Alchymical Mirror: Real-time Interactive Sound- and Simple Motion-Tracking Set of Jitter/Max/MSP Patches

Elizaveta Eidelman
lizets@yahoo.com

Serguei A. Mokhov
mokhov@cse.concordia.ca

Concordia University
Montréal, Québec, Canada
December 2005

Mon Dec 12 12:15:23 EST 2005
**Abstract**

This document supplements an experimental Jitter / Max/MSP collection of implementation patches that set its goal to simulate an alchemical process for a person standing in front of a mirror-like screen while interacting with it. The work involved takes some patience and has three stages to go through. At the final stage the "alchemist" in the mirror wearing sharp-colored gloves (for motion tracking) is to extract the final ultimate shining sparkle (FFT-based visualization) in the nexus of the hands. The more the hands are apart, the large the sparkle should be. Moving hands around should make the sparkle follow. To achieve the desired visual effect and the feedback mechanism, the Jitter lattice-based intensional programming model is used to work on 4-dimensional (A+R+G+B) video matrices and sound signals in order to apply some well-known alchemical techniques to the video at real-time to get a mirror effect and accompanying transmutation and transformation stages of the video based on the stability of the sound produced for some duration of time in real-time. There is an accompanying video of the result with the interaction with the tool and the corresponding programming patches.
Contents

1 Introduction
  1.1 Purpose ................................................................. 1
  1.2 Jitter and Max/MSP .................................................... 1
  1.3 Brief Review of References Used ..................................... 1

2 Methodology and Implementation .................................................. 3
  2.1 Master Patch – alchemy.tracking.alpha .................................. 3
  2.2 Dissolving Colors with alchemy.water.solvent ............................ 4
  2.3 Mirroring – alchemy.mirror ............................................... 4
  2.4 Finding Bounds – alchemy.findbounds .................................... 4
  2.5 Finding Pitch and an Amplitude – alchemy.pitch ........................ 5
  2.6 Dissolver Expressions – alchemy.dissolver ................................ 5
  2.7 alchemy.mirror.bugs ...................................................... 6
  2.8 alchemy.mirror.star ..................................................... 6
  2.9 Recording – alchemy.qt.record .......................................... 6

3 Conclusions ................................................................. 7
  3.1 Limitations .............................................................. 7
  3.2 Acknowledgments ........................................................ 7
  3.3 Future Work ............................................................... 7

Bibliography ................................................................. 8
Chapter 1

Introduction

1.1 Purpose

This document supplements an experimental Jitter [Cyc05a] / Max/MSP [Cyc05b] collection of patches that set their goal to simulate an alchemical process for a person standing in front of a mirror-like large LCD screen. The work involved takes some patience and has three stages to go through. At the final stage the alchemist in the mirror wearing a sharp-colored gloves to extract the final ultimate shining sparkle in the nexus of the hands. The more the hands are apart, the large the sparkle should be. Moving hands around should make the sparkle follow. This would be the definition of the purification process of an alchemist working on a some sort of Philosopher’s Work.

1.2 Jitter and Max/MSP

The Jitter lattice-based intensional programming model is used to work on 4-dimensional ($A + R + G + B$) video matrices and sound signals in order to apply some well-known alchemical techniques to the video at real-time to get a mirror effect and accompanying transmutation and transformation stages of the video based on the stability of the sound produced for some duration of time.

1.3 Brief Review of References Used

A number of alchemical works have been used as a reference material to create the new mirror-based process of purification. Additionally, a modern unusual physics-based dynamics book [LM97] was used to create and test some expressions in the Jitter environment. A number of reference include the Jitter and Max/MSP tutorial patches for motion tracking, finding bounds, extracting FFT off a video matrix, and getting pitch (FFT-based) and an amplitude information from an external pitch~ patch done by Tristan Jehan [Jeh05].
The two previous works by Eidelman [Eid05] and Mokhov [Mok05] were taken as the initial foundation in this collection of Jitter patches; while a lot of those unused in this particular projects, they are still found the patches directory of this work. An accompanying QuickTime movie alchymical-mirror.mov gives an approximate summary how the process works. Some concepts and ideas from other, less related work, had also some impact in here, e.g. from [Edm76, Mac01, Mac, bBE78].
Chapter 2

Methodology and Implementation

The origins of this work in portions resulted from the work of extracting a quintessence of gold by Agricola in [Agr38] and perfection of the alchemists themselves while in the process study done by Newman in [New04]. Like gold, a soul may have a various degree of purity. A common golden or red color of soul represents most pure, so while traveling through the stages of perfection, and alchemists should observe some reddening of the source video stream at all stages but the last. The implementation consists of a set of alchemy.* patches. The starting-point patch for this work is alchemy.tracking.alpha.

2.1 Master Patch – alchemy.tracking.alpha

Our master patch summons all the sub-patches and relates them one to the other. It begins by taking the streaming movie from the camerainput patch of Freida Abtan and send it to the alchemy.mirror one that reflects it by the y axis, giving the mirror effect. It also triggers the alchemy.pitch sub-patch that turns on the analysis of the sound coming into the microphone. It analyzes the sound and depending on its duration and stability varies the performer’s level of progression and gives out the progression percentage to the next level. This percentage is demonstrated by the value of the $R$ channel in the first 3 levels of the experience. Depending on the level of progression, other sub-patches are triggered, helping the user to visualize his/her progress level. The sub-patches are triggered in the following order:

- level 1: direct movie from the alchemy.mirror object;
- level 2: alchemy.mirror.bugs;
- level 3: alchemy.dissolver;
- level 4(final): alchemy.water.solvent that previously passed by the alchemy.mirror.star object. Here the star controlled by the alchemy.findbounds object was added to the original
mirrored movie. Reaching the level 4, the user is able to control the star using his hands or other objects of a color set in the \texttt{alchemy.findbounds} patch.

The follow up sections describe more the patches mentioned above.

### 2.2 Dissolving Colors with \texttt{alchemy.water.solvent}

This patch piece has already made appearance in the Alchemy Framework in \cite{Mok05}. Here its description is summarized again for convenience.

As it has been seen in the summary of alchemical works \cite{Hum96} done by various groups, there is a set of colors attribute to the transformation of any type of matter. The color green was often attributed to the allegorical \textit{Green Lion} representing the perfect gold. The color red was a common attribute of the gold at the final stage of preparation (resurrection after being burnt). As it’s been known for ages, the two colors combined give the color yellow, a day-to-day visual attribute of gold.

Thus dissolving our source material of video into basic $R$, $G$, and $B$ planes, and combining $R$ and $G$ is the first step in the process. The color blue ($B$) is discarded. Then the original $(A + R + G + B)$ material and the extracted pre-golden material $(A + R + G)$ are used further in the process.

Through so-called solvent water patch, \texttt{alchemy.water.solvent}, the visual media stream is split into the $R$, $G$, $B$ components out of which only $R$, $G$ along with alpha $A$ are retained, as described earlier. The patch simply unpacks the planes with \texttt{jit.unpack} and then recombines the needed ones with \texttt{jit.pack}. Thus, the output has three matrices: $(A + R + G)$, $(A + G)$, and $(A + R)$. In the \texttt{alchemy.tracking.alpha} patch the last two are unused and the result is only achievable of after passing through the other two stages representing purification through “burning” with \texttt{alchemy.mirror.bugs} and “calcination” with \texttt{alchemy.dissolver}, though their names do not correspond exactly to what those patches do as of this writing :-).

### 2.3 Mirroring – \texttt{alchemy.mirror}

This patch takes a movie matrix and reflects it by the $y$ axis, resulting in a real mirroring effect. The mirroring patch takes as input a streaming movie (in our case the movie is coming from the \texttt{camerainput} patch). Using the \texttt{jit.mxform2d} object, which applies linear algebra operations on matrices, the movie is mirrored by the $y$ axis and the final result is outputted in the only outlet.

### 2.4 Finding Bounds – \texttt{alchemy.findbounds}

This patch is used to find the outline box of a user-specified color and output center coordinates of the box, its height and width. The \texttt{alchemy.findbounds} patch takes a streaming movie in the
matrix form as its input and sends it to a \texttt{jit.pwindow}. A \texttt{suckah} object placed right on top of the movie matrix permits quick access to the its colors. By clicking on the movie, we can define which color must be identified; we also allow a small variation in the color that could result due to the lighting of the room where the experiment takes place. The minimum and the maximum color values, as well as the input movie matrix, are sent to the \texttt{jit.findbounds} object that outputs the bounding coordinates of the color. Taking those coordinates, the \texttt{jit.lcd} object draws an outline box of the color. We also use those coordinates to compute and output in the four outlets the center coordinates \((x,y)\) of the outline box and it’s width and height.

### 2.5 Finding Pitch and an Amplitude – \texttt{alchemy.pitch}

This patch is used to take a sound input and depending on the pitch, amplitude and duration of the sound, outputs the level achieved by the user and the percentage of the user’s progression to the next level.

As the patch is triggered, the microphone is turned on and the sound is directed for analysis into the \texttt{pitch\~} object that returns an amplitude and pitch values of the audio signal. Amplitude and Pitch analysis that follows are exactly similar so we will describe only one procedure as the other one is analogous. The values are analyzed at a 200\text{ms} interval because natural human voice changes gradually if analyzed at very small deltas \(\Delta f\) and \(\Delta a\) as we allow a small fluctuation in the voice, if it would be analyzed continuously, any sound would be qualified as homogeneous. So we decided to analyze it ever roughly 5 times per minute. The value is then compared to the previous one to see the fluctuation. If it is in an acceptable range, then the value is passed on and the timer continues to counts the duration of that homogeneous sound. Otherwise, if the fluctuation is too big, a bang is generated signifying that the timer should restart since the sound has changed. The timer displays the duration of the sound. If the duration was long enough for a certain level, a bang is sent to the counter saying that the level must be changed. We have generated many outlets for debugging purposes, however the only two outlets that were used by the final program were the first one, giving the percentage of completion of the current level and the second one, displaying the level reached at present point.

### 2.6 Dissolver Expressions – \texttt{alchemy.dissolver}

The \texttt{alchemy.dissolver} patch has changed since the last version of the Alchemy Framework presented in \cite{Mok05}. It does no longer do very basic frame-difference-based motion tracking with the matrix-wide operator \texttt{!-}. It accepts an additional input parameter and has a few expressions implemented based on the Chapter 13 of \cite{LM97}. Out of the four expressions only a combination of the 2nd and 3rd is activated to simulate “calcination-in-motion”. The 2nd inlet to the patch now is the parameter to those expressions. This patch may get renamed at a later point.
2.7 \texttt{alchemy.mirror.bugs}

This not-very-well-named patch acts as a source of “purification-through-burning” of an image with a noise and a projected goal of the star in it as an ultimate goal. There are two parts to this patch. The first one applies an expression on input video matrix from the random numbers logistic map adapted equation from [LM97] where the parameter $i$ may vary from the progress reported by the \texttt{alchemy.pitch}. This piece is matrix-subtracted from a fractal noise generated by the \texttt{jit.bfg} object used in its example. The two are averaged and the FFT is extracted to form a star in the middle (basically FFT repeated 4 times in 4 quadrants in the matrix) and then all these pieces (the transmuted video, the fractal noise, and the FFT star) are combined together at the output. (The name \texttt{.bugs} was used to indicate that there were many bugs with expression previously, before it ended up in the final patch.)

2.8 \texttt{alchemy.mirror.star}

This is the final stage patch that takes effect when the final “golden” stage is reached. In that stage the output of the \texttt{alchemy.findbounds} patch goes as an input to this patch along with the output of \texttt{alchemy.water.solvent}. This includes the coordinates of the center point of the bounding box (used to place the star) and the height and the width of the box. The height and the width are used to properly scale the coordinates and the star size so when supposedly one moves their hands (with distinctly colored gloves) apart it should grow bigger, and if one places their hand closer together it should be smaller. Likewise, if the hands with the This effect works, but is quite unstable and requires more calibration. The star itself is a FFT-quadruple of the video signal coming it, and as such, is shining-animated.

First, the FFT transform of the video matrix is taken to determine the star’s shape. Then, the star is scaled based on the height/width ration we get as an input using \texttt{jit.mxform2d}. Further, the star is repositioned using \texttt{jit.repos} and the $x$ and $y$ offsets calculated from the center coordinates received. Finally, this altered star is combined with the original incoming video matrix to produce the final result.

2.9 Recording – \texttt{alchemy.qt.record}

This is a wrapper around the \texttt{jit.qt.record} object. We changed it to start recording the movie as soon as our patch begins, to automatically record it as real-time video and we added another inlet to be able to stop the recording whenever needed.
Chapter 3

Conclusions

3.1 Limitations

The most prominent limitation of the patch as of this writing is instability in extracting and catching and navigating the star at the final stage.

3.2 Acknowledgments

- Dr. Xin Wei Sha, for unconventional course on Alchemy, Real-time Media, and Calligraphic Video and allowing us using the TML resources.

- Freida Abtan, for an awesome Jitter intro.

3.3 Future Work

First, the future work will focus on stabilizing the star-bounds effect. Additionally, a supplemental degree of sound feedback will be added as it was not at all addressed yet in the present work. Finally, more experimentation with physics and the corresponding expressions as well as attaining more realistic mirror effects, and maybe an installation alongside with the TML.
Bibliography

[Agr38] Joannes Agricola. Treatise on Gold. Adam McLean; The Alchemy Web Site, July 1638. Translation by Leone Muller; transcription by Mark House; http://www.levity.com/alchemy/agricola.html.

[bBE78] Transcribed by Brehm Edmund. Triumphal Chariot of Basil Valentine, volume MBIX Vol. 23, Part I. The Alchemy Web Site, 1678. http://www.levity.com/alchemy/antimony.html.

[Cyc05a] Cycling ’74. Jitter 1.5. [online], 2005. http://www.cycling74.com/products/jitter.html.

[Cyc05b] Cycling ’74. Max/MSP. [online], 2005. http://www.cycling74.com/products/maxmsp.html.

[Edm76] Brehm Edmund. Roger Bacon’s Place in the History of Alchemy, volume MBIX Vol. 23, Part I. The Alchemy Web Site, 1976. http://www.levity.com/alchemy/rbacon.html.

[Eid05] Elizaveta Eidelman. Search for purity of heart. Concordia University, 2005. Midterm Paper.

[Hum96] Burt Humburg. On the Color Changes in the “Great Work”, or the Alchemical Transformation of Matter. The Alchemy Web Site, 1996. http://www.levity.com/alchemy/humburg.html.

[Jeh05] Tristan Jehan. pitch ~ Pitch tracker (based on fiddle ~ from Miller Puckette). Tristan Externals, 2005. http://web.media.mit.edu/~tristan/.

[LM97] Rubin H. Landau and Manuel J. Paez Mejia. Computational Physics: Problem Solving with Computers. New York: Wiley, 1997. Book & Disk edition, 520 pp. ISBN 0471115908.

[Mac] Charles Mackay. Memoirs of Extraordinary Popular Delusions, volume III, Book I. The Alchemy Web Site. http://www.levity.com/alchemy/mackay.html.
[Mac01] Charles Mackay. *Extraordinary Popular Delusions And The Madness Of Crowds*. Litrix Reading Room, 2001. [http://www.litrix.com/madraven/madne019.htm](http://www.litrix.com/madraven/madne019.htm)

[Mok05] Serguei A. Mokhov. *Towards Extraction of Quintessence of Soul with Jitter in Max/MSP*. Concordia University, 2005. Midterm Paper.

[New04] William R. Newman. *Promethean Ambitions: Alchemy and the Quest to Perfect Nature*. The University of Chicago Press, September 2004. ISBN: 0-226-57712-0.
# Index

Acknowledgments, 7

API

| Function                | Pages |
|-------------------------|-------|
| alchemy.dissolver       | 3, 5  |
| alchemy.findbounds      | 3, 4, 6 |
| alchemy.mirror          | 3, 4  |
| alchemy.mirror.bugs     | 3, 4, 6 |
| alchemy.mirror.star     | 3, 6  |
| alchemy.pitch           | 3, 5, 6 |
| alchemy.qt.record       | 6     |
| alchemy.tracking.alpha  | 3, 4  |
| alchemy.water.solvent   | 3, 4, 6 |
| camerainput             | 3, 4  |
| jit.bfg                 | 6     |
| jit.findbounds          | 5     |
| jit.lcd                 | 5     |
| jit.mxform2d            | 4, 6  |
| jit.pack                | 4     |
| jit.pwindow             | 5     |
| jit.qt.record           | 6     |
| jit.repos               | 6     |
| jit.unpack              | 4     |
| pitch                   | 1, 5  |
| suckah                  | 5     |

Conclusion, 7

Files

| File                        | Pages |
|-----------------------------|-------|
| alchemy.*                   | 3     |
| alchymical-mirror.mov       | 2     |
| patches                     | 2     |

Future Work, 7

Implementation, 3