing, private communication, manipulating game environment, creating NPCs and controlling other devices. Moreover, wearable GM consoles were visually different than the player devices. Group3 preferred a different color, Group4 expressed that GM has a more flamboyant device and Group5 proposed devices which can be worn to both arms different from the single-arm devices of players.

Participants preferences in the workshop showed that GM's can either have a separate console or a wearable device for controlling the game. Independent from the version they have, GMs should be able to manipulate many aspects of the game. Some of the abilities they have even may make them feel as if they are super-powered players of the game. Corroborating with this, in case they have wearable devices, these devices should be different and even more flamboyant and superior than player devices.

## 6 Design Implications

User reactions and device concepts lead us to extract design implications which may guide the designers of such devices. Moreover, we believe that these implications will also be constructive for other kinds of wearable and personal gadgets which may be used in computer games, pervasive games, serious games or gamification projects.

**Non-Distracting Interaction Techniques.** All groups preferred interaction techniques which remains in the perceptual area of the players. For example, haptic or audial feedback which does not require a direct attention to be perceived preferred more than other techniques. Visual feedbacks were mostly solid colors or LED lights at which can be perceived without directly looking. Likewise, gestural, voice or tangible inputs preferred which does not require a direct look, browsing and such. This is important for maintaining the social interaction and satisfies our motivation about the calm interaction [28].

**Designing devices in interaction with the auxiliary objects.** Four of the groups decided to keep the supportive objects like dice, grids, and figures. Therefore, instead of assigning the roles of these objects to wearable by removing them from the game, designers should scrutinize to form an interaction between this objects and the wearable. This finding is also supported by previous research suggests that use tangible objects like dice increase the table top gaming experience [5].

**Automatization of Uncaptivating Processes.** By design, out of game moments like calculation after dice rolling occur repeatedly during the gameplay of TTRPG. All of the groups assigned processes like dice-rolling or storing character information to device. Thus, device has to speed up all of the out-of-game processes. Previous research on CAG role-playing games also suggest the advantage of electronic devices in this manner [18, 19].

**Different information levels.** As explained in the descriptions of “Device Concepts”, the information needed by players were classified into two as public and private information. Therefore, designers should consider how to place information which is relevant to other players and which is private to the wearer. Private displays or auidial feedback were preferable for private information while LED’s or public displays were used for public information.

**Enhancing the communication between players.** Another function used by all groups was private communication between players via auditory output or via displays. GM or other players need to communicate with each other secretly time to time. This property also was reported preferable by users in a previous study [3]. Therefore, easing the communication between players should be considered as an important property of the device.

**Assigned in-game actions should be adaptable to narrative.** All actions assigned to the devices have to be simple actions like attacks, or skills which are liable to success check, details of which can be expressed by game master according to the narrative. Otherwise assigning commands to each action is not scalable. Therefore, no action should be precluded because the device does not support them.

**Exploring new gameplay styles.** All the groups proposed new interaction techniques both for players and GMs via use of embedded sensors or electronic auxiliary objects. Moreover, Group1 transferred mechanics from CRPG while Group2 introduce a whole new approach with movement-based gameplay. Therefore, designers should not ignore that novel interaction techniques and gameplay mechanics are welcome by players in an integration of such device.

**Customization of the device can serve as an upgrade to character properties.** As Group 4 and Group 5 suggested devices may be a part of an environment where the fictional characters’ skills are developing as the device is visually upgraded with different parts in real life. This also supported the claim of Isbister suggesting that costumes may increase the connectedness to imaginary world [11] as players consider them as a part of their fictional characters.

**Participatory customization space.** While three of the groups proposed a customization space with pre-designed parts, two of them proposed customizing the device from the scratch. We believe that a customization space for such device should form an environment which guides players to design their devices easily with pre-designed parts while letting them to modify it with outer parts.

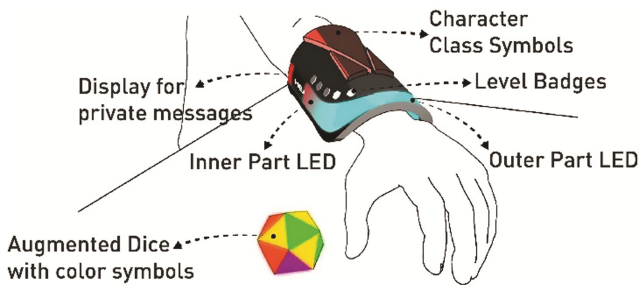
**GM as a player.** Game masters can be considered as god-like beings in the fictional world of the game while granted with improved skills for their devices. One of the participants expressed that “Game Masters should also be considered as a “player”, as moderation and story-telling get boring if you cannot participate in the game.” Therefore, while designing a wearable device for PnPRPG, game masters should not be considered referees or moderators only as they also devote themselves to the game voluntarily and for enjoyment.

**Enhanced visual appearance for GM Device.** Visual properties of the devices also showed differences from the players’ devices. Group 3 favored a color change in modules, Group 4 and Group 5 designed a bigger, more flamboyant and multiple-module device. Therefore, GM device should be different than the other players’ devices and its visual properties should express the GM’s superior status.

**Immediate control ability of GM.** As in the GM consoles of Group 1 and Group 2, game master should be able to step in the decision mechanism of devices whenever she/he wants and manipulate the outcomes according to the story. For example, if a dice calculation or a result of a challenge based attack is more than what is meant to be according to story, GM should be able to change the output.

## 7 Design Speculation

Upon our analysis and design implications extracted from the user preferences, we designed a speculative arm-worn device which may satisfy the TTRPG Players (Fig. 9). Design speculations contribute to the field by informing the community about the possible future designs about a specific topic [31–33]. Still, this is only a one type of interpretation of the design knowledge we presented and it may lead to many more different proposals. Among our many implications we extracted following design motivations for our speculative design. We only focus on player device, thereby our implications about GM device are not in the scope of the following speculation. Our motivation for this speculative design is based on (Design Motivation 1) automatization for uncaptivating process, (DM2) introduction of new game mechanics with movement-based play, (DM3) support by auxiliary objects, (DM4) customization depending on the



**Fig. 9.** Speculative arm-worn device design for TTRPG



fictional character, (DM5) non-distracting interaction techniques, (DM6) introducing actions adaptable to narrative. We also conducted a preliminary user test with an experience prototype which encapsulates some of these design motivations as a successor of this project [34].

**Concept.** This device aims at encouraging the players to act their characters by performing the actions with body movements and visually customizing the device for reflecting the fictional character. Moreover, the device works for automatizing the dice calculations and private communication between players.

**Interaction Technique.** WeaRPG is mainly operated with gestures (DM2, DM5). Gestures are only assigned for actions which may define the essence of the movement like power, concentration, reflex and precision (DM6). In this way, these actions can be adapted to many different scenarios in the narrative of the game. For example, an attack with sword requires power gesture which needs swinging the arm as strong as possible while dodging requires rapid movements of arm in the right timing. However, gestures do not affect the outcome directly, yet affect the augmented dice. If the gesture is successful, the green sides of the dice increase compared to red sides (DM3). Output is provided with a LED stripe inner part of which reflects the private information like a secret notification from GM while the outer part demonstrates the public information like a success of the move performed (DM5). There is also a small display which only shows private messages from the GM (DM5).

**Actions.** Combat and Non-combat actions can be performed with WeaRPG thanks to the global gesture system which may be adapted to a wide range of actions in the game. Moreover, it also calculates dice-rolls and provides private communication (DM1). In an example scenario, a player encounters with an enemy and performs concentration and power gestures for activating a fireball spell. The gesture performance is fairly good, so the green parts of the dice increase. When the dice is rolled, luckily, green side comes which result in the elimination of the foe.

**Visual Factors.** The device includes a component which allows magnetic parts to be attached. As seen in Fig. 9, players can attach different figures which can reflect their factions, races or classes depending on the different game systems (DM4). Moreover, badges define the levels of the character (DM4). Other than the customization properties, a LED strip surrounds the device. Moreover, a display is embedded to the inner part of the device enabling only the player who wears it see.

## 8 Conclusion

As a result of our study we presented detailed explanation of all projects in our participatory design workshop with 25 participants. We also reflected our designerly comments on the devices, extracted design implications drawing upon the proposed designs, participants' comments, ideas, presentations and made a design speculation for a wearable device which can be used in TTRPG. Our findings demonstrated that an arm-worn device may contribute to augmentation of table-top games in terms of adding new

gameplay styles, removing the undesired game processes and fostering the sensory experiences which lacks in conventional table top setting. Moreover, we conclude that non-distracting interaction techniques like gestures, tangible buttons, voice commands, simple visuals and audial feedback should be preferred in order to maintain the social environment without capturing players' attention to devices.

The speculative design we proposed should be tested with further user tests to understand its effect on player experience. However, a product which would works towards enhancing the gameplay experience with a better character identification can only be possible with a ready-to-hand product. Our study proposes the detailed explanation of conceptual projects, design implications and a speculative concept which adds to the field with user-oriented design knowledge on wearable device design for TTRPG and forms the path which goes to such ready-to-hand design.

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