# HandyFeet: Social Bodily Play Via Split Control of a Human Puppet's Limbs

**Figure 1.** The puppet player (centre) has a controller strapped to each leg. Each controller is paired with a handheld controller for each puppet master.

**Figure 2.** The puppet master whose turn it is (on right) leaning sideways to signal a forward movement for the puppet's left leg.

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## Abstract
Players sharing control of each other's bodies offers a promising direction for delivering engaging collaborative experiences in digital physical games. We present HandyFeet – a movement based game platform in which two players compete to most effectively direct the body of a third player. This third person becomes like a puppet that has two masters. The two directing players take turns making hand signals to guide one of the puppet player's legs. The puppet-person is prevented from seeing both their own legs and the floor, and so is dependent upon the directors' instructions for navigating the physical environment. To further the development of movement based games involving players surrendering or sharing control of their own bodies, we offer five themes that arose from analysing our initial play-tests.

## Author Keywords
Digital bodily play; social play; collaborative play

## ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

## Introduction
Many different kinds of games can be seen as a struggle between two opposing forces: sharing and

**Figure 3.** The game requires the puppet player to hold a board horizontally. This prevents them from seeing their own feet and legs.

control [6]. The objects of control and sharing are typically one or more inanimate phenomena such as an artefact or an area of territory. For instance in sports such as football or rugby, players compete to control a shared ball or dominate a shared playing field. Or in strategic games such as chess, play revolves around players attempting to gain control of the board. However, physiological control is also important for many forms of play. To perform well in many physical games, players need optimum control of their own bodies, not only for fine or powerful, sensory motor co-ordination, but also to put themselves into the most appropriate mental and emotional states for peak performance.

Within many multiplayer physical games, interpreting the bodily expression of other players - whether team mates or competitors, is crucial for effective instructions. For an instance when a team mate indicates where they would like a ball passed, or a player attempting to anticipate the actions of an opponent through observing their facial expression or other body language. At times in many team sports, players, coaches and fans may strongly wish that they could physically direct the actions of their team members. Video game equivalents of most popular sports have hundreds of millions of regular players. This suggests that controlling individuals and groups of digital avatars are very attractive and rewarding play experiences.

Now, on-body wireless sensors open up new opportunities to exploit new relationships between sharing, communication and control of the objects of play and players bodies. As an initial exploration of these dynamics, we created *HandyFeet* - a three-player movement based game in which two opponents compete to most effectively guide a third player's body. The controlled player or puppet is required to perform bodily movements according to directions gestured by the two competing "puppet masters". The imperfection of the social coordination involved appears to make this a very promising platform for challenging, but humorous digital bodily play. This game platform actually arose out of experimentation with precisely tracking, translating and comparing the motions of different limbs of different players. Through these attempts, we came to realize that digital technology might also be effectively utilized to facilitate play that enables human players to concentrate upon the challenge of understanding, comparing and anticipating each other's bodily movements.

*HandyFeet* is part of an ongoing project exploring how movement based games may exploit sensory deprivation[2] and/or perceptual interdependency [4] to foster novel shared play experiences. Here we contribute a description of how a minimal use of technology and a simple collaborative play mechanic results in engaging experiences which may be inspiring for explorations of interpersonal bodily understanding.

## HandyFeet system description

The basic idea is that each puppet master controls only one leg of the human "puppet", and so puppet masters take turns to attempt to navigate the puppet to their advantage. Our current *HandyFeet* prototype uses four Sony PS Move controllers. Two controllers are strapped to the ankles of the player who takes the role of the "puppet". The other two players, who act as puppet masters, each hold a controller in their hands (Figures 1-2). The controllers on the ankle of the puppet are

**Figure 4.** Towards the end of one play session, a puppet is seen positioned awkwardly amidst many squashed insects (plastic cups).

**Figure 5**. Puppet master (on right hand side) twists herself backwards to guide puppet (off camera) towards her.

each paired with one of the handheld controllers, so that only the LEDs of only one handheld controller and one ankle strapped controller are illuminated at the same time. When the LED on the controller of a particular puppet master is illuminated, it is their turn to guide the puppet. The puppet leg a puppet master is permitted to guide is indicated by one of the controllers on the ankles of a puppet displaying a similar LED colour to that of the puppet master's controller.

Simultaneously with illumination of a pair of controllers, the system signals turn taking via haptic feedback to both the hand of the puppet master and the ankle of the puppet leg that is to be moved. Puppet masters and spectators have a clear view of the alternating illumination of the pairs of LEDS. However the haptic feedback is necessary for the puppet because the puppet is required to hold a large piece of cardboard or tray horizontally, so that they are not able to see their own legs (Figure 3). The reason for giving the puppet such "blinkered" vision was to make the puppet entirely dependent on the guidance of the other players, rather than being able to adjust their leg movements according to their own view of the floor.

*Remote Controlled Mosquito Stomping Zombie Waiter*
This novel navigation system was explored through creation of a "minefield" like play environment. On the floor were laid 24 plastic cups to form a grid of approximately two metres wide by four metres long. The cups were of two different colours. These colours (orange and blue) corresponded to the two colour states of the LED controllers. The aim of the game for each puppet master was to be the first to have cups of their colour destroyed, whilst avoiding any damage to the cups of the opposing puppet master. These aims were to be accomplished through guiding the puppet into stamping and kicking cups of their target colour, whilst navigating around cups of their opponent. The game was explained to players with a lighthearted apocalyptic scenario: the puppet player was a zombie waiter that different scientists were fighting for control of in order to stomp on different species of dangerous insects - as represented by the differently coloured cups (figure 4).

## Themes arising from playtests

We performed play-tests indoors, with six different trios of players, all participants of an international computing summer school. Play testers were approximately 30% female, 70% male. Playing of the game was video documented from a variety of angles, and semi-structured group interviews were conducted with participants upon completion of each round of play. In subsequent video analysis we attempted to identify and explain moments when the puppet and puppet master were performing well together, as well as other factors that contributed to enjoyment or displeasure for any or all participants. We offer five of the most interesting themes arising from reviewing and reflecting upon user testing. These themes will inform our further exploration of shared bodily play.

*Fun of free interpretation*
Very different modes of instruction and response emerged with different trios of players - particularly in relation to mapping, scale and tempo of instructions. Users established a variety of conventions concerning the mapping of gestural instruction to leg movements. For instance, several groups of players adopted a lateral inversion command format whereby the puppet should mirror the movement of the relevant handheld

**Figure 6.** Puppet master on right extends into personal space of competitor to signal a big move.

**Figure 7.** Puppet master on left shifts their own leg position whilst cautiously signaling with their hand.

controller. Other groups preferred to play with a non-transformed mapping, e.g. a puppet master's hand movement towards their own body, was a way to beckon the legs of the puppet towards them (figure 5). When a puppet was maneuvered to face to one side, or even inadvertently led to face in the opposite direction from which they started, this brought additional challenges for coordination, and on occasion led to the directional mapping changing mid-game.

Players also addressed discrepancies in scale and motion capabilities of different limbs in a variety of ways (Figures 5-7). For instance, some puppet masters made very exaggerated up-and-down movements with the controller in order to signal taking a step. One puppet interpreted a horizontal forward or beckoning motion by a controller as requesting a sliding forward of the leg, whereas most saw this as a step.

Dramatic changes of player's tempo either within or between turns often led to laughter. Some puppet masters played in a very contemplative manner, and in each of their turns would very carefully issue a single gestural instruction for a single gentle movement. By contrast, other players were much more frantic, and attempting to use each turn to issue numerous and various commands, often for complex movements. Although such instructions were less precise and effective in themselves, by issuing frequent gestures within a single turn, a puppet master could attempt to iteratively correct their instructions. In our initial tests, when two different such "styles" of puppet master player competed, neither style appeared more successful than the other. Puppet players also interpreted the game conditions in a variety of ways, for instance some appeared to match the pace and vigour of the puppet masters' gestures whereas others maintained a consistent, careful speed, despite different instructors gesturing at different speeds and intensities.

*Full bodied challenge for all players*

Upon reviewing videos of the play tests, it became apparent that full bodily actions of the puppet master were also very important to the game. This was contrary to our original design, in which we envisaged instructions would be imparted just by the movement of the hand that grasped the controller. Facial expressions, and head movements of puppet masters clearly played a role in giving directions. This generally seemed to function as a means of amplifying or echoing the gestural instructions. That is, the head of the puppet master would make similar movements to that of their controller holding hand, presumably to increase the saliency of their commands. These kinds of actions were particularly visible towards the end of a puppet master's turn when players were attempting to re-iterate or improve an imprecisely executed command. The success of a puppet's action was often readable upon the face of their master. It seems feasible to suggest that micro-interactions of puppet masters' facial expression may also have influenced the fine-tuning of directions on occasions. Although it is easy to imagine how such additional forms of non-verbal communication could be designed out of the game, we see great value in their continuing presence as the full bodied experience for all players is likely to increase levels of engagement and sociality [5].

On occasions, puppet masters could also be seen as using their own bodies as a resource in order to figure out the instructions they would issue. For instance

**Figure 7.** Very fast hand movements from a blue LED holding puppet master resulted in the controlled player inadvertently crashing into furniture.

when puppet players were inadvertently maneuvered into awkward unstable and twisted positions, puppet masters could be seen to perform epistemic actions in the form of subtle twists and bending of their knees and hips. There was an even a couple of instances of puppet masters walking slightly backwards to emphasise the direction of travel they desired for the puppet (figure 5).

*Shapes in the air versus situation on the ground*
Most of the puppet masters and the puppet players felt quite liberated by the dissipation of responsibility that this novel control system offered. The puppet masters enjoyed being free to make expressive gestures in the air. Often these were quite removed from the situation on the ground that the puppet was blindly dealing with. Directing someone to walk, fight or dance is an unusual social experience for most people. However, issuing instructions to make another person perform violence resembling and/or rhythmic actions often seemed to be relished by the puppet masters. Although some puppet masters began more cautiously than others, a tendency to issue more vigorous and rhythmic instructions as play progressed was a clear trend.

Puppet players reported enjoying a physically liberating play experience. Not being able to see their own legs brought a lack of responsibility for any error they made or damage they caused both within and beyond the actual game. For instance, inadvertently kicking over a chair (Figure 7) that was near the edge of the play area gave a thrill that was both physical and social.

*Imperfection contrasting with relentless automation*
The haptic buzzing on the hands and ankles of paired limbs, was for puppet masters, a clear means to signal turn-taking. Furthermore, the haptic feedback made very clear for the puppet, which of their limbs was "in play". As one puppet player put it "when I felt one ankle buzzing, I instantly switched my focus towards seeing what the other controller was going to get me to do". This automated scheduling of turn taking, freed players to direct much more attention towards their fellow players. In addition, this minor element of computerization was reported to be very complementary to the game's zombie narrative themes of remote automation and dehumanization.

For puppet masters, the imperfectness with which puppets executed directions was highly engaging in that it spurred continual improvement and adaption. The challenge of issuing precise motoric commands to another human was also remarked upon as unusually engaging. In addition to controlling the pace of the game, the alternating illumination of the LEDs made turn taking very accessible to spectators too.

*Dehumanized play-object or cared for collaborator?*
Entertainment also arose from differences in attitudes toward puppets displayed by puppet masters, and the emotional responses of the puppet. When the puppet player became twisted or unsteady on their feet, some puppet masters felt a responsibility to make the player more comfortable. Other puppet masters were less considerate and treated the puppet much more like an inanimate object (figure 8). However, it is not in the interests of a puppet master to be too disrespectful to their human pawn, as if a puppet begins to favour one master over the other, they may decide to more faithfully follow the commands of their kinder master. The fun arising from the contortions performed can be seen as similar in some ways to the precarious

**Figure 8.** Competing puppet masters issue inconsiderate instructions that make it difficult for the object of their control (centre) to balance.

and improbable positions that occur during the popular parlour game *Twister.* However, the unlikely poses struck by the puppet in *HandyFeet* differ from those of *Twister* players in being the result of deliberate instruction rather than randomly generated.

## Discussion

The degree of interpersonal attention and exchange in HandyFeet is not what everyone looks for in computer games. However, the expressiveness engendered by unmediated face-to-face bodily communication may open up new opportunities for game designers to develop play experiences for some of the many people who are left unmoved by games that revolve around purely digital challenges.

The limited, but important role of the digital in *HandyFeet* is to highlight relevant body parts and signal turn taking. This enables players to directly focus on the bodily actions of themselves and their fellow players, the responses each makes to the other, and the misunderstandings that arise. Walking is a complex biomechanical activity. However, once learnt, most people normally perform this form of locomotion unconsciously. The potential fun of disrupting habitual actions can be summarised by Mandoki's observation that "the opposite of play is not seriousness but the automatic" [3]. The enduring appeal of three-legged races in many countries' school sports days highlights the value of disruptions through closely coupled embodied collaboration with another person.

In early ubicomp research, the concept of "seamful interaction" [1] was developed to argue for the potentially positive value of gaps and disruptions to smooth (or "seamless") networked experiences. Seamful interaction on an interpersonal level appears a promising perspective for further investigation for digital bodily play. In addition, it may complement physical skills based perspectives to facilitate collaboration more generally (e.g. [7]).

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