# 3 Sketch for a Programming Project: Ear Training and Assessment Activities (ET2A)

*Notes:*

*In describing this project some screen images are used that were taken from a previous program. These are generally a bit different from the ones that you will be generating – but they do serve to help communicate some of the basic ideas involved in the ET2A system.*

*These notes are far from "polished" – but they do describe system requirements in a fairly well-defined manner, and they provide some common sense suggestions regarding how to proceed with the implementation.*

## 3.1 Overview

ET2A is intended to be a Web-based collection of ear training and assessment activities. I would like to offer people an opportunity to log on to the Web-based ET2A system and engage in activities of training and assessment. In exchange, the people provide us with some data. This data will have to be collected on a CS machine. Furthermore, the data should be archived in a manner that is suitable for mining activities. One file per user. Each file a text file. Each filed richly formated with self-documenting "labels". I'm interested in learning (1) the relative merits of the various ear training activities, and (2) the degree of interest that people exhibit in the various ear training activities.

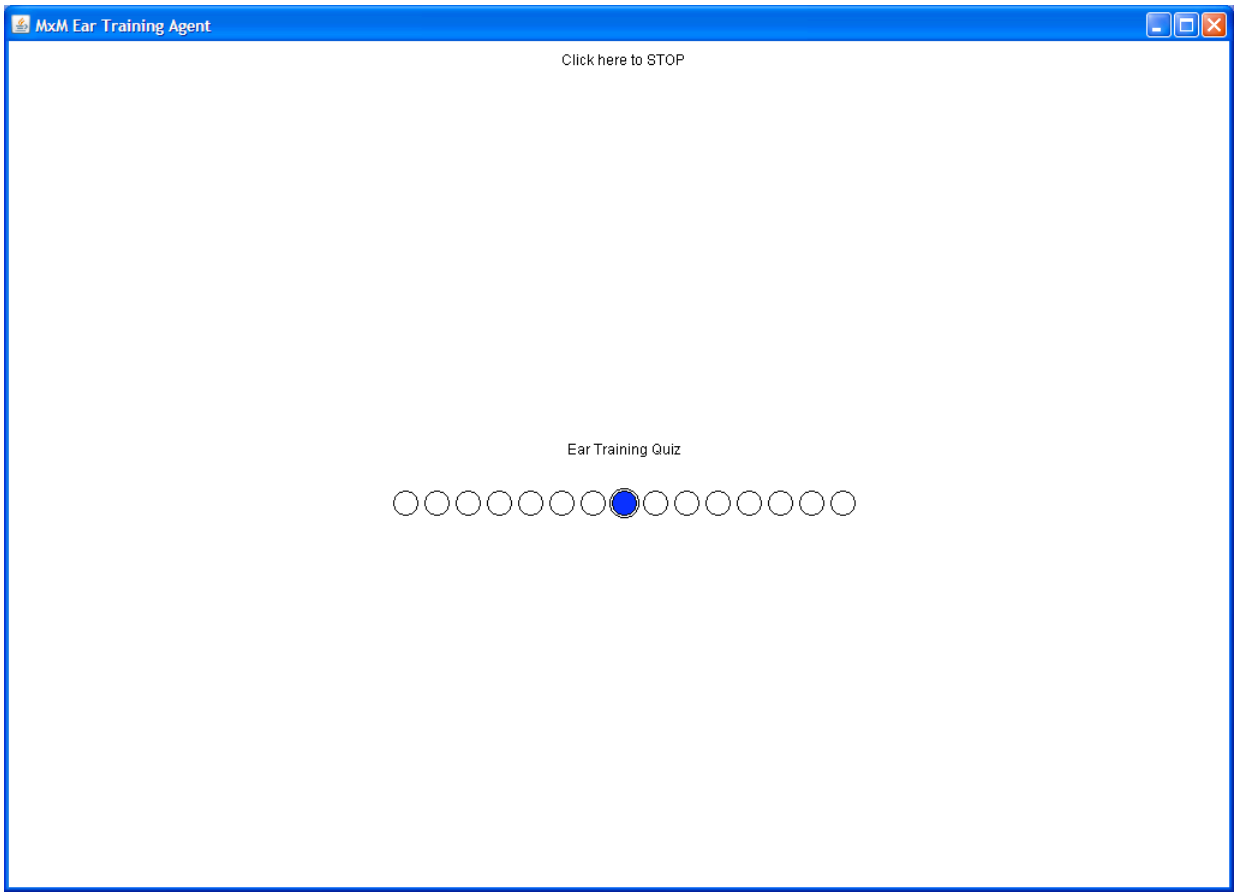
Each module will take the form PRE-ASSESSMENT-ACTIVITY → EAR-TRAINING-ACTIVITY → POST-ASSESSMENT-ACTIVITY. There will actually be just one assessment activity, which will be used for pre-assessment and post-assessment in each module. There will be 5 different ear-training activities.

The assessment activity will run for 2 minutes (but program it to last for N seconds – just in case we decide to alter the time it will be run for). Each ear-training activity will run for 10 minutes (but program it to last for N seconds – just in case ...). Thus, each module will last for 15 minutes, as there will be a 30-second "break" between modules.)

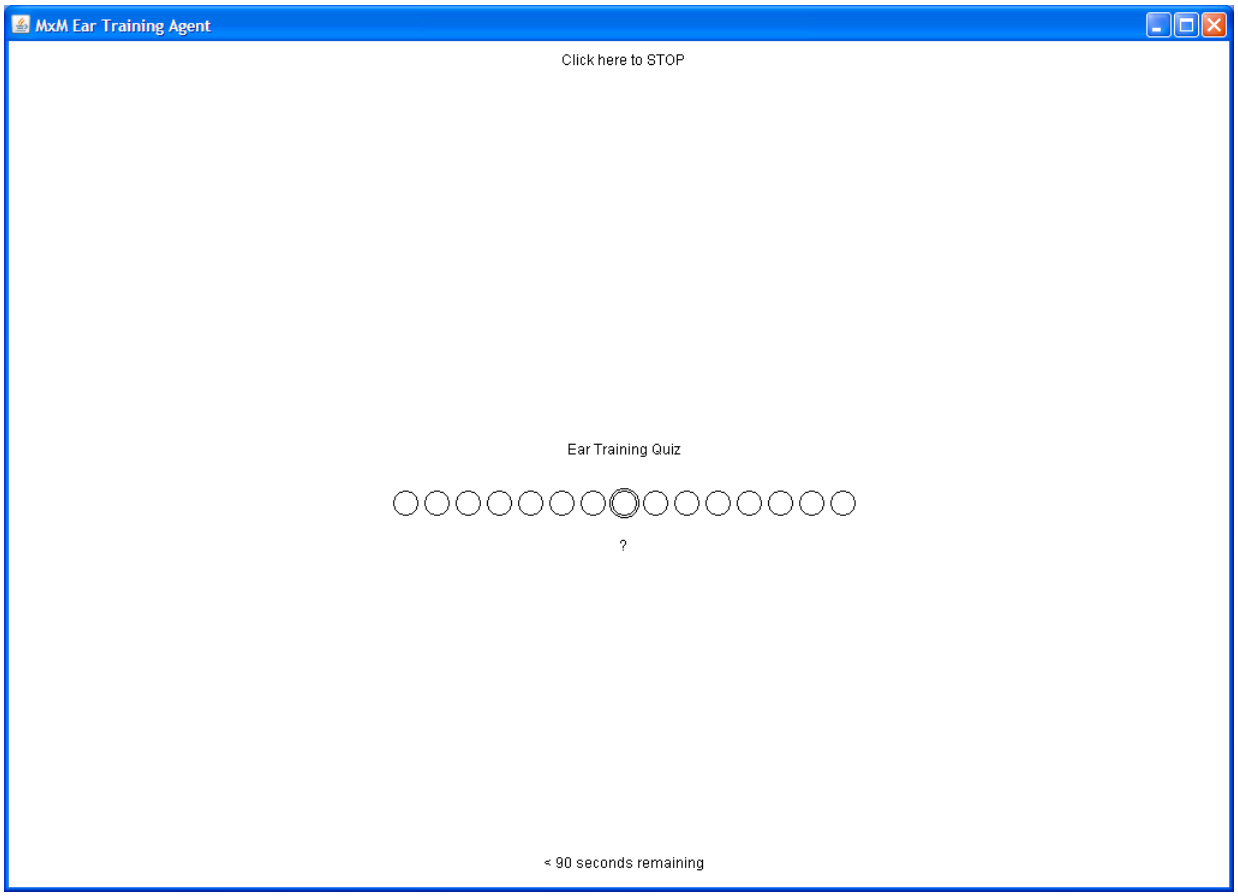
## 3.2 The Assessment Module

The assesment module will consist of a sequence of assessment trials in the context of a fifteen consecutive (major scale) pitch “bubble machine” beginning on the tonic of a scale (lowest note) and ending on the tonic of the scale (highest note). Each assessment trial will be comprised of the following sequence of three phases.

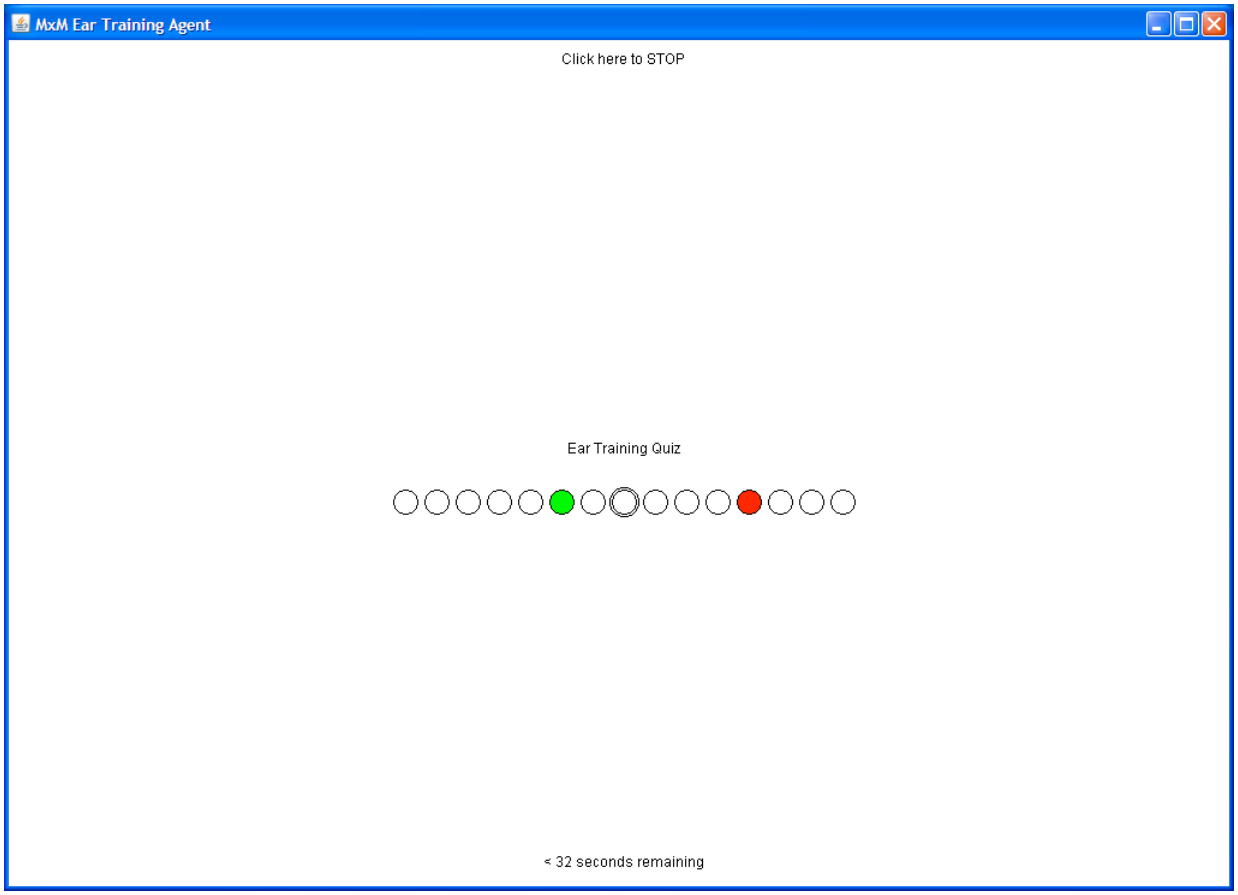
**TONIC PRESENTATION PHASE** A screen image like that shown below will be presented – along with a short sonic event corresponding the playing the tonic with a piano for something like half a second (but parameterize the time length).



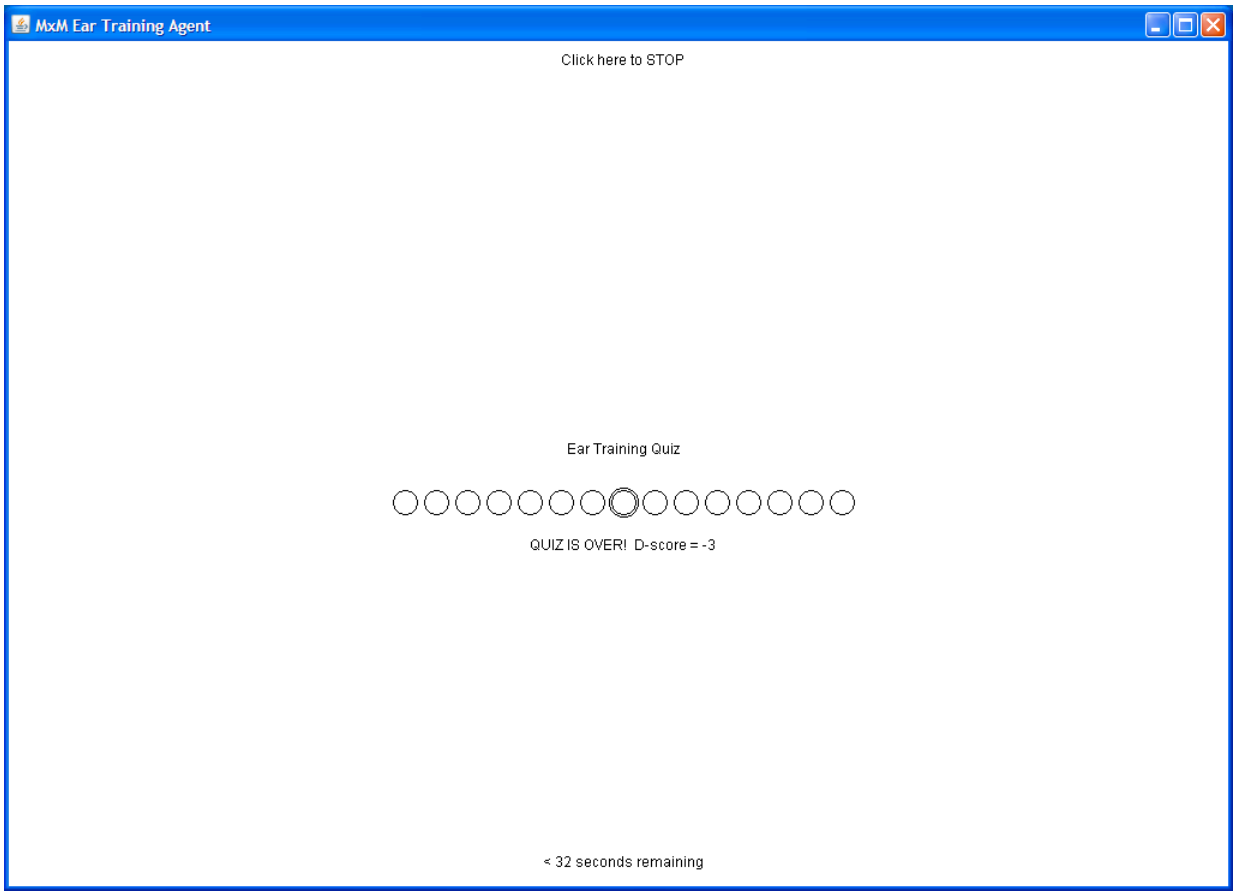
**TONE PROBLEM PRESENTATION PHASE** A screen image like that shown below will be presented – and at the same time one of the 15 tones is chosen at random and sounded for something like half a second (but ...).



**RESPONSE PHASE** The user imagines what tone was sounded and clicks in the corresponding bubble. If the user was correct, the bubble lights up green for a short, but definitely discernable amount of time (parameterize it). If the user was incorrect, two bubbles light up simultaneously, the one the user selected in red and the one corresponding to the posed tone in green. Here is a screen image for the latter case.



When time expires, the user is presented with a screen like the following.



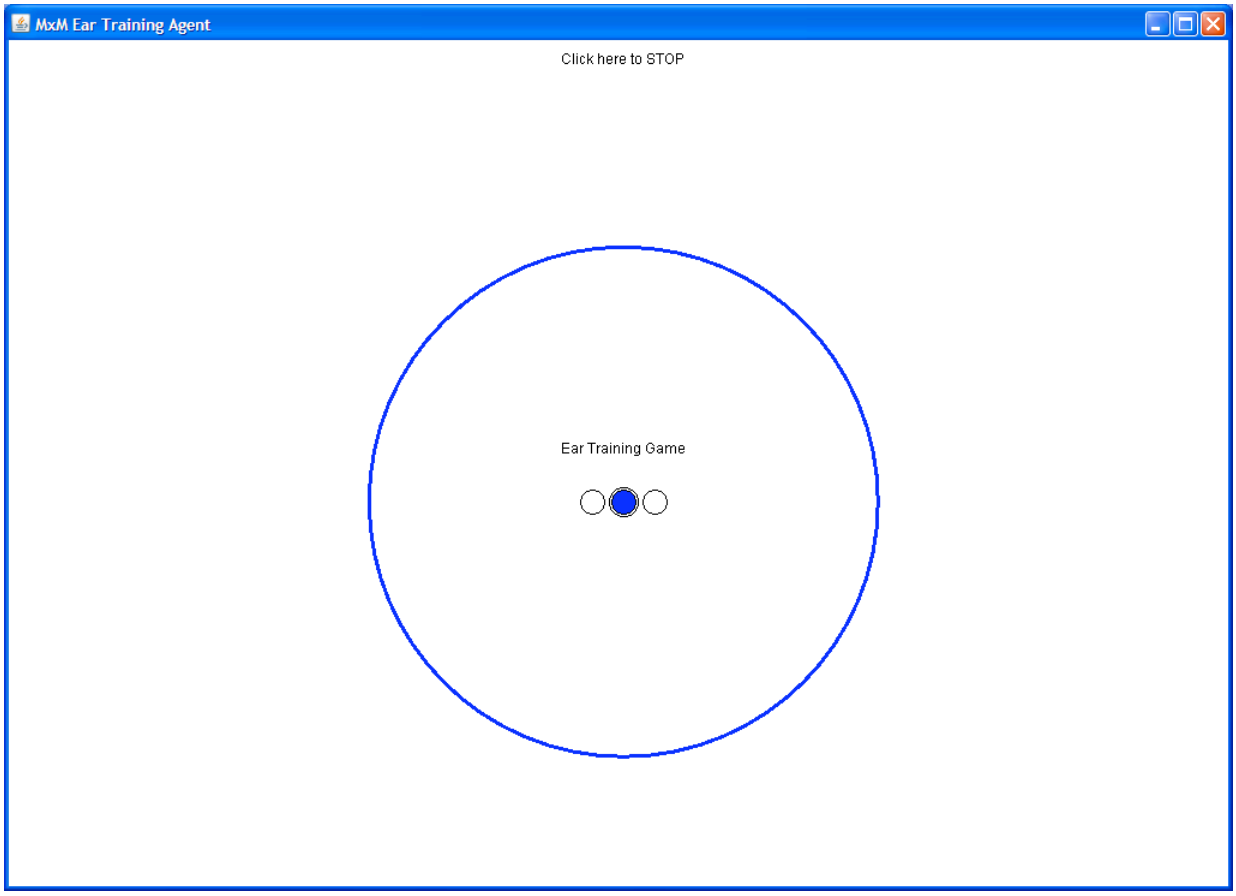

Note that the user is presented with a D-score. This is a rather different statistic – the number of correct answers minus the number of incorrect answers. The screen should remain for 15 seconds. Then a new screen should appear letting the user know that the ear-training activity is about to begin. In 15 seconds it will ...

If the module runs to completion, a record of information should be transported over the internet to the data-archive. This record should include:

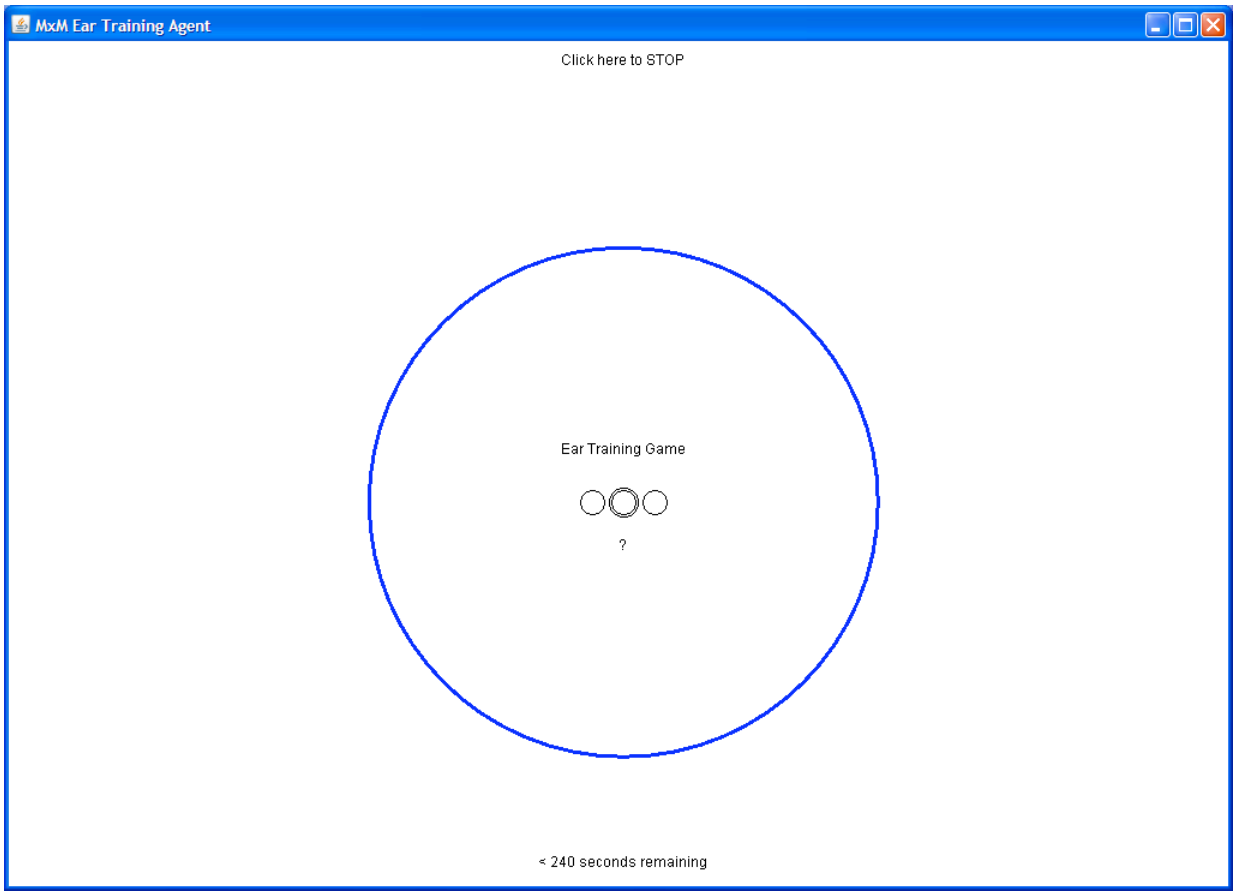
1. user-id
2. module-number (with respect to this user)
3. activity-id (like “assessment pretest” or “assessment posttest”)
4. date
5. time-started
6. D-score
7. number-correct
8. number-incorrect
9. correct-response-profile (CP11 CP12 CP13 CP14 CP15 CP16 CP17 CP21 CP22 CP23 CP24 CP25 CP26 CP27 CP31)
10. incorrect-response-profile (IP11 IP12 IP13 IP14 IP15 IP16 IP17 IP21 IP22 IP23 IP24 IP25 IP26 IP27 IP31)

## 3.3 The Ear Training Game Activity

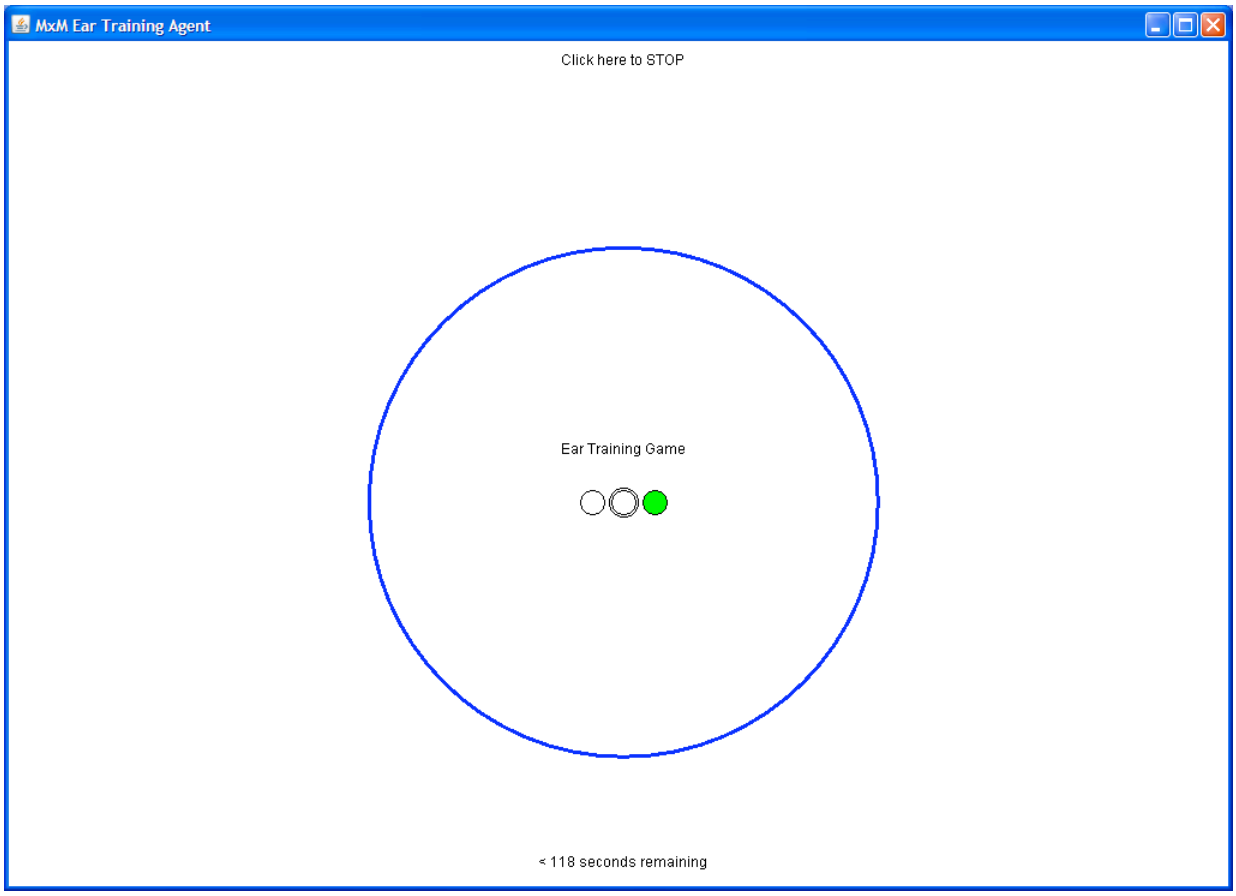
This activity is a sort of "audio game" in which the user can move from level to level by accomplishing tasks – just one task, actually. For a particular game, a major scale is randomly selected for use throughout the entire game. The player is initially presented with a screen image like that shown below. The dots correspond to the tonic of the major scale, the seventh degree of the scale one half step below the tonic (to its left, pictorially), and the second degree of the scale one whole step above the tonic to its right, pictorially). When the image is first presented, the tonic is sounded and its bubble is rendered blue – both the sound and the image for the same short but discernable amount of time.



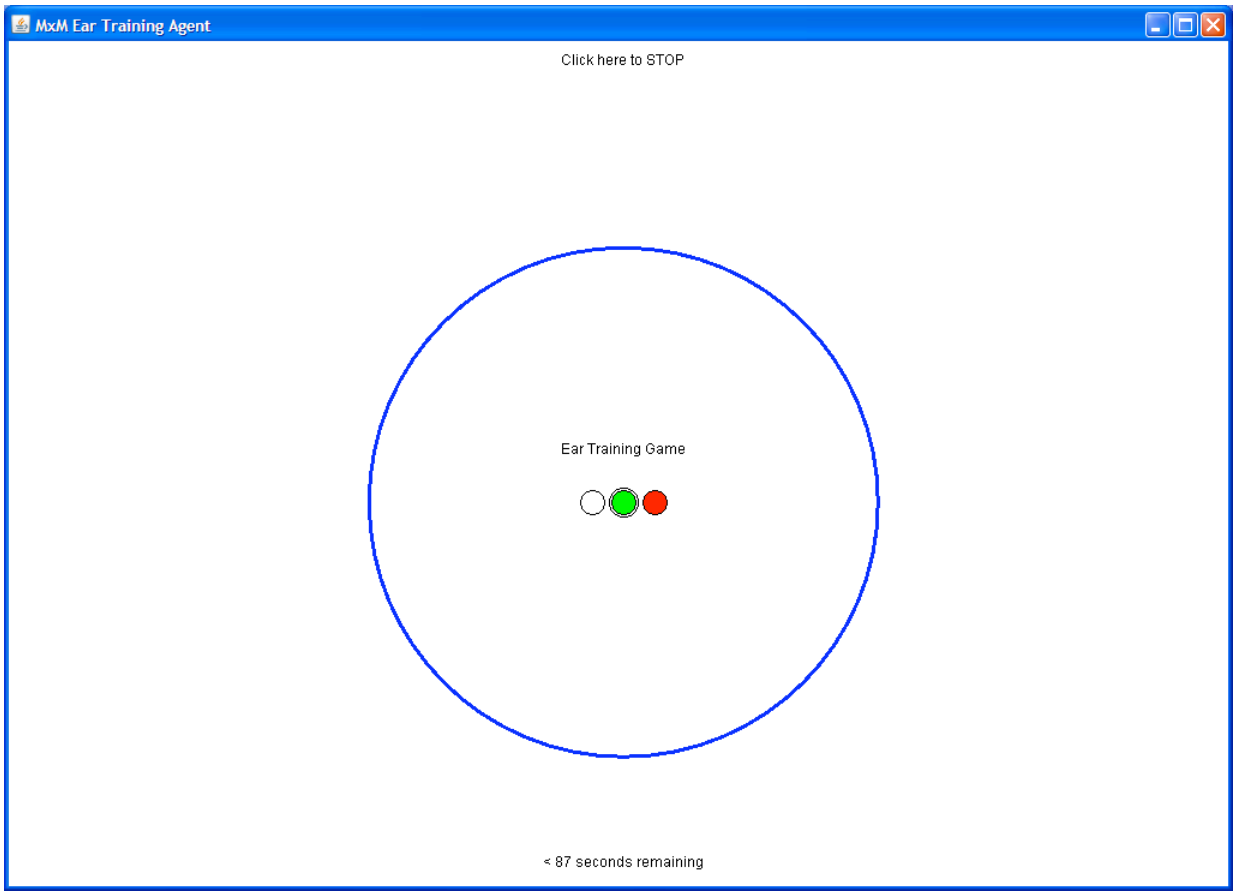
One of the three tones is then chosen at random and sounded for the short but discernable time unit, while the screen image appears as follows. (Note the question mark which prompts the user for input.)



The user is suppose to click on the bubble corresponding to the pitch that was sounded. If the user is correct, the sounded bubble appears green for the short period of time – confirming the correctness of the response.



If the user clicks on an incorrect bubble, that bubble is flashed red while the correct bubble is flashed green, simultaneously for the short period of time.



The three bubble situation is known as the “level 1” situation. If the player gets seven **consecutive** answers correct, a screen congratulating the player is presented for a few seconds, and the the player moves on to the next level. Level 2 has five tones, the tonic, the 6th and 7th degrees of the scale below it, and the 1st and 2nd degrees of the scale above it. And so it goes!

When time expires, the game is stopped and the player is presented with a screen indicating the current level. The screen remains for 15 seconds. Then a screen is presented for 15 seconds indicating that a post-assessment is about to begin.

If the module is completed, the level and the number of trials presented at each level, along with some other information, will be transmitted to the data archive in the form of a record containing ...

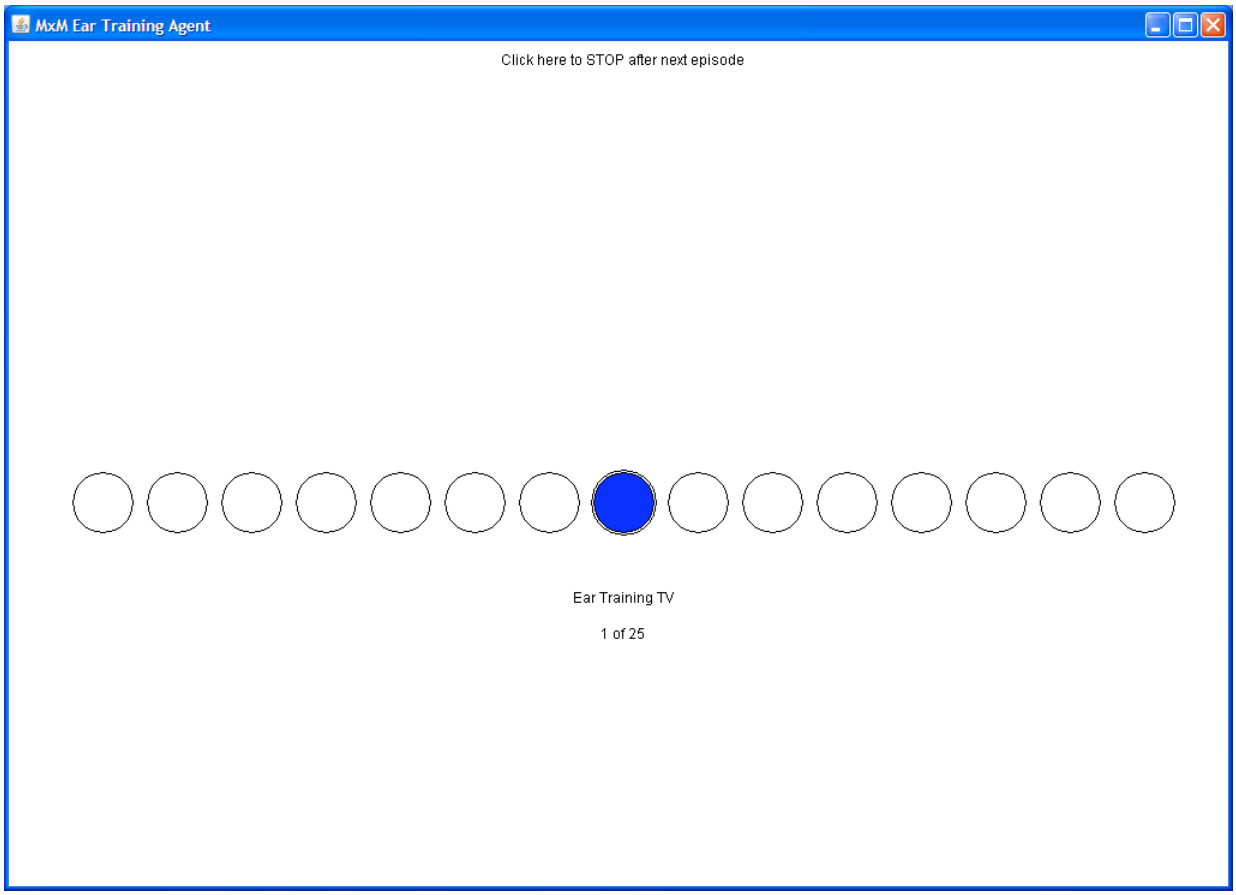
1. user-id
2. module-number (with respect to this user)
3. activity-id (like “game” or “isolated note TV” or “last note TV (L)” or “last note TV (F)”)
4. date
5. time-started
6. final level (a positive integer)
7. trial profile (N1 N2 N3 N4 N5 N6 N7 N8)

## 3.4 The Isolated Note Identification Interactive TV Activity

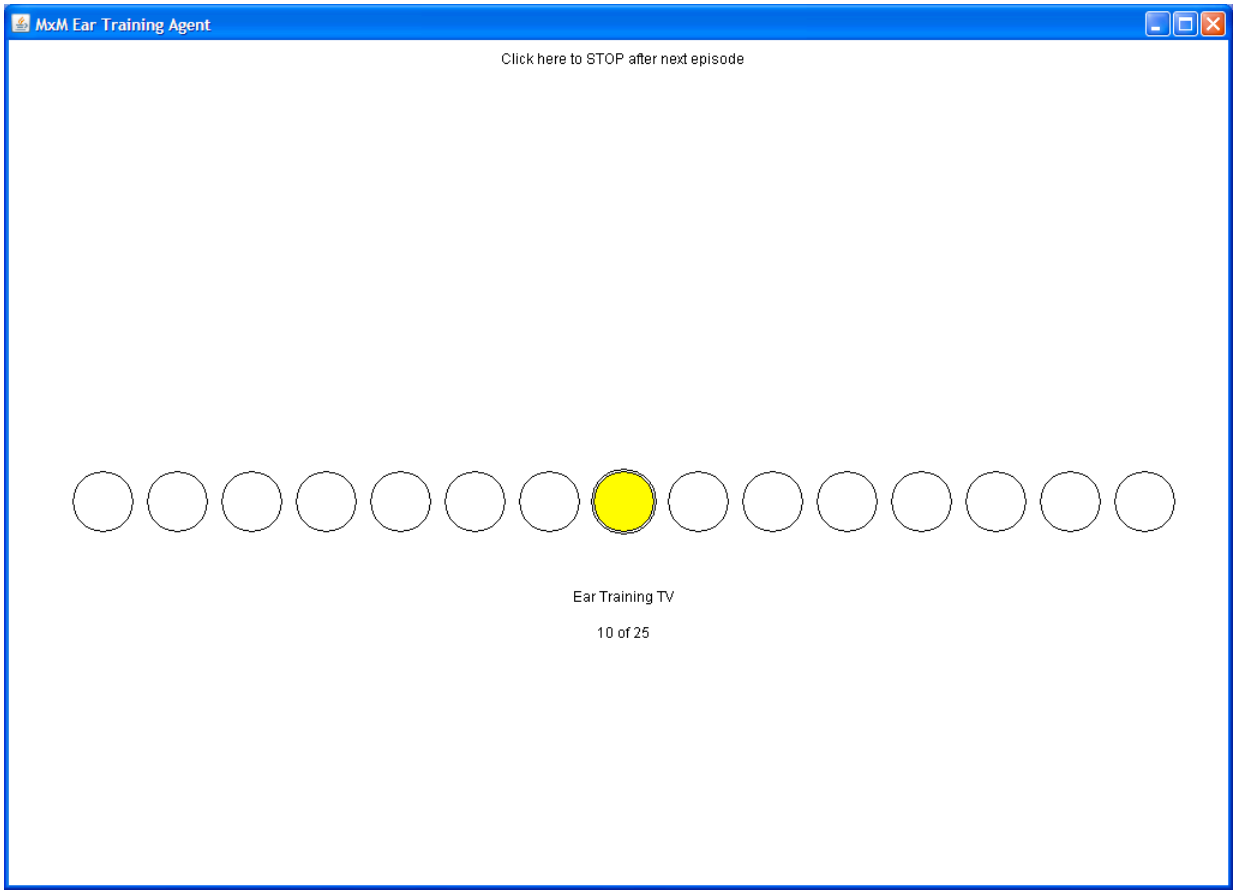
This activity takes place in the context of a 15 note “bubble instrument” – tonic ... tonic ... tonic roughly in the middle of a keyboard. The activity consists of a number of trials – as time permits. For each trial ...

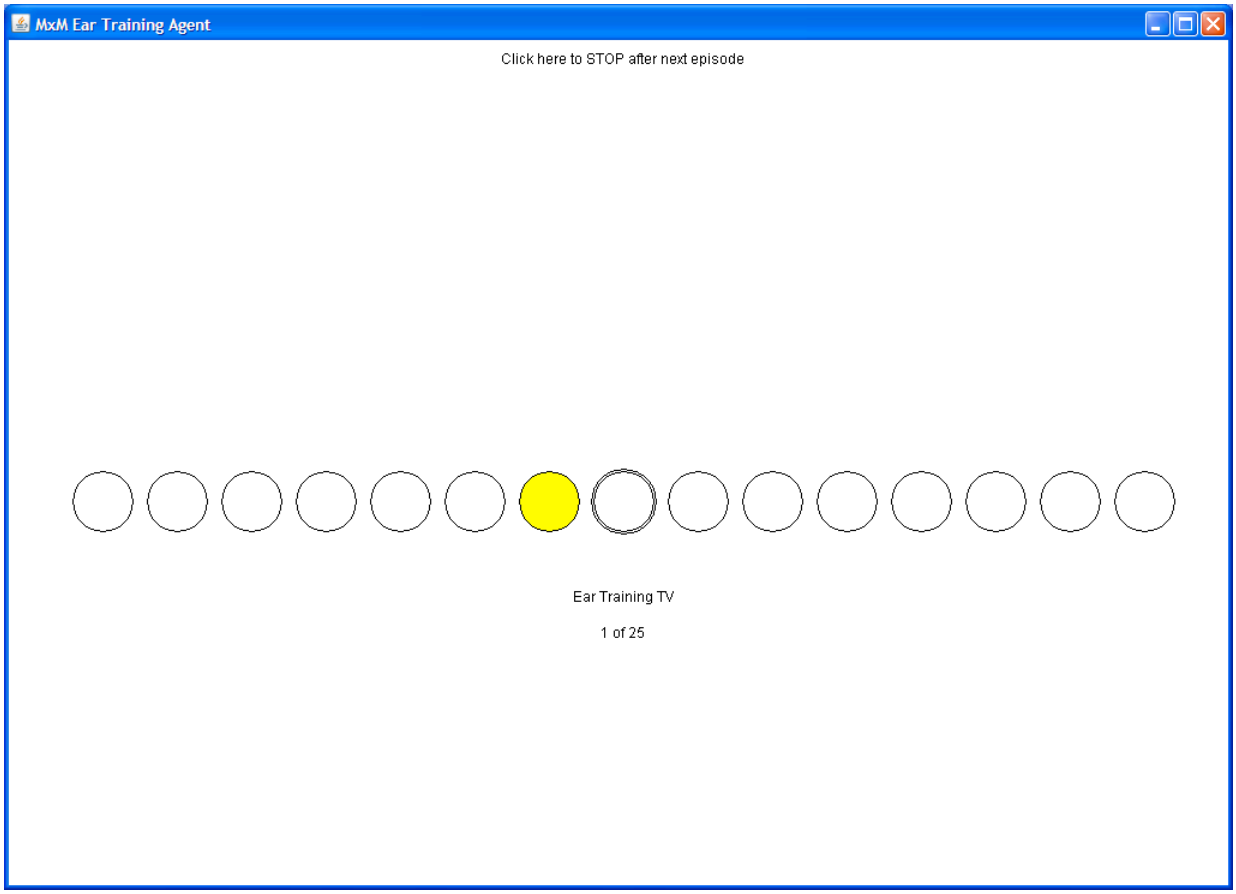
1. A random major scale is selected.
2. The tonic pitch is sounded in the middle of the machine, and the middle bubble is rendered blue as it is sounded.
3. A goal pitch is then sounded for a bit – with no corresponding image signaling the tone that is played.
4. The human then clicks on the bubble that they believe corresponds to the goal pitch.
5. If the user is correct, the goal pitch bubble is made green for a bit. If not, it is made red for a bit.
6. Regardless, the human then sees a sequence of dots lit up in fairly rapid succession, with accompanying tones being played, from the center tonic to the goal pitch. Each of the highlights are yellow except for the goal pitch which will be shown in green.
7. Data is collected for the trial: the goal pitch; the response pitch; whether or not the guess was correct.

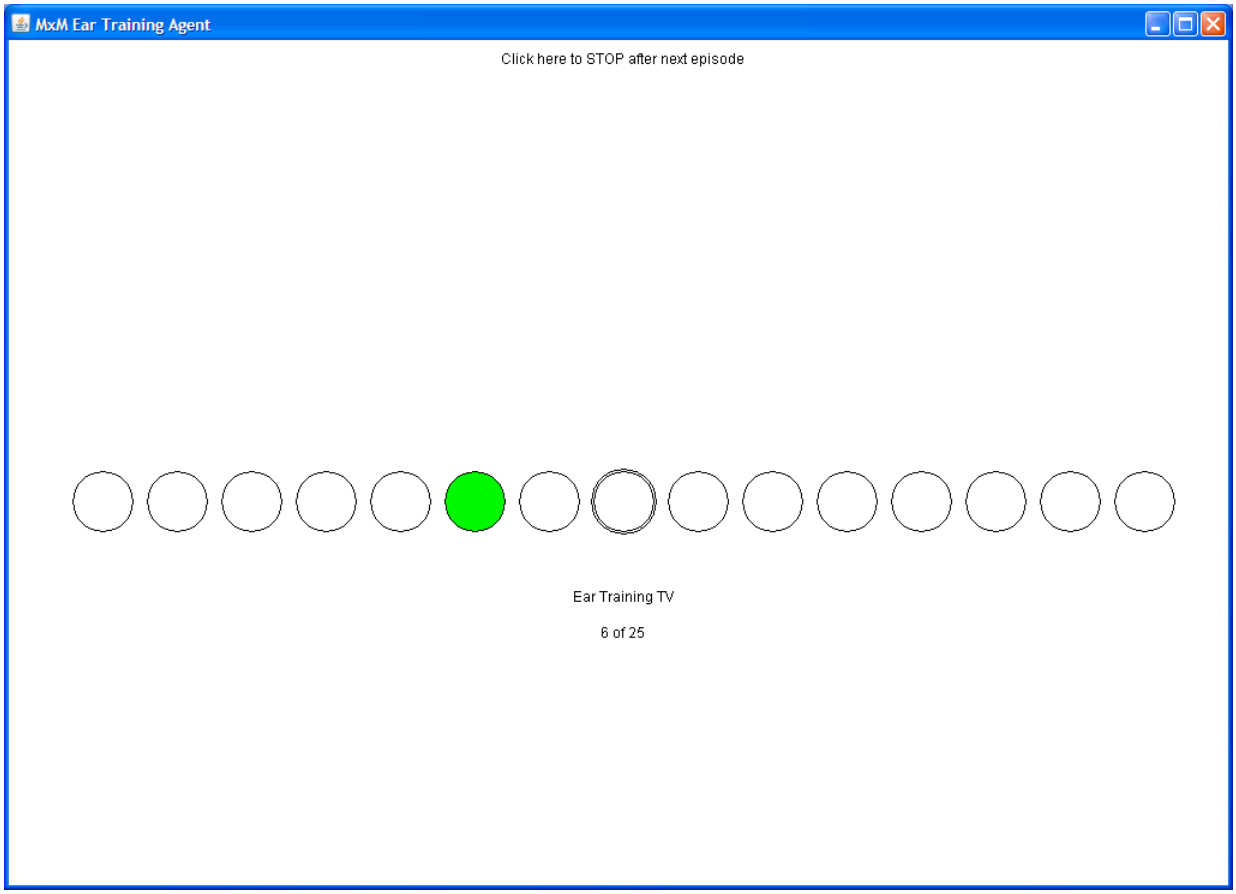
Here is the opening screen.



Imagine that the sixth degree of the scale is sounded in the lower register, without any imaging. Further, imagine that the human then clicked on the fifth bubble in the lower register. The fifth bubble would then be made red – indicating a wrong answer. The human would then "watch" (and listen!) to three tones being played, as the following three screen images suggest.


MxM Ear Training Agent
Click here to STOP after next episode
Ear Training TV
10 of 25


MxM Ear Training Agent
Click here to STOP after next episode
Ear Training TV
1 of 25


MxM Ear Training Agent
Click here to STOP after next episode
Ear Training TV
6 of 25

If the human had answered correctly, the same “TV program” would be played for the human. Trials continue until time expires.

Note: Timing of events should be programmed in such a way that parametric changes can be made.

## 3.5 The Last Note in Identification Interactive TV (F) Activity

This activity is intended to be more ecologically valid than the "Isolated Note ID" activity. The activity consists of a number of trials – as time permits – but these trials feature melodic fragments of folk songs. Here is the basic idea:

1. A melody is selected at random from the Essen Folk Song Collection.
2. The tonic pitch is sounded in the middle of the machine, and the middle bubble is rendered blue as it is sounded.
3. The first N notes of the melody is played, where N is a random integer from 4 to 7 – with *no* corresponding image signaling the tone that is played.
4. The human then clicks on the bubble that they believe corresponds to the *last* note played (the goal note).
5. If the user is correct, the goal pitch bubble is made green for a bit. If not, it is made red for a bit.
6. Regardless, the human then sees a sequence of dots lit up in fairly rapid succession, with accompanying tones being played, where the dots correspond to the random fragment. Each of the highlights are yellow except for the goal pitch which will be shown in green.
7. Data is collected for the trial: the goal pitch; the response pitch; whether or not the guess was correct.

### 3.6 The Last Note in Identification Interactive TV (L) Activity

Similar to the previous activity, but this time each random melodic fragment is generated by a randomly created L-system in a randomly selected key.

## 3.7 The GUI

The user should be able to select from among the modules, and do whatever modules they wish in whatever order they wish as many times as they wish. What they choose to do will be an indication of what they think of the modules.

## 3.8 A few "implementation" notes

*These notes are mostly just a gathering of thoughts expressed previously.*

1. Ideally, a *sound design* for the complete system will be established prior to coding the system.
2. The design should be *inherently incremental*, and should *emphasise demos* of working bits as they are completed.
3. Writing "modules" of code without writing programs to demo the code should be strictly avoided. (I have seen enough of that for one life time.)
4. Establish a work site to archive a collection of "module specs" and demos.
5. Most of the code, if not all of it, should be written in Java (with JFugue helping with respect to sound/midi programming.)
6. The data will have to be collected on a CS machine. Probably you should talk with ro if you need anything in this regard.
7. The data should be archived in a manner that is suitable for mining activities. One file per user. Each le a text file. Each led richly formated with self-documenting "labels".
8. The assessment activity will run for 2 minutes (but program it to last for N seconds just in case we decide to alter the time it will be run for). Each ear-training activity will run for 10 minutes (but program it to last for N seconds just in case ...). Thus, each module will last for 15 minutes, as there will be a 30-second break between modules.)
9. Parameterize time lenghths for sounding notes and coloring bubbles.
10. Don't try to implement all of the activities at once. This project is large enough that some may not get implemented. Work on the activities in the following order – **coming to completion on one prior to commencing the next!**
    (a) Start with the assessment activity.
    (b) Next, work on the "game" activity.
    (c) Then, the "isolated last note" activity.
    (d) Then, the two more ecologically valid activities.
11. Have some fun. Allocate tasks according to skills. If ET2A doesn't all get done, that is life. If it does, GREAT! A wonderful tool for cognitive musicology research! A really wonderful, fun set of tools and methods will be available to the world for relative pitch training!!