Research Work-Package Methodology exemplified by the Multiple Screens Project
- Pinch Game using Unity for Android -

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Abstract
In this paper we will first introduce the Research Work Package Methodology (RWPM) as part of the Master Course curriculum for students at Gotland University, Sweden. We will then proceed to exemplify the RWPM by demonstrating the results of the single image mobile telephone multiscreen display work-package. Firstly, the iOS application was developed to be run on Android devices also. Secondly, the game engine Unity has been incorporated into the system and thirdly, new game design possibilities have been created as exemplified in the game described in this paper. This project is a collaboration with the Tokyo University of Technology.

Keywords
Pinch, Multiscreen, Games, User Interface, Mobile Device, Touch Screen, Social Interaction. Research Work-Package Methodology (RWPM)

1. Introduction
The University of Gotland collaborates with several universities in research through the implementation of research work-packages distributed to small teams of our master students. Students receive approximately 8 work-packages per year. In the fall of 2012 Prof Kunio Kondo and Associate Professor Takashi Ohta visited Gotland University to present the Pinch and Multiscreen iOS based technology as developed at the School of Media Science, Tokyo University of Technology. Students at Gotland University were introduced to this technology in a workshop, and then provided with a work-package to develop new ideas using the pinch and multiscreen technology for mobile devices. The results of the work-package are presented in this paper. The results are three fold. Firstly the iOS application was developed to be run on Android devices also. Secondly the game engine Unity has been incorporated into the system to facilitate game design and thirdly new game design possibilities have been created as exemplified in the game described in this paper.

2. Technical Network Solution
Through using AllJoyn for Android and the game engine Unity we have an automatic discovery mechanism that allows any android device to join the local area network in order to establish a connection with a common session associated with a game. This is done without the use of a dedicated connection server. This solution is similar to the functionality of Bonjour for iOS. The session can be used as a peer-to-peer connection as well as with a classic host configuration. AllJoyn enables the use of a variety of connection protocols, regular local network over wifi, Wi-Fi Direct or over BlueTooth. AllJoyn is used as an alternative to the iOS exclusive Bonjour. Because sessions are open, even new devices can connect to games already in progress, resulting in an inclusive multiplayer system leaving no player behind.

3. Inter-device Interaction
In order for devices to facilitate interaction between them they must first be joined together. To join two devices at least one of the devices has to hold an active room. An active room is defined as a room populated by a player character or a room in direct or indirect contact with a room currently populated by a player character. Since all devices are part of the same network session, this allows groups of players to have separate game sessions that can then be combined into one game session at any time by simply pinching the two groups of devices together into one game. When a player lifts up or shakes a device the gyroscope or accelerometer is triggered and the system un-joins from its neighbouring devices. The device is however still connected to the session and can thus be used as another game piece to be re-joined. If the device being unjoined holds an active room the neighbouring devices go blank instead, likewise if a link to a device is broken it also becomes blank.
4. Pinch to Join

When two devices simultaneously register a swipe each in any direction a pinch has been made. The devices register their rotation so that the swipes point towards each other. When a pinch occurs and the devices form an unbroken chain towards a device that holds an active character, a door opens to a new room.

![Fig 1. Swipe connection as pinch](image1)

The devices join together with the pinch, clearly showing where and when it is possible to connect a new device without the need for additional UI. (fig 1)

![Fig 2. Open doors between devices](image2)

5. Doors With Pinch

Each device represents a room. Characters in the game move from one room and device to another by passing through the doors represented by the use of the pinch. (fig 2)

6. Game Design

In this project, the narrative environment is a dungeon-based game in which doors are utilised by the user to move between rooms. Each room occupies the entire screen of a connected device. Using multiple screens, we aim to create a system for games in which users can form paths through a randomly generated sequence of rooms as used in dungeon games.

Each screen will display and represent one room at a time, multiple screens can be linked and unlinked as participants wish to progress. When a link is broken, that particular path is lost for the rest of the session, thereby making the rooms a temporary resource for participants. Sequences of rooms can be saved however, through keeping continuous screens linked in series through pinching.

Additionally, the act of pinching a door to an empty screen is a player procedure abstracting the physical act of exploration. The user needs to actively choose to explore further areas of the dungeon rather than have them be added automatically. Likewise, the act of physically removing a device offers participants the sense of actively closing a door behind them, forever closing that specific room.

The room generation system innovates on previous works by using the pinch multiscreen function. An example being, in the case of a room that is too difficult to access it is possible for users to rearrange their path by disconnecting the difficult room, and reconnecting the device to the same position or in another position in order to build an alternative pathway.

7. Social Interaction

The game is designed for multiple players. The simplicity of the pinch-feature in combination with multiple mobile phones as the platform effectively encourages several players to sporadically gather and play together. This in turn allows for a wide range of participant personalities interacting and playing together without conflicting interests or tension regarding how best to proceed.

Participants can also play in single player mode with one device or more while preparing for coming sessions with several players. As devices simply need to be connected on the same local network in order to join a session, this allows for single players to enter into game session with other players when they want to. However, to do so participants need to physically find other players and interact by placing their devices next to each other.

If a participant wishes to leave a social session, they need only to remove their device or devices to stop playing or to continue playing on their own.

8. Future Work

Because of the open nature and flexible design of the Unity game engine, our current system can also be used to create games within other genres. As Unity is also an accessible and well supported tool in the game industry, this enables the opportunity for this project to be further developed by a wide range of different developer-groups.

The possible ways in which participants may interact with the multi-screen function, in both social structure and physical representation, is similar to that of traditional board games. This opens up the possibility of converging personal face to face interaction of classic analogue media together with state of the art digital media, and by doing so opening a space allowing for creative and tangible games supporting personal interaction between participants.

References