

# Plink Jet

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## Abstract

Plink Jet is a robotic musical instrument made from scavenged inkjet printers and guitar parts. We investigate the expressive capabilities of everyday machine technology by re-contextualizing the relatively high-tech mechanisms of typical office debris into an electro-acoustic musical instrument. We also explore the performative relationship between human and machine.

## Introduction

Plink Jet is a robotic musical instrument made from scavenged inkjet printers. The mechanical parts of four inkjet printers are diverted from their original function, re-contextualizing the relatively high-tech mechanisms of typical office debris into musical performance. Motorized, sliding ink cartridges and plucking mechanisms play four guitar strings by manipulating both pitch and strumming patterns mimicking human hands fingering, fretting, and strumming a guitar. Plink Jet is designed to play in three modes: automatic (played by a micro-controller), manual (played by a musician), or a combination of both. A musician can choose varying levels of manual control over the different cartridges (fretting) and string plucking speeds (strumming), while improvising with preprogrammed sequences of Plink Jet.

## Interface

Plink Jet is designed to play guitar strings both manually and automatically. The interface consists of four toggle switches, four three-way switches, four dials, a single six-position rotary switch and a single power switch. Each of the four toggle switches and three way switches is associated with a single ink carriage. The rotary switch allows the user to select different pre-programmed patterns while a carriage is under automatic control.

### Fretting

The guitar strings are strung across the printer mechanism where the optical sensor used to be. Cartridges slide up and down the strings and touch the strings just enough to change the pitch, similar to a slide guitar. The farther

away the cartridge is from the plucking mechanism, the lower the pitch of the note.

Each carriage is controlled by a toggle switch and a 3-way switch. Toggle switches control whether the associated inkjet carriage is under manual or automatic control. While under manual control, the back-and-forth motion of each carriage is controlled by a three-way switch. While under automatic control, the carriage is controlled by a micro-controller containing programmed patterns of movement.

### Strumming

The guitar strings are plucked by motors with a single thin metal strip that strikes the string as it rotates around. Four dials control the speed of the strumming motors. Control over the strumming motors exists regardless of whether the associated carriage is under manual or automatic control.

### Amplification

Inside each ink cartridge is a piezoelectric microphone used to pick up the sound of the plucked guitar string as well as the ambient sounds of the sliding cartridge. In many ways Plink Jet is an elaborate guitar, and like an electric guitar it has a single quarter-inch output jack which allows it to be connected directly to a guitar amplifier.

## Technology

The printer carriages and motors are from four inkjet printers. The controlling circuits and electronics are custom-designed. The optical encoder of each inkjet printer has been removed and replaced with a tunable guitar string that uses actual guitar tuning mechanisms built into the machine.

### Circuitry

While under manual control, Plink Jet's circuitry is completely analog. The only digital element is the micro-controller used in automatic mode.

### *DC Motors*

A DC motor connected to an H-bridge chip controls the back and forth movement of each carriage. While in manual mode, the three-way switch controls the H-bridge with 5VDC. While in automatic mode, the H-bridge is under the control of the micro-controller.

### *Stepper Motors*

The strumming mechanism is driven by stepper motors, normally used for the docking procedure of the ink carriages. Each dial is attached to a potentiometer which controls the speed by changing the voltages on an oscillator chip. The oscillator signals are connected to hex divider chip, that acts as a stepper driver. The stepper signals are then relayed through a Darlington array before triggering the stepper motors.

### *Micro-controller*

Plink Jet uses an ATMEGA168 chip containing six pre-programming patterns to control the fretting when a carriage is in automatic mode. A six-position rotary switch selects which pattern to use. When a carriage is in automatic mode, the ATMEGA controls the associated motor's H-bridge.

## **Everyday machines and music**

The repurposing of consumer technology is a growing trend for artists and technologists in the DIY genre exploring circuit bending, hardware hacking and retro-engineering.<sup>4</sup> Artists who have used the mechanics of printers for producing sound include Paul Slocum with his dot matrix printer and Eric Singer's printer/scanner-inspired musical instrument, GuitarBot. The innovative American composer Harry Partch built many of his instruments out of trash and his own carpentry. Plink Jet emerged from the process of hardware hacking and could be considered an *infra-instrument*, a concept developed by John Bowers and Phil Archer. Infra-instruments are often created by taking a non-instrument and finding the instrument within.<sup>1</sup> With Plink jet, we have found the infra-instrument within the inkjet printer.

## **Structure and Improvisation**

A musician playing Plink Jet is like a pianist playing a player piano. Two performance operations are occurring

simultaneously. There are the programmed, ordered movements of the machine itself, and there are the improvised decisions of the user regarding levels of automatic and manual control and his or her reactions to the precise mechanical patterns. The Player Piano is one of the first examples of an automatic, mechanically played musical instrument, but early player piano rolls lacked expressiveness when played because they were created by hand directly from the music score.<sup>2</sup> Electronic or machine music often evokes very different emotions as opposed to human-performed music because of its super-human precision. The combination of these two musical aesthetics (prepared and improvised, machine and human) expresses a tension in our relationship with machines. Reflecting upon the interplay between a mechanical presence and human player, Eric Singer of LEMUR has said "I believe it is an entirely new experience for the human players. The robots create a physical, responsive presence (unlike synthesizers) which can profoundly affect the humans interacting with them. Because they move as well as sound, they take on a personality of sorts, and inspire the human players in a unique way."<sup>3</sup> Numerous options for playing Plink Jet between manual and automatic control opens a dialog between the player of Plink Jet and the robotics of the mechanisms themselves, and a performance broadcasts this dialog between machine structure and human improvisation.

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- 2 Kapur, Ajay. 2005. "A History of Robotic Musical Instruments." In *International Computer Music Conference*. [http://mistic.ece.uvic.ca/publications/2005\\_icmc\\_robot.pdf](http://mistic.ece.uvic.ca/publications/2005_icmc_robot.pdf).
- 3 Lotti, Giulio. 2007. "LEMUR: League of Electronic Musical Urban Robots." In *Simultaneita*. <http://www.simultaneita.net/lemur2.html>.
- 4 Ramocki, Marcin. "DIY: The Militant Embrace of Technology." <http://ramocki.net/ramocki-diy.pdf>.