

# Wireless Gamelan: A Gestural Interactive Music Performance Environment

Mr. Jeremiah Nugroho  
University of Sydney  
Wilkinson Bldg G04 2006 Australia  
jnug0221@mail.usyd.edu.au

Professor Kirsty Beilharz  
University of Technology Sydney  
P.O. Box 123 Broadway 2007 Australia  
kirsty.beilharz@uts.edu.au

**Abstract.** This paper presents a new approach for implementing RFID technology. Specifically, it provides a new kind of musical instrument or live music performance environment. Contextualised in performative interactive art installation, we discuss the technical and musical implementation of our gestural Virtual Gamelan as a vehicle for investigating embodied RFID technology, exploring user responses to the interface and the technology, issues of body culture, embodiment and Cyborgism.

## General Terms

Human-Computer Interaction

## Keywords

RFID, Gamelan, Interaction Design, Auditory Aesthetics, Gestural Interaction, Spatial interfaces.

## 1. INTRODUCTION

The idea of an intangible (non-tactile, gestural, spatial) musical instrument to produce sound is an expansion of the conventional framework for human music creation and instrumental performance. A basic premise for this project is attempting to challenge the notion of post-humanism in which, according to N. Katherine Hayles, there are no essential differences or absolute demarcations between bodily existence and computer simulations, cybernetic mechanism and biological organism, robot teleology and human goals (Hayles 1999, pp. 2-3). In the Wireless Gamelan project, the designers embody cybernetic mechanism in the biological mechanism, thereby taking a literal interpretation of Hayles' notion of post-humanism. The cybernetic mechanism included in this project is the RFID technology (Radio Frequency Identification) while the biological organism is the human body.

The Oxford American Dictionary's definition of machine is "an apparatus using or applying mechanical power and having several parts, each with a definitive function and together performing a particular task (Elizabeth J. Jewell and Frank R. Abate, 2001)." In order for RFID technology to function, it always consists of several different parts including RFID tags, the RFID reader (or scanner) and some form of system that enables its successful function, e.g. a networked database or a networked music driving system. These parts are intended to be regarded as the machine in this project as the composite parts together provide the ability to perform a task. In this

way, the production of sound by embodying some parts of the machine (in the human body) in this project may be seen as an exploration of post-humanism.

### **1.1. Project Aim**

As humans, we tend to react to new inventions in life. The awe, excitement or even fear of something new, in this case - new technologies, are unavoidable emotional responses. The aim of this project is to investigate the possibilities of how fear and paranoia about embedded technology can evolve and prompt negative views or influence the audience's interpretation of the music delivered via this technology. Therefore we test the possibility of this hypothesis by using an interactive art project, the Wireless Gamelan, and include the analysis of the social reaction provoked by the project.

## **2. CULTURE OF THE BODY, EMBODIMENT AND INDIVIDUALISATION**

The body and the self consist of perceived boundaries, the culture (and politicising) of the body, our perception of it, through it and the body as a medium for expression and individuality. Individualisation can indicate belonging or alterity and the body can be used to evoke independence or to elicit separation.

Perception of self, or defining self, concerns mapping and drawing body-limits. On the one hand, we are examining the difference between embedded, implanted technologies and external motion actuators like sensors, camera-tracking or touch-pads and common musical instruments because Cyborg controllers have crossed a threshold when the chips entered the body (skin). On the other hand, an equally modern view perceives our "self" as extending much further and engulfing a richer anatomy of networks than merely arteries and veins surfaced by skin. William J. Mitchell's interpretation of Cyborgism that encompasses the networks with which we interact moves boundaries and permissions much further from our core or, at least, questions our boundary constructs and our location of being (2003).

The Cyborg performer is not an autonomous music-maker in the sense that a passive transmitter, not an entire machine, is encased in his/her body. The performer is reliant on contact with the RF wireless network and external music drivers in order for his body to be the instrument of performance

## **3. EMBODIED INTERFACE**

The fact that the RF technology is able to work as wireless sensors for various tasks, allows us to explore a new way of human-computer interaction, in this case, human as a performer and computer as a musical instrument.

For the performer, traditional musical instruments provide a robust resistance to the sense of touch, a physical interface and even sometimes haptic (responsive) feedback to the user: the resistance of the tautening string and its release by plucking, the texture of percussion instruments, and so on. Electronic interfaces utilising touch, tangible controller pads, sliders, mixers, dials, knobs, tactile interfaces and electronic keyboards with weighted keys, all provide the kind of conventional haptic feedback we are accustomed to for sculpting performance and the sensibility that is honed with practice and repetition, familiarity and skill. The invisible sensor inside the body with a wireless or gesture-only method of "conducting" and controlling the audio output is already dramatically different. The performer must react to sound rather than touch, yet acuity, accuracy and refinement of gesture are key. The body is anticipating and choreographing while the ears are listening (perhaps eyes also looking).

Proprioception is the relationship between our mind and motor control arising from sense of space and spatial orientation around the body, the sense of the relative position of neighbouring body parts.

To revisit Hayles' view of post-humanism, there is the existence of an imaginative discourse sphere, in which another sphere exists, which is the Cyborg discourse. Thus, one can say that a Cyborg is a form of post humanism. The word Cyborg derives from the word cyber and organism. In this project, we decided to experience the definition of Cyborg in a literal sense. For the performer to become a Cyborg means to have the machine parts in his body included as a part of the system. Since RFID tags can only work with the existence of the reader and a previously calibrated system, it is a part of a machine system. Thus, we believe that by having RF tags underneath the skin, the body becomes integrated and protruded or extended and augmented by the machine. In this project, the role of the performer is almost like a catalyst where, without the performer, the system and the reader can not work alone. The fact that each RF tags has a unique identification code adds an interesting layer in order for this musical instrument to create and produce sounds. The personalization of the musical instrument becomes absolute, since only a performer with "matching" RF tags are able to generate the system to play music. Having tags implanted underneath the skin, the personalization becomes permanently embedded in the performer, which positions the performer as an absolute part in the system.

#### 4. PROJECT IMPLEMENTATION

##### 4.1. Musical Idea

The Max/MSP interface music patch is not simply an "action/reaction" model in which singular gestures trigger single auditory events, rather to produce a musical degree of complexity and richness, gesture actuated by the different tags triggered loop cycles for gamelan gongs of distinctive frequencies and spatial location (Figure 1).

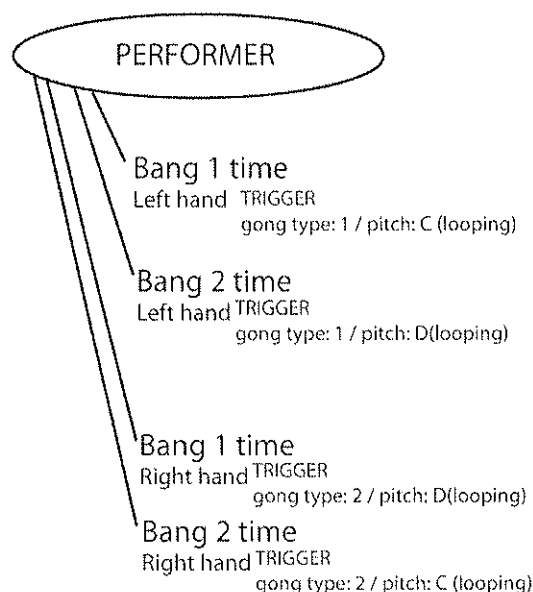
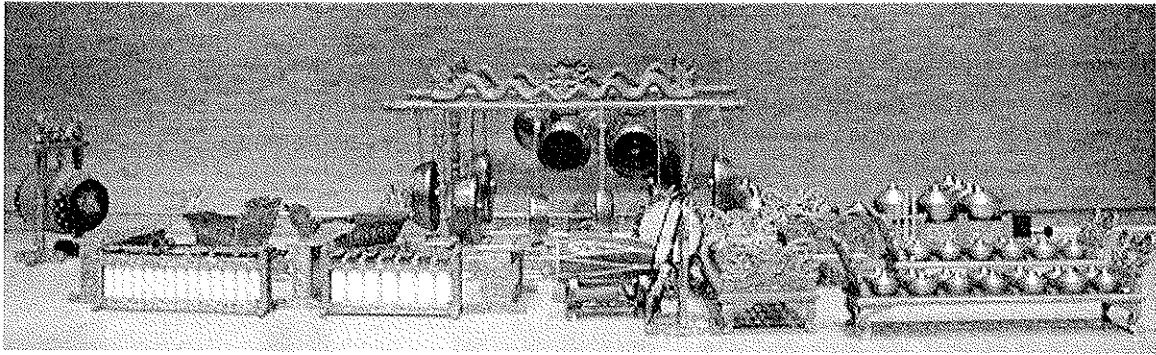


Figure 1. Event hierarchy diagram

The idea for the modality derives from a scale that is used in Traditional Indonesian Gamelan (a musical ensemble typically featuring a variety of instruments (Figure 2) such as metallophones, xylophones, drums, and gongs) music. Originally there were two main scales used in Gamelan performance. These are *Slendro* and *Pelog*. The scale used in the interactive art installation is *Pelog*, a seven-note scale used in Balinese Gamelan music.



**Figure 2. A Gamelan Orchestra**

Photo by R. Zeckoski (<http://www.flickr.com/photos/rzeckoski/516515135/>)

The *Pelog* scale consists of seven different pitches, however, in practice, all seven notes are rarely heard together in one single composition. This is because of the instrument limitation of producing all seven pitches. The intervals of the *Pelog* scale are also hard to characterize, since the tuning for each gamelan is different to the other, characterized by the timbral spectra or overtone series of the instruments. However, one rough approximation of the seven pitches is a subset of 9-tone equal temperament.

The *Pelog* scale in Balinese Music has three different modes, *selisir*, *tembung*, and *sunaren*. The modes all start on the note named *ding*, and then continue going up the scale to *dong*, *deng*, *dung* and *dang* (Table 1). However, the same pitch will have a different name in a different mode.

The analogy for using the Gamelan music scale in the system lies on the origin of the word “gamelan” itself. It comes from the Javanese word “gamel”, which means to strike or hammer, and the suffix “an” (Wiki “Gamelan Definition”). The way the instrument works to produce sound is by the player striking or hammering the instrument. In the installation system, the sounds are triggered by the strike or the bangs from the RFID tags when the reader reads the unique coded embedded in each tag. The wireless virtuality of the system refers to the scenario in which no physical gamelan instruments were present but rather were simulated using spectral modelling of the resonance of real instruments, spatially distributing the rendering across a quadraphonic speaker system to create an immersive and spatial audio experience.

**Table 1. Balinese Modes of *Pelog* scale** (Wiki “Gamelan Tuning 2008)

Balinese Modes			
Tone	Selisir	Tembung	Sunaren
1	Ding	Dung	-
2	Dong	Dang	Dung
3	Deng	-	Dang
4	-	Ding	-
5	Dung	Dong	Ding
6	Dang	Deng	Dong
7	-	-	Deng

## 4.2. Triggering System

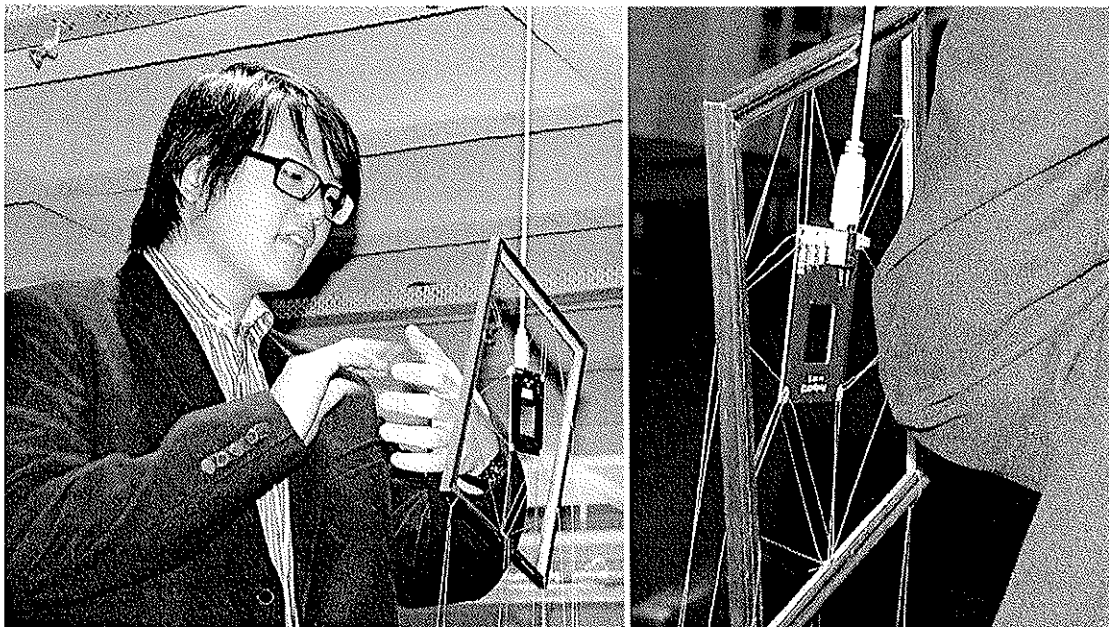
This triggering system is implemented using a hierarchical system in the Max/MSP real-time programming software environment. While the original, physical gamelan is played by hitting the gongs or the panels with the hammer, this project is ‘played’ by triggering sound samples using RFID tags and consequent hand and arm gestures. In the Max/MSP software, a trigger is translated into a button-like signal, a message or ‘bang’. Whenever the RFID reader reads a

unique set of identification code from an RFID tag, it will trigger a bang if it matches the system. This procedure of ‘banging’ in the system creates a resemblance with the ‘banging’ of gongs and iron panels in playing the real gamelan.

In order to increase the pitch of a certain type of gong associated with an RFID tag attached to a specific body-part, the performer must allow the reader to read the tag multiple times to determine the desired intervals. For instance, in order to increase the pitch from C to E, a tag must be read twice (according to the intervals).

### 4.3. Performance Scenario

First, the performer whose hand(s) has been implanted with RFID tags, moves inside the designated area of the installation. The performer commences by positioning his or her hand(s) near the readers (Figure 3). As the reader tracks the code inside the RFID tag, it will trigger sound samples. The sound samples are presented through a spatial audio system to create an ambient and visceral experience. As the music evolves, the performer starts to chant an Indonesian traditional song named “Janger”.



**Figure 3.** Using RFID tags in the hands and elbow to trigger sounds as the tag passes in proximity of the reader (scanner). Photo by Kirsty Beilharz.

The premier performance and pilot evaluation was held at the Hearth in the Faculty of Architecture, Design and Planning Wilkinson building on Wednesday, 9 July 2008. For the pilot performance, the performer did not implant the sub-dermal chips, but “tricked” the audience by hiding the RFID tags underneath adhesive bandages. This was done to provoke authentic reactions to the performance from the audience, in response to the performer’s body manipulation.

### 4.3. Audience Response

In order to receive feedback, the audience was given subjective questionnaires after the performance. The objectives of the questionnaire are as following:

- To gain deeper insight on how human with embodied technology will be ‘othered’.
- To gain opinion on how far accepted is the idea of seamless integration between human and machine.
- To see how the public may approach the implementation of the embodied RFID technology to their everyday life.

During the performance, we managed to get feedback from 22 audience members that filled in the questionnaires. When asked if the chip implant technology is disturbing or not, most of them think that it is disturbing and unacceptable. For the performance, we included several pictures, which explains the surgical procedure in implanting the RFID tags. These pictures managed to create a form of discomfort among the audience members, which resulted a number of audiences to fear the technology implementation. The fact that these RFID tags are included in the performance as if they have been surgically implanted, it articulates the notion of man-machine hybrid beings that allows the performer to be fully immersed and integrated with technology in a very literal sense (surgically implanted). However, if one is to look deeper, the performer also interpolates the notion of socially networked beings, since by pretending to have RFID tags implanted allows him to be connected directly to the technology and control the sound samples as well. We would like to argue here by the fact that the audience members thought that these RFID tags were implanted prior to the performance, invokes the feeling of disturbance and discomfort from the audience members.

Only 7 out of 22 audience members think that it is not disturbing to have chips implanted underneath one's skin. In instance, one of them mentioned the use of pacemakers and bionic ears, which have become accepted in the world today. Another audience member commented that the media played a big part in creating the public's paranoia towards the technology of man-machine hybrid beings. One of the audience members commented that it is not unacceptable if the technology of chip implants is to be used towards good causes for the community. The public's paranoia of having machine parts implanted inside one's body is also mentioned in one of the opinions, saying that the "Big Brother" sense plays a big part in building this paranoia. Here we can see that the majority of the audience members think that it is disturbing to have chips or machine parts implanted underneath one's skin.

When asked if they will look at people with chip implants differently, only 5 people agree, while 11 people disagree, and the rest could not decide what their answers were. By looking at the number of the respondents that disagree, we would argue that there is a possibility that these audience members do not have issues with man-machine hybrid beings. However, we would also argue that the underlying reason for this is because there is a rarity of people with chip implants or any kinds of implants in life these days. People with chip implants or any other kind of embodied technology are still a minority in the community. For that reason, these audience members hardly ever encounter this minority group.

We suspect these audience members have various underlying reasons to state that they will not look at people with chip implants differently. Since the performance / installation only includes implantable RFID tags which are small in dimension, it creates an altered perspective for the audience. What they saw during the performance was a human with almost invisible machine parts integrated to his body, which is why the majority of the audience members say in the questionnaire that they will not view someone with chip implants differently or perhaps their determination not to appear discriminatory. However, what if the machine parts were protruding outside from the skin and expose the connection between human flesh and machine parts? We believe that the visual and physical appearance of embodying technology, due to its perceived invasiveness, plays a prominent part in this case.

Throughout this exploration, we found various reasons that lend inflection to the practice of implanting RFID tags or embodying technology in general:

- The issue of surveillance or control over individuals by more powerful groups.
- The issue of (possible) extended or eternal life.
- The issue of (possible) alien appearances.
- The issue of medical procedures involved.

The most logical explanation for the first issue can be derived from the production and legalization stage of these machines. Serial numbers, I. P. Addresses, identification numbers on RFID tags have always been on-going issues in personal information systems. These identification systems are always included within the Cyborg issues. Therefore, for someone to be a Cyborg, his or her personal information (for example: location, personal financial records, etc.) can always be recorded and acknowledged by the more powerful groups or organizations, such as

the government and private companies or even other individuals. This paranoid or perhaps legitimate concern is perpetuated by publications such as *Spychips* that provokes the notion that RFID tags will inevitably and primarily be used for surveillance at worst and market research or pushing products at best, i.e. for manipulative processes and invasion of privacy.

The second issue can be explained by examples such as medical patients with pacemakers, cochlear implants, and disabled people with artificial implants. If a hearing impaired person's ability to hear can be amplified by having cochlear implants, then there is always a possibility for normal people to have similar implants in order to enhance his or her hearing ability.

The issue of alien appearances is connected with nanotechnology and technological fetishism. This particular issue will mostly arise in Othering (alterity) (Baumann and Gingrich 2004), prejudicing and discriminating against Cyborgs with the notion of man-machine hybrid beings. In the future, the idea of nanotechnology and seamlessly integrating machine parts underneath the skin is not something that is impossible to achieve. However, technological fetishism always includes technological voyeurism and technological exhibitionism, which could be regarded as the primary reason behind the alien appearances.

The fourth reason, which is the issue of medical procedure involved, is based on the experience of Wireless Gamelan project. In the performance, the audience members were persuaded to believe real implantation of the RFID tags as the result of false images displayed on the performance sheets. These images have provoked discomfort among the audience members, which caused the audience to view the RFID implantation technology as unacceptable and disturbing. This articulates the public's fear of the implantation technology, which is a part of the cyborg technology.

## **5. CONCLUSION**

This project creates a parallel between the embodied technology and the culture of the body. By embodying a part of the technology inside the body, humans are becoming machines or Cyborgs. However, in this case, the paranoia of human extinction and being taken over by machines is irrelevant or negated by the purpose of performative music-making and the necessity of man and machine as composite parts in a *system*. The dependency for machine to operate relies entirely to human. However, the public fear and paranoia for embodied technology still plays an influential part in the acceptance of this technology. This paper has outlined the technological and musical project for performance that requires embodiment for its rendering. The performance provided the opportunity to gauge audience reaction to social and cultural issues of embodiment and technology pervasion, summarized in the second part of the paper. As technology plays an increasingly important and pervasive role in our lives, it is necessary to investigate and develop our understanding of the social ramifications and influence of context.

## **ACKNOWLEDGEMENTS**

Special thanks to Sam Ferguson, research assistant and programmer on this project. This research is supported by an Australian Research Council Discovery Project Grant DP0773107 investigating "Gestural Interaction with Aesthetic Sonification": Chief Investigator, Professor Kirsty Beilharz.

## REFERENCES

Albrecht, K. and McIntyre, L. 2006 *Spychips*, Penguin Books, London.

Baumann, G. and Gingrich, A. 2004 *Grammars of Identity / Alterity: A structural Approach*, Oxford: Berghahn Books, New York, pp. x, 5, 7, 142

Elizabeth J. Jewell and Frank R. Abate (editors). 2001 *The Oxford American Dictionary*, Oxford University Press, UK.

Hayles, N. K. 1999, *How We Became Posthuman: Virtual Bodies In Cybernetics, Literature, and Informatics*, The University of Chicago Press, London.

Mitchell, W. J. 2003, *Me++: the Cyborg Self and the Networked City*, MIT Press, Massachusetts.

Wiki "gamelan" <http://en.wikipedia.org/wiki/Gamelan> accessed 10 July 2008