

# DIGITAL SYNESTHESIA



USING MOBILE TECHNOLOGY TO INTERACT WITH OUR WORLD

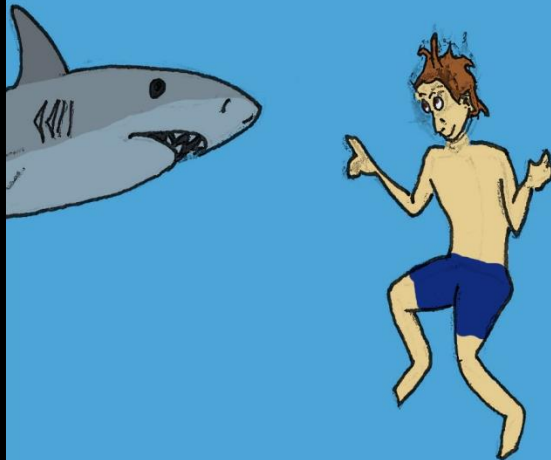
PHD PROPOSAL BY:  
SANTIAGO ALFARO

COMMITTEE:  
V. MICHAEL BOVE JR.  
JOSEPH PARADISO  
KEVIN SLAVIN

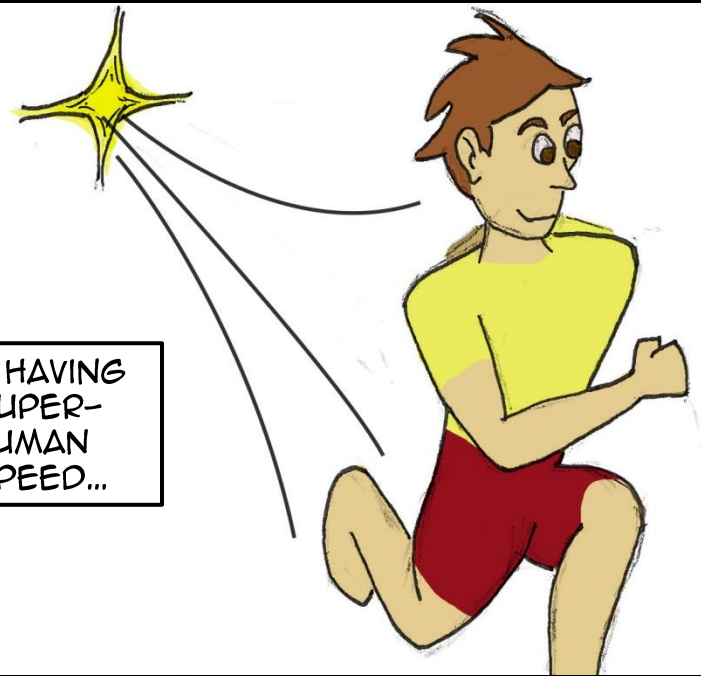
HUMANS HAVE  
DREAMT OF  
GOING PAST  
OUR PHYSICAL  
CAPABILITIES  
LIKE...



... BREATHING UNDER  
WATER...



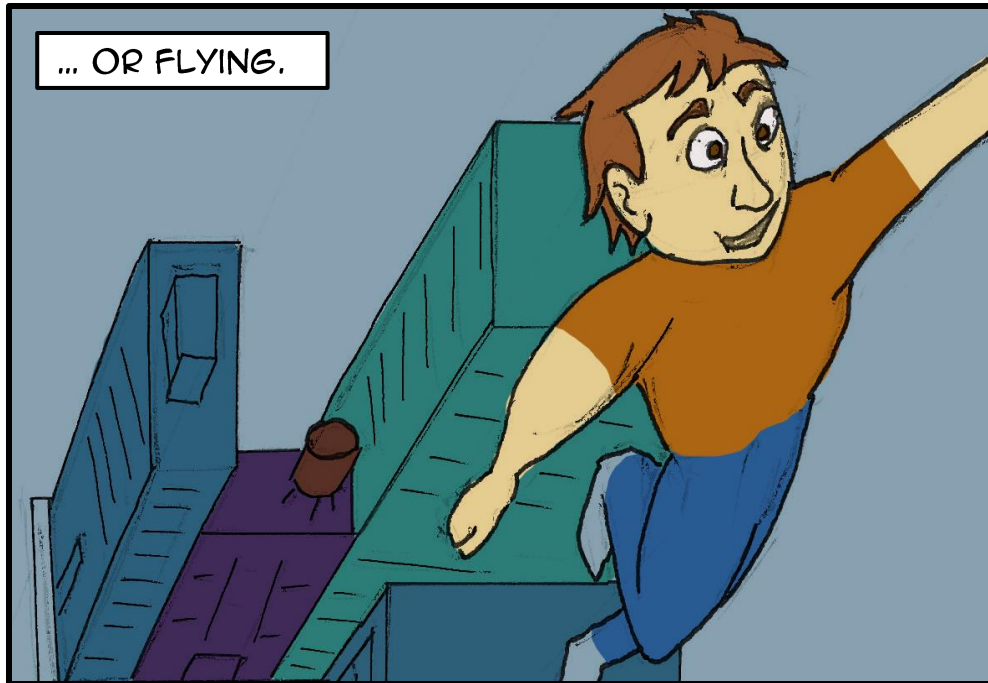
... HAVING  
SUPER-  
HUMAN  
SPEED...



... GOING TO SPACE...



... OR FLYING.





OTHER DREAMS  
ARE ABOUT  
OUR SENSES...

... SIGHT...



SOME ARE  
ABOUT SENSES  
WE DON'T  
POSSESS



... SPIDEY SENSE...



... HEARING...



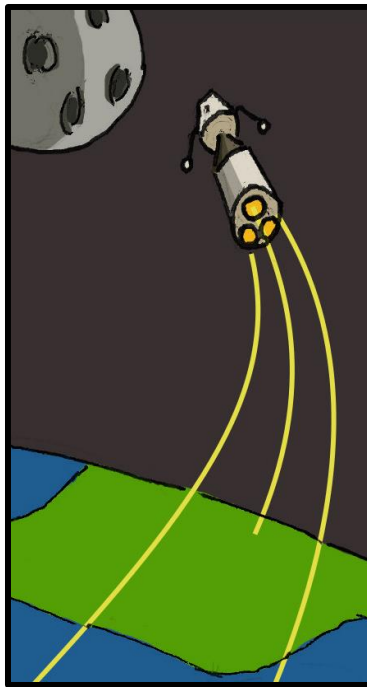
... A DISTURBANCE  
IN THE FORCE.



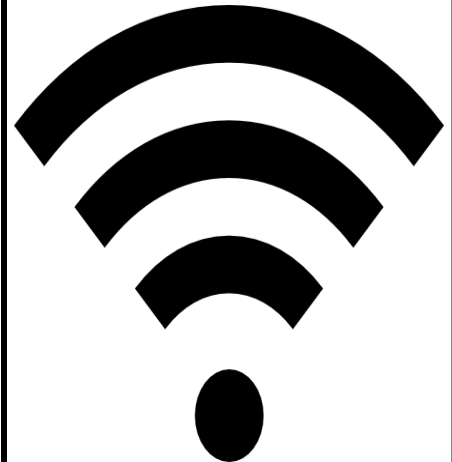
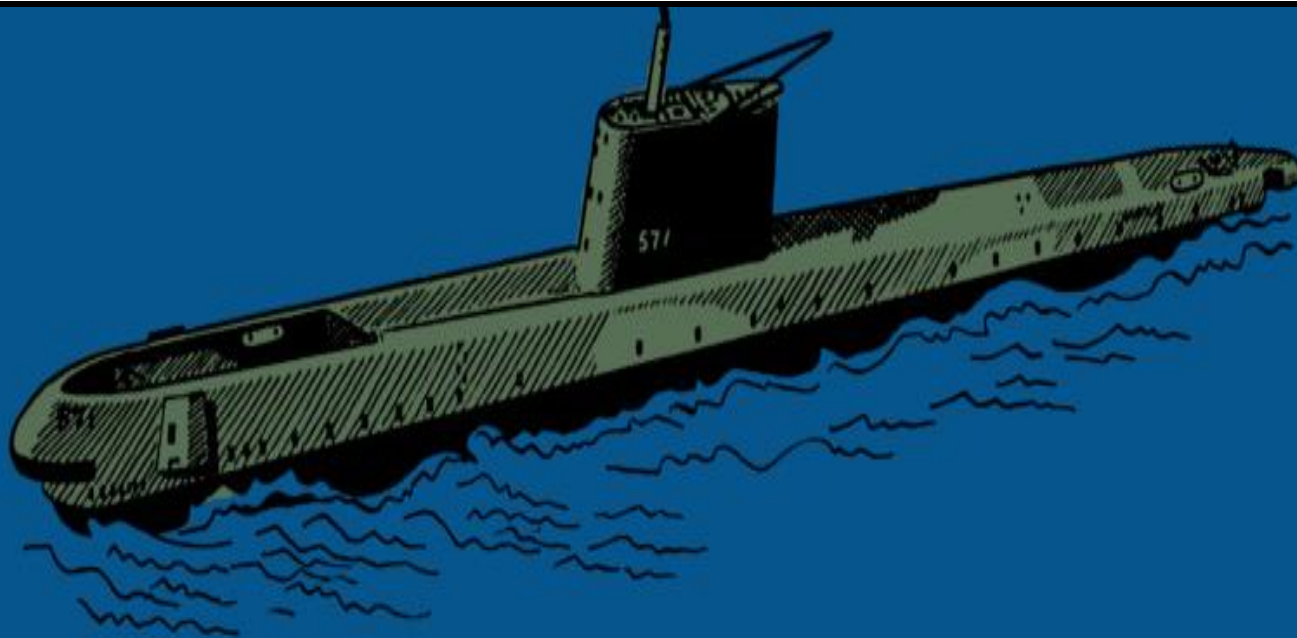
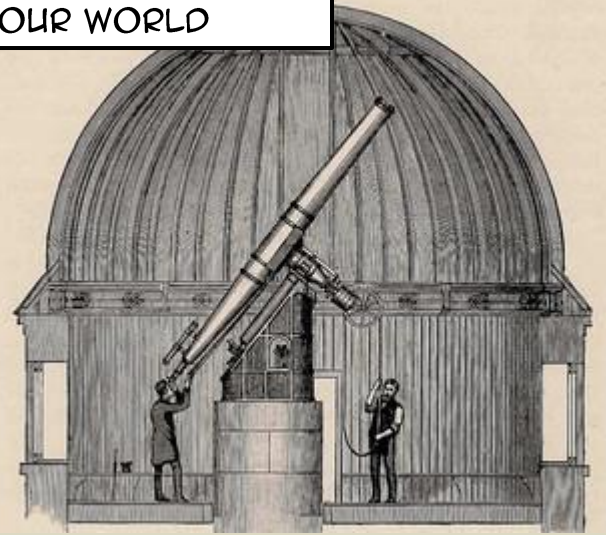
WE HAVE  
REACHED SOME  
DREAMS



WITH TECHNOLOGY

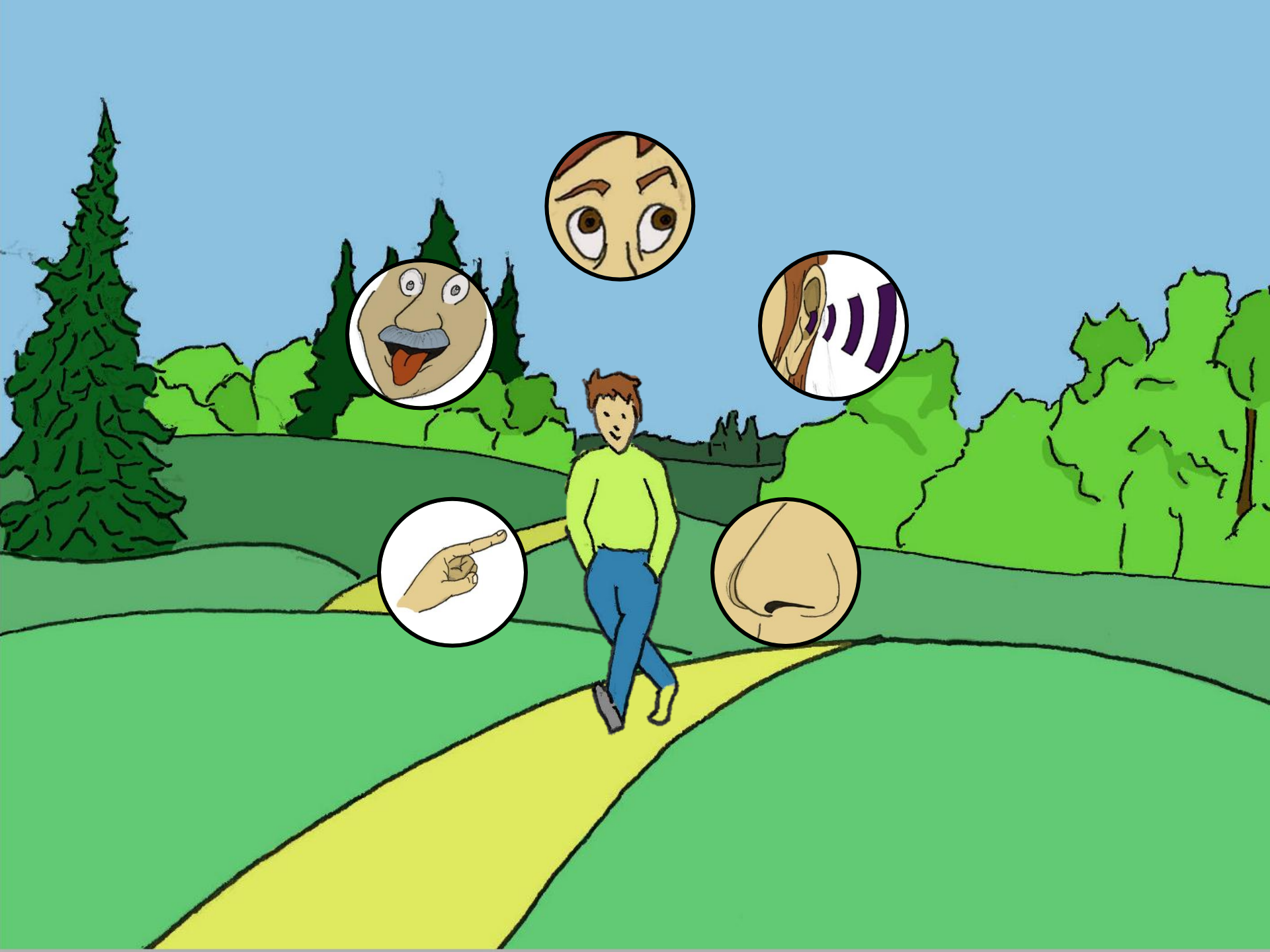


AND BY  
UNDERSTANDING  
OUR WORLD

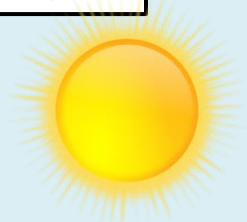








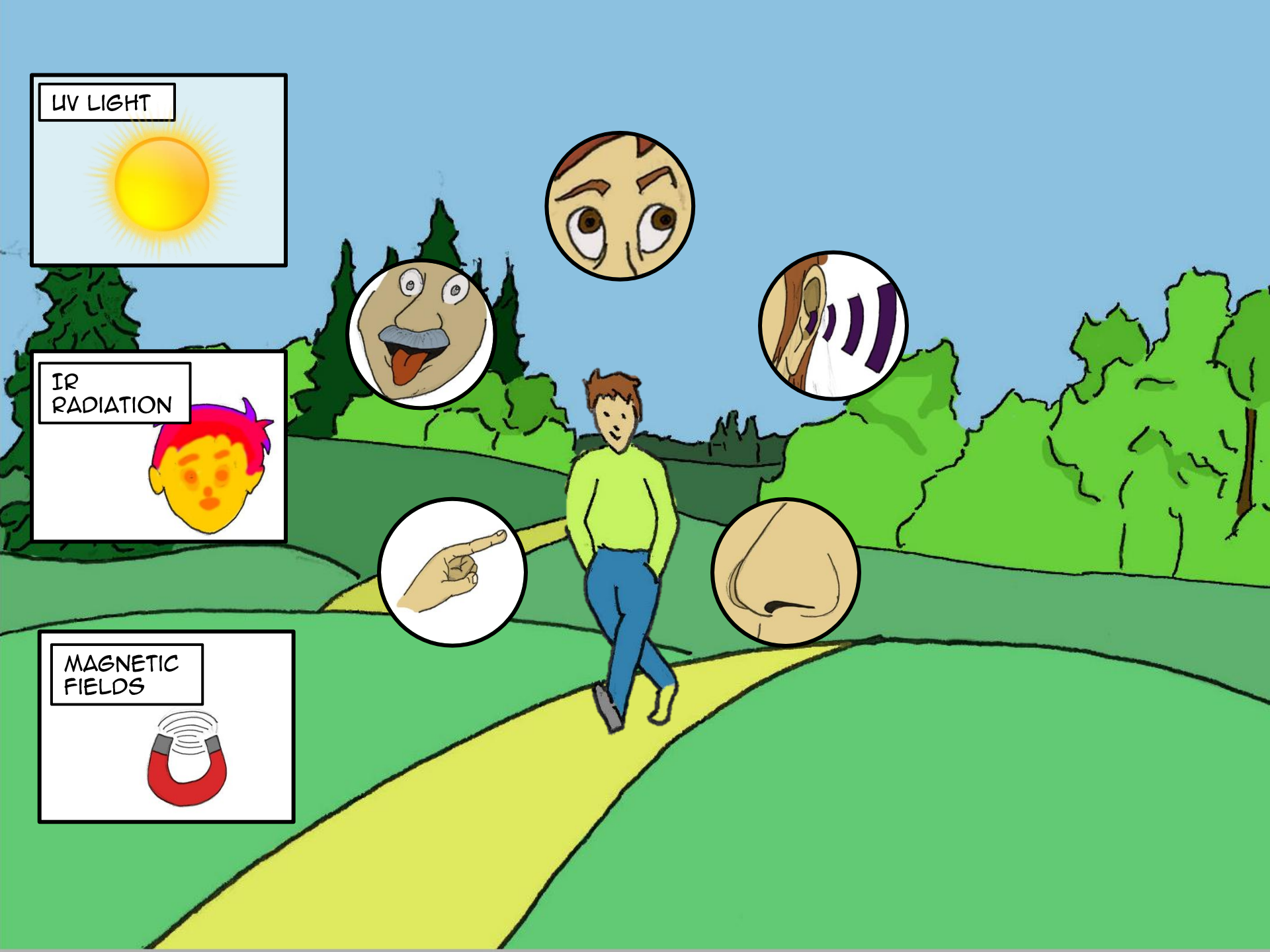
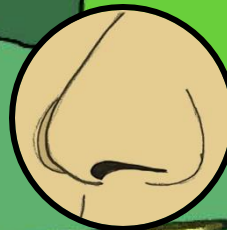
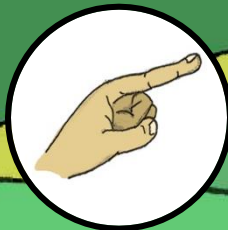
UV LIGHT



IR RADIATION

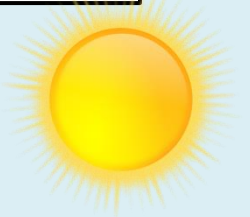


MAGNETIC FIELDS





UV LIGHT



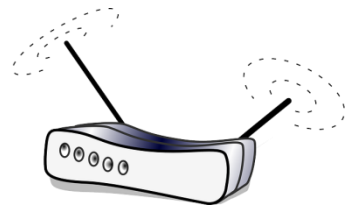
IR RADIATION



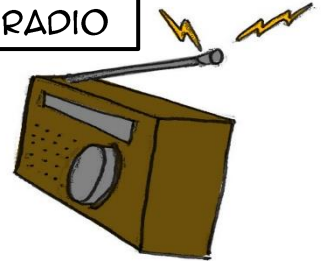
MAGNETIC FIELDS



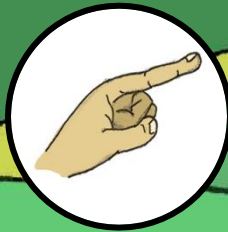
WIFI



RADIO



POLLUTION





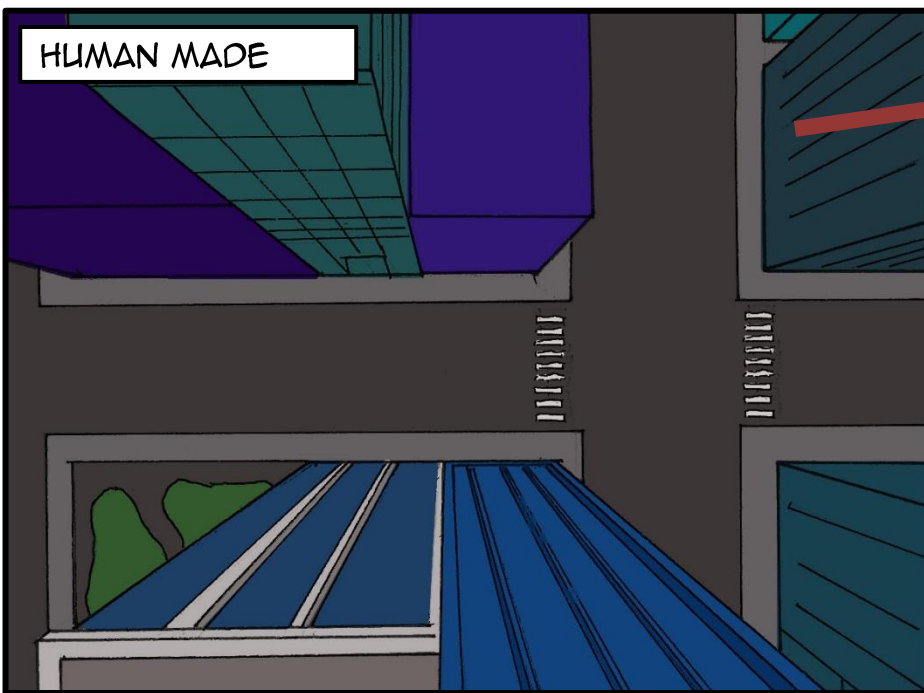
NATURE SIGNALS

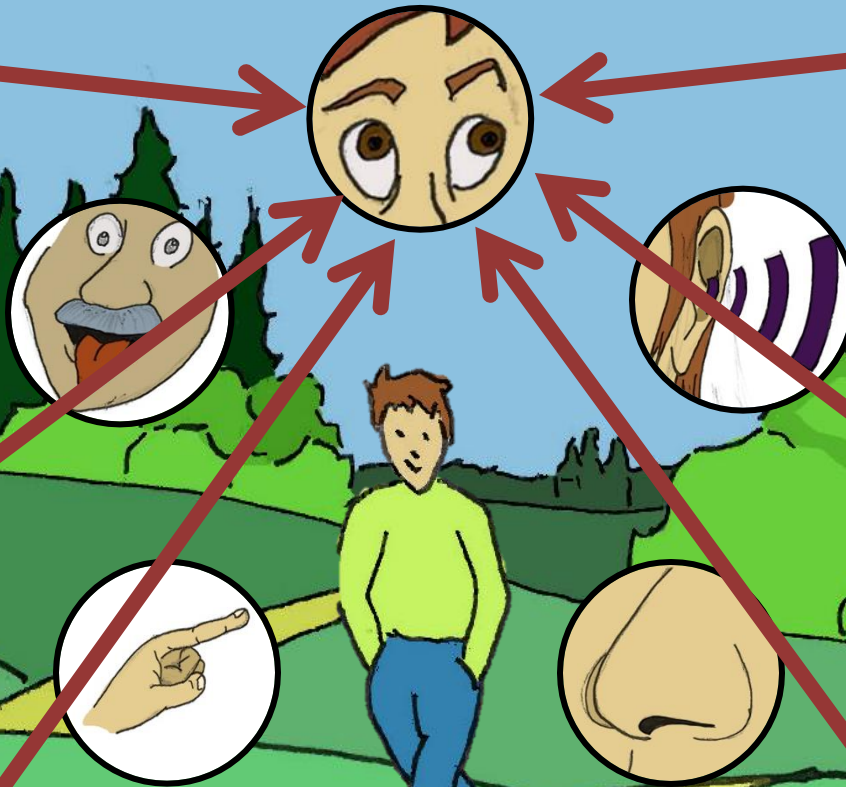
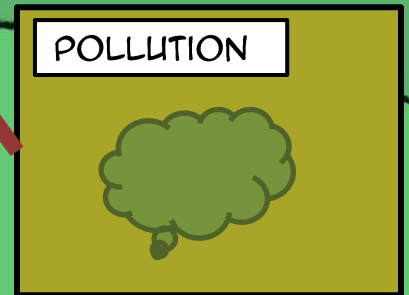
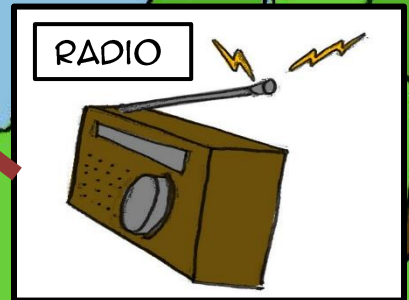
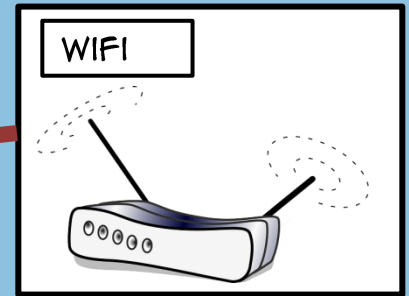
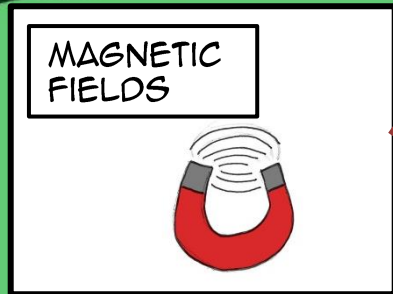
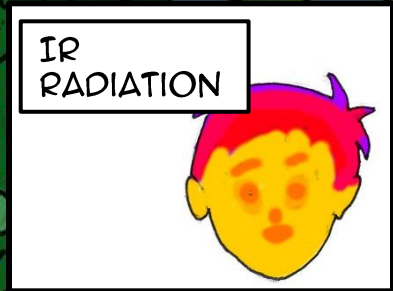
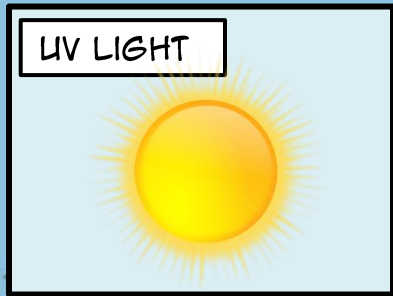


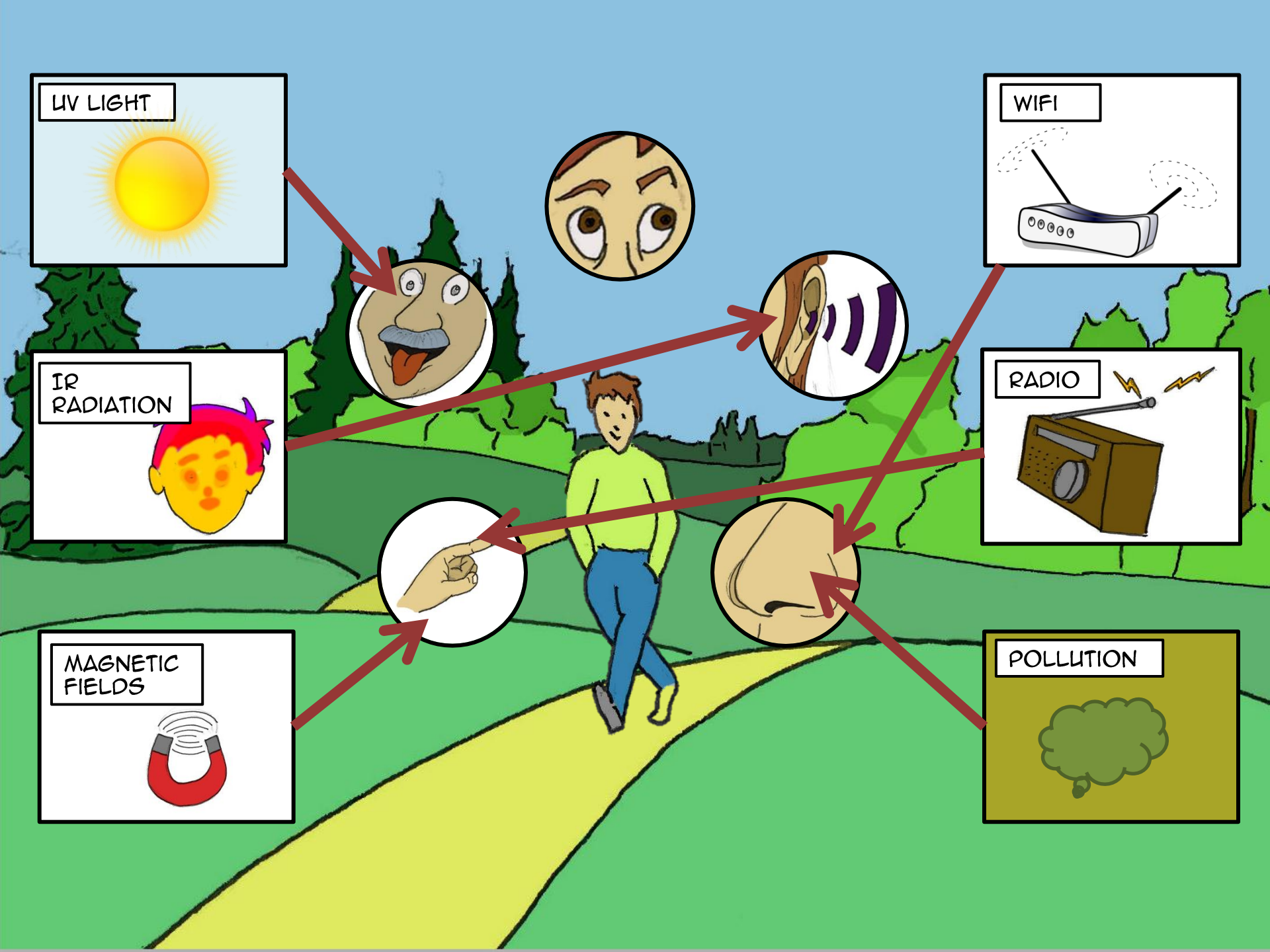
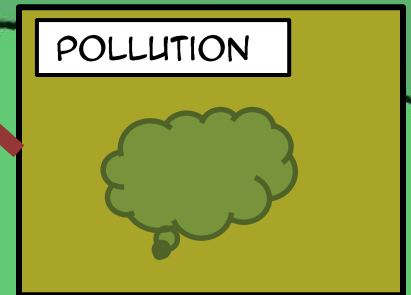
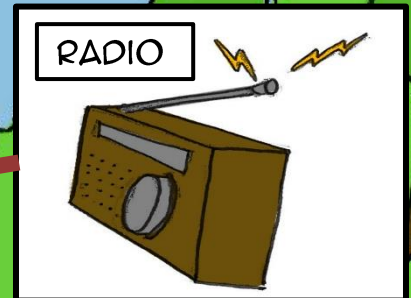
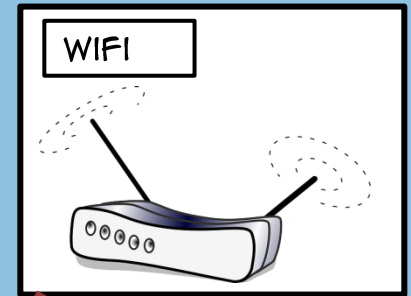
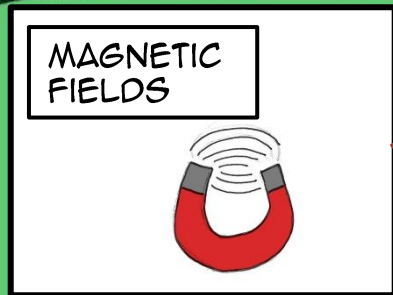
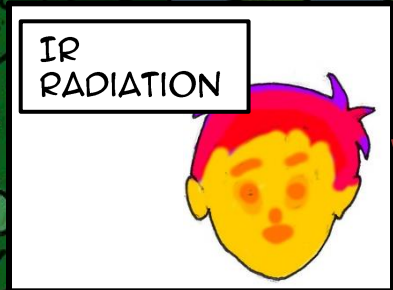
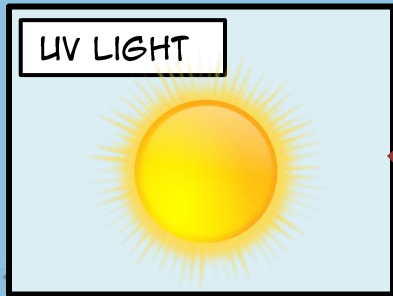
MOBILE DEVICE  
TRANSLATES



HUMAN MADE

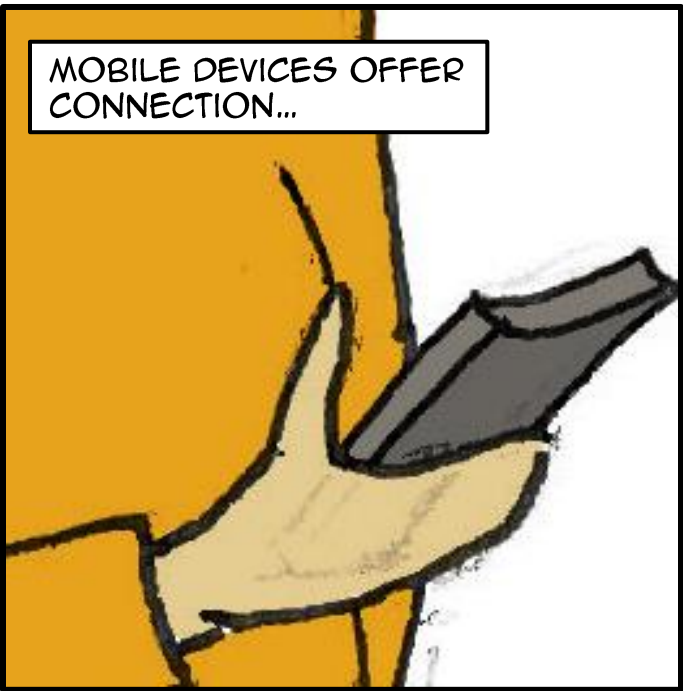








MOBILE DEVICES OFFER  
CONNECTION...



... AND ALSO  
DISTRACTION



DIGITAL SYNESTHESIA  
WILL CREATE AN  
IMMERSIVE EXPERIENCE  
IN THE REAL WORLD...



... AGAIN!

BACKGROUND:

THERMAL  
INTERFACES

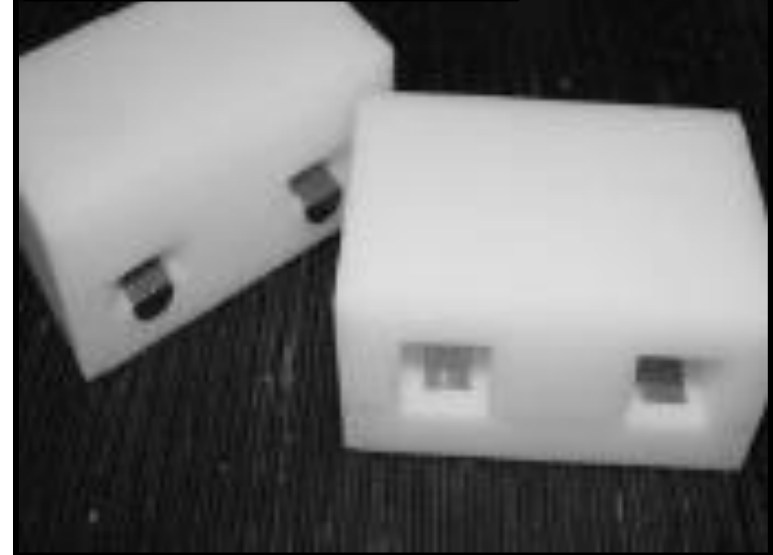


THE PRESSURE AND  
TEMPERATURE CHANGE  
OF THE FINGER WAS  
MEASURED

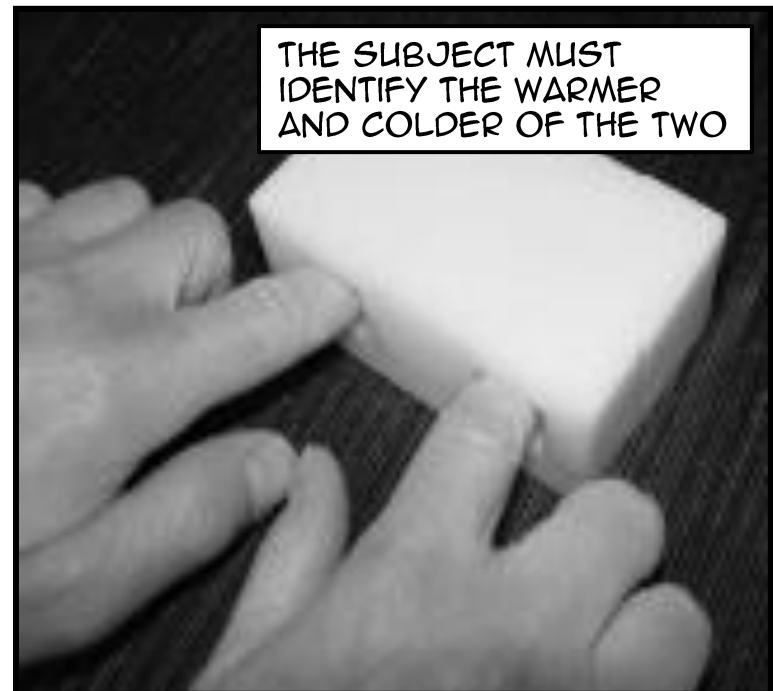
DEVELOPMENT OF THERMAL DISPLAYS AND  
UNDERSTANDING THE NATURE OF THERMAL CUES.

"MATERIAL DISCRIMINATION AND THERMAL PERCEPTION"  
L. A. JONES AND M. BERRIS

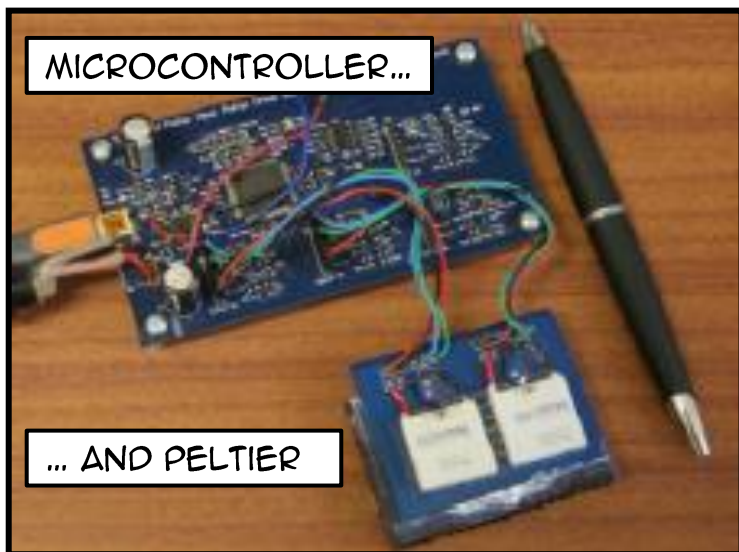
DIFFERENT MATERIAL ARE  
PLACED IN THE DEVICE



THE SUBJECT MUST  
IDENTIFY THE WARMER  
AND COLDER OF THE TWO

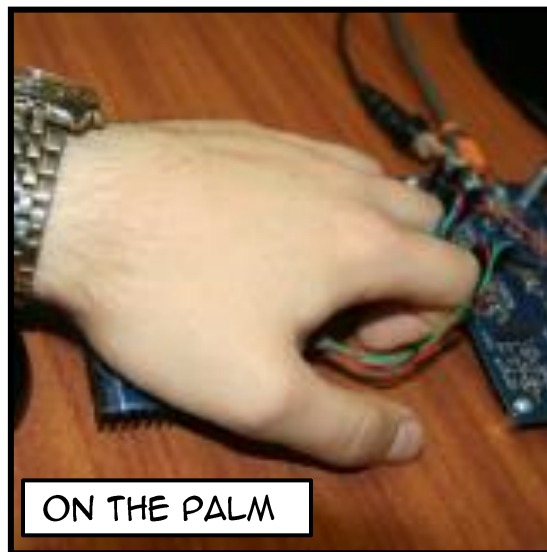






MICROCONTROLLER...

... AND PELTIER



ON THE PALM



ON THE ARM

USERS DETECT HOT AND COLD STIMULI PRESENTED TO THE FINGERTIPS, THE PALM AND THE ARM

TWO STUDIES. ONE STATIC INDOOR AND ONE MOBILE



THE EXPERIMENT WAS REPEATED WITH THE SUBJECTS WALKING AROUND

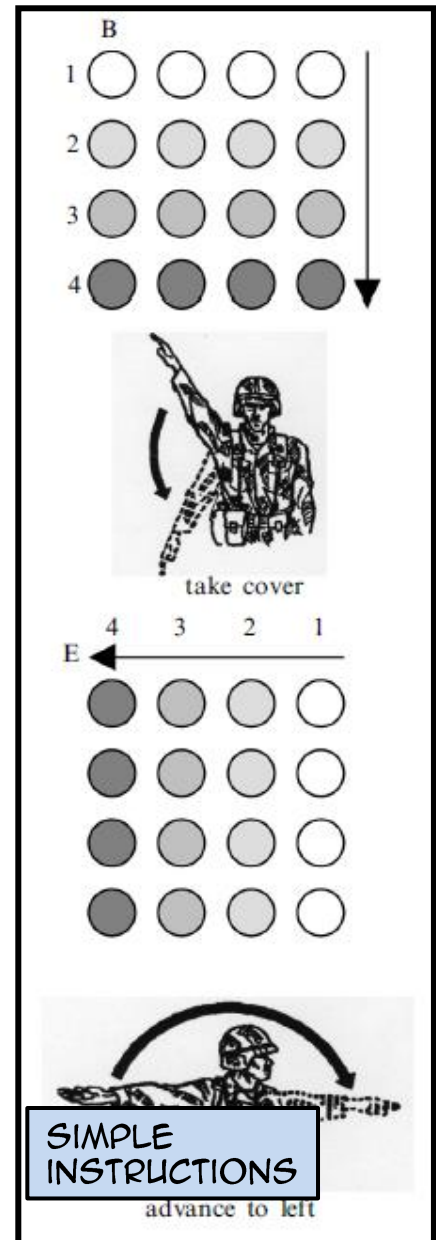
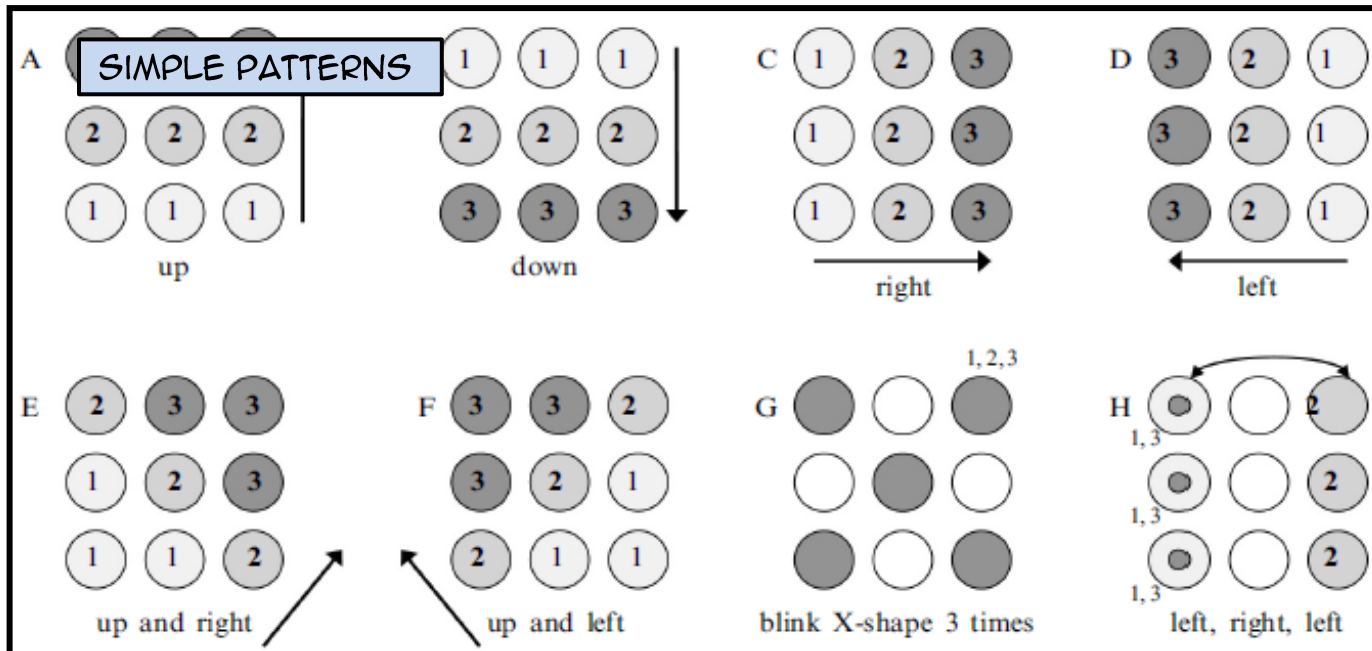
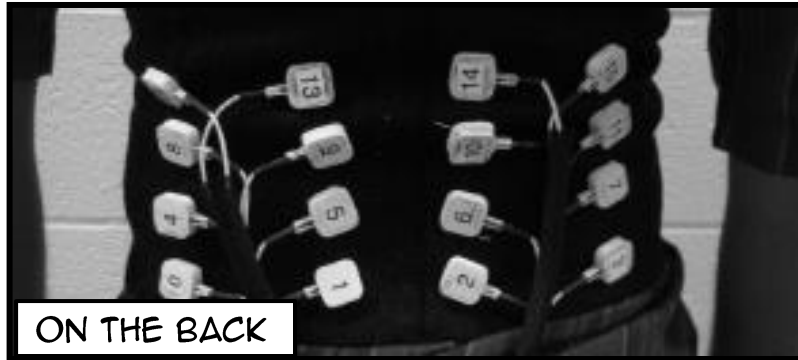


"SOME LIKE IT HOT ? THERMAL FEEDBACK FOR MOBILE DEVICES"  
G. WILSON, M. HALVEY, S. A. BREWSTER, AND S. A. HUGHES,

BACKGROUND:

VIBRATION  
INTERFACES

# HOW A TACTILE DISPLAY CAN COMMUNICATE SIMPLE INSTRUCTIONS AND COMMANDS





NO NEED FOR  
POSITIONING, THE  
SYSTEM DETECTS  
STRUCTURED  
LIGHT.

DLP (digital micro-mirror)  
projector

Time-modulated light

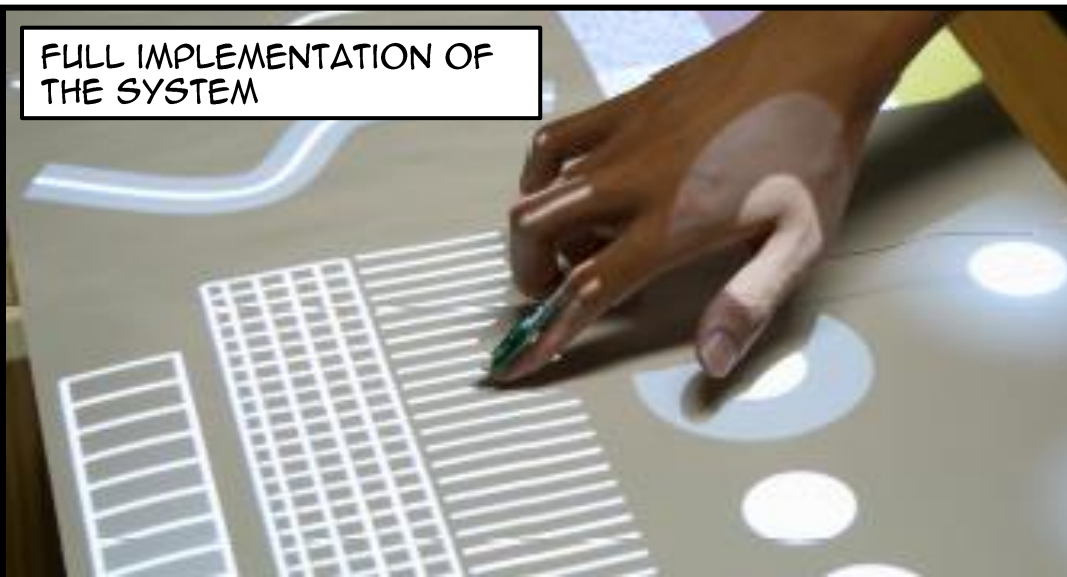
(2) tactile pattern A

(1) no tactile feedback

(3) tactile pattern B



FULL IMPLEMENTATION OF  
THE SYSTEM



OPTICAL-HAPTIC SUBSTITUTION

"SENSEABLERAYS: OPTO-HAPTIC SUBSTITUTION FOR  
TOUCH-ENHANCED INTERACTIVE SPACES"  
J. REKIMOTO

BACKGROUND:

MOBILE DEVICE  
INTERFACES

## AFFECTPHONE

DETECTS A USER'S EMOTIONAL STATE USING GSR, AND CONVEYS THIS STATE VIA CHANGES IN THE TEMPERATURE OF THE BACK PANEL OF THE OTHER HANDSET



GSR SENSOR  
DETECTS USER'S  
EMOTIONS

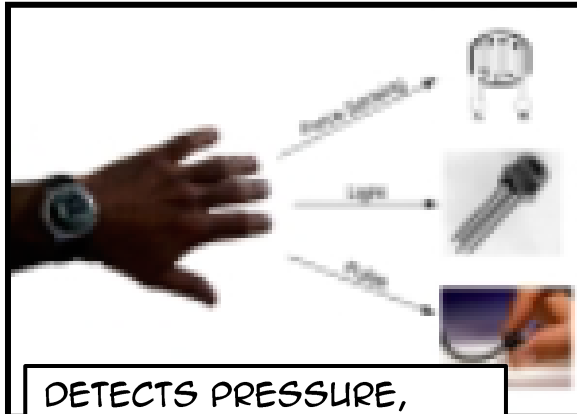
PELTIER DELIVERS  
WARMTH OR  
COOLNES



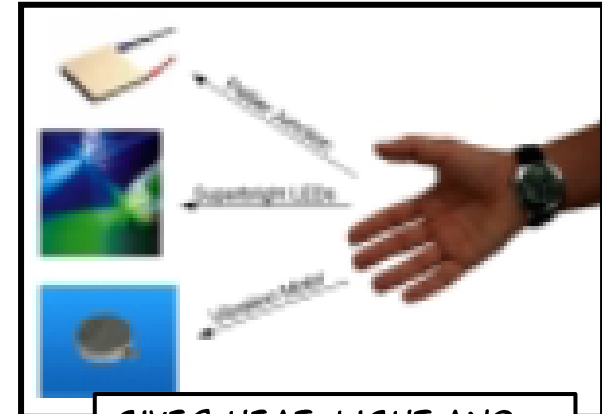
"AFFECTPHONE: A HANDSET DEVICE TO PRESENT USER'S EMOTIONAL STATE WITH WARMTH/COOLNESS"  
K. IWASAKI, T. MIYAKI, AND J. REKIMOTO

## CONNEXUS

AIMS TO DETECT VARIOUS CONDITIONS AT A TIME AND TRANSMIT THEM IN DIFFERENT WAYS



DETECTS PRESSURE,  
AMBIENT LIGHT AND  
HEARTBEAT



GIVES HEAT, LIGHT AND  
VIBRATION

"CONNEXUS: A COMMUNAL INTERFACE"  
E. PAULO



BACKGROUND:

SENSORY  
SUBSTITUTION

## BRAINPORT AND EYEBORG

IMAGES CAPTURED BY  
THE CAMERA...



... ARE TRANSLATED TO  
ELECTRICAL SIGNALS IN THE  
TONGUE



"BRAINPORT: AN ALTERNATIVE INPUT TO THE BRAIN"  
Y. DANILOV AND M. TYLER

USES A COLOR SENSOR  
AND CAMERA TO  
TRANSLATE...

... COLOR INFORMATION  
TO SOUND

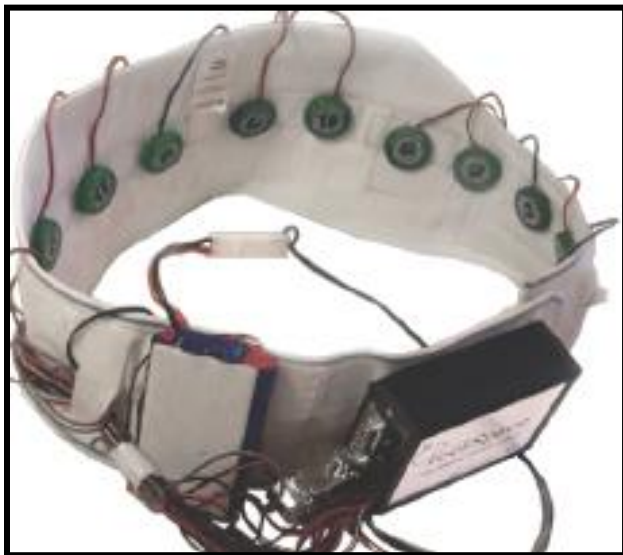


"EYEBORG"  
NEIL HARBISSEON

BACKGROUND:

NEW SENSES



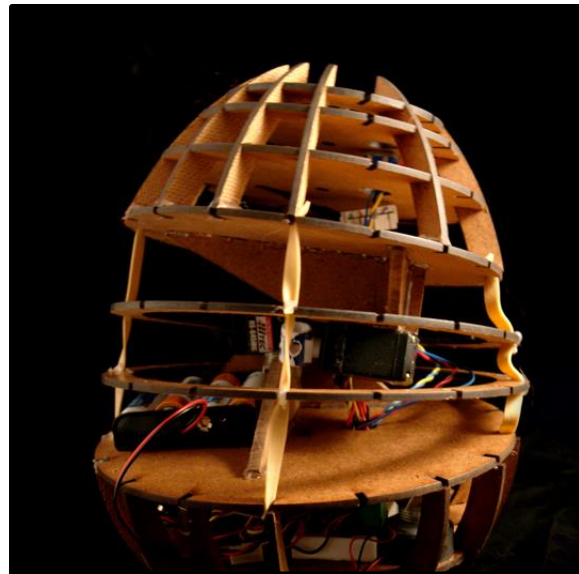


"FEELSPACE BELT"  
NAGEL, S. K., CARL, C., KRINGE, T., MÄRTIN, R.,  
& KÖNIG, P.



"BODY HACKING: MY MAGNETIC IMPLANT"  
D. BERG

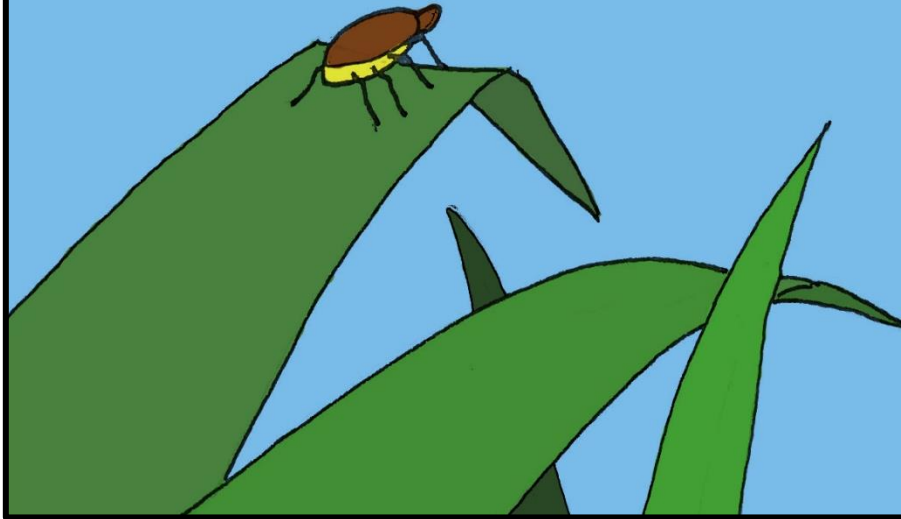
FEELSPACE BELT,  
BODY HACKING AND  
MOMO



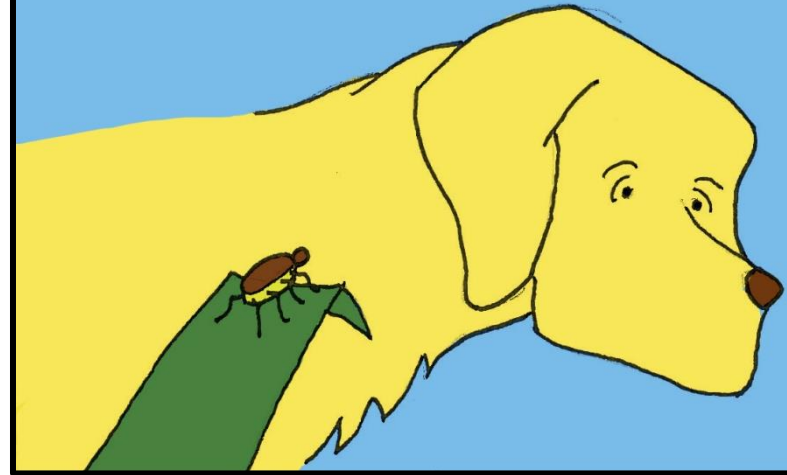
"MOMO: A HAPTIC NAVIGATION DEVICE"  
C. WANG AND K. O'FRIEL

# DIGITAL SYNESTHESIA

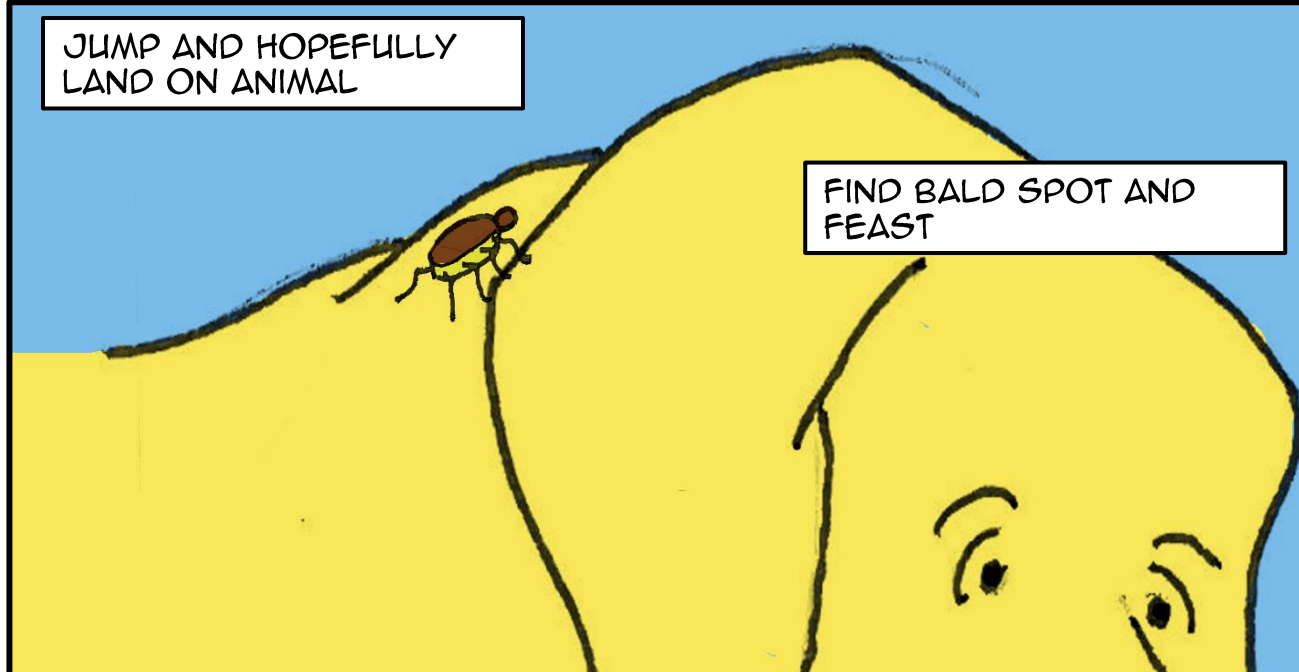
SKIN'S LIGHT SENSITIVITY  
TO FIND A TALL GRASS



SENSE VICTIM THROUGH  
SMELL



JUMP AND HOPEFULLY  
LAND ON ANIMAL



FIND BALD SPOT AND  
FEAST

THE TICK UNDERSTANDS  
ONLY THREE SIGNS

SMELL

TEMPERATURE

HAIRINESS

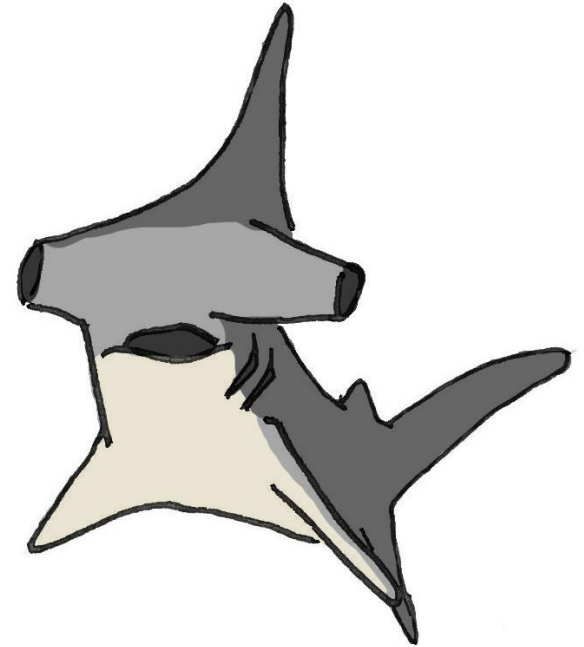
"A FORAY INTO THE WORLDS OF  
ANIMALS AND HUMANS"  
JAKOB VON HEXKÜLL



BEEES CAN USE UV LIGHT  
TO PICK FLOWERS



HAMMER-HEAD SHARKS  
HUNT SENSING ELECTRIC  
SIGNALS FROM THE  
MUSCLES OF PREY



BEEES CAN USE UV LIGHT  
TO PICK FLOWERS



HAMMER-HEAD SHARKS  
HUNT SENSING ELECTRIC  
SIGNALS FROM THE  
MUSCLES OF PREY





## COGNITIVE LOAD

WHEN BY-PASSING THE VISUAL SENSE, IT IS EASIER FOR THE BRAIN TO INTERPRET INFORMATION WITHOUT SHIFTING ATTENTION FROM CURRENT TASK







WE ALL FEEL THE SAME  
CONDITIONS IN A  
DIFFERENT WAY



# RESEARCH PLAN

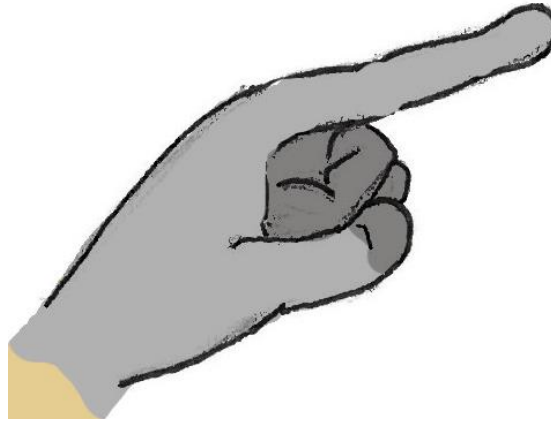
STAGE I:  
COMPARE NATURAL AND ARTIFICIAL SENSES

STAGE II:  
NEW SENSES IN A KNOWN CONTEXT

STAGE III:  
NEW SENSES WITH UNKNOWN CONTEXT

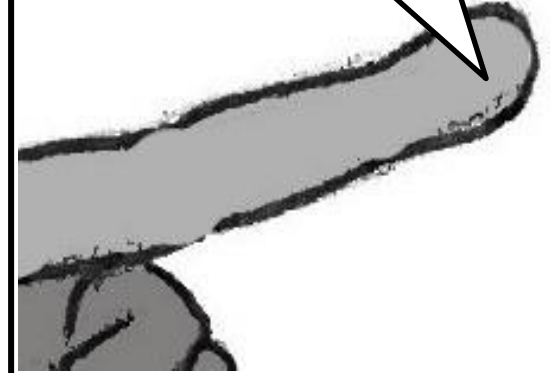
STAGE IV:  
GENERALIZING PROJECTIONS OF SYNESTHETIC DESIGN

# RESEARCH PLAN, STAGE 1

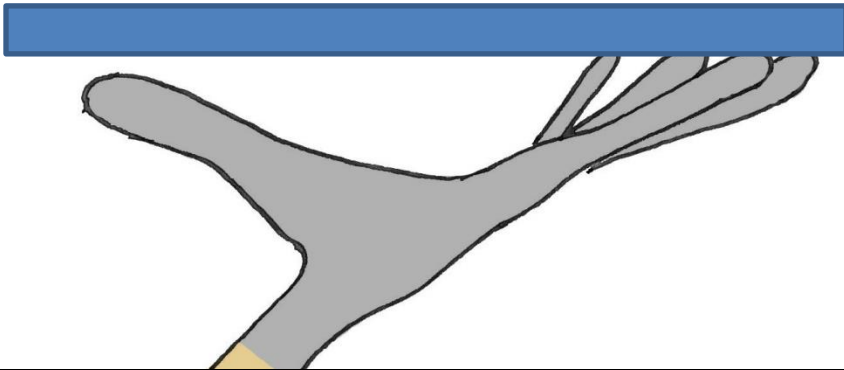


A GLOVE WITH A  
PRESSURE  
SENSOR...

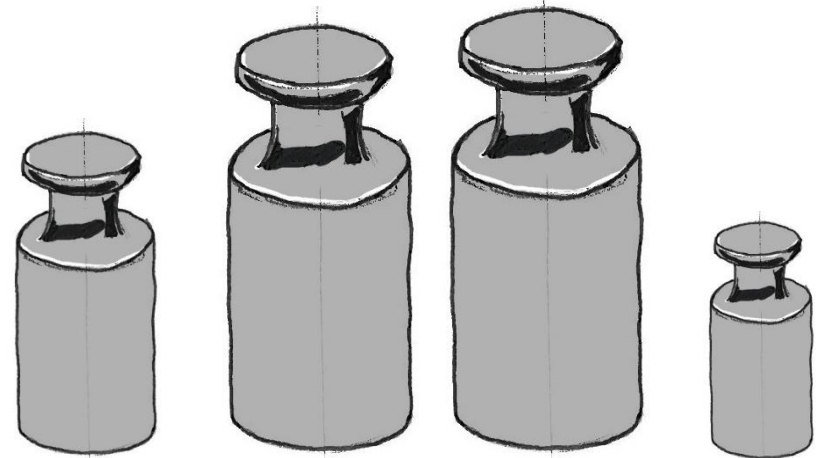
... ON THE TIP  
OF THE RING  
FINGER



THE USER WILL  
HOLD A TRAY AND  
LOCATE VARIOUS  
OBJECTS ON IT



THE TASK IS TO  
ORGANIZE THE  
OBJECTS ACCORDING  
TO WEIGHT



# RESEARCH QUESTIONS, STAGE I

DISCREET OR CONTINUOUS?

DOES THE USER FIND DISCREET SIGNALS BETTER THAN A CONTINUOUS CHANGING SIGNAL?  
DOES THIS DEPEND ON THE EXPERIENCE?

SENSE AUGMENTATION?

IS THERE A BENEFIT OF THE ARTIFICIAL SENSE OVER THE NATURAL SENSE WHEN USED TOGETHER?

SENSE SUBSTITUTION?

CAN THIS ARTIFICIAL SENSE REPLACE AN EXISTING SENSE FOR THE GIVEN ACTIVITY?

NEW STIMULI?

HOW ACCURATE IS THE DIGITAL SENSE IN COMPARISON TO THE NATURAL SENSE?



# RESEARCH PLAN, STAGE II

HEAD BAND

OUTWARD IR SENSORS ON THE FOREHEAD

INWARD TRANSDUCERS

SET UP A GROUP ACTIVITY

USER WILL HAVE AN  
ADVANTAGE

DETECTING THE  
STRESS LEVEL OF  
THE OTHERS

## RESEARCH QUESTIONS, STAGE II

### NEW SENSES?

HOW DOES THE USER PERFORM WHEN HAVING ACCESS TO A NEW SENSE?

### NEW STIMULI?

HOW ACCURATE IS THE DIGITAL SENSE IN THE CONTEXT?

### SENSE SUBSTITUTION?

CAN THIS ARTIFICIAL SENSE REPLACE AN EXISTING SENSE FOR THE GIVEN ACTIVITY?

IS THERE A PHANTOM SENSE FEELING?

IS THERE A DIFFERENCE DEPENDING ON THE USER'S FAMILIARITY WITH THE TASK?

# RESEARCH PLAN, STAGE III

NECK

PELTIER DEVICE RESPONDS TO LOCATION...

WITH THE GLASS INFRASTRUCTURE

INTERACT WITH THE LAB

USE DOPPELLAB  
TO INTERACT WITH  
THE USER

# RESEARCH QUESTIONS, STAGE III

HUMAN DEVELOPMENT?

WHEN LEARNING A NEW SENSE, ARE CHILDREN BETTER AT IT THAN ADULTS?

NEW STIMULI?

HOW FAST TO USERS UNDERSTAND THE NEW STIMULI?

DOES IT DEPEND ON THE ACTIVITY OR THE FEEDBACK?

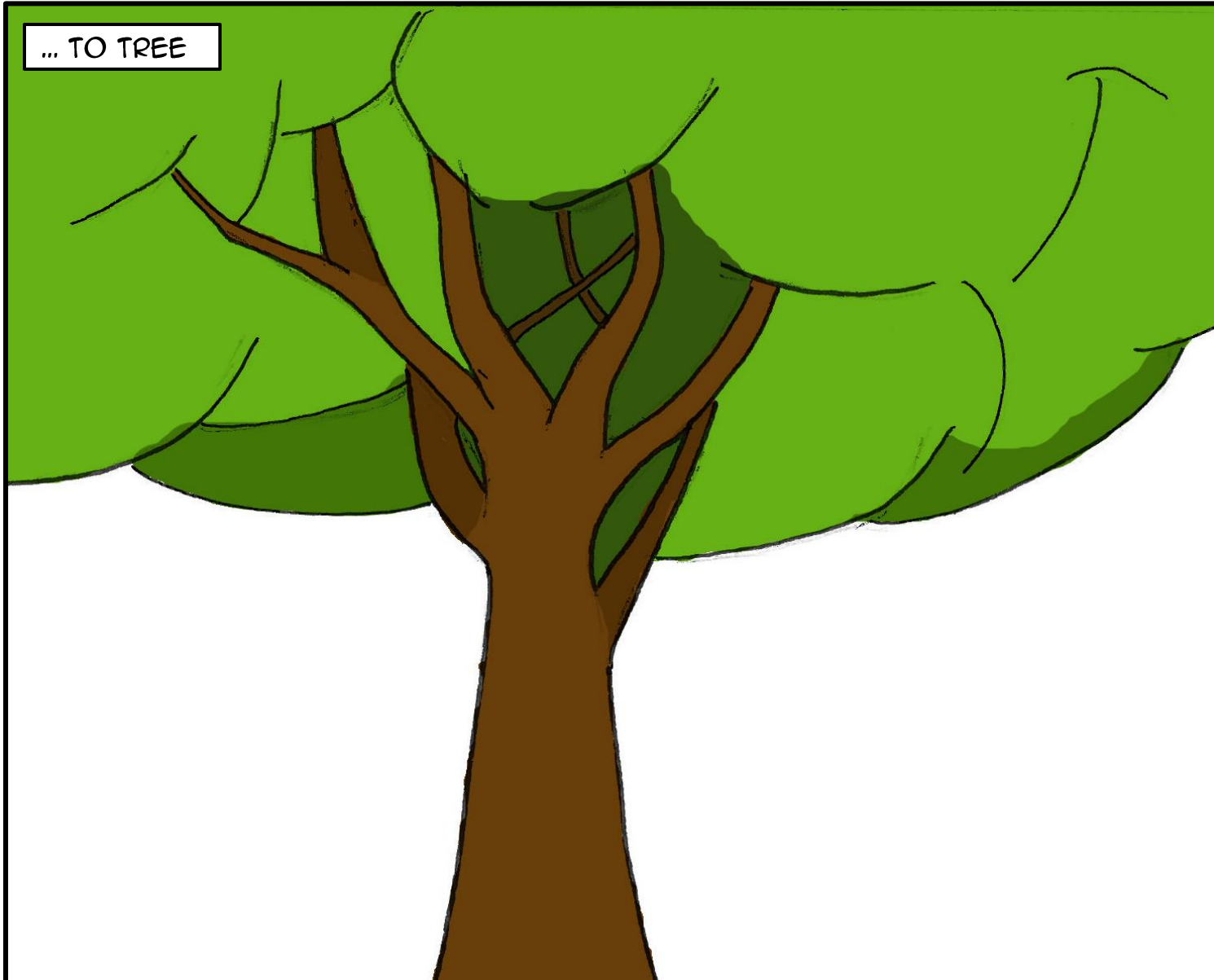
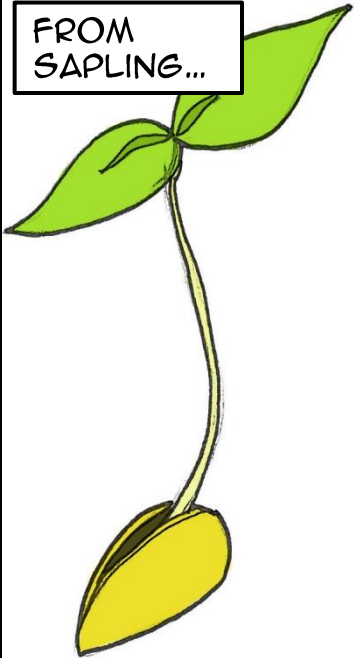


# RESEARCH PLAN, STAGE IV

DESIGN  
THINKING

... TO TREE

FROM  
SAPLING...



# RESEARCH QUESTIONS, STAGE IV

ESCAPING THE VISUAL INTERFACE?

CAN THIS ARTIFICIAL SENSE REPLACE AN EXISTING SENSE FOR THE GIVEN ACTIVITY?

DESIGN THINKING?

CAN A PATTERN BE IDENTIFIED TO GENERALIZE A DIGITAL SYNESTHESIA DESIGN PROCESS?

# TIMELINE

## PHASE ONE (JANUARY - MARCH)

THIS STAGE IS DEALING WITH THE FINAL CONTEXTS THAT WILL BE DEVELOPED TO PROVE MY THESIS AS WELL AS GETTING THE PROPOSAL SUBMITTED AND APPROVED BY MASCOM AND DEFENDED.

THIS IS THE DEVELOPMENT STAGE. FABRICATION AND INITIAL TESTING OF THE DEVICES

## PHASE TWO (MARCH - APRIL)

FINAL TESTING WILL BE MADE OF EACH OF THE SYSTEMS FOR THE CONTEXTS CHOSEN. EXTRA ATTENTION WILL BE PUT ON THE MOBILITY OF THE SYSTEM AND ITS FUTURE DEPLOYMENT OUTSIDE THE LAB. USER TESTING ON THE FIRST STAGE WILL BEGIN.

## PHASE THREE (MAY - JUNE)

USER TESTING WILL BE DONE FOR THE SECOND AND THIRD STAGES.

## PHASE FOUR (JULY - AUGUST)

THESIS WRITING AND DEFENSE.

THE END

THANK YOU...

QUESTIONS?