

"The Birth and Rise of the Laptop Orchestra"

excerpt (pp. 248-274) from *Artful Design*,
Chapter 5 "Interface Design"



<https://artful.design/>

THE BIRTH AND RISE OF THE LAPTOP ORCHESTRA!

DIRECTLY OUT OF PERRY AND DAN'S WORK ON EMBODIED INTERFACES AND SPEAKER ARRAYS, THE **LAPTOP ORCHESTRA** PUSHES THE IDEA OF ELECTRONIC CHAMBER MUSIC TO A NEW (IL)LOGICAL EXTREME: NOT ONE, BUT AN **ENSEMBLE** OF EMBODIED INTERFACES WITH HUMANS IN THE LOOP!

IN 2005, THE **FIRST** OF ITS KIND AND SCALE WAS BORN: THE **PRINCETON LAPTOP ORCHESTRA** (P_{LORK})!

LAPTOPS? ORCHESTRAS? NE'ER THE TWAIN SHALL MEET! AND YET...



DAN TRUEMAN



...THIS **STRANGE PAIRING** MAKES IT ALL THE MORE INTRIGUING!



SCOTT SMALLWOOD

HOW DOES IT CHANGE THE WAY WE **COMPOSE**...

...AND **DESIGN** INSTRUMENTS, AND CRAFT LIVE PERFORMANCES?



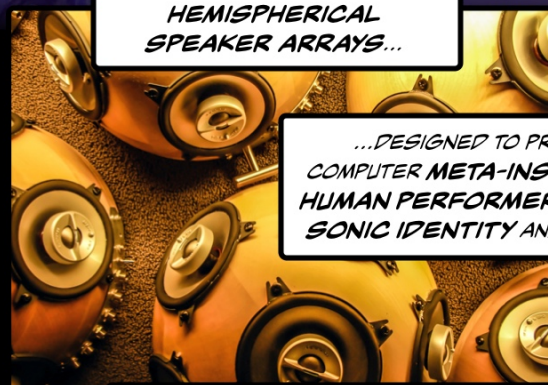
AND FIND A GOOD **BALANCE** BETWEEN HUMAN AND TECHNOLOGY?

THE **LAPTOP ORCHESTRA** IS A LARGE-SCALE, COMPUTER-MEDIATED PERFORMANCE ENSEMBLE, **DESIGN LABORATORY**, AND **CLASSROOM**, EXPLORING A RADICAL INTERACTION OF **SCIENCE** AND **TECHNOLOGY** WITH **ART**, DRAWING FROM BOTH CONVENTIONAL AND CUTTING-EDGE PRACTICES.

S_{LORK} IN BEIJING 2014

ENSEMBLES IN THIS MEDIUM CAN BE COMPRISED OF MORE THAN **20** LAPTOPS, HUMANS, AND...

...CUSTOM MULTI-CHANNEL **HEMISPHERICAL** SPEAKER ARRAYS...



...DESIGNED TO PROVIDE EACH COMPUTER META-INSTRUMENT AND HUMAN PERFORMER WITH THEIR OWN **SONIC IDENTITY** AND **PRESENCE**.



THE **LAPTOP ORCHESTRA** IS CAPABLE OF FUSING A POWERFUL SEA OF SOUND WITH THE **IMMEDIACY** OF HUMAN MUSIC-MAKING, ATTEMPTING TO CAPTURE THE **ENERGY** OF A LIVE ENSEMBLE AS WELL AS ITS **SONIC INTIMACY**...

...IN WHAT WE THINK OF AS A FORM OF **ELECTRONIC CHAMBER MUSIC**.

P_{LORK}'S WEST COAST SIBLING, STANFORD'S **S_{LORK}** WAS FOUNDED THREE YEARS LATER IN 2008.

THE **LAPTOP ORCHESTRA** EMBODIES MANY OF THE IDEAS WE'VE ENCOUNTERED -- RE-MUTUALIZATION, **BODY**, CO-DESIGN, INTERFACES AS EXTENSIONS...

THAT THE NOTION OF A "LAPTOP ORCHESTRA" IS SEEMINGLY **PARADOXICAL** IS ONE OF MY PRIMARY MOTIVATIONS FOR CREATING ONE; THE PAIRING OF THESE TWO INVENTIONS IS PERHAPS OBVIOUS ONLY BECAUSE OF ITS APPARENT **IMPOSSIBILITY**. ONE IS AN ALMOST **ARCHAIC** INSTITUTION WHOSE CONTINUED EXISTENCE IS SOMETHING OF A MIRACLE, THE OTHER IS A **TECHNOLOGICAL NEWCOMER** THAT HAS BECOME COMMONPLACE AND SEEMS LIKELY TO BE WITH US, AT LEAST IN SOME FORM, FOR QUITE SOME TIME...



ONE SERVES TO PERFORM PRIMARILY EUROPEAN MUSIC FROM CENTURIES AGO, WHILE THE OTHER IS A CONVENIENT TOOL FOR EDITING TEXT, CRUNCHING NUMBERS, BROWSING THE WEB, AND CHECKING E-MAIL. **NEVER** THE TWAIN SHALL MEET.

THE ORCHESTRA VS. THE LAPTOP (IN PERFORMANCE)

- IS **LARGE**
- TYPICALLY LIVES IN A REASONABLY LARGE PERFORMANCE HALL WITH GOOD MUSICAL ACOUSTICS
- **SOUND** IS NET SUM OF MANY RELATIVELY **PROXIMAL** INSTRUMENTS IN THIS HALL
- IS DIVIDED INTO **SECTIONS** ACCORDING TO THE NATURE OF THESE INSTRUMENTS
- INSTRUMENTS TYPICALLY TAKE DECADES TO MASTER, AND HAVE BEEN UNDER REFINEMENT FOR EVEN LONGER, SOMETIMES CENTURIES
- IS USUALLY **CONDUCTED**

- IS TYPICALLY USED **ALONE**
- PLAYS IN ALL SORTS OF SPACES: BARS, CLUBS, SOMETIMES CONCERT HALLS
- SOUND IS TYPICALLY AMPLIFIED THROUGH A **CENTRALIZED** PA SYSTEM
- INSTRUMENT DESIGN IS CONSTANTLY **IN FLUX**, SOMETIMES EVEN GENERATED DURING THE ACTUAL PERFORMANCE (LIVE CODING); OFTEN CREATED BY THE **PLAYER**
- **MASTERY** OF INSTRUMENTS CAN TAKE A FEW MINUTES OR **MUCH LONGER**
- "WHAT? A CONDUCTOR?"



THE LAPTOP ORCHESTRA MEDIUM WAS DESIGNED WITH THE **ETHOS...**

"**BORROW** WHAT MAKES SENSE. **INVENT** THE REST."

THE LAPTOP ORCHESTRA

- TYPICALLY BETWEEN 4 (QUARTET) AND 20 (FULL ENSEMBLE) PERFORMERS IN SIZE
- EACH **HUMAN PERFORMER** IS PAIRED WITH A **META-INSTRUMENT**, SO CALLED BECAUSE IT'S A LAPTOP STATION THAT CAN BE DESIGNED INTO DIFFERENT AND MORE **SPECIFIC** INSTRUMENTS
- A **META-INSTRUMENT** CONSISTING OF A **LAPTOP**, MULTI-CHANNEL AUDIO INTERFACE, AND -- CRUCIALLY -- A MULTI-CHANNEL HEMISPHERICAL **SPEAKER ARRAY**
- SOUND IS **LOCAL** AND **PROXIMAL** TO EACH INSTRUMENT AND PLAYER
- INSTRUMENTS ARE OFTEN DESIGNED ON A CASE-BY-CASE BASIS, TIGHTLY TAILORED TO EACH **WORK** IN QUESTION, AS BESPOKE EXPERIENCES FOR EACH PIECE
- THE NOTION OF **PLAYING** THE INSTRUMENTS ARE AS VARIED AS THE INSTRUMENTS
- **FORMATS** OF PIECES RANGE FROM FREE-FORM OR STRUCTURED IMPROVISATION TO RIGIDLY SCORED PIECES; NO PRESCRIBED LIMITATION ON TYPES OF MUSIC (E.G., GENRE)

TYPICAL SETUP FOR EACH **META-INSTRUMENT** IN THE STANFORD LAPTOP ORCHESTRA

HEMISPHERICAL SPEAKER ARRAY
KEEPS SOUND **LOCAL** TO THE INSTRUMENT

LAPTOP
FOR INTERACTION, PROGRAMMING, AND SOUND SYNTHESIS

AUDIO INTERFACE
MULTI-CHANNEL AUDIO SIGNAL TO SPEAKER ARRAY

MEDITATION PILLOW
MIGHT AS WELL BE COMFORTABLE

BREAKFAST TRAY
FOR HOLDING THE LAPTOP

MEDITATION MAT
WE SIT CLOSE TO THE GROUND

FOR ME, THE ALLURE OF THE LAPTOP ORCHESTRA IS A **DESIGN LAB** WHERE THE INSTRUMENTS WE BUILD AND THE WORKS WE COMPOSE ARE "DEPLOYED" IN CONCERT SETTINGS WHERE, AESTHETICALLY, THE RUBBER MEETS THE ROAD.

IT IS IN THIS REAL-WORLD CONTEXT THAT SUCCESS IS MEASURED. IT'S ABOUT FINDING THE **RIGHT INTERPLAY** BETWEEN WHAT PEOPLE ARE GOOD AT DOING AND WHAT COMPUTERS ARE GOOD AT DOING (WHILE EMBRACING THEIR RESPECTIVE LIMITATIONS) TO ACHIEVE AND EXPLORE AN AESTHETIC GOAL.

THAT WE HAVE TO DESIGN THE INSTRUMENTS FROM THE **GROUND UP** FOR EACH NEW WORK IS BOTH A **BLESSING AND CURSE**.



FOR EACH DESIGN, A FIRST-ORDER SANITY CHECK

DOES THE END PRODUCT JUSTIFY THE TECHNOLOGY?

DOES IT DO AT LEAST ONE THING THAT CAN BE ACHIEVED BY NO OTHER MEANS?

DOES THE DESIGN USE THE MEDIUM TO SUPPORT THE RIGHT INTERPLAY BETWEEN TECHNOLOGY AND HUMANS?

IF IT **FAILS** ANY OF THESE CHECKS, THEN PERHAPS THE DESIGN, AS IT STANDS, ISN'T THAT INTERESTING OR SHOULDN'T USE THE TECHNOLOGY. DESIGN IS COGNIZANT OF SPECIFICITIES OF THE MEDIUM, AND WE TRY TO SEE **HUMANS AND COMPUTERS** AS TWO FUNDAMENTALLY DIFFERENT TYPES OF ENTITIES, EACH WITH BUILT-IN ADVANTAGES AND LIMITATIONS.

COMPUTERS VS. HUMANS

- NO INHERENT NOTION OF **INTENTION** OR **AESTHETICS**
- FOLLOW **CLEARLY DEFINED** INSTRUCTIONS AND LOGIC
- CAPABLE OF PRECISELY CARRYING OUT SEQUENCES OF SIMPLE OPERATIONS
- CAN SYNTHESIZE SOUNDS TO SPECIFICATION
- CAN BE NETWORKED

- INHERENT DESIRE TO **EXPRESS**
- CANNOT HELP BUT **INTEND**
- NATURALLY **SOCIAL**
- CAPABLE OF **REASON**
- CAPABLE OF AESTHETIC **JUDGMENT**
- REMARKABLY **ADAPTABLE** (WE ARE JACKS-OF-ALL-TRADES); SPECIALIZATION TAKES TRAINING

GOOD DESIGN EMBRACES EACH SIDE FOR WHAT IT IS. HERE, THE **MEDIUM** IS THE **MIXTURE** OF COMPUTERS AND HUMANS.

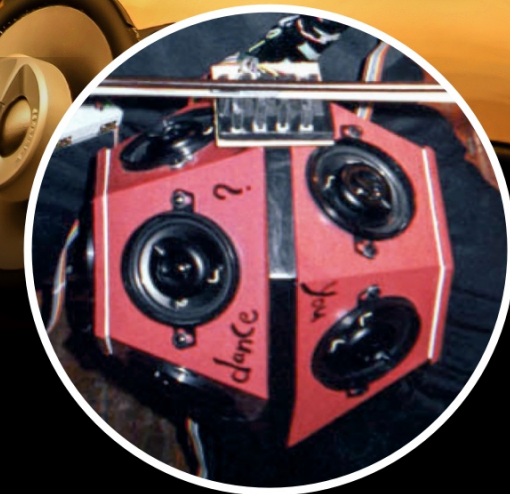
CENTRAL TO THE LAPTOP ORCHESTRA IS THE IDEA OF DESIGNING DIFFERENT TYPES OF MUSICAL INTERACTIONS THAT **BRIDGE** THE TRADITIONAL HUMAN-CENTRIC ASPECTS OF MUSIC-MAKING AND THE UNIQUE (AND LESS UNDERSTOOD) POSSIBILITIES OF TECHNOLOGY.



THE SOUND OF A VIOLIN DOES NOT NATURALLY COME OUT OF SPEAKERS AROUND YOU, BUT RATHER FROM THE **ARTIFACT ITSELF...**

OUR **SPEAKER ARRAYS** ARE DIRECT DESCENDANTS OF RESEARCH THAT PERRY AND DAN CONDUCTED IN THE 1990s. MUCH LIKE THE **BOSSA**, **HEMISPHERICAL SPEAKER ARRAYS** APPROXIMATE **OUTWARD-RADIATING** SOUND SOURCES, EMULATING THE WAY ACOUSTIC INSTRUMENTS RADIATE SOUND.

THEY PROVIDE A **SONIC PRESENCE** AND THE IMPRESSION OF A **PHYSICAL ARTIFACT** MAKING THE SOUND IN PROXIMITY TO YOU, IN STARK CONTRAST TO THE **DISEMBODIED** SOUND FROM SPEAKERS THAT SURROUND YOU.



INDEPENDENTLY ADDRESSABLE

MEANING WE CAN SEND **DIFFERENT** SOUND TO EACH SPEAKER, MAKING POSSIBLE TECHNIQUES FOR SPATIALIZATION AND EFFECTS

6 SPEAKERS

5 AROUND, 1 FACING UP

MULTIPLIED OUT TO AN ENSEMBLE OF SUCH SOUND SOURCES, THIS EMBODIED APPROACH CHANGES THE WAY WE DESIGN INTERFACES AND WRITE MUSIC

ENCLOSURE == IKEA SALAD BOWL (THAT'S RIGHT, SALAD BOWLS)



THESE THINGS WEREN'T EXACTLY **OFF-THE-SHELF**, SO WE HAD TO **DESIGN AND BUILD** THEM FROM SCRATCH. HERE IS HOW WE BUILT OURS FOR SLORK...

6-CHANNEL INPUT AND POWER





ADVENTURES IN BUILDING THE STANFORD LAPTOP ORCHESTRA!

IT BEGAN WITH A TRIP TO THE LOCAL IKEA TO PROCURE 25 WOODEN SALAD BOWLS...



STEP 1: GET SALAD BOWLS

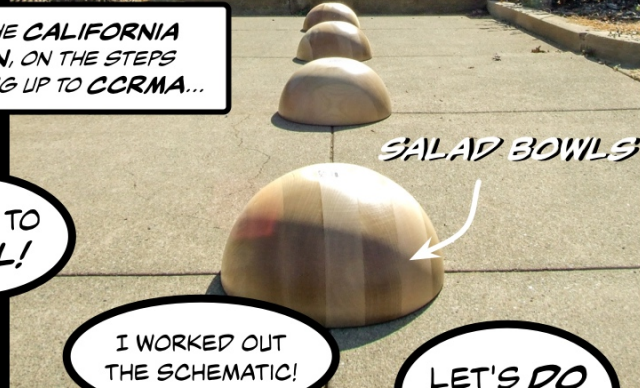


C.C.R.M.A.



IN THE CALIFORNIA SUN, ON THE STEPS LEADING UP TO CCRMA...

READY TO DRILL!



SALAD BOWLS

I WORKED OUT THE SCHEMATIC!

LET'S DO THIS!



REED

CHRIS

MARK

NICK

LAWRENCE

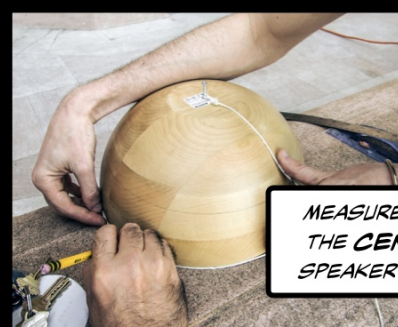
DIANA

DAVID

IT WAS SPRING BREAK 2008. WHILE MANY PARTIED ON BEACHES ELSEWHERE, A SMALL GROUP OF DEVOTED BUILDERS HAD DIFFERENT PLANS.



YEAHHH!!!



MEASURE AND MARK THE CENTERS OF SPEAKER LOCATIONS



ZZZZZNNHHNN

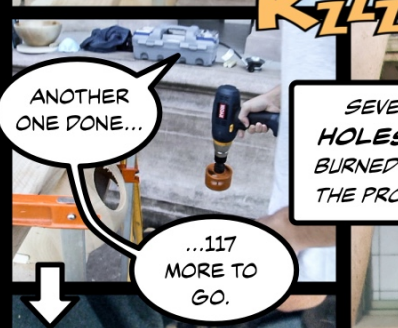
STEP 2: DRILL!



WITH 20 HEMIS AND 6 CHANNELS EACH, WE HAVE TO DO THIS 120 TIMES!



KZZZZNNNNHHZNN



ANOTHER ONE DONE...

...117 MORE TO GO.

SEVERAL HOLESAWS BURNED OUT IN THE PROCESS.



?

HMM, IT DOESN'T FIT. WHAT THE...



STEP 3: INSTALL SPEAKERS

AND UNFORESEEN ISSUES AROSE...



UHH, THE SPEAKER DRIVERS HAVE CORNERS *SLIGHTLY LARGER* THAN THE HOLES...

DRILLING, DRILLING, DRILLING.

OKAY NO PROBLEM! WE'LL JUST *GRIND* SOME GROOVES UNTIL THINGS FIT!



HMM THAT'S *LESS* THAN SPECTACULAR...

SEVERAL ROTARY GRINDERS MET THEIR *DEMISE* IN THE PROCESS...



LEADING TO SOME *MANUAL* FILING...

THE MEASURING, DRILLING, AND FILING WENT WELL INTO THE NIGHT...



STEP 4: MAKE THINGS FIT



THE NEXT DAY...

THEY FIT!

THE SALAD BOWLS' NEW GROOVES!

SOON THEREAFTER, WE HAD OUR SALAD BOWL SPEAKER ENCLOSURES.



LATE NIGHT, AT STANFORD'S PRODUCT REALIZATION LAB...

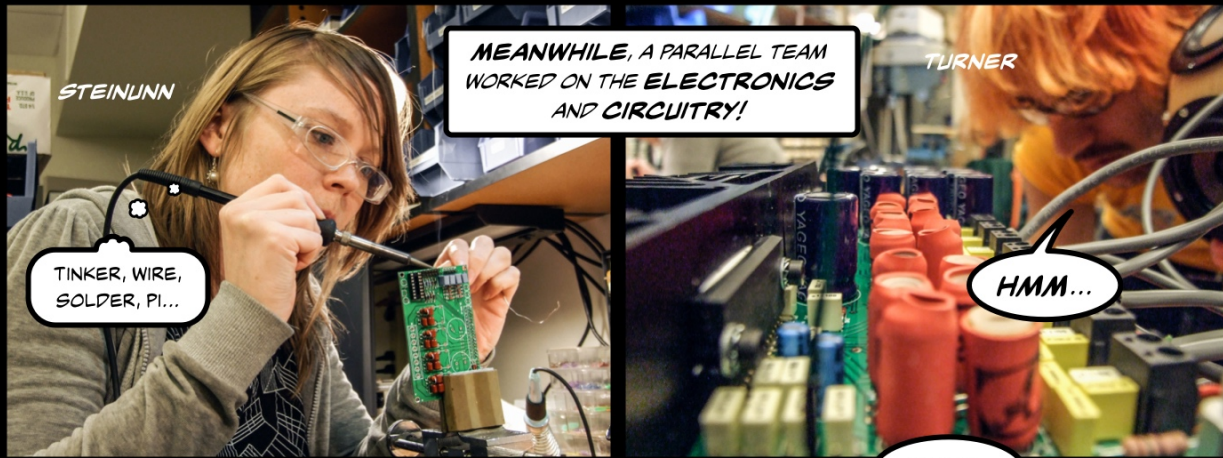
GOTTA MAKE 'EM LOOK *NICE* AND FEEL *SMOOTH*...



STEP 5: CUT AND ROUTE BASE PLATES

THE BASE PLATES ARE CUT FROM LARGE SHEETS OF POPLAR WE GOT FROM A HARDWARE STORE. THEY WERE ROUTED FOR A SMOOTH FINISH.

NO ONE IN THE AUDIENCE WILL EVER DISCERN THIS DETAIL, BUT IT WAS *IMPORTANT* TO US...



STEINUNN

MEANWHILE, A PARALLEL TEAM WORKED ON THE **ELECTRONICS AND CIRCUITRY!**

TURNER

TINKER, WIRE, SOLDER, PI...

HMM...



PROTOTYPES OF VARIOUS FORM FACTORS AND SIZES WERE BUILT!

NOPE...

BAEK

... HEAR ANYTHING?

LET'S CHECK THE WIRING AGAIN.



ADNAN

WHERE IS THAT OTHER AMP CIRCUIT?

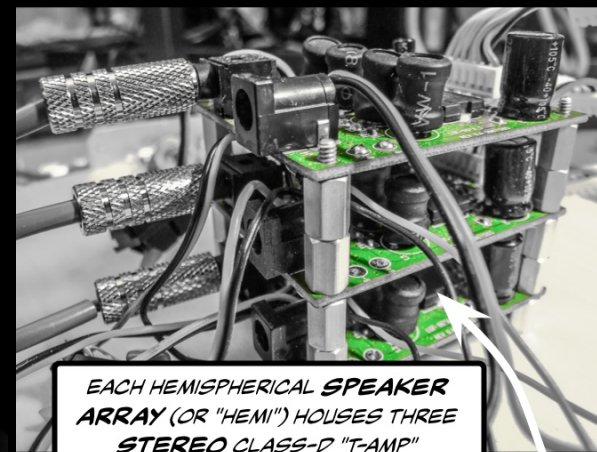
HAYDEN

MAYBE THIS SWITCH WILL FIT BETTER...

HOW COULD THIS NOT WORK?

STEP 6: ELECTRONICS

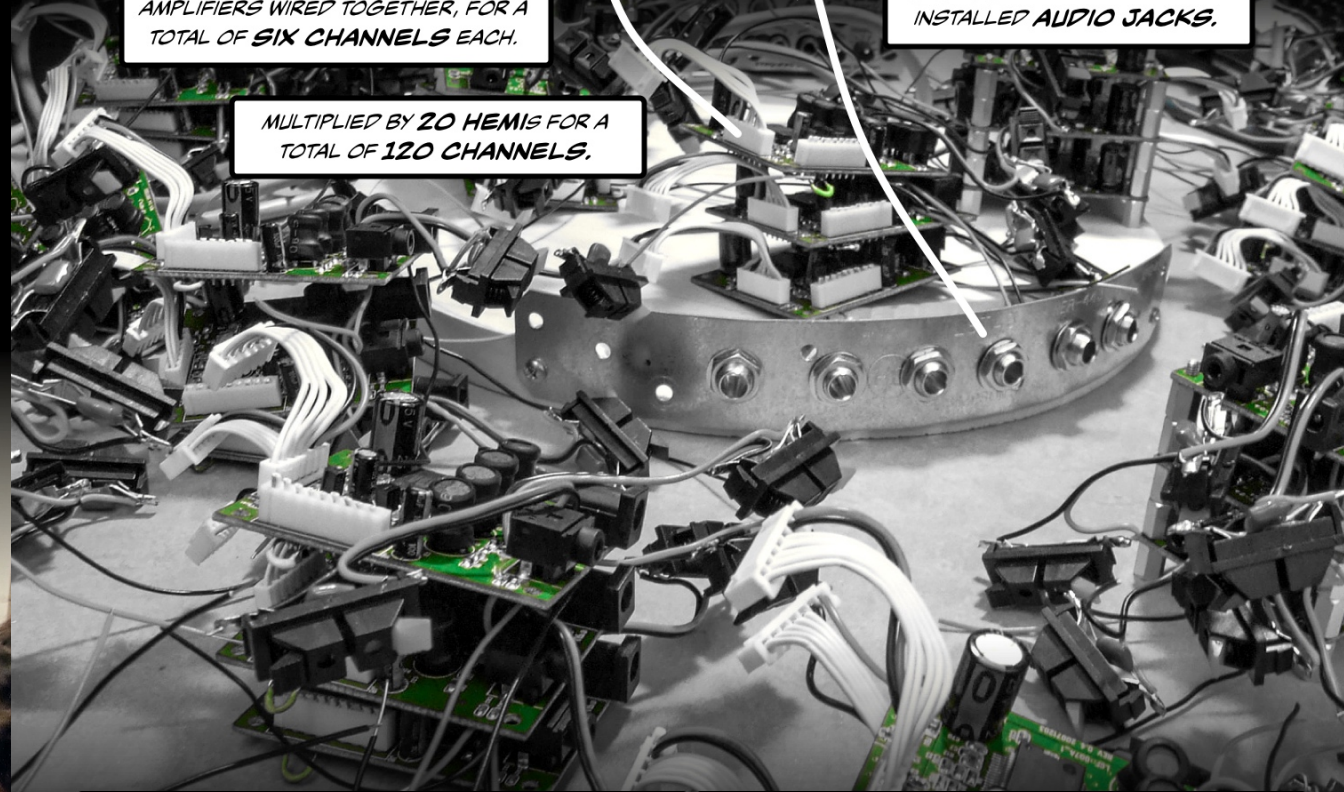
FOR THE NEXT TWO WEEKS, **CORMA'S MAX LAB** (NAMED AFTER MAX MATHEWS) TRANSFORMED INTO AN AROUND-THE-CLOCK VENUE FOR **SOLDERING, CIRCUIT BENDING, DRILLING, CUTTING, GLUING, EXPERIMENTING, ASSEMBLING** THE LAPTOP ORCHESTRA.



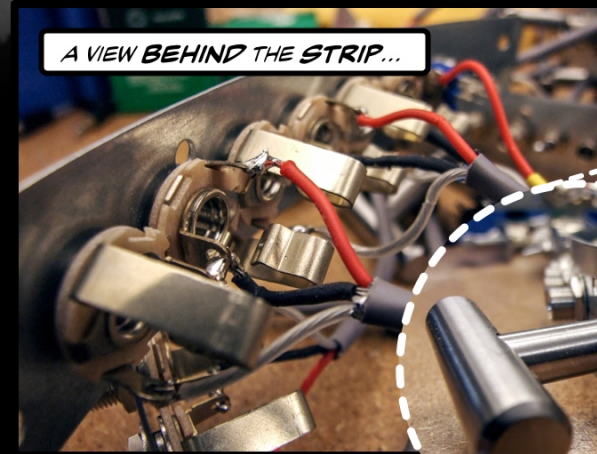
EACH **HEMISPHERICAL SPEAKER ARRAY** (OR "HEMI") HOUSES THREE **STEREO CLASS-D "T-AMP"** AMPLIFIERS WIRED TOGETHER, FOR A TOTAL OF **SIX CHANNELS** EACH.



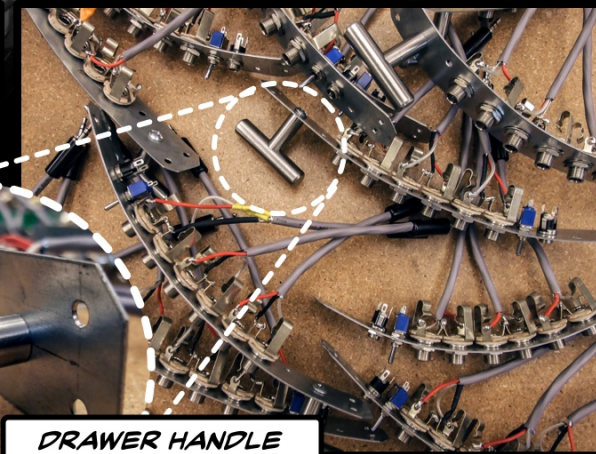
WE DRILLED HOLES IN **METAL STRIPS** THROUGH WHICH WE INSTALLED **AUDIO JACKS**.



MULTIPLIED BY **20 HEMIS** FOR A TOTAL OF **120 CHANNELS**.



A VIEW BEHIND THE STRIP...



DRAWER HANDLE FOR CARRYING THE HEMI



STEP 1: ASSEMBLE!

ENCLOSURES, SPEAKERS, AMPLIFIERS, WIRES, SWITCHES, JACK PANELS: ALL READY TO BE PUT TOGETHER!



UP AND DOWN, IN AND OUT OF THE BUILDING, CCRMA WAS BURSTING WITH ACTIVITY!



I'D LIKE TO ORDER SIX "KING KONG" PIZZAS!



I CAN'T BELIEVE THIS ENSEMBLE GOES LIVE IN TWO WEEKS!



GE! THIS PLACE IS HOPPIN'!

HEY JOHN!



SINA



4" CAR SPEAKER DRIVERS INSTALLED AND WIRED



CONNECT EVERYTHING UP, AND SEAL THE ENCLOSURE!

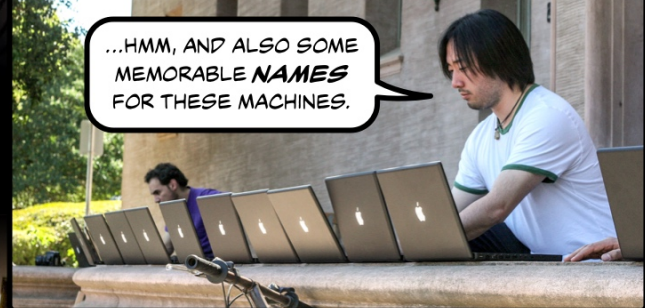
LUKE



STEP 3: INSTALL SOFTWARE!

OKAY, WE GOTTA GET THESE LAPTOPS CONFIGURED WITH SOFTWARE -- PROGRAMMING ENVIRONMENTS CHUCK (FOR AUDIO AND INTERACTION), PROCESSING (FOR GRAPHICS), AND C++ (FOR LOW-LEVEL SYSTEM DEV).

WE'LL NEED A REASONABLE WAY TO SYNCHRONIZE AND TRACK MUSICAL INSTRUMENTS (CODE, AUDIO, DATA, SCORES) ACROSS ALL MACHINES...



...HMM, AND ALSO SOME MEMORABLE NAMES FOR THESE MACHINES.

LATER THAT EVENING...



WE'VE JUST NAMED ALL THE MACHINES AFTER FOOD. GUESS WHOSE IDEA THAT WAS?

- ALBACORE
- BANHMI
- CHOWDER
- DONUT
- EMPANADA
- FOIEGRAS
- GELATO
- HAMBURGER
- ICETEA
- NACHOS
- JAMBALAYA
- KIMCHI
- LASAGNA
- MEATLOAF
- NACHOS
- OMELET
- PHO
- QUINOA
- RATATOUILLE
- SHABUSHABU
- TURDUCKEN
- UDON
- VERMICELLI
- WONTON
- XIAOLONGBAO
- YOGURT
- ZITI

**STEP 9:
TEST-DRIVE**

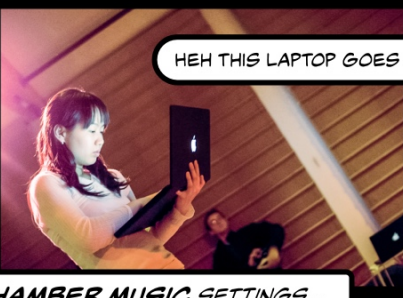
BEST WAY TO TEST A LAPTOP ORCHESTRA: MAKE MUSIC WITH IT!



FROM CONCERT HALLS...



TO AN OUTDOOR SCULPTURE GARDEN...



HEH THIS LAPTOP GOES TO ELEVEN.

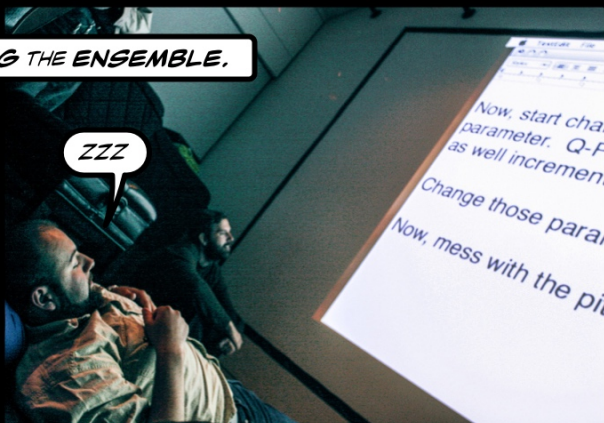
TO INTIMATE CHAMBER MUSIC SETTINGS...



...WHERE WE DEPLOY FEWER STATIONS...



...AND THE AUDIENCE SITS AMONG THE ENSEMBLE.



ZZZ

Now, start cha
parameter. Q-F
as well increm
Change those para
Now, mess with the pi

AND FROM CALIFORNIA TO BEIJING...



ALEX

ROMAIN

HANA

**你好!
NI HAO!**

...WITH A NEW GENERATION OF SLORKERS AT THE STANFORD CENTER AT PEKING UNIVERSITY!

SUMMER 2014



WE CREATED NEW WORKS INSPIRED BY THE SOUNDS, CULTURE, AND PEOPLE OF BEIJING...



AND PERFORMED IN THE MIST...



KITTY



BEIJING CAN BE GORGEOUS, ON DAYS WHEN THE SUPER SMOG LIFTS...



STEP 10: DESIGN NEW WORKS!

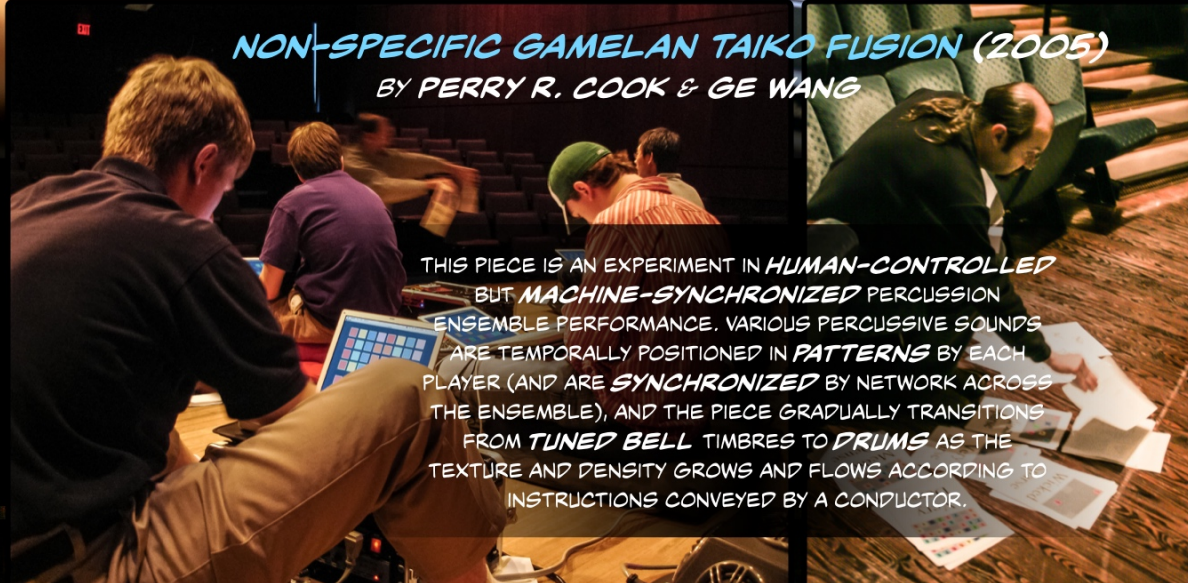
THE **INSTRUMENTS** IN THE LAPTOP ORCHESTRA ARE AS DIVERSE AS THE WORKS THEMSELVES. THEY ARE TRULY A **TESTAMENT** TO PERRY'S "MAKE A PIECE, NOT AN INSTRUMENT" PRINCIPLE. COMPUTERS AS A DESIGN MEDIUM SEEM TO UNIQUELY SUPPORT THIS MODEL OF **PIECES** IN SEARCH OF A **CUSTOM INSTRUMENT**, WHERE INTERFACES ARE DESIGNED SPECIFICALLY TO SUPPORT EACH PIECE.

INDEED, WE USUALLY DON'T DESIGN **GENERAL-PURPOSE** INSTRUMENTS AND **THEN** WRITE MUSIC FOR THEM, BUT RATHER WE START WITH AN **IDEA** FOR A PIECE, AND WE WORK **BACKWARDS** TO INVENT THE INSTRUMENT(S) SPECIFICALLY FOR THAT PIECE, OR WE **CO-DESIGN** THE PIECE WITH THE INSTRUMENT(S). IT'S A GOOD WAY TO DISCOVER WHAT FEATURES THE INTERFACE ACTUALLY NEEDS!



NON-SPECIFIC GAMELAN TAIKO FUSION (2005)

BY PERRY R. COOK & GE WANG



THIS PIECE IS AN EXPERIMENT IN **HUMAN-CONTROLLED** BUT **MACHINE-SYNCHRONIZED** PERCUSSION ENSEMBLE PERFORMANCE. VARIOUS PERCUSSIVE SOUNDS ARE TEMPORALLY POSITIONED IN **PATTERNS** BY EACH PLAYER (AND ARE **SYNCHRONIZED** BY NETWORK ACROSS THE ENSEMBLE), AND THE PIECE GRADUALLY TRANSITIONS FROM **TUNED BELL** TIMBRES TO **DRUMS** AS THE TEXTURE AND DENSITY GROWS AND FLOWS ACCORDING TO INSTRUCTIONS CONVEYED BY A CONDUCTOR.

EACH INSTRUMENT IS PART OF A **NETWORKED STEP SEQUENCER** THAT **PRECISELY SYNCHRONIZES** ALL THE MACHINES, LEAVING THE PLAYER TO CONSTRUCT AND EVOLVE THE **MUSICAL PATTERNS** ON A DISCRETE TEMPORAL GRID.

A **CONDUCTOR** SIGNALS THE **DENSITY** ("WICKED SPARSE" TO "VERY DENSE") AND **TIMBRE** (WHICH COLORS TO USE) IN THE **PATTERNS** EACH PLAYER IS CONSTRUCTING.

CONDUCTOR
HOLDS UP PIECES
OF THE SCORE

INKJET PRINTER

THE SCORE SHEETS ARE **PRINTED LIVE** ON-THE-FLY DURING THE PERFORMANCE, FURTHER UNDERSCORING THE **IMPROVISATIONAL** NATURE OF THE PIECE

ENSEMBLE
OCCASIONALLY ALSO INCLUDES
ACOUSTIC BELLS AND DRUMS

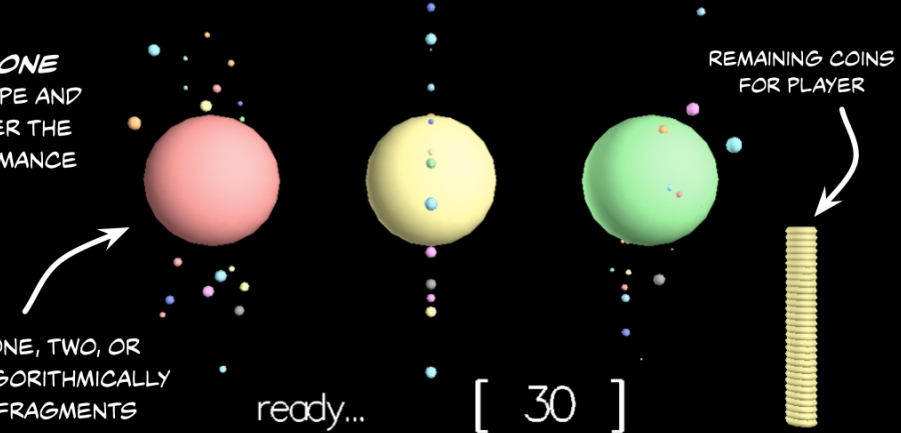
A TOTALLY DIFFERENT PIECE, AND INSTRUMENT

ON THE FLOOR (2005)

BY SCOTT SMALLWOOD

A **C-MAJOR CHORD DRONE** CARPETS THE SOUNDSCAPE AND RAMPS UP INTENSITY OVER THE COURSE OF THE PERFORMANCE

CHOICES OF WAGER: ONE, TWO, OR THREE, RESULTING IN ALGORITHMICALLY GENERATED MELODY FRAGMENTS



YOU WILL NOTICE WHEN YOU WALK INTO A CASINO THAT THE MACHINES ARE ALL TUNED TO THE **SAME KEY**: A C-MAJOR CHORD. THIS CHORD FLOATS AROUND THE SPACE, IN AND OUT OF EVERY CREVICE, CONSTANTLY ARPEGGIATING, HUMMING, DRONING, TWITTERING, ECHOING, SOMETIMES INCORPORATING SNIPPETS OF MELODY. THIS HAPPY DRONE **SOOTHES** THE NERVOUS CUSTOMERS AS THEY SLOWLY DROP THEIR MONEY INTO THE MACHINES. THEY CREATE A SEA OF C-MAJOR, EACH AND EVERY ONE OF THEM, PRESSING BUTTONS ON THE MACHINES, CREDIT AFTER CREDIT, ALL DAY AND ALL NIGHT.



AS PART OF THE THEATRIC GESTURE OF THIS PERFORMANCE, PLAYERS CONTINUE PLAYING UNTIL THEY **LOSE ALL THEIR CREDITS**, AT WHICH POINT THEY PHYSICALLY GET UP AND **SLOWLY WALK OFF THE STAGE...**

I AM
VIRTUALLY
BROKE!

THE PIECE ENDS WHEN **EVERYONE** LOSES THEIR VIRTUAL MONEY!

THE **CONDUCTOR** (A.K.A. "THE HOUSE") **SURVEILS** ALL THE PLAYERS FROM A CENTRAL MACHINE AND CAN REMOTELY **CHANGE THE ODDS** OVER THE COURSE OF THE PERFORMANCE (WHICH ALSO HELPS TO ENSURE THE PIECE **ENDS ON TIME!**)



DRONE (2005)
BY DAN TRUEMAN

TRACKPAD
(CONTROLS TIMBRE)

TILT: SIDE TO SIDE
(CONTROLS TUNING)

NUMBER KEYS
(CONTROLS BASE PITCH)

TILT: FRONT TO BACK
(CONTROLS INTENSITY)

SOME WORKS EMPLOY MORE PHYSICAL GESTURES THAN OTHERS...

USING **ACCELEROMETERS** (SUDDEN MOTION SENSORS INTENDED TO PROTECT MECHANICAL HARD DRIVES IN THE EVENT OF, WELL, SUDDEN MOTION) BUILT INTO THE LAPTOPS, THE PLAYERS INTRODUCE SUBTLE ADJUSTMENTS TO RICH (IF SIMPLE) ADDITIVE SYNTHESIS ALGORITHMS IN AN EFFORT TO CREATE RISSET-ARPEGGIO-LIKE PATTERNS. A RICH, PENETRATING DRONE ARISES WITH INTRICATELY SHIFTING **TIMBRES** AND **HARMONICS** CREATED BY THE SLIGHT CONTROLLED **DETUNING** BETWEEN ALL THE MACHINES.



THE CONDUCTOR SHAPES THE TRAJECTORY OF THE PERFORMANCE

CONDUCTING SIGNAL

RESULTING PLAYER ACTIONS

- SIGNAL NUMBER (1-8) → CHOOSE **BASE PITCH** OF DRONE
- POINT DIRECTIONALLY → MOVE MOUSE CURSOR TO CHANGE TIMBRE
- OPEN ARM FORWARD/BACK → TILT LAPTOP FORWARD/BACKWARD TO CONTROL INTENSITY
- "CRADLE"; ROCK LEFT/RIGHT → TILT LAPTOP LEFT/RIGHT; **LISTEN**; MAKE INTERESTING BEATING PATTERNS
- "SPRINKLE" → RANDOMIZE ONE OR MORE PARAMETERS; CONTINUE UNTIL NEXT GESTURE
- "MIMIC" → ONCE THIS MODE IS SIGNALLED, EACH PLAYER PLAYS WHEN CUED, **MIMICKING** AND **EMBELLISHING** ON GESTURE OF PREVIOUS PLAYER



SECTION A

WE CONVEY NUMBERS USING HAND GESTURES!

FULL ENSEMBLE; EXPLORE VARIOUS TIMBRES; SHOULD SOUND **FULL** TO ALMOST (BUT NOT) OVERPOWERING; EVENTUALLY INCLUDE ALL CONDUCTING CUES EXCEPT FOR "MIMIC"; RANDOMIZATION SHOULD HAPPEN AT LEAST ONCE AND AT MOST TWICE; INCLUDE THREE TO SIX TOTAL CHANGES TO FUNDAMENTAL PITCH.

SECTION B

"MIMIC" ONLY; ONE PLAYER AT A TIME, AS CUED BY CONDUCTOR.

SECTION C (OR A')

RETURN TO SECTION A, AND (1) RIFF ON A YET-UNEXPLORED FUNDAMENTAL PITCH; (2) THE **LOUDEST** POINT IN THE PIECE OCCURS IN THIS SECTION; (3) COMMIT TO A PARTICULAR TIMBRE AND FUNDAMENTAL AND FADE OUT ON IT.

OVER 300 PIECES HAVE BEEN CREATED BETWEEN PLORK AND SLORK SINCE INCEPTION OF THE MEDIUM.



BUT OF COURSE.

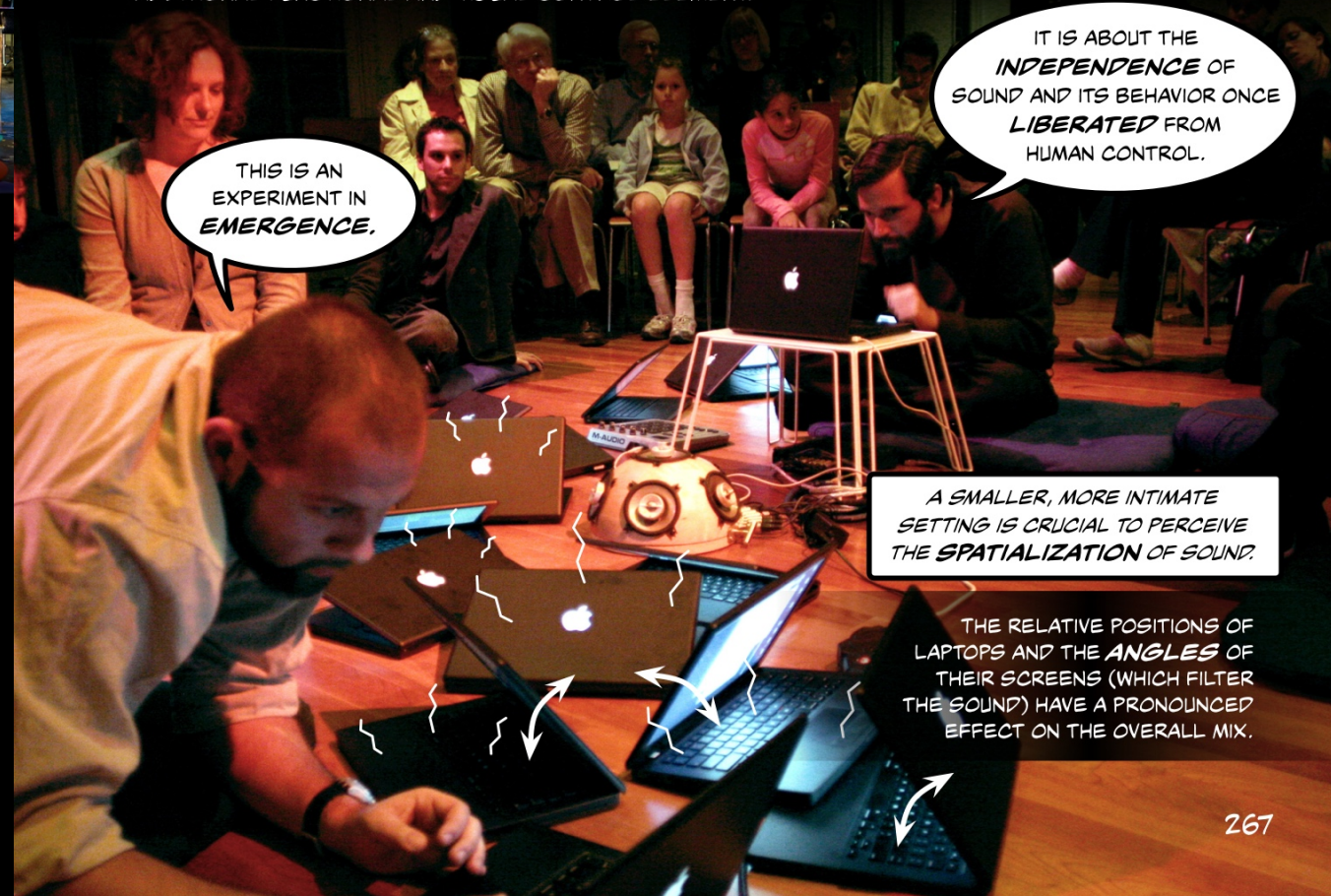
UM, CAN YOU PLEASE PASS THE LAPTOP?

20 (2008)

BY APNAN MARQUEZ-BORBON AND KYLE SPRATT

IN THIS WORK FOR **20 "UNPLUGGED"** LAPTOPS (AND ONLY 2 HUMAN PERFORMERS), EACH LAPTOP IS EQUIPPED WITH A PROGRAM THAT CAPTURES THE INCOMING SOUND FROM THE MICROPHONE AND PLAYS IT OUT ON THE ONBOARD LAPTOP SPEAKERS. THE LAPTOPS ARE INTRODUCED, ONE-BY-ONE, INTO A PHYSICAL CONFIGURATION OF CONTINUOUS **MUTUAL AUDIO FEEDBACK**. THE PHYSICAL LAPTOP **SCREENS** ARE USED AS A CRUDE **LOW-PASS FILTER** FOR THE SOUND, ADDING AN ADDITIONAL FUNCTIONAL AND VISUAL CONTROL ELEMENT.

MANY WORKS WERE COMPOSED FOR THE FULL ENSEMBLE. OTHERS -- LIKE THIS ONE -- WERE DESIGNED FOR A SMALLER, CHAMBER-SIZED SETTING...



THIS IS AN EXPERIMENT IN EMERGENCE.

IT IS ABOUT THE INDEPENDENCE OF SOUND AND ITS BEHAVIOR ONCE LIBERATED FROM HUMAN CONTROL.

A SMALLER, MORE INTIMATE SETTING IS CRUCIAL TO PERCEIVE THE **SPATIALIZATION** OF SOUND.

THE RELATIVE POSITIONS OF LAPTOPS AND THE **ANGLES** OF THEIR SCREENS (WHICH FILTER THE SOUND) HAVE A PRONOUNCED EFFECT ON THE OVERALL MIX.

IN ADDITION TO BEING AN ENSEMBLE AND DESIGN LAB FOR NEW INSTRUMENTS...



...THE LAPTOP ORCHESTRA IS ALSO A **CLASSROOM** THAT EXPLORES MUSIC, PROGRAMMING, INTERACTION DESIGN, COMPOSITION, AND LIVE PERFORMANCE AS PART OF A SINGLE CONTINUUM.

A LOT OF WORK HAPPENS LEADING UP TO AND ON PERFORMANCE DAY...



TO TRANSPORT SPEAKERS, COMPUTERS, MATS, PILLOWS...

...AUDIO INTERFACES, WIRES, POWER ADAPTERS, POWER CONDITIONERS, TRAYS, CONTROLLERS, SUBWOOFERS... ARE WE FORGETTING ANYTHING?



JIELIN



CHARLES

STUDENTS COME FROM MUSIC, COMPUTER SCIENCE, ARCHITECTURE, BIOLOGY, ECONOMICS... BUT AS PART OF OUR **TEACHING PHILOSOPHY**, WE DO NOT EXPLICITLY DIVIDE UP STUDENTS ACCORDING TO RESPECTIVE BACKGROUND (E.G., COMPUTER SCIENCE, MUSIC, DESIGN, ETC.); INSTEAD WE EXPECT EVERYONE TO NEGOTIATE THE **FULL CREATIVE PIPELINE**, EMPHASIZING THE **CO-DESIGN** OF ELEMENTS.

MAYBE THIS **COWBELL?**

SETTING UP THE ENSEMBLE TAKES A FEW HOURS.



ANYONE SEEN THE **ROUTER?**



JIANFENG



AUDREY

SOFTWARE CONFIGURATIONS

SOUNDCHECK...



SOME "JUST-IN-TIME" CODING...

ROGER.

REHEARSAL..



ADNAN

MICHAEL

LIVE PERFORMANCE SERVES AS AN END GOAL, A **FORCING FUNCTION** TO BUILD SOMETHING THAT **WORKS** AND IS **AESTHETICALLY COMPLETE**.

HMM...

LET'S UP THE REVERB MIX TO **.08** FOR THIS SPACE?

AND **DEBUGGING** -- BOTH MUSICAL AND TECHNOLOGICAL

SHOWTIME!

TWILIGHT (2013)

BY GE WANG



INSPIRED BY THE CLASSIC SCIENCE FICTION SHORT STORY "TWILIGHT" BY JOHN W. CAMPBELL (PUBLISHED IN 1934, UNDER THE PSEUDONYM "DON A. STUART"), THIS PIECE RUMINATES NOT ON THE DAWN, ASCENSION, NOR TRIUMPH OF THE HUMAN RACE, BUT ON OUR POSSIBLE *DEMISE*, SET *SEVEN MILLION YEARS* IN THE FUTURE. THIS END IS NOT ONE OF ANNIHILATION THROUGH WAR, NOR DECIMATION FROM FAMINE OR DISEASE, BUT A GOLDEN *DECRESCENDO* OF DEFEAT BROUGHT ON BY THE GRADUAL, PEACEFUL, BUT UNSTOPPABLE USURPING OF *TECHNOLOGY* AND *MACHINES* -- AND THE LOSS OF HUMANKIND'S *CURIOSITY* AND SENSE OF WONDER. FROM THE ORIGINAL TEXT:

"TWILIGHT--THE SUN HAS SET. THE DESERT OUT BEYOND, IN ITS MYSTIC, CHANGING COLORS. THE GREAT, METAL CITY RISING STRAIGHT-WALLED TO THE HUMAN CITY ABOVE, BROKEN BY SPIRES AND TOWERS AND GREAT TREES WITH SCENTED BLOSSOMS. THE SILVERY-ROSE GLOW IN THE PARADISE OF GARDENS ABOVE."

MOVEMENT ONE THE DEAD CITY

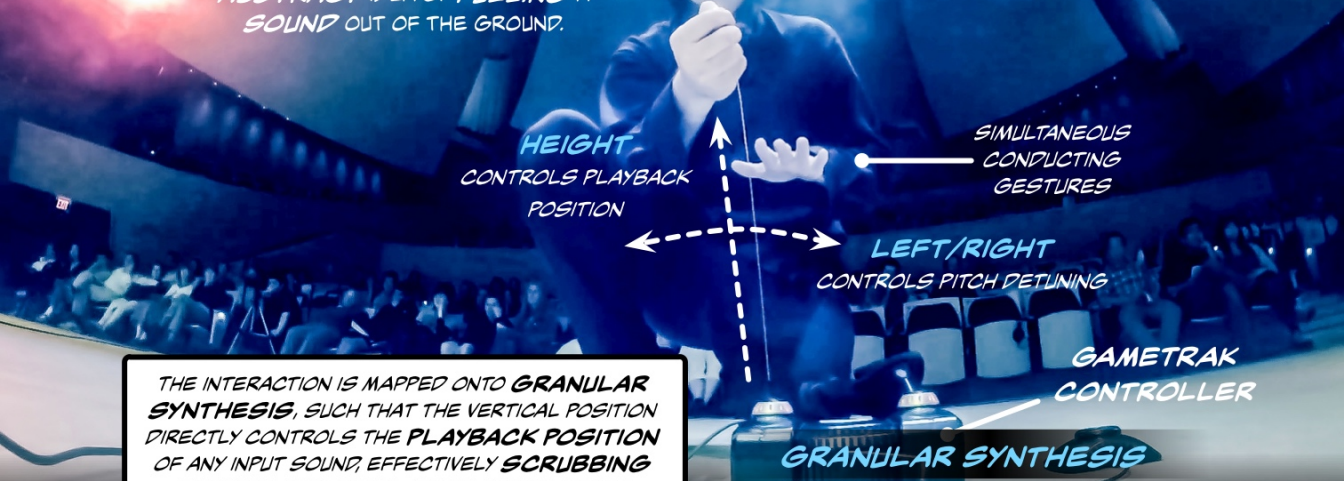
"AND ALL THE GREAT CITY-STRUCTURE THROBBING AND HUMMING TO THE STEADY GENTLE BEAT OF PERFECT, DEATHLESS MACHINES BUILT MORE THAN THREE MILLION YEARS BEFORE -- AND NEVER TOUCHED SINCE THAT TIME BY HUMAN HANDS. AND THEY GO ON. THE DEAD CITY. THE MEN THAT HAVE LIVED, AND HOPED, AND BUILT -- AND DIED TO LEAVE BEHIND THEM THOSE LITTLE MEN WHO CAN ONLY WONDER AND LOOK AND LONG FOR A FORGOTTEN KIND OF COMPANIONSHIP. THEY WANDER THROUGH THE VAST CITIES THEIR ANCESTORS BUILT, KNOWING LESS OF THEM THAN THE MACHINES THEMSELVES."



THE DESIGN BRINGS TOGETHER A CLASSIC SCIENCE FICTION NARRATIVE, A **PHYSICAL METAPHOR** (PULLING A SOUND OUT OF THE GROUND), AND A **SYNTHESIS ALGORITHM** (GRANULAR SYNTHESIS).

"THE METAPHOR"

THE PRIMARY INTERACTION IN MOVEMENT ONE IS BASED ON THE ABSTRACT IDEA OF **PULLING A SOUND** OUT OF THE GROUND.



HEIGHT
CONTROLS PLAYBACK
POSITION

SIMULTANEOUS
CONDUCTING
GESTURES

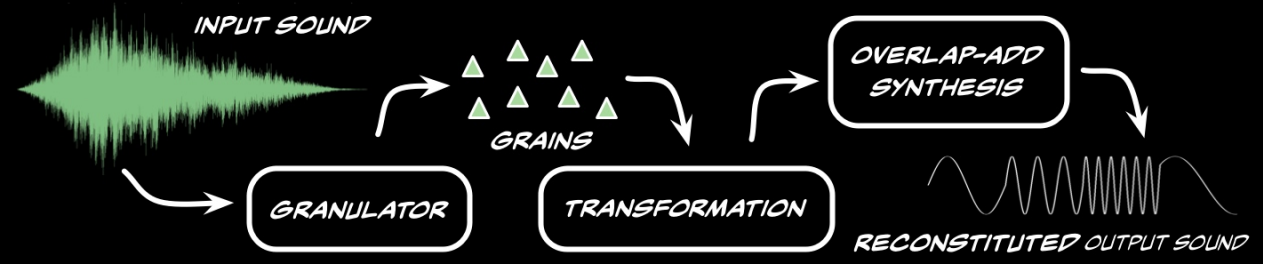
LEFT/RIGHT
CONTROLS PITCH DETUNING

GAMETRAK
CONTROLLER

THE INTERACTION IS MAPPED ONTO **GRANULAR SYNTHESIS**, SUCH THAT THE VERTICAL POSITION DIRECTLY CONTROLS THE **PLAYBACK POSITION** OF ANY INPUT SOUND, EFFECTIVELY **SCRUBBING** THROUGH THE SOUND. IF THE MOTION STOPS HALFWAY, THE SOUND WILL **CONTINUE**, BUT IT IS **FROZEN** AT THE CURRENT PLAYBACK POSITION. **GRANULAR SYNTHESIS** MAKES THIS EFFECT SEEM **SMOOTH** AND **TIMELESS**.

GRANULAR SYNTHESIS

CHOPS UP AN INPUT SOUND INTO TINY (10-100::MS) WINDOWED PARTICLES (CALLED **GRAINS**), **TRANSFORMS** THEM (IN PITCH, DENSITY) AND **RECONSTITUTES** THEM INTO **IMPRESSIONISTIC SOUND CLOUDS**



THE RESULTING EFFECT IS A SENSE OF SOUND BECOMING **UNSTUCK** IN TIME, ALLOWING US TO "SCRUB" THROUGH IT WITH OUR **GESTURE**.

THE **INPUT SOUNDS** FED INTO THE **GRANULATOR** VARY FROM A METAL CHAIR BEING **DRAGGED** ACROSS A CONCRETE FLOOR IN A PARKING GARAGE, TO A METALLIC **RINGING** SOUND, TO A MAJOR-CHORD **DRONE**...



IT CREATES THE HAUNTING SOUND OF THE **DEAD CITY**, A SONIC MAELSTROM OF HUMMING, SCREECHING, AND DRONING MACHINERY, LONG LIBERATED FROM HUMAN DESIGN AND MAINTENANCE.

THE ENSEMBLE MIRRORS THE CONDUCTOR'S MOTION, MOVING IN UNITY, GIVING VOICE TO A CITY OF MACHINES.

DAY TURNS TO DUSK. THE ENSEMBLE -- WHO EARLIER ASSUMED THE ROLES OF MACHINES AND THE CITY SPIRES -- NOW REPRESENT HUMANITY, LYING DOWN TO SLEEP, PHYSICALLY, METAPHORICALLY...



TO DREAM...

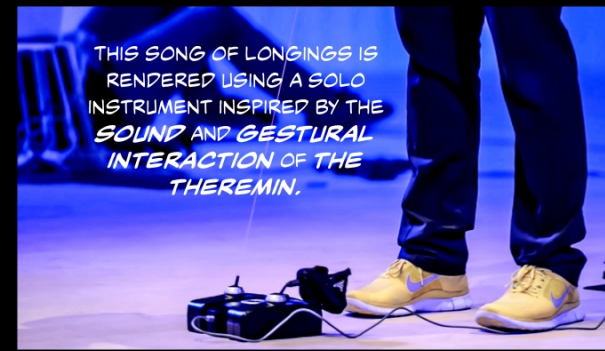
...A SONG OF LONGINGS.



MOVEMENT TWO

A SONG OF LONGINGS

"AND THE SONGS. THOSE TELL THE STORY BEST, I THINK. LITTLE, HOPELESS, WONDERING MEN AMID VAST UNKNOWING, BLIND MACHINES THAT STARTED THREE MILLION YEARS BEFORE-- AND JUST NEVER KNEW HOW TO STOP. THEY ARE DEAD-- AND CAN'T DIE AND BE STILL."



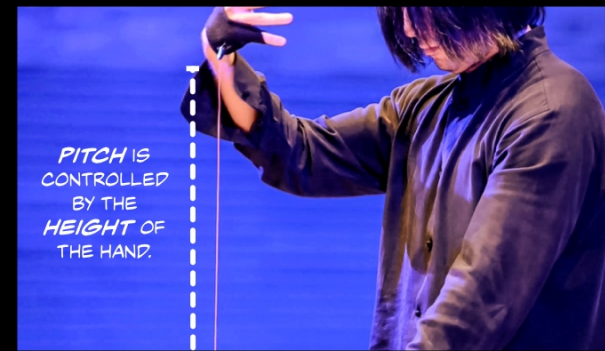
THIS SONG OF LONGINGS IS RENDERED USING A SOLO INSTRUMENT INSPIRED BY THE SOUND AND GESTURAL INTERACTION OF THE THEREMIN.



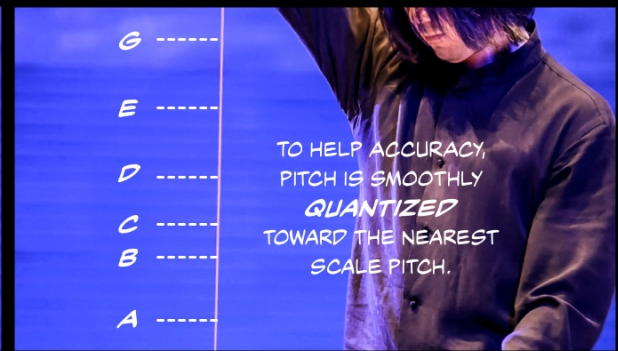
PUSHING FORWARD SOUNDS THE PITCH, AND GRADUALLY ADDS VIBRATO.



PULLING BACK SILENCES THE INSTRUMENT.

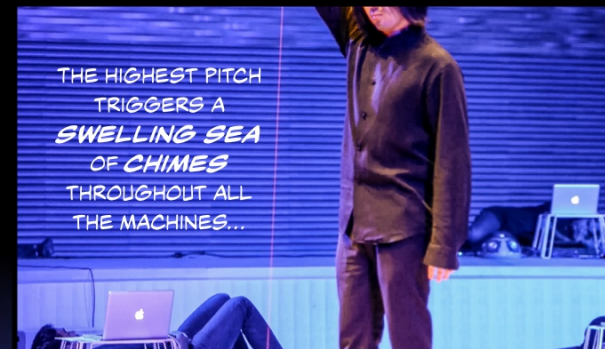


PITCH IS CONTROLLED BY THE HEIGHT OF THE HAND.



G
E
D
C
B
A

TO HELP ACCURACY, PITCH IS SMOOTHLY QUANTIZED TOWARD THE NEAREST SCALE PITCH.



THE HIGHEST PITCH TRIGGERS A SWELLING SEA OF CHIMES THROUGHOUT ALL THE MACHINES...



THE SIMPLE MELODY RISES AND FALLS WITH EACH GESTURE...

WHILE A LOW DRONE THROBS ACROSS ALL THE MACHINES, SOMBERLY ACCOMPANYING THE SONG...





THE FINAL BOW OF HUMANKIND IS A QUIET EXIT FROM THE STAGE.

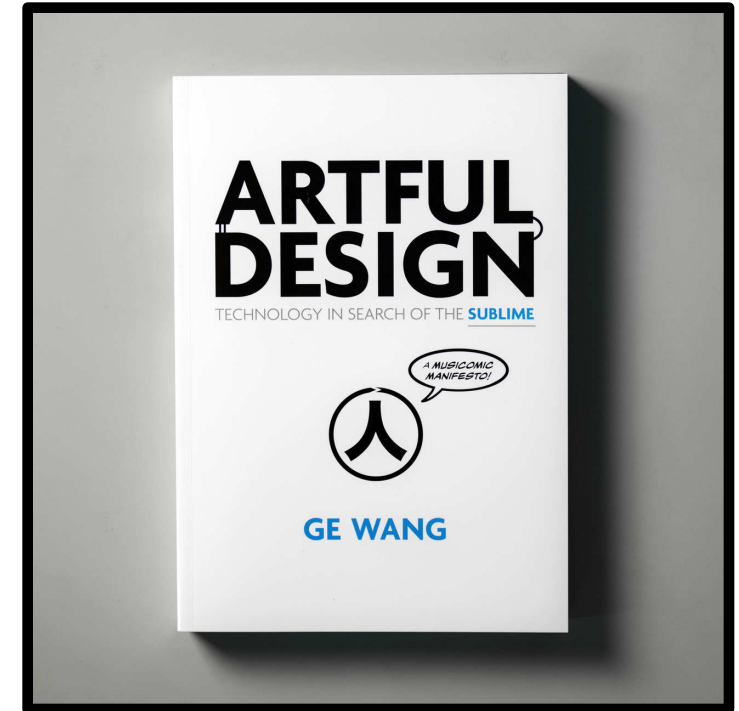
AS THE MACHINES DRONE ON...



...BECAUSE NO ONE TOLD THEM HOW TO STOP.

THERE IS SOMBER BEAUTY EVEN IN *DESTRUCTION* AND *DESOLATION*. "TWILIGHT" IS AN IMAGINING OF HUMANKIND'S SUNSET, MAKING US EXAMINE OUR PRESENT TIMES.

THIS WAS A PERFORMANCE DESIGNED TO EXPRESS THE PSYCHOLOGY, LONGING, AND SADNESS OF A *TWILIGHT* OF HUMANITY ENDING NOT IN A BANG, BUT AN IRREVERSIBLE *POWERDOWN*, BASKED IN THE GOLDEN, LINGERING, DYING GLOW OF OUR DUSK. TOLD, FITTINGLY PERHAPS, THROUGH THE *TECHNOLOGICAL MEDIUMS* OF OUR PRESENT.



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