From Me to Us,
a computer generated music installation

by

M.Koray Tahiroglu

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Abstract

From Me to Us is a computer generated music installation for participants of all kinds of musical backgrounds. It is an improvisation process, interacting with MIDI instruments by using electric guitar as an interface. During the moment of playing, there is a contact between the sound created by the participant and the sound generated by the computer. The improvisation turns into a continuous composition as long as a participant takes an active role in the installation. An important goal of the From Me to Us installation is to provide a situation where a participant can experience a musical collective improvisation.

Thesis Supervisor: Antti Ikonen
Thesis Reader : Andrea Botero
Thesis Evaluators: Kalev Tiits and Ilkka Niemeläinen

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Chapter 1

Introduction

Many forms of human to human, human to machine, and machine to machine interaction has taken place in many disciplines in many years. The musicians' collective improvisation is framing ground for this interactivity in music.

When it comes to music, the word *improvise* can be defined as performing without a musical score, or producing sound in a performance without preparation. It is a way of playing that gives unexpected results. Karlheinz Essl (2002), Austrian composer, improviser and performer, describes the real time in which improvisation takes place, is passing by where one has to follow a certain way which might have been thought about before or which turns out to be negotiable during the improvisation. At the same time one must be continuously conscious of references; what has happened before, how can this be developed further? Therefore there is an intentional visiting of previously existing conditions. It is a process without writing. This process definition may also mean that there is a logical process involved in the improvisation, and this may have a consequence as individual styles and methods of decisions followed during the process. What happens when people with individual styles come together and take part in the production of sound? The interaction comes forward on to the stage and brings unexpected beauty into the collective or group improvisation of musicians.

Music, in one way or another, is a part of our lives and the advanced development of technology has made it possible for people to be musically creative without having a traditional musical background in the western culture. The interactive systems are potential environments for computer generated improvisations and compositions in which computers are the main actors. From Me to Us is a cooperative environment because of its collective improvisational identity between humans or humans and machines. Besides creating the possibility for everyone to explore musical creativity by taking part in the improvisation process, this identity of cooperation evaluates the From Me to Us installation into an open form music composition (see section 1.1 Concepts behind From Me to Us).

Is it really possible for someone with no training or formal education in music to play an important role in a composition by participating in a collective musical improvisation? The purpose of the thesis is to explore this question and to document the whole process from the beginning of its theoretical dream identity to the implementation part of the installation.

This thesis consists of the present document, a videotape and the CD-ROM materials. The videotape has a ten minutes video shootage of the installation. The sound files and the digital format of the thesis written part are included in the CD-ROM.

1.1 Concepts Behind From Me to US

> "The two kinds of music now that interest me are on the one hand a music which is performed by everyone. And I would like to say that the Chinese people are, from my point of view, now performing a beautiful music, which I would actually like to go and hear. So I like that music by many, many people. And here, more and more in my performances, I try to bring about a situation in which there is no difference between the audience and the performers. And I'm not speaking of audience participation in something designed by the composer, but rather am I speaking of the music which arises through the activity of both performers and so-called audience . . . "
>
> John Cage (1997 cited Perloff 2002)

Romanticism is an attitude or intellectual orientation that in the Western civilization (from the late 18th century to the mid-19th century) characterized many works of literature, painting, music, architecture, criticism, and historiography. This resulted in the artist being viewed as an individual and unique creator. The artist's creative sprit was held more important than formal rules and traditional procedures. This has caused individuality to be dominant in the way music is composed in the western culture to date. After Romanticism composers became the lead persons along with all their individual self-expressions. The use of a soloist in Romanticism typified the Romantic spirit of individual self-expression as well as the role of the performer in music. Furthermore with the involvement of a conductor the big thick line has been more visible between the audience and the performer. The roles or the titles were clarified as "I am the composer, there is a performer and you are the audience".

I came up with the idea of From Me To Us to find a way to go beyond this line by supporting varieties of music and the interaction. The Audience becomes more than just participants in this installation, they take part in composing the piece as well as performing it. I expect this is the creative freedom that the interaction itself supports.

Nontraditional and computer based applications simulate the possibilities of creative freedom and enlarge them into open form music structures. Instead of the finite length and the finite musical characteristics, constant flow identity of the pieces becomes an active part of the structure. The open form music structure evaluates the composition into a process where participation may be required for the continuity of it. This is the crucial statement one can achieve from interactivity in music. Each participant composes a piece of the composition during the From Me to Us installation and as long as they are actively taking part, it becomes a continuous process. There is no logical beginning or end in this music composition.

The From Me To Us installation gets its name from evaluating the term "me" inside the composers into "us" due to its collaborative participatory identity.

1.2 Context

In this section I will briefly outline the installation's major background contents, which are relevant to the theoretical aspects of the thesis.

1.2.1 Electric Guitar As A Cultural Icon

Wolf Dieter Prix, former architect of the Coop Himmelblau architecture team, states that the ability of creating tension in space with the vibration of the strings and the amplified electric sound makes the electric guitar one of the most innovative inventions of the twentieth century (Aker 1993). The electric guitar has been an icon of the bridge between the electric and the acoustic sonic worlds since its invention and it can easily be viewed as having been the bridge between humans and electric technology in the history of music.

Until the beginning of 1930s, the guitar was mainly in the background as a rhythm instrument. When a wire connected the instrument to a box and out came a strange new sound, it changed the hierarchical role of the guitar among the band instruments. This new sound was the result of simple physics. A vibrating metal object moving in a magnetic field creates a signal that can be picked up by a wire coil. Inventor and musician George Beauchamp, who played Hawaiian music in Los Angeles, is said to have created the first crude electric guitar on his dining room table (1930 cited NPR 2003). The selling point to musicians was the volume. Electric guitars had volume, but it needed a second wave of innovation to turn the instrument into an icon of the new generation of music. In 1943, California radio repairman Leo Fender and musician Doc Kaufman built a prototype solid-body guitar that was very similar to the original "frying pan," but with a better pickup and tone controls (NPR 2003). Because suppliers could provide parts for production on an assembly line, the guitar became relatively cheap. It was a guitar for the masses. This created dynamic relationships among inventors, supplier, and users. The electric guitar came to fame through the desire of musicians and inventors for a louder, better, and different sound. Through the interactions of listeners, players, manufacturers, engineers, dealers, and, eventually, researchers and experts, it grew to be an important element in the western music. This interaction formed the electric guitar into a cultural icon. The electric guitar helped musicians be creative in a new ways, they and their audience heard new things and imagined new possibilities for their music and, ultimately, saw themselves and the world in a new way. Rock and roll music was in particular associated with the new electric guitar. It became the heart of the cultural revolution that rock and roll symbolized. The mass production of highly desirable electric guitars allowed masses across the western world to reinvent themselves in terms of a vision of musical rebellion and independence.

Electric guitarists had become the superstars of rock music. Live performances in large concert halls and open-air concerts increased the demand for greater volume and performance abilities. Popular groups like the Beatles and the Rolling Stones brought about an international following out of America beginning from the early sixties.

a)  b) 

Figure 1-1: a) Jimi Hendrix created his own technique in the late sixties and became a legend. b) The Beatles were a famous guitar band in the sixties. Large crowds came to see their concerts, so they had to move into the stadiums.

The rise of stadium concerts had a big influence on the development of guitar culture, and as a result, on the music industry. New sounds and textures, like distortion and feedback, became part of the guitarist's language. Electric guitar became a fundamental instrument in band music.

Not only new sounds have been developed, but also new techniques such as maneuvering the guitar's tremolo arm and playing close to the amplifier, has increased the visual effect of electric guitar more than the other band instruments. Jimi Hendrix can be considered a pioneering guitarist in the techniques mentioned above (NPR 2003).

In the second half of the 1970s, when punk music became the new musical style, it created the next guitar culture as well. The color of distortion sounds, out of tune melodies and simple structured songs influenced the idea of forming guitar bands. Sex Pistols was a punk band followed by millions of people who listened and covered their political sounds.

As guitarists experimented with their styles and techniques, a new loud, distortioned music came through. Power chords, flashy solos, and overall volume sounds began to take part in music and constituted Heavy metal as a guitar culture in the 1980s. The beginning of 1980s was also the golden years of the synthesizer music. Synthesizer bands, like Depeche Mode, began gaining popularity, even though they did not have any guitar sound in their music.

As with everything else all things are subject to change in the music culture. In today's music a small scale band consists of at least two djs and one vj, but even so the electric guitar stands for being a cultural icon in the development of band music. Therefore the electric guitar was chosen as an interface in this installation, in order to simulate the musical band environment. This interface associates directly with the participants' expectations from the installation. Being familiar with an electric guitar as an interface can create more possibilities to discover the interaction paths, but not being familiar with a guitar does not end up being a disadvantage in this installation. Neither a background in music or previous electric guitar experience is required for taking part in this jam session.

Figure 1-2: The Sex Pistols are the best representatives of what punk music was like in the late seventies. ”Anarchy In The UK" made everyone aware of them. They put together violence and heavy stage shows with their punk melodies.

1.2.2 Participating in new media art

Pierre Guiraud (1994), French philosopher and writer, describes the observer’s desire to interact with the medium as an emotional relation. In his own words a call for participation is a call for love. He associates the gestures and the behaviors with the lovers’ desire to be one to experience the same situation. This keeps the communication live and makes it real.

The emotion that exists between the people who participate in any kind of communication in order to be together, gets to a larger scale when it is done by a group of people or a community. Stage performances, religious or political ceremonies, songs, dances and marching are aimed at making participants act together.

The emotional relation to become a participant relies upon the event, and it conditions the cooperation. The process involves doing the same things together during the event. In order to become a participant, actual physical relation is fundamental.

The excitement created by the event can also influence the emotional bond between the audience and the performance. The exciting scenes of a concert, witnessing the interaction between band members, and the light, ritual, performance setup, can make this observable connection interesting enough for the audience become participants (Winkler 1998). A desire to experience an unusual event or to bring the unexpected into life in the form of a performance, can be the first step for establishing love between the audience and the performer in order to create participation. Why do performers of the new medium want or need audience to become participants? On an emotional level it can be Gulliard’s definition of participating. A desire to be us. I will not go any further into the discussion on contemporary art identities or formations, however the dynamics of today’s world and the consequences of the age we are living have a direct influence on artists and works of art. The aim of art pieces has shifted from the audience enjoying the pieces from afar, to the audience taking part in the actual performances. Taking part

becomes a fundamental element of an art piece, which results in participants becoming dynamic sources of the installations or the performances.

To achieve its goal, the From Me to Us installation requires a high level of participation. Participants are an important part of this installation and it would not be able to go any further without them.

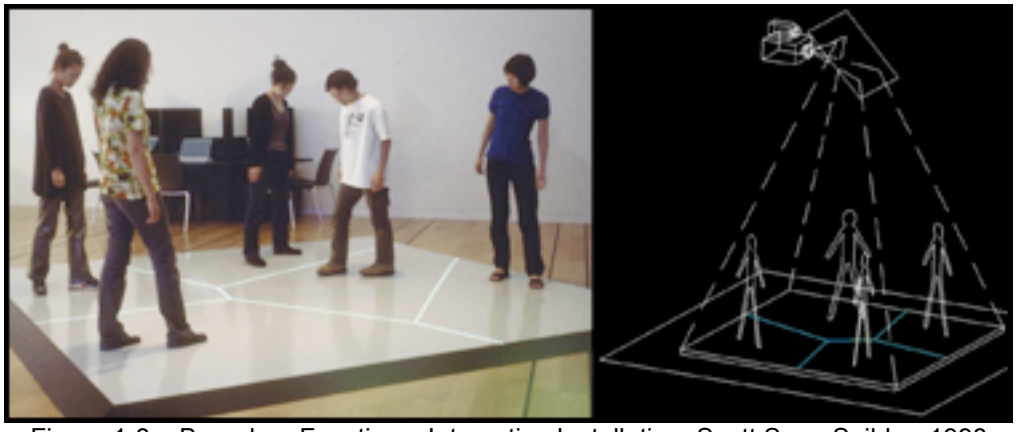

Figure 1-3: Boundary Functions, Interactive Installation, Scott Sona Snibbe, 1998

Figure 1-4: The Paranoid Panopticum, Interactive Installation, Hermen Maat, 1999.

Chapter 2 introduces the classification of interactive systems and related works in the computer generated music field. The background examples are chosen to present a historical review of computer generated music applications and to associate them with the From Me to Us installation both in a theoretical and an application scale. Chapter 3 overviews the algorithmic composition categories and some methods that have been used in this field. It also briefly presents a controlled randomness method in the application part of the From Me to Us installation.

Chapter 4 documents the application progress between late winter and fall 2003. It details the ideas and the development of the application process. The conclusion part consists of the participants' feedback concerning the installation on the 31st October 2003. It also discusses the possible next steps of the From Me to Us concept.

Figure 1-5: The From Me to Us installation at mlab UIAH Helsinki, 31.10.2003.

Chapter 2

Background and Related Works

In this section I will introduce some key figures and their applications, which have made history in this field. The purpose of the classification part is to familiarize the reader with the interactive systems that have been used in the computer generated music field, and associate them with the application part of the installation.

2.1.1 Classification

During the past decades various interactive systems have been implemented in computer generated music applications. These implementations are constructed on their suitable algorithmic music theories. Music theories have their individual identities in relation with their time and application systems, however there are similarities and relations between each other as well. Their evaluation may even be built on the earlier efforts of other implementation. Robert Rowe (1993) identifies the applied systems' similarities and relations by developing a classification of interactive systems. The computational methods of classification, which are in touch with the From Me To Us installation, are the interactive computer response methods.

The response methods in Robert Rowe's classification are transformative, generative and sequenced groups;

- Transformative methods take existing musical material and apply transformations to produce outcome variants. These variants may or may not be recognizably related to the original. For its algorithms, the source is complete musical input, often these transformations are applied to live input as it arrives.

- Generative methods use sets of rules to produce complete musical output from the stored fundamental material that source material can be elementary or fragmentary. Taking pitch structures from basic scalar pattern according to random distributions can be an example for this method.

- Sequenced techniques use prerecorded music fragments in response to some real-time input. (Rowe 1993)

The response technique is sequenced. Everything the engine plays has been stored. The score followers method can be regarded as a player paradigm system, because they realize a recognizable separate musical identity.

- Systems following a player paradigm try to construct an artificial player, a musical presence with a personality and behavior of its own, though it may vary in the degree to which it follows the lead of a human partner. (Rowe 1993)

The engine that runs in the From Me To Us installation is a part of a system that follows the player method as well as a part of a response technique methods. The aim of this systems interpretation is not to place this installation in a certain classification method, but it is to associate with earlier works.

2.2 Computer Generated Music Applications – review

> "It is now easy to make a lot of noise, and pretty fancy noise at that. But isn't this so-called democratization of music in popular culture really no more than a new generation of under- educated intelligent instruments which is basically automating and perpetuating a simple view of music and its accompanying habits?"
>
> Paul Lansky (1990)

In the history of music sequencing, from the appearance of the first automatic instrument Aeoles in the early second century BC, up to this time, there have always been new ideas coming forth on creating and developing new musical instruments, styles and theories (Muro 2000). There has been a cross influence relation between the technology and the existing music forms in any timepiece. This does not only has a consequence new devices, but it also opens up new possibilities for musicians to expand their abilities.

In the beginning computer generated music was not a real time interactive art form. The early examples are most likely limited by the requirement of the computer technology. Musicians composed computer programs to create models for their music. They run in a non real time environment, and each have their own compositional rules. Programming languages have turned this into an algorithmic music. In this situation the composer becomes a programmer, and writes an algorithm (a series of instructions to the computer) to create the sound as well as the music.

2.2.1 Lejaren Hiller

Computer generated music started in the mid 1950s when composer Lejaren Hiller and the mathematician Leonard Isaacson began experimenting with the Illiac computer at the University of Illinois (Bohn 2003). The best known pioneering work in computer generated music is the Illiac Suite, for String Quartet (1957) by Hiller and Isaacson. It was a set of four experiments based on a generate-and-test principle.

The computer was programmed to generate large quantities of random numbers. Each number was tested and either accepted or rejected according to the specific compositional rules of the harmony. They used the Markov chains, a counterpoint and a rule based system for generating a pitch and a rhythm (Franz 1998). Because the computer sound synthesis had not yet been developed during that period, the outcome of this computer program was a score for an acoustic string quartet.

He composed his second computer music composition called *Computer Cantata* with Baker in 1963. They used Baker's computer program MUSICOMP (Music Simulator Interpreter for COMpositional Procedures). During his life Hiller composed a variety of different music styles from jazz, performance art, to folksongs as well. His 1976 Electronic Sonata is a 45-minute sonata-form movement made entirely of computer-generated and computer-manipulated sounds (Alpern 1995).

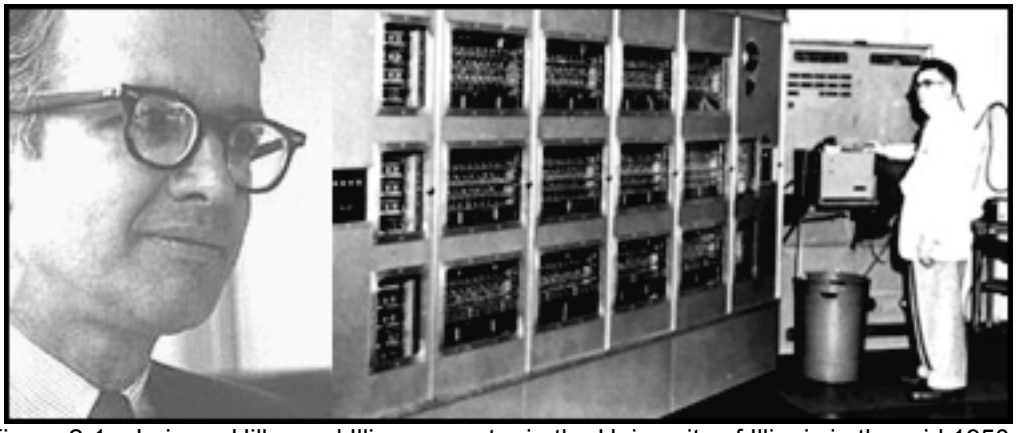

Figure 2-1: Lejaren Hiller and Illiac computer in the University of Illinois in the mid 1950s.

> "Should a person listen to these pieces as he might 'ordinary music?' Yes, I think, but with this important qualification: They are much more didactic than expressive compared to most music. These pieces are truly experimental because they are concerned with revealing process as well as being final product. They are embodiments of objective research results. They are laboratory notebooks. Sometimes the results have surprised us because a compositional routine seems less effective than expected, sometimes more so. If I were to delete everything that disturbs me aesthetically, I would falsify the research record. So, for the present, my objective in composing music by means of computer programming is not the immediate realization of an aesthetic unity, but the providing and evaluation of techniques whereby this goal can eventually be realized. For this reason, in the long run I have no personal interest in using a computer to generate known styles either as an end in itself or in order to provide an illusion of having achieved a valid musical form by a tricky new way of stating well-known musical truths."
>
> Lejaren Hiller (e-journal 2003)

2.2.2 Iannis Xenakis

> "God has been replaced by science and as such provides the most concrete truths."
>
> Iannis Xenakis

Xenakis' background in mathematics, engineering and architecture gave him various advantages to experiment and expand his identity as a composer. His first musical work is based on the design for the surfaces of the Philips pavilion, which was to be built for the Brussels Exposition (1958) by Le Corbusier's architectural team (Isast 2001). In 1954 he composed an orchestral piece called the *Metastasis* for sixty musicians. After experimenting with this new musical composition technique, he moved on to find out about mathematical and computer means in his music modeling. His celebrated early algorithmic compositions are *Diamorphoses*, 1957 for four-channel tape, and *Concret PH*, 1958 for a 2-track tape. He developed one of the most important techniques called stochastic music. His approach was based on random generation and probability theory, which is used to generate material in a number of ways. Stochastic process is a process whose behavior is controlled by a random or probabilistic procedure, and therefore the outcome of it is unpredictable (Fonseka 2000).

Xenakis developed a method of deriving groups of pitches stochastically and called it "The Theory of Sieves". This involves taking the full range of an instrument and creating a scale by dividing the range into steps (Xenakisworld 2003). Makis Solomos (2002) analyzes *Diamorphoses* as dimensions of time and pitch, which represents the loudness by thickness. He views the most important characteristic of the *Diamorphoses* as being the types of sounds used. The distinction and numbering functions of these sounds are written by subdividing numbers referencing to his stochastic music.

Xenakis continued his stochastic compositions as well as developing new approaches to the new ways of modeling the music. He designed a computer system utilizing a graphic interface (the UPIC), which has proven to be a liberating, provocative pedagogical tool as well as a powerful environment for computer composition (Isast 2001). Xenakis and his team at CEMAMu developed the musical drawing board in 1975. *Mycenes Alpha,* 1978 for two-channel tape, *Pour la Paix*, 1981 four versions, *Taurhiphanie,* 1987 for two-channel tape and *Voyage absolu des Unari vers Andromede*, 1989 for two-channel tape, are the compositions composed with the UPIC (Solomos 2002).

When the amount of work Xenakis did and its distinctiveness until the time of his death in February 2001 is evaluated, there is no doubt about him being a major figure in the area of algorithmic composition or his influence on contemporary music.

Figure 2-2: Outside view and Masks from Sequence 2 “Matter and Spirit”, Philips Pavilion, 1958.

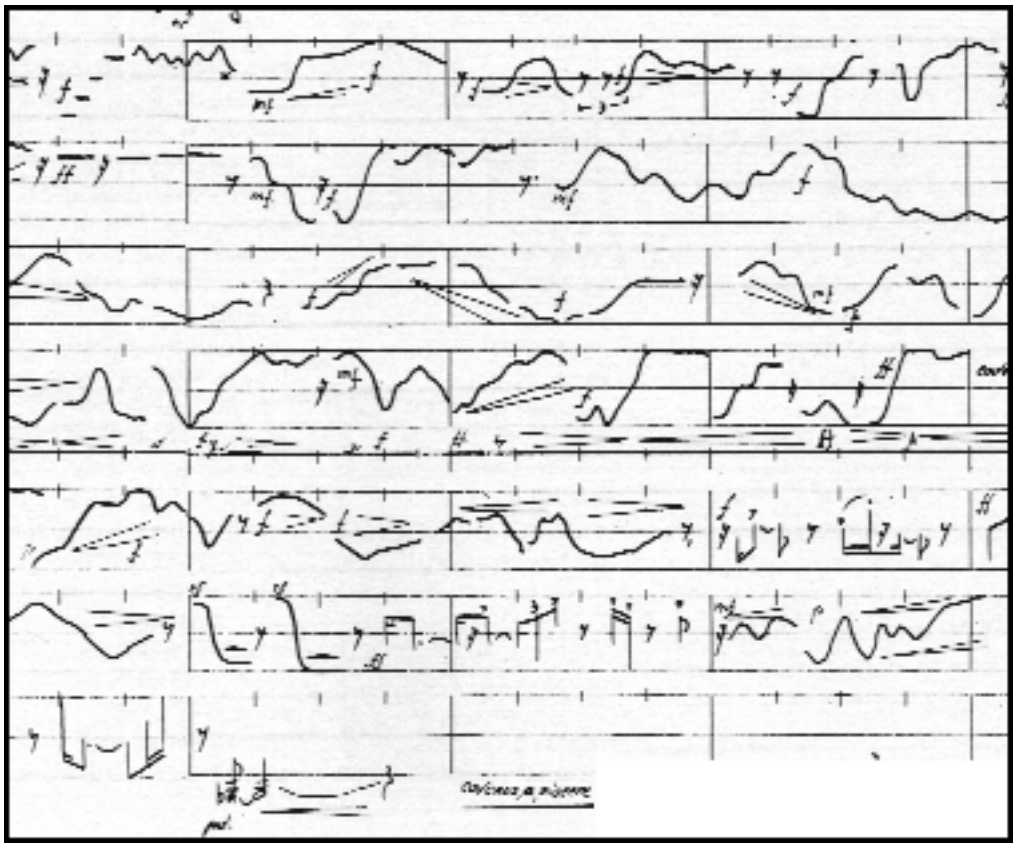

Figure 2-3: The scores for *Poeme electronique*, Philips Pavilion, 1958.

2.2.3 Karlheinz Essl

Håkon Normann:	How would you describe the generative music that you make (genre, style etc) ?
Karlheinz Essl:	XXX (Xtremly Xperimental Xpressionism)

Generative Music Answers to a Questionnaire (Normann 2003)

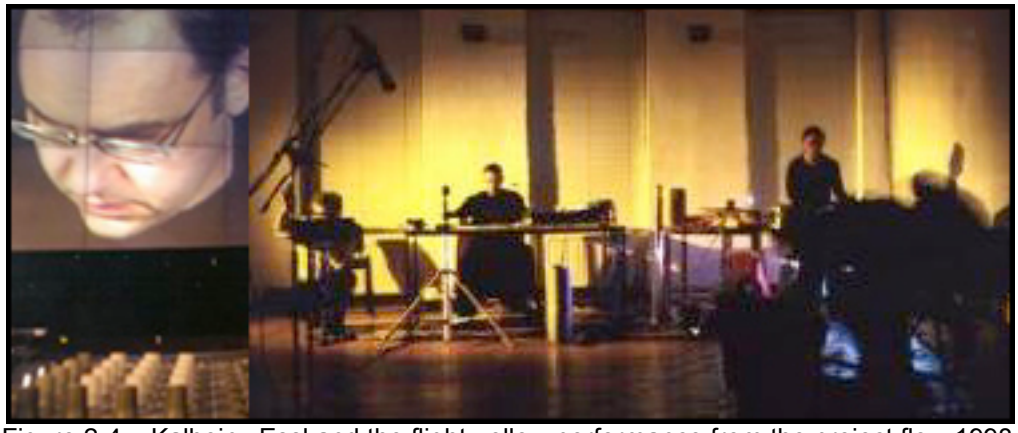

Figure 2-4: Kalheinz Essl and the flight-yellow performance from the project flow 1998.

Essl has been involved with algorithmic composition since 1985 by developing the theory of Structure Generators, however his generative music compositions began in the early 1990s when he was working on a commission at IRCAM (Normann 2003).

Lexikon-Sonate is one of his noted interactive realtime composition environment, which is a generative piece for computer-controlled piano. In this piece he programmed the algorithms of the various music generation modules in Max/MSP program (an interactive graphical programming environment).

The name of Lexikon –Sonate was influenced by the very first literary HyperTexts novel called "Lexikon-Roman" which was written between 1968-70 by the Austrian-Slovakian author Andreas Okopenko (Essl 2003). This novel contains several hundred small chapters. The author structured reference arrows in the novel to provide the possibility for the reader to create his/her own version of the novel. There are different musical modules in the Lexikon –Sonate as there are different chapters in the novel. Each module represents an abstract model of a specific musical behavior, created by a hundred random generators. As a result of these random generators in Lexikon-sonate, the composition never repeats itself.

The Amazing Maze is his other real-time composition which started in 1993 at IRCAM (Essl 2003). It is a computer program which generates music by manipulating sampled instrumental sounds according to certain compositional algorithmic strategies. These modules are also programmed in a MAX/MSP environment and by referencing to the Real Time Composition Library (RTC-lib). The Real Time Composition Library for MAX/MSP environment is a collection of software

modules that offers the possibility of experimenting with a number of compositional techniques. It is an open source library available for everyone to download and experience serial procedures, permutations and controlled randomness modules for computer generated music compositions.

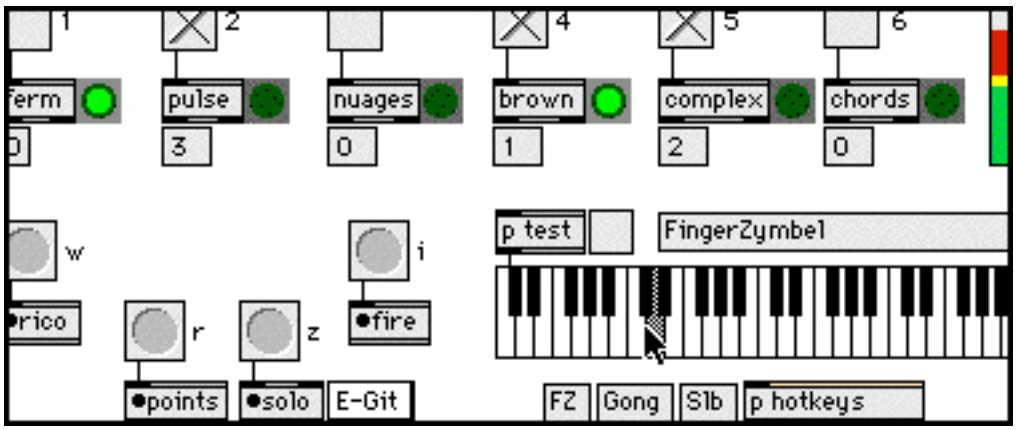

Figure 2-5: Interface of the Realtime Composition & Improvisation Environment, Amazing Maze.

> "...Lexikon –Sonate manifests itself as a computer program that composes the piece – or, more precisely: an excerpt of a virtually endless piano piece – in real time. It lacks two characteristics of a traditional piano piece:
>
> - there is no pre-composed text to be interpreted,
> - and there is no need for a pianist or an interpreter."
>
> Karlheinz Essl (2003)

2.2.4 Paul Lansky

Lansky is one of the composers that attracted by the excitement of serialism in the sixties found himself using a computer in his compositions as consequences. After his collaboration with George Perle concerning the development of Perle's *twelve tone tonality* ideas which is a way of combining serial techniques with pitch centered motion, he developed his own set of programs (McCarthy 2003). Linear Prediction Coding and Cmix (in the 1990s) are freely available for everybody to compose their own music.

His early works consist of combining traditional acoustic instruments with a computer-synthesized tape (*As If* – string trio and tape, 1982). He uses the computer as an instrument to mix the real and the synthetic instruments as well as to sample and process sounds.

The Six Fantasies is the first composition that he used the Linear Predictive coding (LPC) algorithm to alter his given material (McCarthy 2003). LPC was designed to compress speech for efficient transmission and for modeling and manipulating the human voice. Lansky uses previously existing music, ambient urban sounds and the language in his compositions. He also manipulates the language that concerns reading a text, improvised conversations, or verbs and nouns as a contour of the

spoken language which he calls the sounds of the real world. *Things She Carried, Things She Remembered, Things She Noticed, Wish In The Dark, Night Traffic, Quakerbridge* are some compositions based on this manipulation (Perry 1995).

A major characteristic of Lansky's compositions is that he associates the sound with human activity. The activity creates a physical space an he goes out to capture these physical actions and manipulates them into new sounds, which he then uses in his compositions.

> "Technology is not going to allow us to make better music. It will allow more people to make music more easily. I don't believe that music improves as time goes on. It just gets different and reflects the mind of its age"
>
> Paul Lansky (cited Clark 1997)

2.2.5 Tod Machover

Tod Machover was the Director of Musical Research at Pierre Boulez's IRCAM Institute in Paris between 1978 and 1985 where he was first introduced to computer music. He has been recognized as one of the most important and innovative composers in this new way of making music which involves a different kind of collaboration between technology and art (Machover 2003).

In addition to his work as a composer, Machover is widely noted as a designer of new technology for music. He is the inventor of Hyperinstruments, a technology that uses smart computers to expand musical expression.

Valis (1987) – a science fiction opera, *Bug-Mudra* (1990) - a special dataglove project developed to measure left-hand conducting, concentrating on sound mixing and timbre modification, *The Sensor Chair project with Penn and Tellerı* (1994) – a new mini-opera, *Hyperinstruments, Brain Opera* and *Hyperscore* are his well-known compositions and projects. At the present he is an Associate Professor of Music and Media at the MIT Media Lab (Machover 2003).

2.2.6 mlab MIT / Brain Opera

> "I want people to feel as if they were walking into somebody's mind."
>
> Tod Machover

The Brain Opera is a highly collaborative opera that requires the audience in the performance of the work. The participants interact with the hyperinstruments either as a live audience in the opera space or by playing a hyperinstrument on their home computer via Internet. The opera piece is created by participating. Every new session becomes a new opera.

The first part of the brain opera consists of the hyperinstruments that are played by the audience who are present at the actual opera hall. Machover calls the first part the forest of new instruments (Dyer 1996). The Audience explores the parameters of musical expression such as melody, harmony, rhythm, gesture and singing. All of the audience's creative playing goes into the computers, and parts of it emerge in the second part.

The audience experiences with the work in a specially designed performance space. Moving images are projected on the walls, floor and ceiling, and the audience will be encouraged to move around. Raw materials created in the first part are put together with the music Machover has created earlier. The hybrid of works create the part before the end. The finale part consists of the input of the audience members who have joined the performance via the Internet. The "Sensor part" is created during the finale for the members of the audience to dance on it. Then the work closes with a quiet moment (Dyer 1996).

The name of the performance symbolizes the collaborative creativity and also works as a metaphor for the way the brain works.

Figure 2-6: Tod Machover and the images from the Brain Opera performance.

2.2.7 mlab MIT / Hyperscore

Hyperscore was developed by Mary Farbood and Egon Pasztor as an important component of the Toy Symphony project at MIT Media Lab. Hyperscore is a graphical composition environment that interprets the gestures of the strokes and lines the user draws in an intuitive way. The user can pen musical ideas, store them for later use, and create new pieces. It is a canvas where one can compose music by regular computer drawing tools. The Hyperscore software consists of random algorithmic generators that outputs the musical composition related to the analyzed drawn lines (Farbood 2003).

2.2.8 mlab MIT / Hyperinstruments

The hyperinstrument project was started in 1986 by Tod Machover at MIT Media Lab with the goal of designing expanded musical instruments. Hyperinstruments were designed to expand guitars and keyboards, percussion and strings, and even conducting. Hyperinstruments are usually a manipulated version of the traditional instruments, but they can also be sophisticated bug shaped plastic boxes (Hyperinstruments 2003).

The research group aims to build interactive musical instruments for non-professional musicians of all musical backgrounds. Some of the famous names who have used Hyperinstruments are Yo-Yo Ma, the Los Angeles Philharmonic, Peter Gabriel, and magicians Penn & Teller.

Figure 2-7: Hyperinstrument Sensor Chair and the interface of the Hyperscore

Chapter 3

Algorithmic composition

The following text will present the identity of an algorithmic composition. It will discuss the usage of the algorithms in compositions and categorize the algorithmic processes in the field of computer generated music.

> "Everything around us can be represented and understood through numbers."
>
> Max Cohen (Pi 1998)

The musicians of ancient Greek built their musical systems upon the theoretical applications of numbers and various mathematical properties derived from nature (Maurer 1999). These properties were the formalisms, or algorithms. These early algorithms did not involve the musician to be entirely removed from the decision-making process of the composition. Therefore, the music of Ancient Greek was not an "algorithmic composition" in any sense. However these musical systems of intervals and modes which are based on the concept of the "Music of the Spheres" are undoubtedly important historically in music for its leaning towards formal extra-human processes.

The Webster's College Dictionary defines an algorithm as a set of rules for solving a problem in a finite number of steps, in order to find the greatest common divisor. A sequence of steps designed for programming a computer to solve a specific problem (Maurer 1999). In musical applications, algorithms may be thought of as procedures that test potential compositional material for its suitability within the given context. Algorithmic composition is the application of a rigid, well-defined algorithm to the process of composing music (Jacob 1996). Using an algorithmic composition can free the composer from a note-by-note composition, allowing him to explore theories of music and composition, without worrying about the actual notes. Bruce L Jacob (1996) defines creativity in two different types: the flash out of the blue (inspiration genius), and the process of incremental revisions (hard work). In this context the algorithmic composition can also be thought of as a compositional tool that simply speeds up the process of hard work. It is a methodology that allows a human composer to work more quickly.

3.1 Categories of Algorithmic Processes

Kristine H. Burns (1997) lists the types of Algorithmic processes as stochastic, chaotic, rule-based, grammars and artificial intelligence. The algorithmic module in the From Me to Us installation matches with the stochastic type because of the controlled random processes of the engines. In this section I will briefly interpret these five processes will be.

3.1.1 Stochastic

Wolfgang Amadeus Mozart used random numbers to bring together the small musical fragments, and combining them by chance, to construct a new piece from randomly chosen parts in *Musikalisches Wurfelspiel* (Dice Music) composition (Alpern 1995). This very simply form of algorithmic composition depends on chance of what makes it possible for the dice to decide what notes to be used. The concepts of chance and determinacy are fundamental elements that have been used to construct algorithmic compositions. Although the leading process of chance and determinacy can be slightly different however they still have the same outcome method; nobody knows what the outcome will be. The concept of chance can have a consequence strategic and conscious planning, on the other hand determinacy can take us to randomness through situation. Thus controlled randomness can be defined as the combination of chance and determinacy.

The concept of indeterminacy suits well for computer generated music since the musical features are not precisely fixed or determined in advance. John Cage is one of the pioneer figures in these compositional techniques of the indeterminacy beginning from the forties and fifties. He created very strict rules (algorithms) to generate large scores. He used random procedures to pick one of many compositional options to set his musical parameters. He also used indeterminacy in his performances, offering verbal instructions or graphic images to performers in place of traditional scores. He experimented with chance operations, such as throwing coins, to create the smallest details or to create larger musical structures (Winkler 1998).

Stochastic has been a technique for transforming the process into randomness, the concepts of chance and disorder to get an unpredictable outcome. The statistics have been used to deriver the music composition from mathematic and logic. One manner of statistical analysis that has been used in algorithmic musical compositions is the Markov Chains.

Andrei A Markov is particularly remembered for his study of Markov chains (1901), sequences of random variables in which the future variable is determined by the present variable but is independent of the way in which the present state occurred from its predecessors (O'Connor and Robertson 1996). This work launched the theory of stochastic processes. It is a mathematical model used to represent the tendency of one event to follow another event.

> "To describe how music is modeled by Markov chains, let's first define the terminologies and notations – A first order, discrete time Markov chain C is a random *walk* $X_t, t = 1,2,3,\ldots,$ in a state space $S = \{ s_1, s_2, .., s_N \}$ according to a $N \times N$ state-transition matrix $P_{i,j} = p(X_{t+1} = s_j \mid X_t = s_i)$, where $P_{i,j}$ denotes the element on the i^{th} row and j^{th} column, and $p(\cdot|\cdot)$ is the usual notation of the conditional probability distribution function.
>
> Mathematically, it suffices to say that a Markov chain C is characterized by its state-transition matrix P, up to one-to-one mappings between homeomorphic state spaces. One can even sloppily write $C = P$. However, how the transition matrix actually means depends upon how the state-space is defined. For example, if the (pentatonic) state space is defined as $S = \{ C4, D4, E4, A4, G4 \}$, then $P_{1,5} = 0.3$ reads the next note is G4 thirty percents of the times when the current note is C4." (Liu 2002)

Probability is the core statement of the decisions in the Markov Chain process. Information is linked together in a series of situations based on the probability that situation A will be followed by situation B. The process is continuously in change because situation A is replaced by situation B and the probability of it being followed by another situation B is still continues. Markov Chains is applied to music by the string quartet Illiac Suit. Lejaren Hiller used the Markov Chains for the statistical analysis and stochastic methods in this algorithmic composition. This modeling technique has been used by various algorithmic composers up to date and even there has been some research about to determine if the Markov chains can be used as tools for the analysis of jazz improvisation because of its randomness model (Franz 1998).

The random outcomes in the From Me to Us installation are determined so that the notations will not be dependent on any predefined structure. Even though certain scales are followed, there is no predefined structure concerning the order of notation that the engine creates. The association between a certain scale and the non-predefined notations constructs the application's controlled random identity.

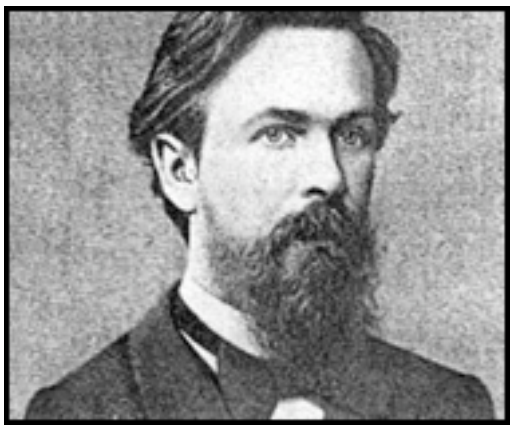

Figure 3-1: Andrei Andreyevich Markov 1856 - 1922

3.1.2 Chaotic

Kristine H. Burns (1997) categorizes the chaotic process related to the composers who applied the mathematical principles involved in studying chaos into their compositions. Irregularities in nature have been focused on by composers in terms of the concept of the randomness. In this scale chaos and randomness associate with the representation of order and disorder.

> "Nature forms patterns. Some are orderly in space but disorderly in time, others orderly in time but disorderly in space. Some patterns are fractal, exhibiting structures self-similar in scale. Others give rise to steady states or oscillating ones. Pattern formation has become a branch of physics and of materials science, allowing scientists to model the aggregation of particles into clusters, the fractured spread of electrical discharges, and the growth of crystals in ice and metal alloys."
>
> Benoit Mandelbrot (cited Burns 1997)

composers who can be considered in this category of algorithmic composition model are Rick Bidlack, Tommaso Bolognesi, Charles Dodge, James Harley, Gary Lee Nelson, and Rodney Waschka II.

3.1.3 Rule – based and Grammars

The Illiac Suit, string quartet by Lejaren Hiller and Leonard Isaacson, is a good example of the rule based algorithmic composition. The total process of the score was constructed by following a series of steps. First certain "raw materials" were generated by the computer, then these musical materials were modified according to various functions, and then the best results from these modifications according to diverse rules were selected. This generator **–** modifier – selectors model was later applied to MUSICOMP, a system for automated composition by Hiller and Robert Baker.

The Grammar method of algorithmic compositions has a system of linguistic theory that assigns a formal system of principals or rules from which the sentences of a language are generated. A set of production rules is the basic identity of the grammars. This set is used to generate the composition the same way as constructing a sentence (Burns 1997).

3.1.4 Artificial Intelligence

Artificial Intelligence systems are rule-based systems that are based on predefined grammar, but these systems have a further capacity of defining their own grammar. They have a capacity to learn. These automated expert systems are based on imitating the methods of a particular human practitioner. The ultimate goal is modeling observable human musical activities. With this kind of modeling, artificial intelligence researches believe they can succeed in building systems that demonstrates human intelligent behavior (Burns 1997).

Balaban (1992) argues that it is not even clear whether the reference domain of

music is emotional, perceptual, intellectual, physiological, or whether all of these domains interplay. For this reason, most researchers find it is difficult to model these references. Most experiments researching human musical activities model the sonic phenomenon of music, not its denotation. This difference in focus indicates that many of the existing AI methods may not be adequate for the task of musicological research. Balaban (1992) states this boundary could be an incitement for developing new approaches capable of extending the scope of AI research.

Kemal Ebcioglu devised a computer program that writes harmonies remarkably similar to Bach's. Ebcioglu came up with 350 rules that govern the harmonization process. The model consists on four-part chorale harmonization task in the style of J. S. Bach. CHORAL, Ebcioglu's automatic system, incorporates three hundred fifty rules to guide the computer in its decision making process. It is given a melody and produces the corresponding harmonization using heuristic rules and constraints. The system was implemented using a logical programming language designed by the author. An important aspect of this work is the use of sets of logical primitives to represent the different viewpoints of the music (melodic view and etc.). These sets of logical primitives allowed tackling the problem of representing large amounts of complex musical knowledge (De Mantaras and Arcos 2002).

Chapter 4

From Me to Us Application Progress

The implementation part of the installation was an open question for me in the beginning. After I clarified the concept of the installation, I began researching some related works that have been done in this field. When I became familiar with these applications, I tried to figure out the best solution for the application part of the installation. The following text documents the development of the application that has been used in the From Me to Us in three different time periods.

4.1 Winter 03 – (17.02.03)

Thor Magnusson and Enrike Hurtado, from IxI software, had a week long workshop at mlab / UIAH in the mid February 2003. The main topic was to experiment with different kinds of interfaces for sound productions. The application part of the From Me to Us installation began during this workshop. The first step was defining the technical requirements for this interactive system. A MIDI sequencer, musical instrument digital interface, and the software Max/MSP, a graphic language for building interactive music systems, were considered the best solutions for building the system within the existing mlab environment.

The application process development started when I was able to receive the MIDI data information from the electric guitar and get this data into the Max/MSP environment. By using the objects, the MIDI data input began to communicate with the MIDI instruments as an output. A pure guitar sound was now supported by another instrument. At this point, I was able to get the same notes at the same time as an output both from the electric guitar and from the MIDI instrument. I began analyzing the input notations in the following step. The early processing stage of the application aimed at having different output notes from the MIDI instrument. The fourth and second notes of the input were generated and these three notes were played at the same time. This turned into an instrument that plays certain chords related to the electric guitar's continues input notes. The fourth and the second notes were used as a well-known technique of constructing the chord. However I built up another arpeg engine that creates the plus eighth, seventh and the third sounds of the input note. The first engine was playing the chords in arpeg technique with the notes in order, the second arpeg engine however used the disordered notes to

construct the chords. It caused the first conflict between the outputs of the same input.

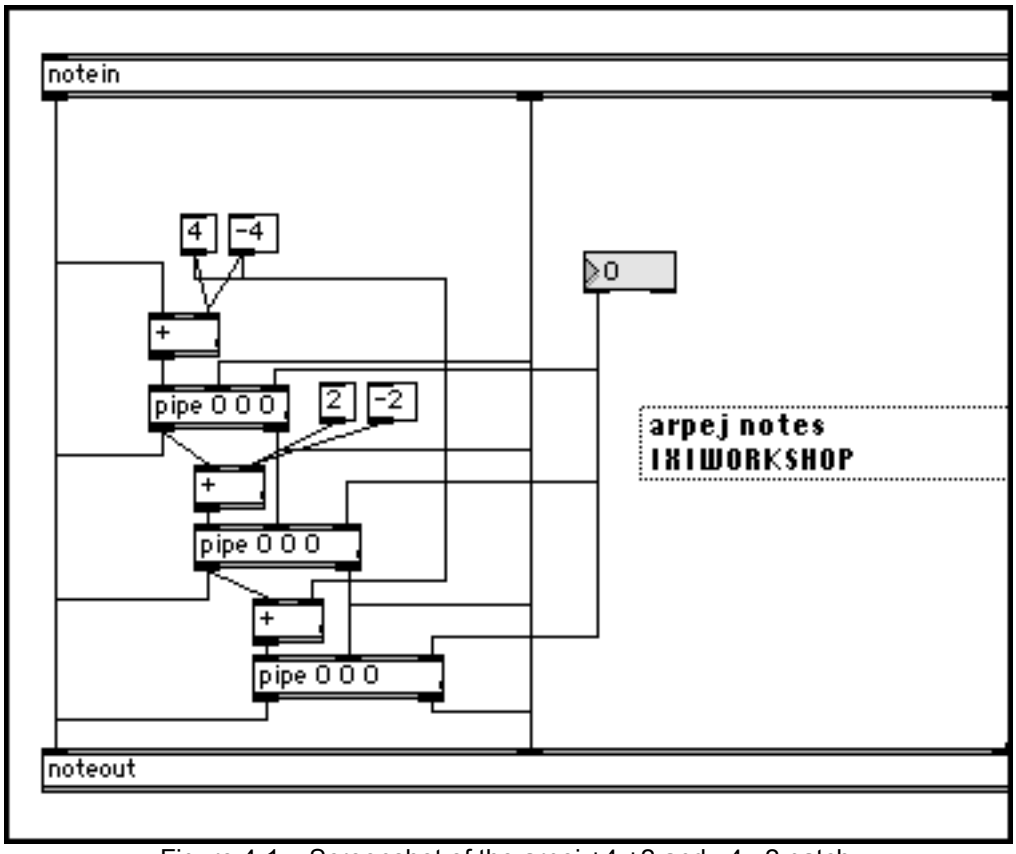

Figure 4-1: Screenshot of the arpej +4 +2 and –4 –2 patch.

The pipe object - was used to control the delay between each notes in the arpeg chords. It is a delay line for different kinds of integers and it sets the delay time interval in milliseconds.

The next step was launching the tempo to assign the rhythmic activity in the system. By using an algorithm the engine will analyze the participant's tempo information and set it as a duration to represent the metronome for the session. However as this is an improvisation session, the metronome shouldn't be predefined or fixed but it should be able to be modified during the same session. The engine will be in charge with all metronome changes.

The tempo engine counts the amount of MIDI data for a certain period of time to track the rhythm information. The counter object, which is set by metro the object keeps the counted integers in ten seconds. The jam message box resets the value in the counter object after ten seconds, so that each metronome set will not use previously counted integers as a new value. The engine multiplies the integer (the

amount of the data in ten seconds) by six to set up the tempo. Every second in a minute represents the sixty-metronome beat.

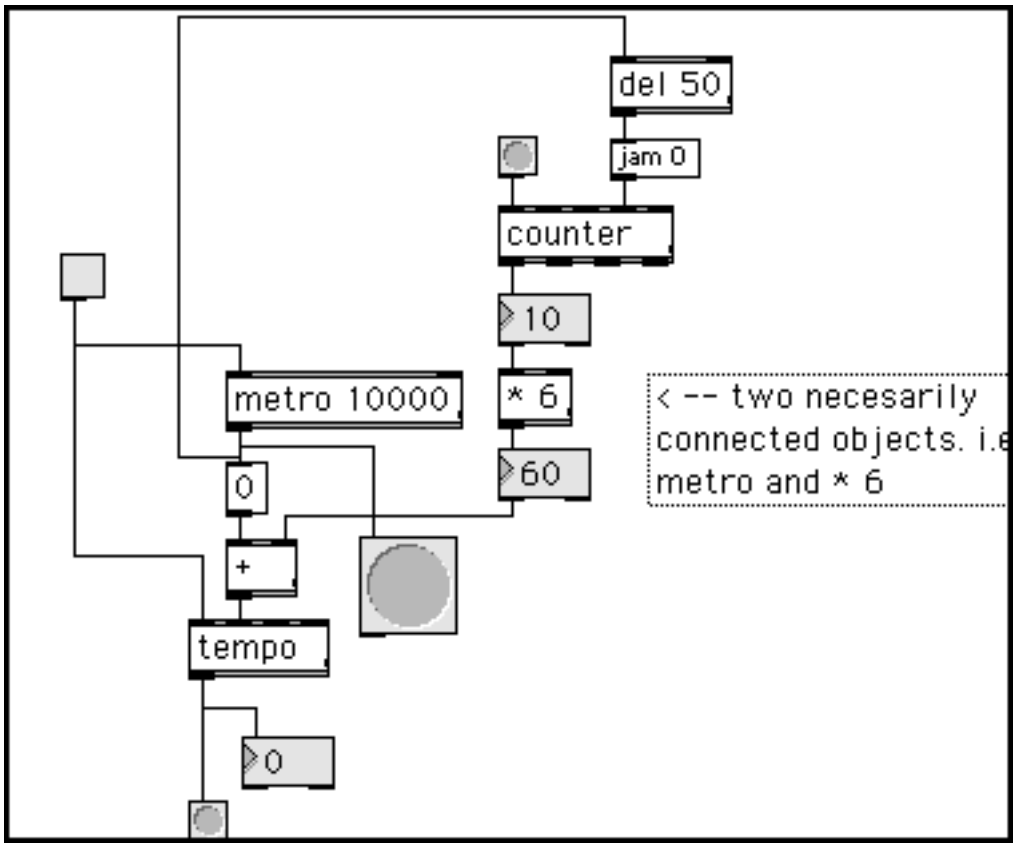

Figure 4-2: Screenshot of the tempo generator engine.

The counter object - is an object that keeps the amount of inputs and gives it out as a counted integer.

The metro object - gives a bang to activate the next object. It takes one argument which is the metronome time in milliseconds.

The jam message - clears the counter object.

The first random notes generated by the engine were the drunk object outputs. The drunk object generates the numbers randomly within a defined set of numbers in a defined number of steps. It is a drunk walk path, and this object performes the drunk walk with certain walking steps.

Eight specific integers were defined to be used in the random engine. When a random number is generated, it enters the sel object. If the random number is one of the numbers of a predefined set, the sel object lets it go forward to an octave

specification. This particular integer is then transformed into a MIDI note and later to a MIDI output. If the random number does not match with the pre-set numbers, then the sel object sends a bang to the drunk object to generate another random number. This random engine became a fundamental building block of the harmonic algorithms in the From Me to Us installation.

The drunk object - takes two optional arguments. The first argument is range specification, the second is step size. The drunk object does a random walk, constrained between zero and the range and step of up to the one less than the maximum step size.

The sel object - selects the defined integers, sends a bang out an outlet that matches the input. It checks incoming ints, floats or symbols against internal values.

At the end of the IxI workshop, I could not manage to connect the tempo generator engine with the other arpeg and the random engines, but the process generated satisfactory results for the next step.

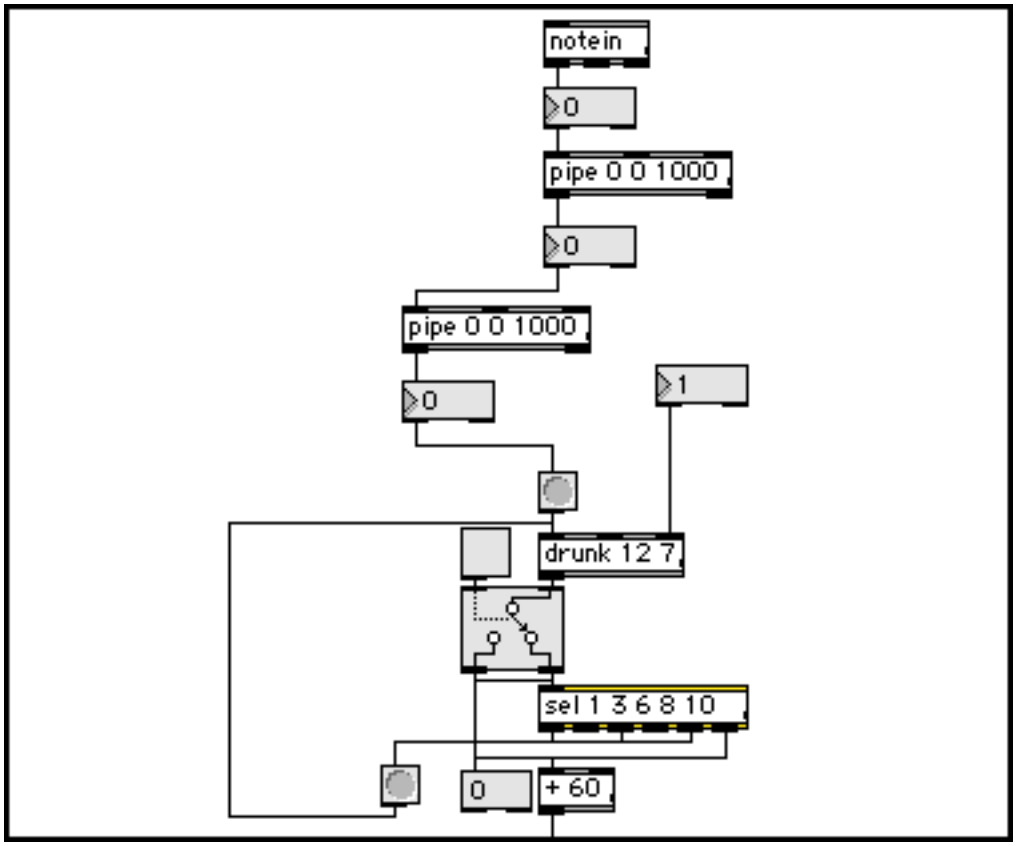

Figure 4-3: Max/MSP patch for the harmony generator engine.

4.2 Spring 03

I focused on analyzing the data in a more specific way than on the previous faces. On this level of the application, three different sub engines with their specific algorithms were running at the same time and each constructed their own individual outputs. These engines represented the basic band members who may play in a collective jam session. The participants of the first application test run also mentioned that they had identified a rhythm and a solo instrument functioning separately during the session.

The tempo engine was developed further. Multiplying the amount of data at ten seconds by six, to complete the whole sixty second process, created the tempo information needed for the rhythmic activity. When I compared the tempo value with another digital metronome, the tempo engine generated a higher value than what it was supposed to. I rearranged the time logic and set a limitation for the highest tempo value. The tempo engine also controls the metronome every sixty seconds, and reacts to any changes in the tempo value. It resets the tempo according to the new values.

The tempo engine directly activates the rhythm pattern that consists of two MIDI instruments as an outcome; bass organ instrument and percussion set.

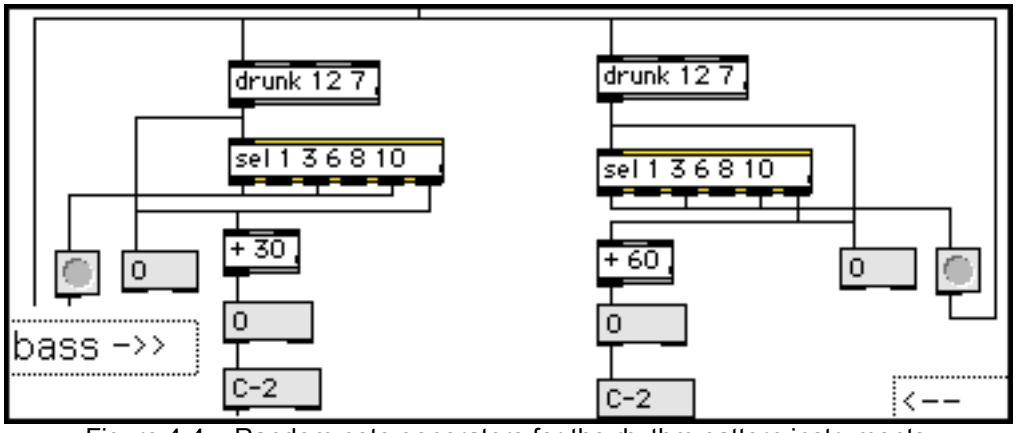

Figure 4-4: Random note generators for the rhythm pattern instruments.

The tempo bangs the signals according to the set metronome beat, and activates these two drunk objects in the algorithm. These objects generate the random notation related to the tempo beat. Bass octave is set for the bass organ and the third octave for the percussion considering the color of the percussion instruments in this octave. The numeric representation of the major scale is set for the sel object, but a couple of additional notes. The number representative set of the major scale, as MIDI information, is (0, 2, 4, 5, 7, 9, 11, 12). When a random number matches with one of these numbers in the set, it can pass through the selection pipe and be transformed into MIDI data for the bass organ or percussion instruments. I also added the numbers 3 and 8 into the set. This transformed the set into, (0, 2, 3, 4, 5,

7, 8, 9, 11, 12). The aim was to create a notation set where the core identities of the major, blues, minor harmonic and the pentatonic scales could be found and analyzed in the set.

The second engine is the harmony generator engine. As it is with the tempo generator, the participant's input is the main source for this generator. The harmony generator engine and the tempo generator engine run separately but they are fed by the same source. Each engine is generated when a particular input enters the system. The controlled randomness theory is one of the key points in the harmony generator engine.

The engine generates a random number between zero and four. The instrument and the notation scale are defined at this point. There are four different scales and instruments associated with each other. It is randomly decided which path of the scale and the instrument will be followed.

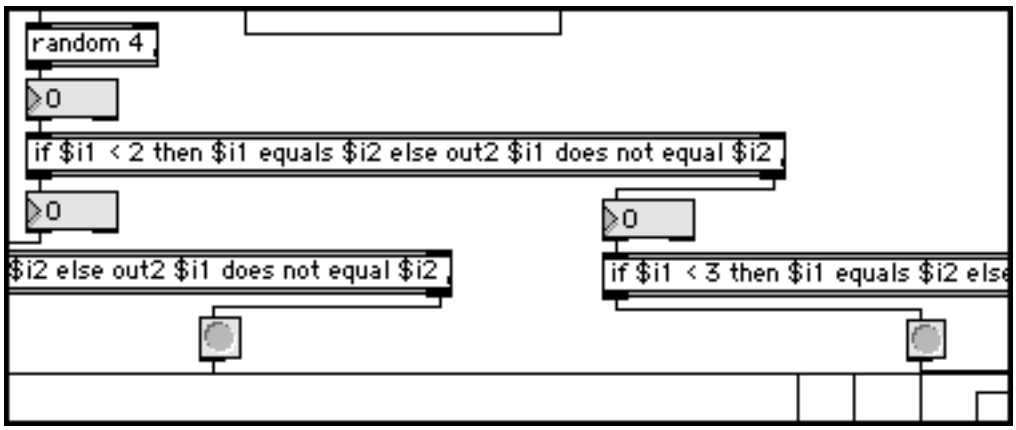

Figure 4-5: The path decides the scale and the instrument randomly,

Most guitar bands often follow one of the major, blues, minor harmonic or the pentatonic scales during their jam sessions. However it does not mean they play the same notes all the time, but that they usually use one of these scales as a major path. I have decided to use these common path scales to keep the same harmonic scale attitude as it may appear in a jam session of a guitar band.

4.2.1 Harmonic Structure

In western music according to the equal tuning system, octaves are equally divided into twelve notes. A scale is a series of notes selected among these twelve notes. Each notes is called a degree and each degree has a name, but is also often designated by a Roman numeral. A scale should constitute a unified collection of notes. In any harmonic music that uses major and minor chords, a suitable scale must be a resource not just for the melody but for the major and minor chords. If we take the major and minor chords to be the fundamental building blocks of any

harmonic system then this means that if a note is not part of any major or minor chord then it is serving no harmonic purpose. It is therefore irrelevant to the harmonic function of the scale, and so cannot be considered to be a unified member of that scale. An example of such a “scale” is: c, d, e, f, g, g, a. Here the g is not a part of a chord, and thus cannot be considered a unified member of the scale (Teoria 2003).

Another requirement for a harmonic scale is that it should not contain any notes that allow for both a major and a minor chord to be built on the same root. This is because in any such a scale one of these two possible thirds will always be heard an extra addition(Tonal 2003).

A scale can be built starting with any note using accidentals in order to maintain the order the whole steps and half-steps. For instance, in order to build a major scale on the note D, F and C have to be altered. Such a scale is called the major scale of D. It is major because of its structure and a scale of D because D is the note upon which it is formed. There is an infinity of scales (Teoria 2003).

A major scale has 7 notes. Notes are separated from one another by one whole step except for degrees III-IV and degrees VII-I: The major scale and the minor scale are the most common scales because they have been in constant use for the past four centuries.

Like the major scale, the minor scale also has 7 notes. However, it has three variants: the natural minor, the harmonic minor, and the melodic minor. These variants differ in the manner in which degrees VI and VII are altered. In the natural minor scale, all notes appear with the same accidentals as in its relative major. Half-steps are found between degrees II-III and V-VI. The degree VII of a minor scale is very often raised. The resulting scale is referred to as a harmonic minor scale because the raising of degree VII is often harmonically motivated. Raising that note forms the dominant chord or dominant seventh chord on the fifth degree of the scale. Besides raising degree VII, degree VI may also be altered. The resulting scale is called the melodic minor scale. The main purpose of this accidental is to facilitate the melodic movement from degree VI to degree VII, avoiding the augmented second that is formed in the harmonic minor scale. Therefore, it is referred to as the minor melodic scale (Teoria 2003).

Types of minor scales

Descending melodic minor scales - Scales produced from just the key signature of the relative major are sometimes called natural minors. The simplest natural minor scale is
A natural minor:
A B C D E F G A’

This variant is sometimes referred to as the descending melodic minor scale as it is often used in descent from the tonic.

Ascending melodic minor scale -	is constructed by sharpening the 6th and 7th scale degrees of the minor scale (or, equivalently, flatting the third degree of the major scale). This variation is used primarily for ascending lines, since it has strong motion towards the tonic. In the key of A minor, the ascending melodic minor scale is: A B C D E F# G# A'
Harmonic minor scales –	Harmonic minors are constructed by sharpening the 7th degree of the minor scale. In the key of A minor, the harmonic minor scale is: A B C D E F G# A' This scale is used in constructing harmony as it contains the major dominant chord and the minor subdominant chord. (Wikipedia 2003)

The harmonic minor scale is well known because it is the harmonic foundation of minor mode music. The reason the harmonic minor scale is used as the harmonic foundation of the minor mode is that, its tonality is very powerful and clear. In a sense the harmonic minor scale is the "default" scale to which the melodic variations must return in order for the tonality to be maintained (Tonal 2003).

Minor scales are sometimes said to be more interesting, possibly because they cause sadder sounds than plain major scales in the context of western music. It represents high emotional level.

The blues scale is a product of the meeting of African and Western music cultures. It combines elements of the major scale with the "blue notes" of the music of the slaves and their descendents. A blues scale will have a blue third, a blue fifth, and a blue seventh, plus notes from the major scale. The blue notes shown above are only approximations, as was explained in the chapter on jazz fundamentals. A blue third should actually lie somewhere between a major and a minor third. Phrases based on the blues scale start to sound the same after a while. This is partly because of the unique sound of the scale, and also partly because of the fact that the scale has only six different notes as opposed to the usual seven. It may be that all phrases based on the blues scale have been played before, perhaps hundreds of times. (Teoria 2003).

The use of the blues scale can be compared with the use of a strong spice. A little bit adds flavor, but too much will dominate and ultimately spoil the overall results.

Pentatonic scales are scales formed of five notes (from the Greek pente: five). These scales have been used very much in the folk music of various countries. Any scale formed of five notes can in theory be called pentatonic. Pentatonic scales, can

be constructed in many ways. A simple construction takes five consecutive pitches from the circle of fifths. If starting on C tonic, the scale will be C, G, D, A, E.

A more complicated construction begins with a major scale and omits the fourth and the seventh scale degrees: a C major scale is C, D, E, F, G, A, B, so a C major pentatonic scale would be C, D, E, G, A (Teoria 2003).

4.2.2 Harmonic Algorithm in From Me to Us

Writing the harmonic algorithms for the application completed the full running version of the application. Minor harmonic, blues, pentatonic and the major scales are the key points in the From Me to US harmonic algorithm structure.

The following notations in C tonic C, D, E, F, G, Ab, B construct the major scale. The numerical representation of the major scale in the Max/MSP MIDI data information is 0 2 4 5 7 8 11. The participant's response bangs the drunken walk object to generate the random numbers. There is a two thousand milliseconds delay between the drunken walk object and the participant's response. The octave value is taken from the participant's input. The participant can change the octave by activating the different frets located on the guitar keyboard and the engine will follow this information.

The numeric and the notation info in C tonic of the minor harmonic, blues, pentatonic and the major scales are as follows;

minor harmonic scale -	C, D, D#, F, G, G#, B	0 2 3 5 7 8 11
blues scale -	C, C#, D, F, G, G#, A	0 1 2 5 7 8 9
pentatonic scale -	C, D, E, F, G, A	0 2 4 5 7 9
major scale-	C, D, E,F, G, Ab, B	0 2 4 5 7 8 11

The if object - conditionally sends messages. As it is in the other script based programs, arguments can be constructed to analyze the statement.

The gate object - it is a traffic control. The Gate takes an argument and let it pass through its outlet in relation with the order of the gate

The random object - generates a random number. When it receives a bang, random will generate a number between 0 and 1 less than its range.

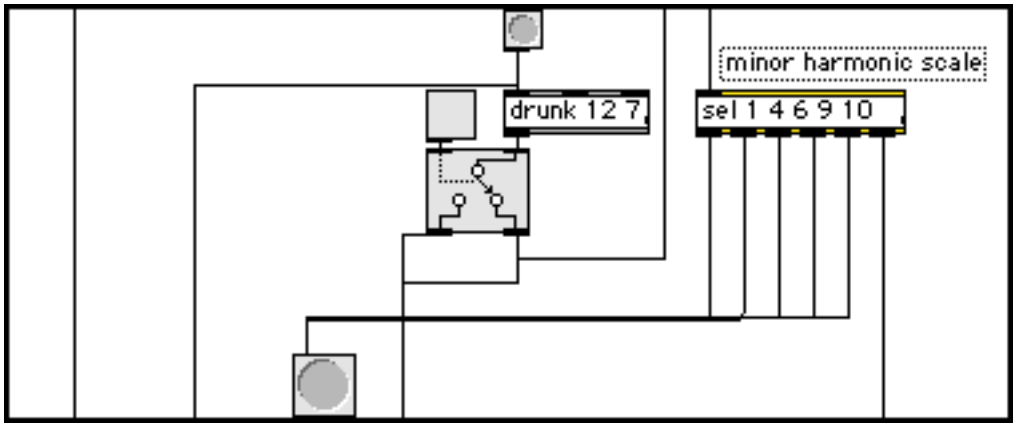

Figure 4-6: Minor harmonic scale is one of the scales that run in the harmony generator engine.

As the harmonic scale is randomly determined by the engine, the same random information determines the MIDI instrument in the harmony generator engine. Four different instruments have been set and juxtaposed with the scale paths. The pgmout object gives a possibility to use a particular MIDI instruments that the MIDI sequencer device supports. The numeric value of the instrument for the major scale is eleven, for the blues scale is twenty five, for the pentatonic scale is fourteen and for the minor harmonic scale is six. The instrument eleven is a mixture of a sonic space sound with a synthesizer in the Korg Wavestation MIDI device. It is a sustained instrument. Instrument twenty five has a deep guitar and organ mixture sound. There is a sustain but not as much as with the instrument number eleven. Instrument number fourteen is a kind of hybrid of deep violin and a sustained brass. Number five is a pure electric piano with a supported sustain.

Each instrument has a different level of velocity. This creates a hierarchy between the instruments. The velocity hierarchy forms an opportunity for the participant to become involved in the jam session with a different level of interactivity. Participant can either be the solo instrument player in the jam session, or can take part as a rhythm guitar player. This might require more listen and respond behavior from the participant.

The sustained electric piano is set to be the lead instrument when it is running in the engine. The engine reacts immediately to changes in the input value. Either consciously or unconsciously, the participant begins to listen to the harmony generator. This constructs a communication according to the color of the instrument. On the other hand the deep guitar – organ instrument is set to run at the rhythm base, but still as a harmony generator instrument. The participant gets into the role of a lead musician and this instrument strongly supports it with its velocity and the color. The participant's level of interaction may also be randomly determined with the harmonic generator engine.

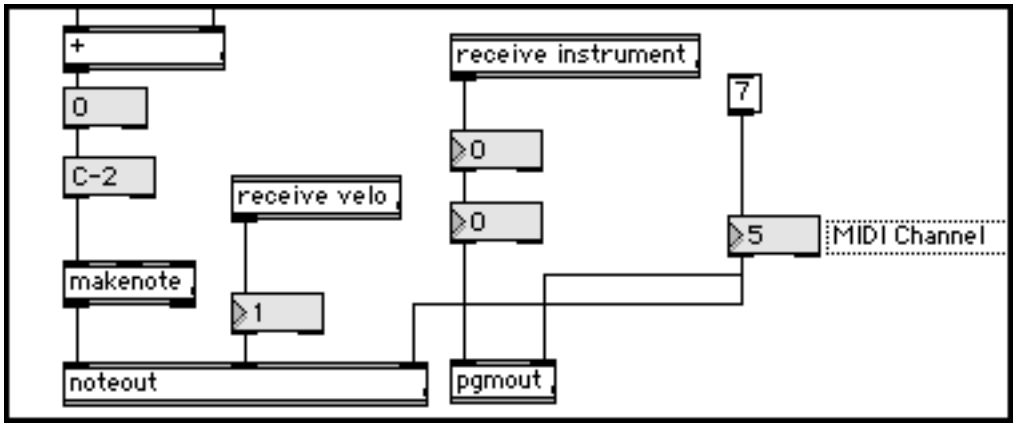

Figure 4-7: Velocity and the instrument informations are received from the random generator.

The send object - takes an argument, a name which allows you to connect to a receive object with the same name. It gives you an opportunity to combine the same named objects patch chords.

The receive object - receives the information from the same named send object

The change object - filters out the repetition. In the minor harmonic drunk walk object, it does not allow the same notes to be generated in a row.

The pgmout object – initializes a MIDI channel number related to the optional argument. This object also gives a chance to control several MIDI ports.

The sub patch of the harmony generator engine is the record and play patch. Every sixty seconds this patch records a sample of the participants exact notation. It follows this sample and evaluates it into a sampler by playing with a different instrument at a certain time. This loops until a new bang activates the record message box in this record sub patch. The whole record sub patch is activated by a metro object. The core issue of this patch is to listen to the participant and give the same input as an output. The test run participants understood that there was communication when the system began to play samples of their input.

a)  b) 

Figure 4-8: a) Antti Ikonen participating in the first test run of the From Me to Us application on 14.05.2003. b) Vesa is exploring the system with a speed technique in the same test session.

4.3 Fall 2003

A crucial difference from the previous face is the way the harmony generator engine functions. When the drunk object generates a random number, the sel object checks if the number belongs to the related scale. If it does, then the number follows the next step of the algorithm. if it does not, at this point the sel object does not bang the drunk object to generate another random number. Only participant's input activates the drunk object. This has an effect on the communication between participants and the system. The jam session seems like more fluent after this rearrangement.

I have changed digital MIDI processor for the installation and began to use the Yamaha MU90R tone generator. Bass organ was replaced with slap bass instrument in the tempo generator engine. Nylon guitar, grand piano, caliopLd and bright are the tone generator's instruments which the harmony generator engine communicates with the MIDI outputs. The main focus of this thesis is on the concept part of this installation, therefore I used the default sound sources from the MIDI tone generator. I did not try to create specific MIDI sounds for this installation, but there is an intuitive selection. The MIDI instruments are chosen consciously so that participants will associate the sounds with the average band instruments.

The new instruments have their own sustain duration value and this also added another function in the makenote object. When the instrument information is determined by the harmony generator, related sustain value to that specific instrument is also send to the makenote object's right inlet. Millisecond is the unit for the duration value. 2000ms for grandpiano, 4500ms for nylonguitar, 1500ms for caliopLt and 2000 ms for the instrument bright is set in the send duration message box.

I added two external sound effects in row to the electric guitar's analog output. The first external effect device was adding a reverb and plus sustain effect to the plain electric guitar's sound. I kept this configuration constant because these effects created a particular space out of the electric guitar's sounds. This would create the installation's own space within the space that the installation would be.

Second external sound effect is a Boss Turbo Overdrive foot pedal. It is a switch pedal so that when it is on it adds an overdrive and distortion sound to electric guitar's analog output. When it is off, it transfers the electric guitar sound without adding any sound effect on it. This effect pedal creates opportunity for participants to change the electric guitar sound into a distortioned one by simply pressing on it. Participants can also change the overdrive configuration of the effect pedal.

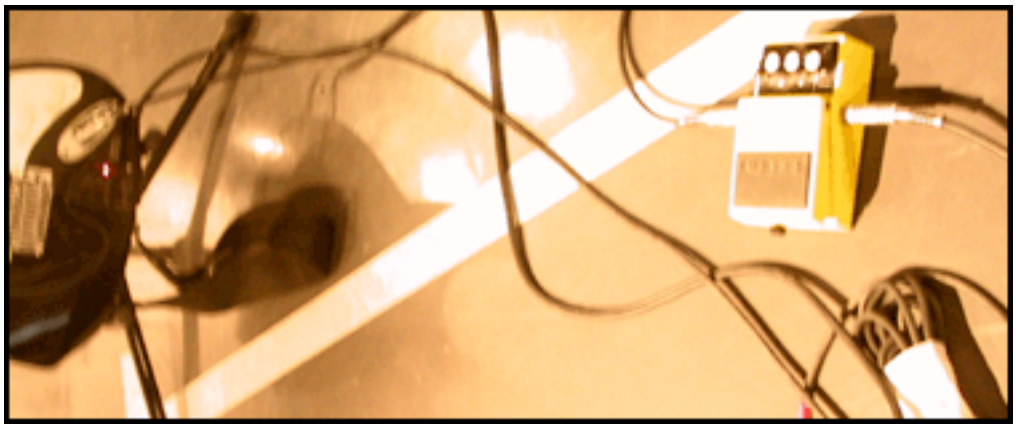

Figure 4-9: Overdrive pedal, which was plugged to the electric guitar during the From Me to Us installation.

Chapter 5

From Me to US Installation

Besides the application part I began to focus on the actual installation setup. I did not have many alternatives for the space that the installation would be running. I decided to set up the installation at the Media Lab's lounge area. It seemed like a good choice as it offered a space with good light condition and a passing point to invite colleagues and students to try my work. Spot lights that are attached to the ceiling gave me an opportunity to use them as stage lights.

a)  b) 

Figure 4-10: a) Setup of the mixer, MIDI processors and an external MIDI in-out device. b) A paper with the word stage on it was one of the elements that created the installation space.

I built up the installation at Media Lab's lounge area on the evening of October 30. The installation ran till the evening of October 31,2003. The set up structure was based on creating an installation space inside another space that functions for some other purposes. I taped a rectangle on the floor and an a4 paper that has the word "stage" on it. This created the area where participant would interact with the electric guitar. I connected four speakers to the mixer to output the sounds. Two of them were used for the electric guitar sounds and the other two were used for the computer generated sounds. I connected the sound cables to the speakers through the ceiling. Speakers with their cables hanging from the ceiling separated the installation area from the actual space. A bright yellow colored chair was another element to get the attention of the people who were passing by. The physical hardware is hidden under the table. I did not want them to be visible, so that

participant can concentrate on the process of the installation rather than the cables and devices. When there is not any participant's interaction with the electric guitar for a long time, system gives out one random note as an output of the rhythm engine every sixty seconds. This also aimed to aware the people about the installation.

Figure 5-1: Setup of the From Me to Us installation.

5.1 Participants' feedback 30-31.10.2003 – mlab lounge / UIAH Helsinki

I asked participants to give feedback about their experience during the installation, which I thought it would be fruitful for the next steps. I wrote down their feedback after each session, however I asked some of them to write down more detailed text out of this installation.

The following text documents the participants' feedback about the From Me to Us installation.

Andrea Botero ,Oct 30 2003, 8pm.

"If I close my eyes I see myself in quiet bar, those which have piano and an old back guy is playing in total concentration and enjoying himself to death.... I am him ...or of course maybe more I am her a black lady! As a total music illiterate that I am, I thought it was quite empowering feeling, to sit there and produce something that does not sound terrible. You just take the guitar and pretend, close a bit the eyes and something coherent comes out of it. The "simulacro" is successful and powerful, the sound surrounds you and you are happy. Koray asked me if it feels like being part of an orchestra and I wasn't so sure, I liked more the cozy feeling that it inspired me, more like a conversation with the guitar and some friends, more intimate. It was very enjoyable.

Looking at it form a more bit critical point, I thought it was quite interesting that the whole setting hides so much the process of what is actually going on, pretends to give me agency and empowerment but at the same time if hides form me in quite

strong way the actual manipulations that makes my noise sound beautiful. Little I end up knowing that will actually "make me understand and learn". The responses that the software and Koray's own manipulations add to my sloppy movements are not shown to me... I think it would be worth to explore weather I could achieve more "endurable" experience if somehow I understand more how the algorithms work, and if the thing will not be so blackboxed, to use this ANT guys term. Demystifying might be also interesting, but I don't know if necessary? Good question anyway.

I think here the collective installation should be understood as being a collaboration in between me, Koray, the guitar and the code pieces in the mac, not to mention possibly also the chair and the hall...."

Figure 5-2: Participant Andrea Botero during the From Me to Us installation.

Sophea Lerner, Oct 30 2003

"I felt that the interaction was presented in an inviting way, and the sense of participating in something that was already going on in the computer system was clear. As a someone who works with a wide range of sounds outside of traditional musical instruments I find that the focus on traditional MIDI instrument sounds and the guitar interface was a hurdle that I had to get over to enjoy the work and I found myself wondering what it would be like with a broader vocabulary of samples. The response of the computer system had a balanced relationship to the input - not too simple but not illegibly complex. this invited an
attentive listening process which was pleasurable and instructive. I didn't feel like I was in a band, but I did feel like I was exploring a responsive system, and for me personally the architecture of this set of relationships was more interesting than the musical result per se.

The guitar as an interface has lots of cultural baggage - I found that the little I know about guitar playing was more of a hinderance than a help in getting immersed in listening to what was happening. The advantage of it being a familiar object and of the cultural associations it has in inviting people to play and be playful were interesting to think about and i wandered if this could be taken further by using

instrument samples that explored cultural melieux of rock and pop sounds/production values more directly.

The most effective aspects of this piece for me were the invitation to participate, to listen and to explore a changing set of sonic relationships over time. Aside from the cultural specificity of the interface and the vocabulary of musical scales and sounds, I felt that the set up of invitation, interactivity, development of the system over time and space for exploratory listening were successfully integrated."

Giedre Kligyte, Oct 31 2003

"It was very great to try your piece. I have been trying to learn myself to play the guitar when I was 16 or so, but it just sounded so bad that I lost any motivation to keep on going. I don't remember anything about the finger positions that make good chords, in general I am not able to play a guitar. But with this piece I felt that the 'invisible band' was responding in a very nice and non-intrusive way, it was kind of teasing and inviting to play more. I felt really involved and enjoyed the dialog with the 'invisible' ones. Sometimes when I was about to leave, there would be some new sounds coming and provoking me to play more. The gentle teasing and inviting aspect of the whole thing was excellent!

The sounds that I was making were quite disharmonious and without any rhythm, but the 'band' responded so that it covered up some unevenness and made me feel better. Usually it is quite uncomfortable to do something that you are not very good at in front of other people. With this piece it was easy, because there was the 'band' covering my mistakes. I also felt that the 'invisible band' really respected me, it would patiently wait till I come up with something and would 'jam' on my proposed themes. So in that sense I felt that I had also a lot of control over the 'band'. I don't play instruments, but sing in a choir where we sometimes improvise. There's always the danger that the more courageous ones win and 'take over the space', so with this 'band' it is good that you were always the initiator of new sounds and the leader of the band. Good for my ego! :)

I have observed other people playing the guitar and it seamed that the better the people were with their music skills, the more the system was interrupting with them. I think 'the band' is the best for atmospheric, ambient music creation and in that sense maybe for less skilled and more shy people.

So.. Maybe that's about it"

Figure 5-3: Participant Giedre Kligyte during the From Me to Us installation.

Joni Lyytikäinen, Oct 31 2003

“Well, if it was a band, they were all new guys for me. Sometimes I felt like they were playing something on their own and not with me. But in terms of interaction, yes I felt interaction. After playing for a while I noticed the "band" playing something I had played earlier.

At first I listened to somebody play for a while. I noticed that it was futile to try and play a "regular" song, like a rock tune or anything with chords actually. The "band" started to make a mess when you played chords, because there where too many notes too fast. Instead I started to play very slow with minimal changes. This gave the "band" time to adjust and respond calmly. At times it felt like I was playing backgrounds for the lead band.

At best times it felt like communication.

The installation for me is a very interesting tool to explore improvisation. I have some experience with playing guitar -- I'm more of a drummer -- but I never learned a bunch of songs like people usually do. Instead I always tried to experiment and learn stuff by listening and copying. This installation really made me enthusiastic about improvisation because the thing the "band" plays is not at all conventional even if you try to play "by the book".

I have played in couple of bands in my life - but not professionally. Although the programming is excellent, it still lacks some controls that are implicit in a real band. For instance with musicians you can use gestures and speech to give hints where you want to go. People can also more clearly "read" the music and set common goals.

I think some of these controls could be easily implemented with a few foot switches; for example the player could suggest the tempo changes with foot stomps instead of playing the notes. This would make it possible to play fast on a slow tempo or vice versa. Also one switch could force the "band" to loop a certain melody or theme. On the other hand maybe this change would make it more like an instrument, I don't know?

At some point I felt like I am composing something. I actually started to make a "piece of improvised music", if there is such a thing, and for a while I felt it was going to be a nice piece. Then on the second time I tried to do the same thing again, but something didn't seem right. I think that with this "band" you are not supposed to play the same thing twice. So it is good to record every session.

I didn't really think of it like the whole session was an infinite composition. I guess it could work if you had a more public setup, with lots of people listening to it for a longer period, like in a bar, a boat, some festival or something. For me it was more personal. I was just playing for my self and then I went off.

In a way music in general stays alive as an infinite composition; almost every kid learning guitar goes to a guitar shop to try out guitars and plays their version of "Stairway to Heaven". It's the same thing! The composition keeps going on.

The best thing about this is actually that you start to listen more carefully. Not only do I think it is a good system to learn how to listen more carefully, I also think it is an interesting tool to learn guitar playing, because you are forced to find interesting and unusual phrases and themes and melodies. You can learn a more intuitive approach to playing, and its fun too!

Thank you for an interesting experience and good luck in the future. You could make a compact box with circuits and MIDI plugs and sell this to young kids learning guitar and maybe we will have more interesting music in years to come!”

Figure 5-4: Participant Joni Kyll during the From Me to Us installation.

Lotta Partanen Oct 31 2003

“I didn’t really feel like I was playing in a band. Perhaps, if I was to play more with it, or if I had experience in playing with a band.

Since I had never played a guitar before, the band allowed me to explore safely the instrument publicly without making an embarrassment of myself. It also made the exploration interesting.

Yes, I noticed the communication.

Since I do not know how to play, I cannot imagine it having been anything else. It was a pleasure to be able to play around with the instrument, explore and experiment. I am fond of it.

I would not call it composing. I understand composing as something that is recorded in such a way that it can be played again, and I did not experience or notice that my playing was recorded in such a way that it can be played again. If that is the case, then perhaps it would be nice to visualise that in some way in the installaion.

I experienced it as improvising, but perhaps there is a confusion in my terminology.

No, since there were pauses in the playing, it wasn't like an infinite composition, I would consider them as separate pieces.

Great work Koray! I hope you get to bring it out also to the public."

Figure 5-5: Participant Lotta Partanen during the From Me to Us installation.

Sami Pekkola, Oct 31 2003

"I didn't feel like I was playing in a band. I was feeling more that I was the one who should make presentation or show. Not computer. Maybe because of setup was build in mlab lobby and there was people passing by.

I was all the time trying to make computer program sound "correct". I was also thinking that it is make job to make computer play correct. I wasn't feeling that computer was supporting me when I was playing.

Yep, improvisation is the only thing I can do. When program changed tunes also I was changing way I was playing. I also notice that maybe I should play longer same tunes to get computer play with me.

I knew the installation idea already but this was my first session with it. I see this as an interesting installation idea.

I have played improvisation based music with my friend and also in those sessions there are part when you cannot affect other player, so I think that in that way it was realistic, heh.

nope, I didn't feel like I was composing, it was only improvisation.

Have you compared this to other applications (example game-likes applications)?

have fun!"

Figure 5-6: Participant Sami Pekkola during the From Me to Us installation.

Markus Norrena, Oct 31 2003

"It is hard to lead, after playing for a while you get the communication. Even I don't play guitar, it felt nice. I was nice that it changes the music styles during the session. I could have played all day. You should have similar one with bass guitar"

Leena Saarinen, Oct 31 2003

"Playing something that you know before hand was confusing. Then I began to experiment with a way that the guitar was not meant to be, and the sound were nice. And it turned out really fun. I felt that if I was a better musician, I could jam with the system"

Kari – Hans Kommonen ,Oct 31 2003

“There was no communication with the tempo generation, it would be nice if there would be a way that system asks my opinion for a confirmation, before it changes something. There were nice responses, surprising enough.”

Ville Tikkanen, Oct 31 2003

“It took sometime to figure out the response. When the rhythm and some melody came from the system, then it was fun.”

Miikka Junnila, Oct 31 2003

“Interesting thing. I am not good at jamming. When I played chords, there was a good response from the computer jamming.”

Pia Hautamäki , Oct 31 2003

“I have never played guitar before. Nice sounds. First I listened to the guitar, not the other members. Sound are fun.”

Dominic Leskinen, Oct 31 2003

“In the beginning I was trying to get used to how to play a guitar and try to figure out how the computer responds. I was messing around, then testing the computer. I felt like playing in a band, kind of warm up.”

Chapter 6

Conclusion

An important goal of the From Me to Us installation is to provide a situation where a participant can experience a musical collective improvisation. This goal supports the main concept of the From Me to Us installation;

Twenty four participants took part in this final of the installation. Most of the participants did not have any experience either in playing guitar or in musical improvisation. However they felt comfortable when they were interacting with the electric guitar during the installation. The ones who had previous experiences in musical improvisation, tried to explore the system more in an actual improvisation process.

Looking back at my initial question: Is it really possible for someone with no training or formal education in music to play an important role in a composition by participating in a collective musical improvisation?

It turned out that it is possible to participate in a collective musical improvisation even with no training or formal education in music. This installation created this situation. Participants' interaction created their own method of logic during the improvisation.

Each participant composed a piece of the whole composition. By participating, each participant became a composer as well as a performer during the From Me to Us installation.

Collective improvisation turned into an open form music composition, even though participants feedback on this issue was more like they did not feel or notice that they were composing a piece. Because they state that they I understand composing as something that is recorded in such a way that it can be played again. This may seem like a conflict between the main concept and what has been declared, but my idea is to show that there can be some other ways of composing music rather than the traditional methods.

6.1 Next step with From Me to Us

During a musical improvisation there is a continuous communication between musicians. This communication can be gestures, verbal as well as musical, and it is constructed on certain shared concepts and experiences. Some of the participants were expecting this kind of communication during the installation. The application, which runs in the From Me to Us installation does not share these concepts and experiences in its current state. As the experience in the trial confirms, there is a communication between participant and the system, but it seems to be more on the listen and respond ground. This is definitively something to explore further.

Another possible direction can be developing artificial intelligence methods in the application part of the From Me to Us installation. The algorithmic process can be developed further to a modeling observable human musical activities, and this modeling can create a system that has a capacity to learn and define its own musical grammar during the musical improvisation. More research on this needs to be done and require competences from other fields.

All in all I think my intuitions and goals were achieved, I will like to develop this installation further and welcome more feedback.

Bibliography

Aker, Can 1993. *Wolf Prix: Rules? What Rules?* Arredamento Mimarlik Vol: 51 (9).

Alpern, Adam 1995. *Techniques for Algorithmic Composition of Music.* Paper. Hampshire College.
Available from: http://hamp.hampshire.edu/~adaF92/algocomp/algocomp95.html.

Balaban, Mira, 1992.*Understanding music with AI : perspectives on music cognition* ed Mira Balaban, Kemal Ebcioglu, and Otto Laske. MIT Press.

Bohn, James 2003. *ILLIAC 1* (online).
Available from: http://cmp-rs.music.uiuc.edu/history/illiac.html.

Burns Kristine H. 1997.*Algorithmic Composition, a Definition*. Paper. Florida International University.
Available from: http://music.dartmouth.edu/~wowem/hardware/algorithmdefinition.html.

Clark, Paul 1997. *Paul Lansky Interview*. Electronicmusic.
Available from: http://electronicmusic.com/features/interview/paullansky.html.

De Mantaras, Ramon Lopez and Arcos, Josep Lluis 2002.
AI and Music : From Composition to Expressive Performance.
AI Magazine Volume 23(3): fall 2002
Available from: http://www.iiia.csic.es/~mantaras/AIMag23-03-006.pdf.

Dyer, Richard 1996. *Playing the future: Tod Machover Brainstorms a make-your-own opera, complete with web site.* Boston Globe Newspaper Company
Available from: http://web.media.mit.edu/~tod/press/media/globe7_96.html.

E-journel 2003. *Lejaren Hiller and Leonard Isaacson-The ILLIAC Suite (1957, excerpt-2nd movement) 4:01* (online)
Available from:
http://mitpress2.mit.edu/e journals/ComputerMusicJournal/Documents/Contents/html/mc-20-CD.html.

Essl, Karlheinz 1998. *Lexikon-Sonate, An Interactive Realtime Composition for Computer-Controlled Piano*. Orginal - Brazilian Symposium on Computer Music" (Canela 1995).
Available from: http://www.essl.at/bibliogr/lexson-klangart.html.

Essl, Karlheinz 2002. *Improvisation on "Improvisation",* ed. Hauser, Jack .
Available from: http://www.essl.at/bibliogr/improvisation-e.html.

Farbood, Mary 2003. *Hyperscore* (online)
Available from: http://www.media.mit.edu/~mary/hyperscore.

Fonseka, Joseph Rukshan 2000. *Musical Agents.* Thesis (Master of Science). Monash University.
Available from: http://yoyo.cc.monash.edu.au/~ruki/downloads/Thesis.doc.

Franz, David M. 1998. *Markov Chains as Tools for Jazz Improvisation Analysis*. Thesis (Master of Science). Virginia Polytechnic Institute and State University.
Available from:
http://scholar.lib.vt.edu/theses/available/etd-61098-131249/unrestricted/dmfetd.pdf

Guiraud, Pierre. *La Semiologie.* 2nd ed. Ankara: Imge Kitabevi Yayinlari, 1994.

Hyperinstruments 2003. *Hyperinsturments* (online).
Available from: http://www.media.mit.edu/hyperins/index.html.

Isast 2001. *Iannis Xenakis Bibliography and Discography* (online).
Available from:
http://mitpress2.mit.edu/e-journals/Leonardo/isast/spec.projects/Xenakisbib.html.

Jacob, Bruce L. 1996. *Algorithmic Composition As A Model of Creativity.* Paper. University of Michigan
Available from:
http://www.ee.umd.edu/~blj/algorithmic_composition/algorithmicmodel.html.

Lansky, Paul 1990. *A View From the Bus: When Machines Make Music*, Perspectives of New Music, vol. 28/2.
Available from: http://silvertone.princeton.edu/~paul/view.html.

Liu, Yi-Wen 2002. *Modeling music as Markov chains - composer identification.* Music 254 Final Report. Center for Computer Research in Music and Acoustics, Stanford University.
Available from: http://ccrma-www.stanford.edu/~jacobliu/254report/ 254report.html.

Machover, Tod 2003. *Biography* (online).
Available from: http://web.media.mit.edu/~tod/Tod/biography.htm.

Maurer, John A. 1999. *A Brief History of Algorithmic Composition.* Paper.
Available from: http://ccrma-www.stanford.edu/~blackrse/algorithm.html.

McCarthy, David 2003. *Biography Paul Lansky*. All Music Guide.
Available from: http://silvertone.princeton.edu/~paul/bio.html.

Muro, Don and Purse, Bill 2000. *TI:ME Course 2A Advanced Sequencing,* course material.
Available from: http://courses.wcupa.edu/frichmon/time2a/sequencing2a.pdf.

Normann, Håkon 2003. *Generative Music Answers to a Questionnaire.* Interview (online)
Available from:http://www.essl.at/bibliogr/generative-music.html.

NPR 2003 . *The Electric Guitar, Present at the Cre*.ation (online).
Available from: http://www.npr.org/programs/morning/features/patc/electricguitar/.

O'Connor, J J and Robertson E F 1996. *Andrei Andreyevich Markov.*Article. School of Mathematics and Statistics University of St Andrews, Scotland.
Available from:
http://www-history.mcs.st-andrews.ac.uk/history/Mathematicians/Markov.html.

Perloff, Nancy 2002. *Postmodernism: The Key*, ed. Hans Bertens and Joseph Natoli , Blackwell. Available from: http://www.ubu.com/papers/perloff_nancy.html.

Perry, Jeffrey 1995. The Inner Voices of Simple Things: A Conversation with Paul Lansky. New Jersey.
Available from: http://www.music.princeton.edu/~paul/perry.interview.html.

Pi 1998. Film. Directed by Darren ARONOFSKY. USA.

Rowe, Robert 1993. *Interactive Music Systems : Machine Listening and Composing.* Cambridge, Massachusetts: The MIT Press.

Solomos, Makis 2002. *Analysing the First Electroacoustic Music of Iannis Xenakis . 5th European Music Analysis Conference, Bristol, April 2002*.

Teoria 2003, *Online Music Theory Reference*.(Online)
Available from: http://www.teoria.com.

Tonal, 2003. *The Tonal Centre – Tonality.* (Online)
Available from: http://www.andymilne.dial.pipex.com.

Wikipedia, 2003. *Minor Scale* (Online)
Available Fromhttp://en2.wikipedia.org/wiki/Minor_scale.

Winkler, Todd 1998. *Composing Interactive Music : Tecniques and Ideas Using Max.* Cambridge, Massachusetts: The MIT Press.

Xenakisworld 2003. *Biography* (online).
Available from:http://www.xenakisworld.com/biog.php.