

# Bubble Jumper

## Enhancing the Traditional Japanese Sport Sumo with Physical Augmentation

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Figure 1: Bubble Jumper a superhuman sport providing you the experience of an augmented sumo wrestler.

### ABSTRACT

This paper introduces Bubble Jumper, a super human sport enhancing your jump and enlarge your bodies circumference (grith) simulating an augmented sumo wrestler. We focus on the experience of superhuman strength in the legs and giving you the feeling of a larger body for the sport. We present the historical context of Sumo as well as our approach to augment the sport into Bubble Jumper. We show some early design prototypes and the iterative process to improve them, as well as rules and ideas for digital augmentation of the sport.

### KEYWORDS

Bubble Jumper, superhuman, sports

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### 1 INTRODUCTION

Since our early childhood we have the image of superheroes being so mighty and inhumanly powerful, being able to see through the walls, fly, read people's thoughts, see the future and fire laser beams through with their eyes [11]. Practically every kid exposed to Japanese Manga or Western Comics at least for a moment dreamed of having such powers. Bringing this childhood dream into reality, at least for one moment, is the main motivation behind the Superhuman Sports Society (S3), established by a group of leading researchers, athletes, artists, and engineers in Japan. Before introducing the reader with the main contents of the paper we find it necessary to spend a moment to provide the context of this work.

The Superhuman Sports Society concentrates its efforts on creating new augmented sports that can equalize the players of different body size and structure and base the "competitive" part of the sports around empowering technology and

the player's ability to use it [8]. Technological augmentation can allow the players to use powers they do not possess in everyday life, such as increased strength using exoskeletons, higher jumping using stilts, sensory substitution or visual overlays using AR/VR technology [2]. By augmenting improving the natural human abilities we can level them among players of different physique, age or gender, which would make the player's skills more important than physical abilities. Obviously novel or augmented abilities give players the powers that people normally do not possess, hence the name of the society. Augmented or novel abilities can be easily called "superhuman", as they can surpass by a great margin what people normally capable of doing. Democratization of sports, leveling the players and novel abilities are the key factors for a superhuman sport, but still competitiveness, joy of participation, and amusement to the spectators are considered to be important factors as well.

The aim of this work is to explore how we can empower players (with different backgrounds and skill sets) to experience superhuman powers [8]. In this paper, we study and document our work in progress on a Superhuman Game that gives players the feeling of being a powerful augmented Sumo wrestler. Traditionally, Sumo wrestlers are well known for their body mass and their considerate strength and force [5, 6]. However, this requires a dedicated and very regimented lifestyle, and impacts their life expectancy. We wondered if it is possible to enable the players to become an augmented Sumo wrestler, by giving them stronger legs and a larger girth. In this work we will also discuss other technologies we used during prototyping and our plans for the future work.

We present "Bubble Jumper", a fusion of traditional Japanese competitive sport "Sumo" with technological augmentation. Our first attempts focus mostly on physical and mechanical augmentations (jumping stilts and a bubble bumper). Bubble Jumper is a wrestling-like competitive game that finds its roots in traditional Japanese Sumo, where rikishi (wrestler) attempts to force another wrestler out of a circular ring. Superhuman Sports are concentrated on human augmentation and seamless human-technology integration, and the Bubble Jumper aims to augment our ability to jump, move and absorb shock using foot strengthening devices and a bubble-like transparent shock damper. Dampers assure players' safety and easy-to-use jumping stilts allow even complete novices with close to no training to enjoy the game.

The main contributions of the paper are as follows: (1) We present "bubble jumper" a novel superhuman sport. We want to explore how to augment the user so they can feel as powerful as a Sumo wrestler. (2) We focus on the clash between wrestlers at the beginning of a fight and trying to replicate and enhance it. We show our prototyping process to augment this part of a fight. (3) We show future technological

possibilities to enhance the user experience of the bubble jumper sport.

## 2 HISTORY AND APPROACH



Figure 2: Traditional Sumo, Kunisada Utagawa.

In this project, we are attempting to combine the long history of traditional Japanese combat sport, Japanese folklore and human augmentation, by letting the players feel like Sumo wrestlers.

"Sumo" has its roots in a Shinto ritual related to harvest and is held in order to honor the Shinto gods, Kami. During the ritual the two rikishi (wrestlers), were trying to attract the attention of the gods by ritual movements (clapping and foot stomps) to get the gods' favor and increase the strength for the competition. Strong Sumo wrestlers were regarded as "blessed by the gods". Given the spiritual roots of this game as well as the supernatural belief in the wrestlers being empowered by the gods, let us classify Bubble Jumper as "Superhuman Sports."

From this Shinto ritual, Sumo developed into a traditional sport. Normally, Sumo wrestlers have to follow strict lifestyle, and be very disciplined considering their nutrition and exercise routines. It takes years to build the body mass, flexibility, force and dexterity that are required for the sport. Therefore, casual fans or people interested in practicing Sumo are usually deterred. Sumo is probably one of the most demanding sports in regards of body strength and size, which makes leveling the players and lowering the requirements for player's physique a very interesting challenge. It seems to be a perfect candidate to base a new Superhuman Sport on, considering the vision and mission of the Superhuman Sports Society. Being a rikishi is more of a lifestyle, rather than mere skill. Letting people experience something akin to a Sumo wrestling match without years of diet and special training is the motivation of this project.

The most noticeable differences between a professional Sumo wrestler and an average person are their size, mass and the physical strength. Altering these two characteristics in order to turn average unprepared players into the Sumo

wrestlers is not as straightforward as it may seem. Adding extra weight to level an average person with a Sumo wrestler would imply increased requirements to the player's physique, which is contradicting one of the main principles of the Superhuman Sports Society, the democratization of sports. Mass aside we are left with two aspects, size and strength. Inspiration for idea on how to increase and level the strength of the players also came from Japanese culture, but this time contemporary.

Our other source of inspiration is "Mecha", a classic genre of Japanese Anime and Manga. Humanoid robots, ranging from large to gigantic are the cornerstone of Mecha. "Mecha" usually refers to a type of exoskeleton or mobile suit that is humanoid in shape but bigger than an actual human and is controlled by the pilot from a cockpit inside the machine. The pilot of a Mecha can perform "Superhuman" actions using it (flying, jumping high, etc.) [3]. "Bubble Jumper" is our attempt of letting the players to take part in an augmented Sumo match, combining the force, size and sense of mass of a sumo wrestler using exoskeleton-like enhancements. Main inspiration for this work that comes from the Mecha genre is the incredible physical strength that the human pilot has while operating the machine. Indeed the physical strength required to participate in a professional sumo match is exceeding the average by a great margin.

For this work we decided to focus on two design requirements. First, enhancing the force of the players using wearable body addons, similar to power suits or exoskeletons. Second, physical size expansion. These are basically the two "superpowers" we concentrate on. Both are inspired by Mecha Anime and the Sumo Sport. In the following, we will explain our design process and prototyping.

### 3 PROTOTYPING AND DESIGN

For both "superpowers" we followed an iterative design process. Our attempts, trials and design decisions are described in detail below.

#### Force Enhancement

Since we want to give the user the feeling of being stronger than normal, we have to design a way to convey that feeling and decide on which muscles to focus the most. Obviously, considering a typical sumo match, arms and legs are the first to come to mind. We decided to begin with legs, in order to augment jumping and the sumo clash. We tried several muscle enhancements from rigid exoskeletons and artificial muscle gel tubes to electric muscle stimulation. Finally a mechanical enhancement of jumping stilts was chosen as the most viable approach.

We ruled out rigid electric motor exoskeletons as being too dangerous for a two player contact sport [12]. Torque and

speed need to be carefully adjusted and controlled, otherwise the exoskeleton can injure the players.

Soft artificial muscles are a promising direction [7, 10]. Yet given our limited time in prototyping, we decided against them. We faced a major issue with them: The force you can provide is limited by the air pressure. This means the user has to carry around a large/heavy compressor, or a long tail of pipes, which also can lead to injuries and not suitable for a sport that requires the players to move freely on the field.

Electric muscle stimulation (EMS) seems interesting for activating a muscle movement (and also for training purposes to increase muscle mass), however we cannot really amplify the force [9]. EMS just activates the already existing muscle. From early prototypes, the users felt that it's not enhancing their movement and it's a bit unpleasant to use.



Figure 3: Jumping stilts used for jumping and speed enhancement

Our final choice for force enhancement, are jumping stilts as seen in Figure 3. They are just mechanical enhancements augmenting the user's legs. With these enhancements, users can jump up to 1.2 metres high and run as fast as 30 Km/h depending on the stilts model [1]. Although they are just mechanical enhancers, they conveyed the feeling we wanted to induce better than the other technologies.

#### Physical Expansion

We also want to give the user the sensation of being taller and heavier in mass, as if they were piloting a "Mecha" enhancement and the body build of a Sumo wrestler.

At first we considered a Mixed Reality environment in which the users battle in miniature city scape giving them the feeling of being huge compared to their surrounding. However, early tests did not seem to provide the desired impression. Also full-body tracking of the two combatants was difficult.

We considered several inflatable additions to the body to give it additional weight and volume. We settled on a bubble bumper used in bubble soccer practice as seen in Figure 5 [4]. First of all, it conveys the increased body volume and is reasonably heavy to give a feeling of being a sumo wrestler. Additionally, it surrounds and protects the body similar to a mobile suit exoskeleton. The user enters the



**Figure 4: Users playing bubble jumper with bubble bumper and jumping stilts**

interior of the sphere, carries it on both shoulders, and grips the handle at the front, giving the user a feeling of body volume augmentation.

The bubble bumper not only prevents the body from directly colliding with the ground but can also act as a safety buffer zone for collisions occurring during game play. The bubble works well together with the jumping stilts as it makes the usage of the stilts safer.

The jumping stilts also contribute to the physical expansion, as they add ca. 25 cm to 45 cm to the user’s height, depending on the model used.

#### 4 BUBBLE JUMPER IMPLEMENTATION

After describing the design process and considerations, we explain the current hardware used and the rules of the game.

##### Hardware

As described before, the Bubble Jumper players are wearing jumping stilts and are equipped with a bubble bumper. To increase the force enhancement of the jumping movement, we tried several additions to the stilts and bubble.



**Figure 5: Falling Test**

To make users fly higher while jumping, we filled the bubble with Helium gas. Initial tests were successful. It’s an effective way to increase the jump height and the duration in air. However, it takes away the heaviness and solidity feeling of the weight of the bubble (associated with a Sumo or Mecha). Therefore it’s a variant that’s possible. Yet, not the recommended bubble jumper setup.

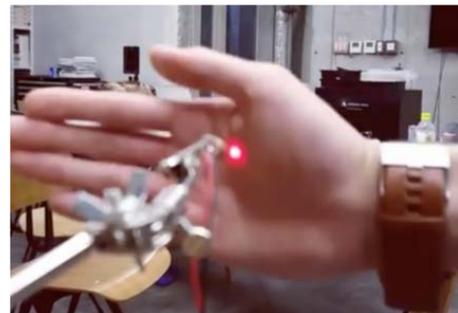


**Figure 6: Bubble Bumper with injected helium gas**



**Figure 7: Jumping Stilts with a haptic feedback system attached.**

For the jumping stilts we added haptic feedback (vibro-tactile motors) to and accelerometers to the legs to increase the feeling of stomping on the ground (see Figure 7). As the feedback from users who tried it was mixed, we also see this as a variant and will continue.



**Figure 8: Optical Judgment System: a photoelectric barrier**

To judge if a user left/stepped out of the ring, we use photoelectric barrier sensor (see Figure 8).

For the Superhuman Design Competition, we will have several variants of the hardware to try out and test.

## Rules

The rules are adopted from Sumo wrestling. The user wins if the opponent lands with parts other than the feet on the ground and if the user pushes the opponent out of the field. The size of the field is octagonal with each side being 9 m (shown in Figures 9 and 10). The field can be adapted, minimum recommended field size is 7 by 7 meters (determined over test trials). The octagon is surrounded by a square that only the players can access. This helps to prevent any accidents between users and spectators.

In order to become a player, users need to have sufficient practice with the equipment. A coach approves a user assessing his ability to stand and move with stilts and bubble. Even though it is not as dedicated as Sumo, Bubble Jumper requires still substantial balance and athletic skills to play.

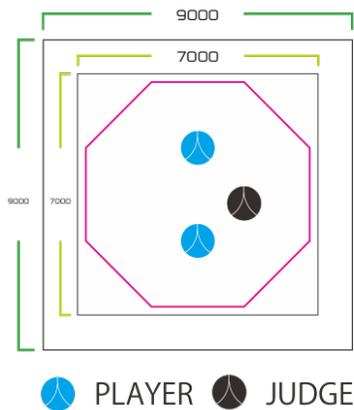


Figure 9: Bubble Jumper Field Size

In Figure 9 the schematic of the Bubble Jumper field is depicted. Each game follows a similar rite to Sumo, the two players are introduced by a judge. The players can show some power moves (like stomping, high jumps). If both players agree, the judge starts the match. As mentioned above, a player wins if the opponent lands with parts other than the feet on the ground and if the player pushes the opponent out of the field. The judge gives the final ruling. A match is usually pretty fast (1-10 minutes), depending on the players.

## 5 SHOWCASES AND PLAYER FEEDBACK

We were able to showcase and testrun bubble jumper in over 20 national and international events see Figure 11 and Figure 12. So far more than 30 people have played the sport. Each competition was open to the public. Several people tried out to walk on stilts. We provided different sizes of stilts (this can be used as a category for the sport similar

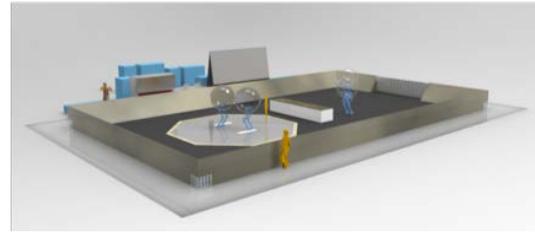


Figure 10: Bubble Jumper Arena

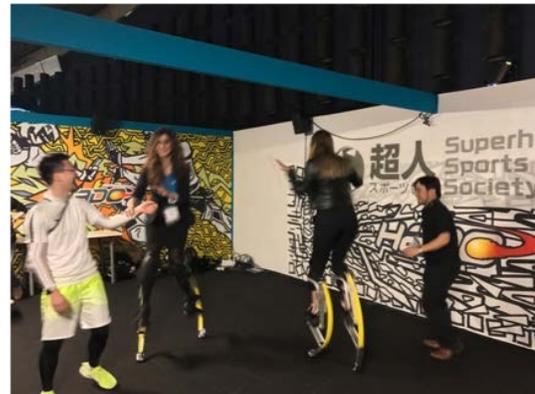


Figure 11: Practice Session at the Laval Virtual Festival in Laval, France



Figure 12: Practice Session at the Niigata University of Health and Welfare

to weight classes). If a person felt comfortable, they were assessed by a bubble jumper coach (one of our personal with sports background) to see if they are ready to compete.



Figure 13: Practice Session for a Bubble Jumper Competition

Figure 13 shows the practice sessions including stilts training. After the training, selected candidates can compete in the tournament as seen in Figure 14.



**Figure 14: Bubble Jumper Tournament**

Interestingly, it seems that the sport emphasises specific skills away from simple size, body mass and fitness of the participants. We could perceive interesting strategies from participants in the Bubble Jumper trial tournaments. Some players were using high jumps to try to intimidate the opponents. Others used the friction on the rubber bubbles after the clash to bring the opponent off balance.

## 6 DISCUSSION AND FUTURE IMPROVEMENTS

Although initially thought of as a mixed reality sport using visual augmentation to give the users the feeling of being a building size, augmented sumo wrestler, we decided for our first implementation to stay with a mechanical augmentation approach. The main reason behind this decision: we wanted the game to be a contact sport and given trouble and delay with tracking and other technical difficulties (e.g. fragility of VR/AR equipment) made it hard to implement it in an augmented reality scenario.

We are already working on several enhancements. We are working on mounting VR headsets in the bubble bumpers. Yet there is a high risk of injury, so we are assessing the right materials for that.

Haptic and in general somatosensory feedback is also explored already. Simple vibro tactile actuators can enhance the stomping for some players. We want to test thermal feedback for the clash between bubbles to give a more embodied feeling to the wrestling (also more feedback related to the friction between bubbles, as some players used it as a strategic mechanism to win).

Projection Mapping technologies was also tried, yet was difficult to do on the bubbles. We are currently experimenting with retroreflective materials related to that.

## 7 CONCLUSION

In this paper, we present Bubble Jumper, a Superhuman Sport inspired by the tradition of Sumo Wrestling and Mecha Anime to convey the superpowers of force enhancement and physical extension. We showed our prototyping process for

both powers and the final hardware/rules design. Finally we discussed about potential enhancements and future work.

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