molT: Multi-Modal Tangibles to Enhance Interaction with Capacitive Touchscreens

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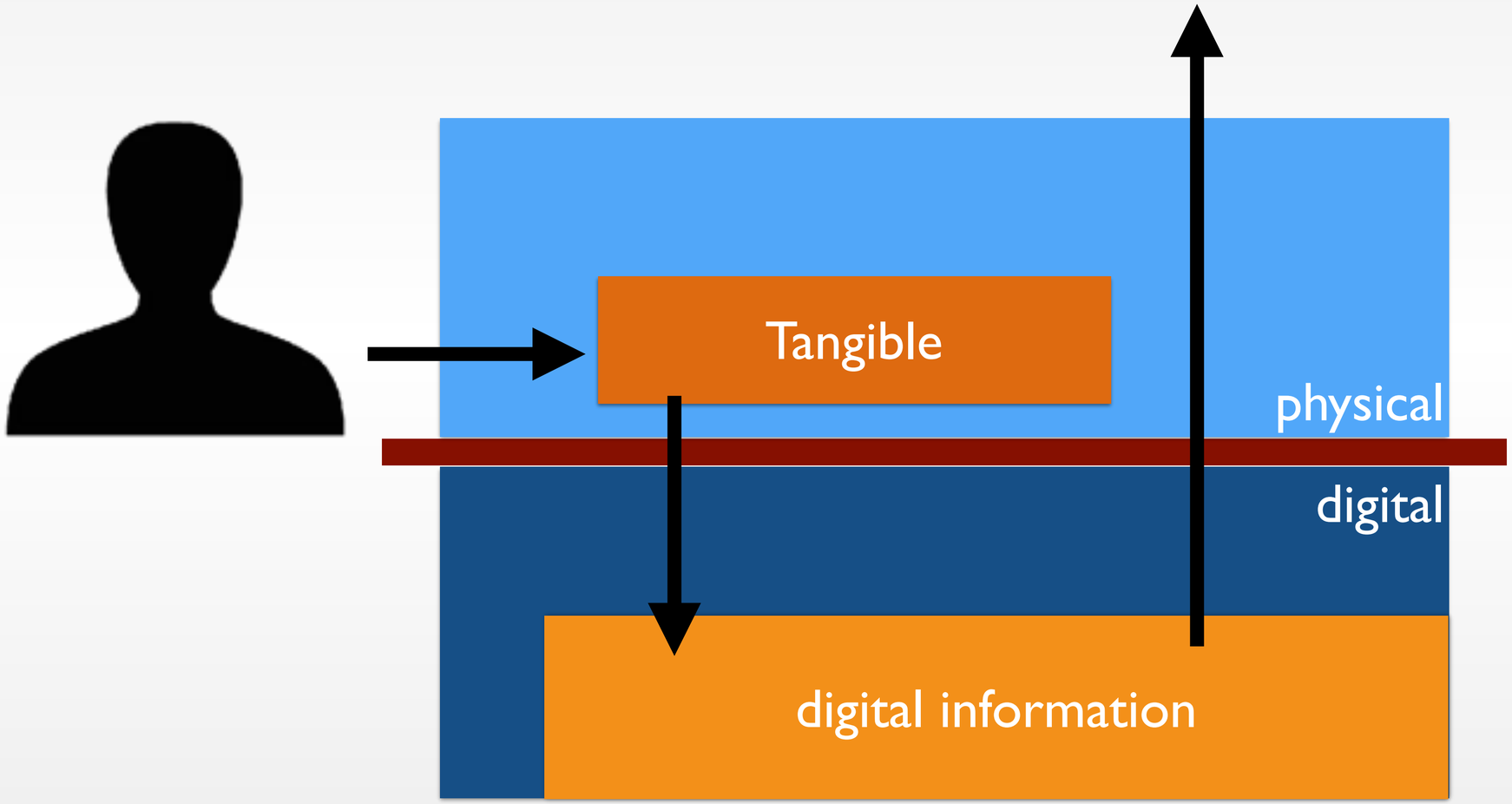
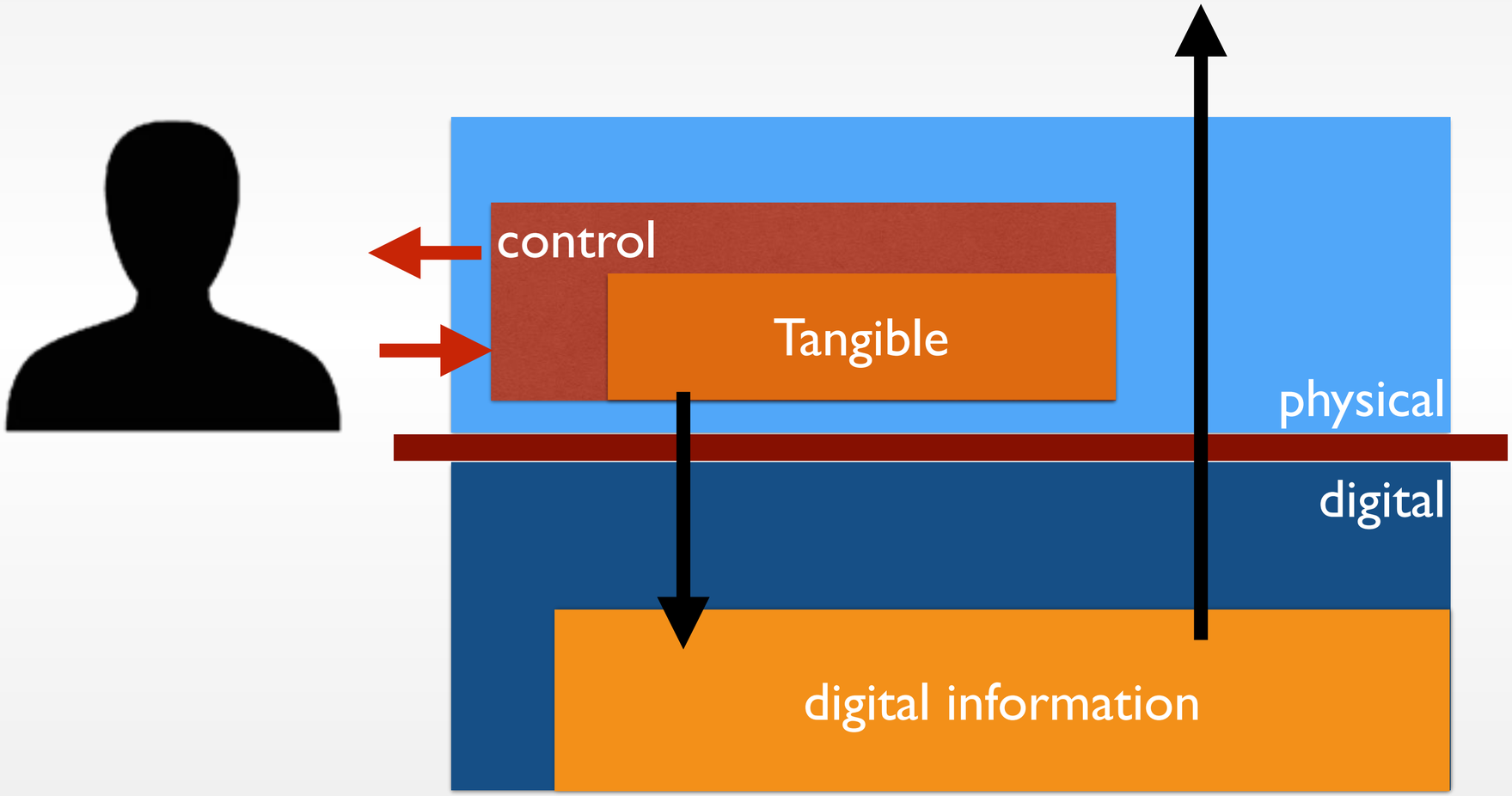
Tangibles

Tangible User Interface



Tangible User Interface



Multi Modal Tangible

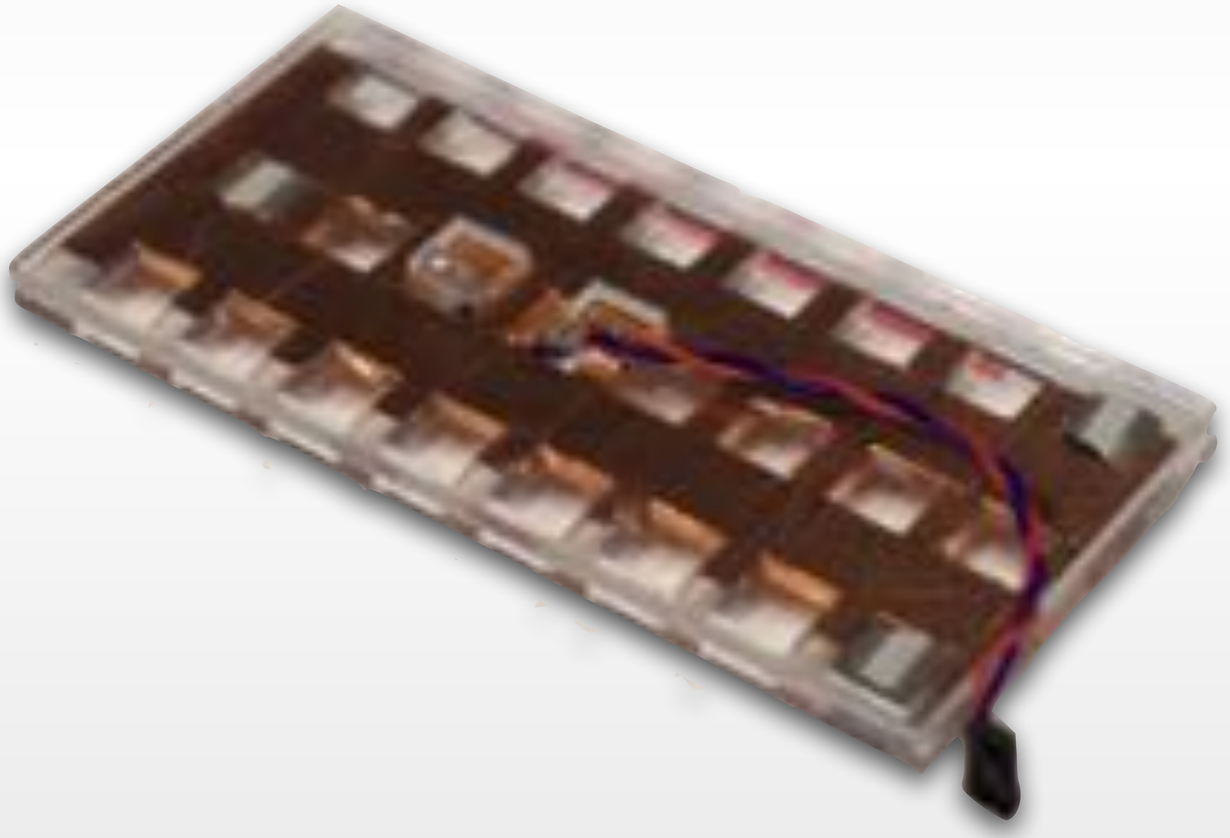
				
Input				
Output				

Multi Modal Tangible

				
Input				
Output				

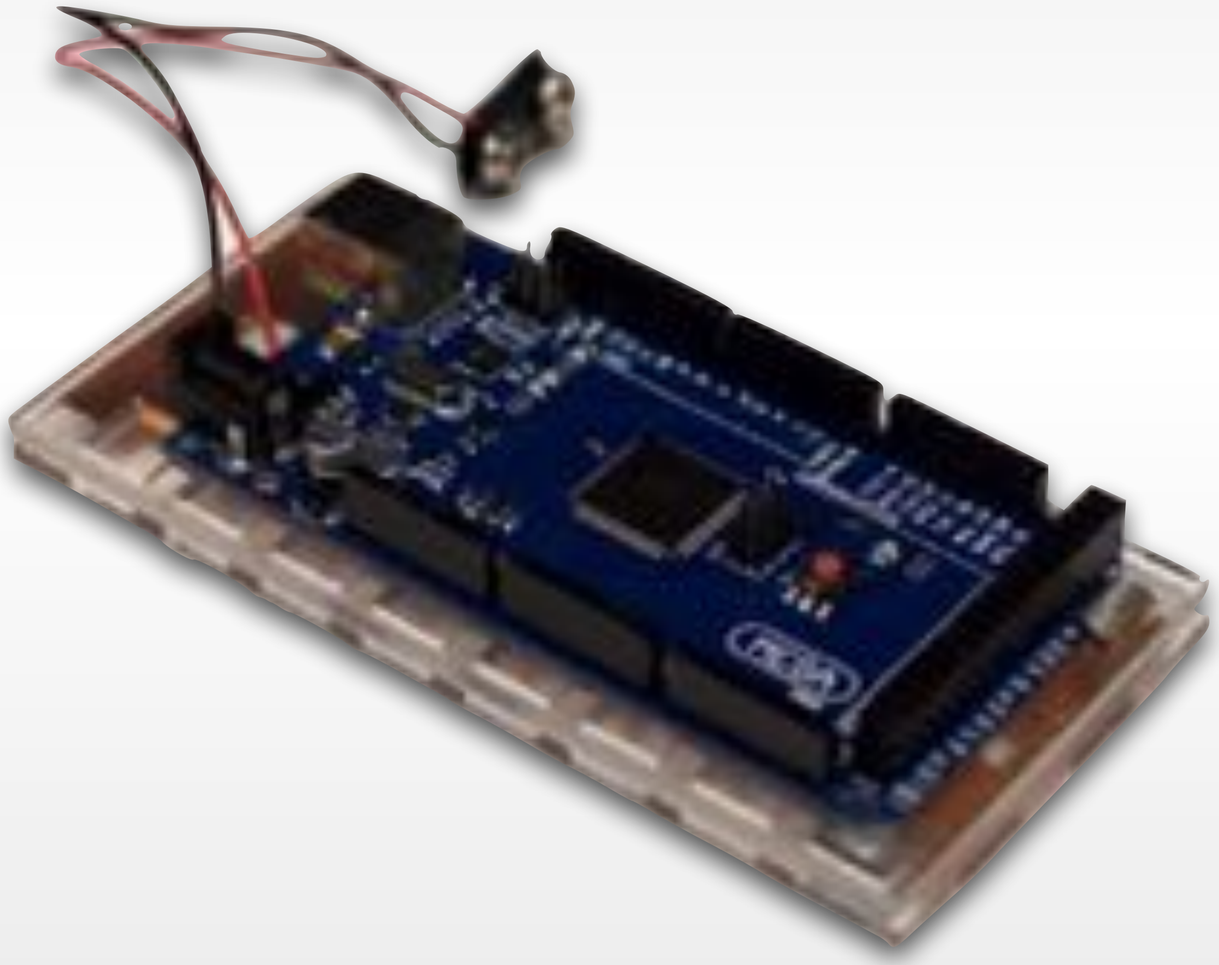
Development

- Classic PERCs ground
- Light & field sensor



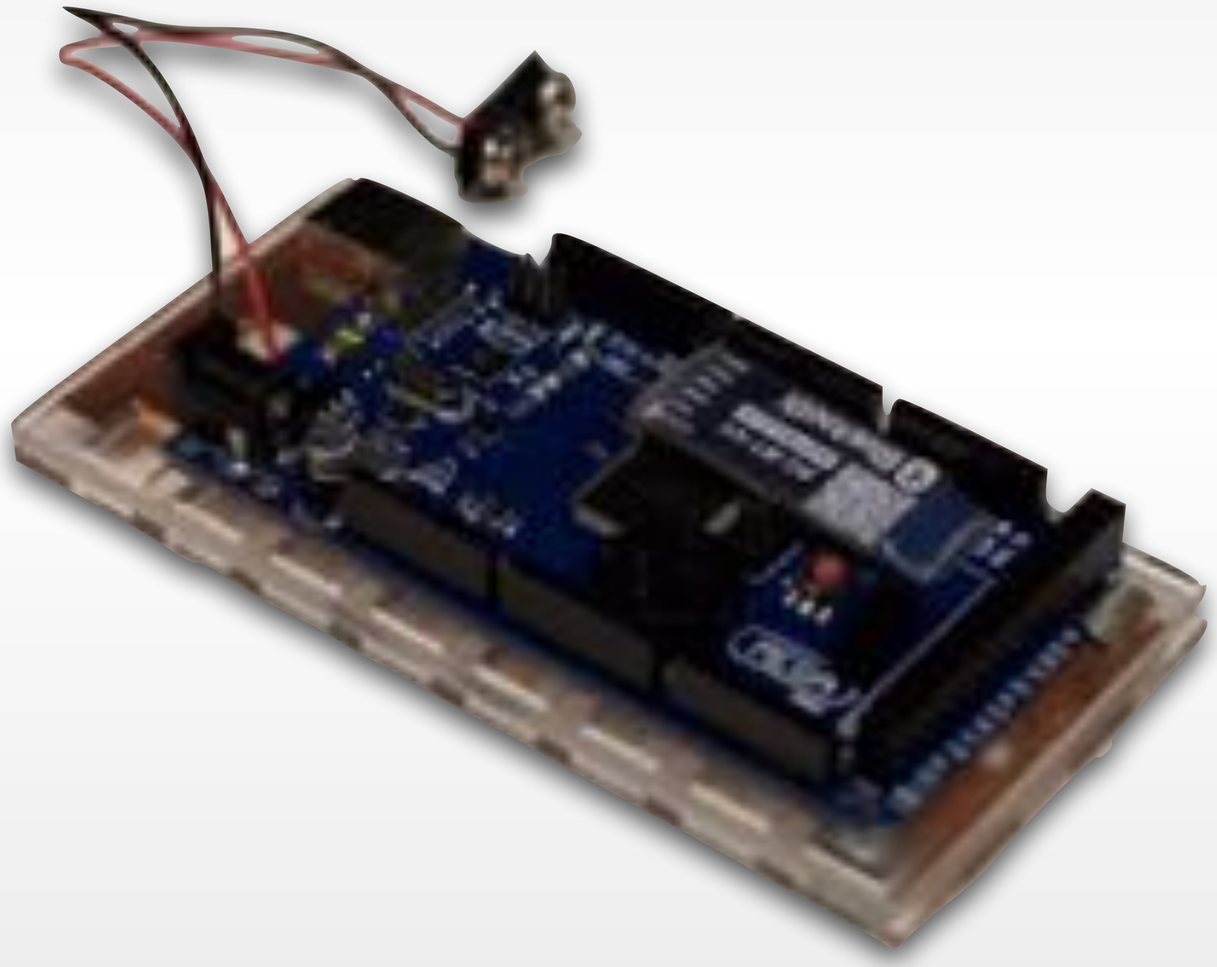
Development

- Arduino Mega 2560
- 51 pins - 256 kb Memory



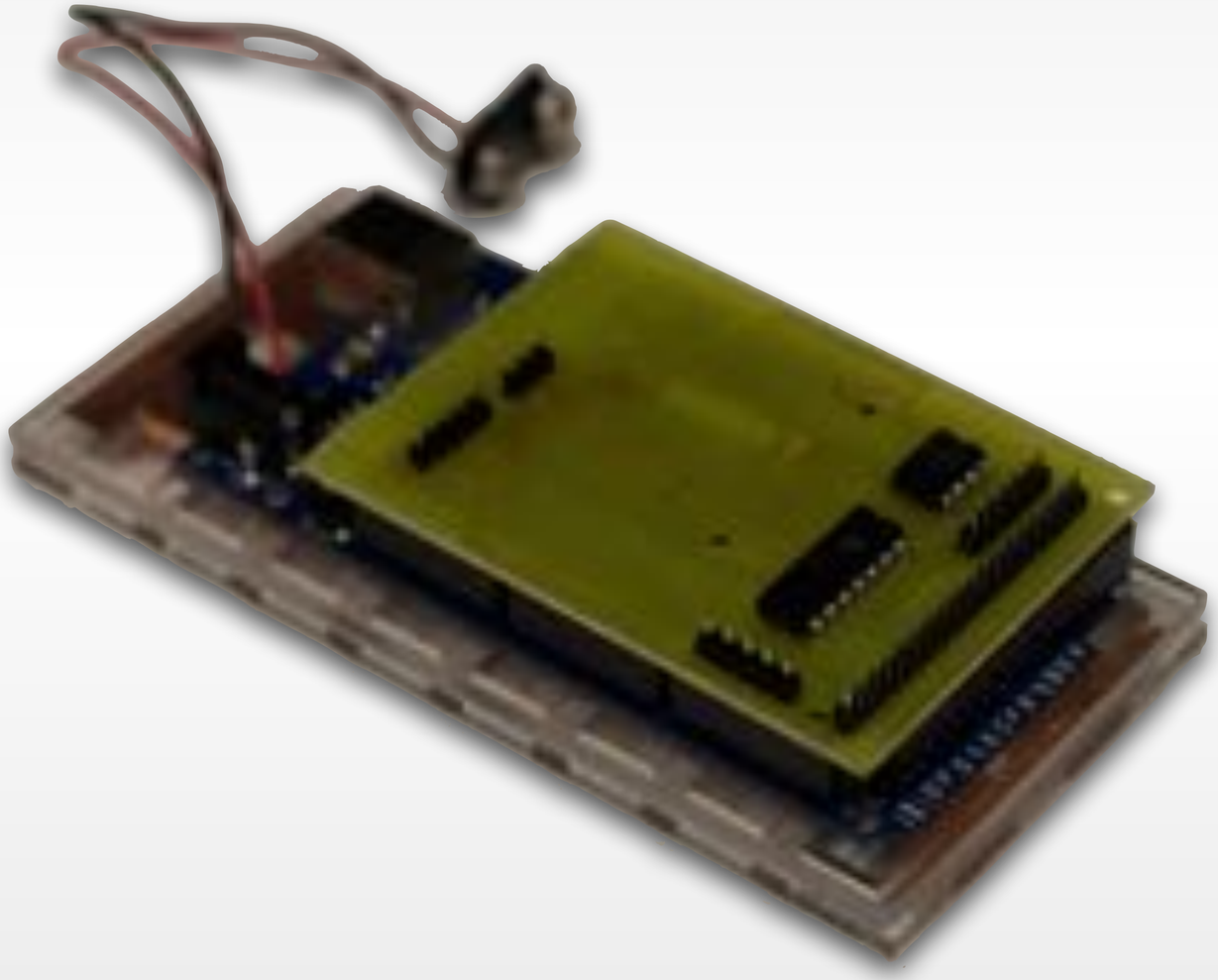
Development

- **Bluetooth LE**
- **Speaker**
- **Tiltsensor**



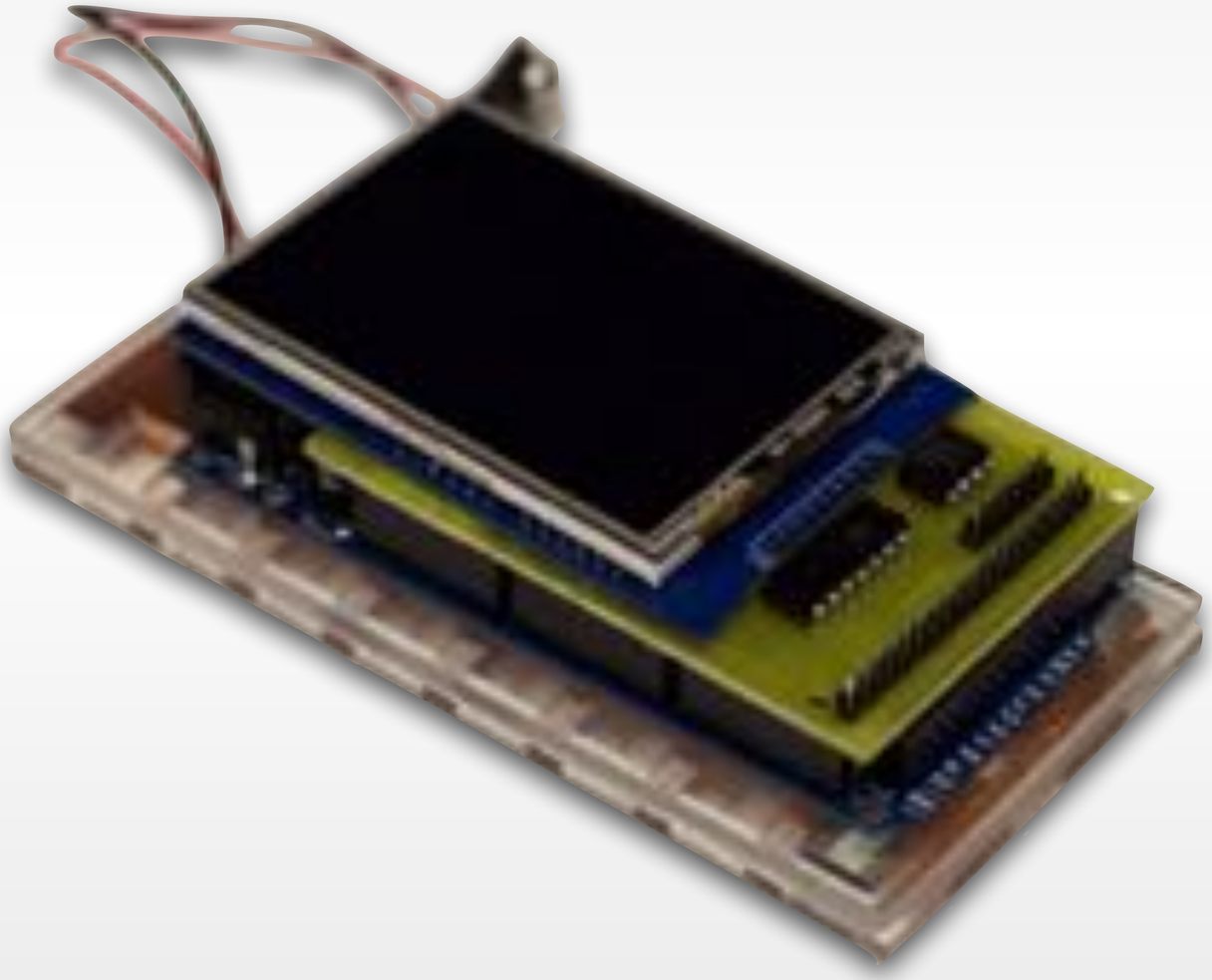
Development

- Shield
  - Own comparator



Development

- TFT 2.8” Touchscreen
  - with microSD card



Development

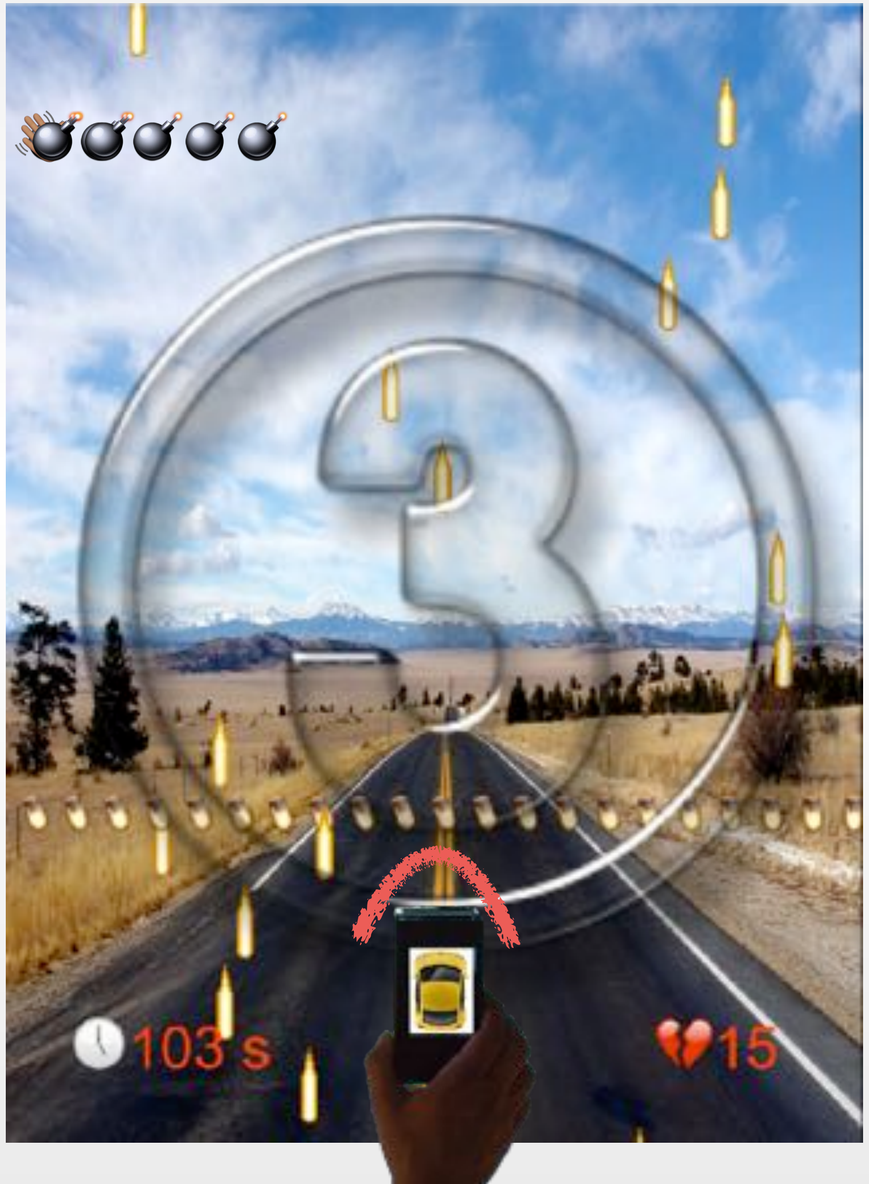
- Vibration & Button
  - connected to Case

Development

- **molT**

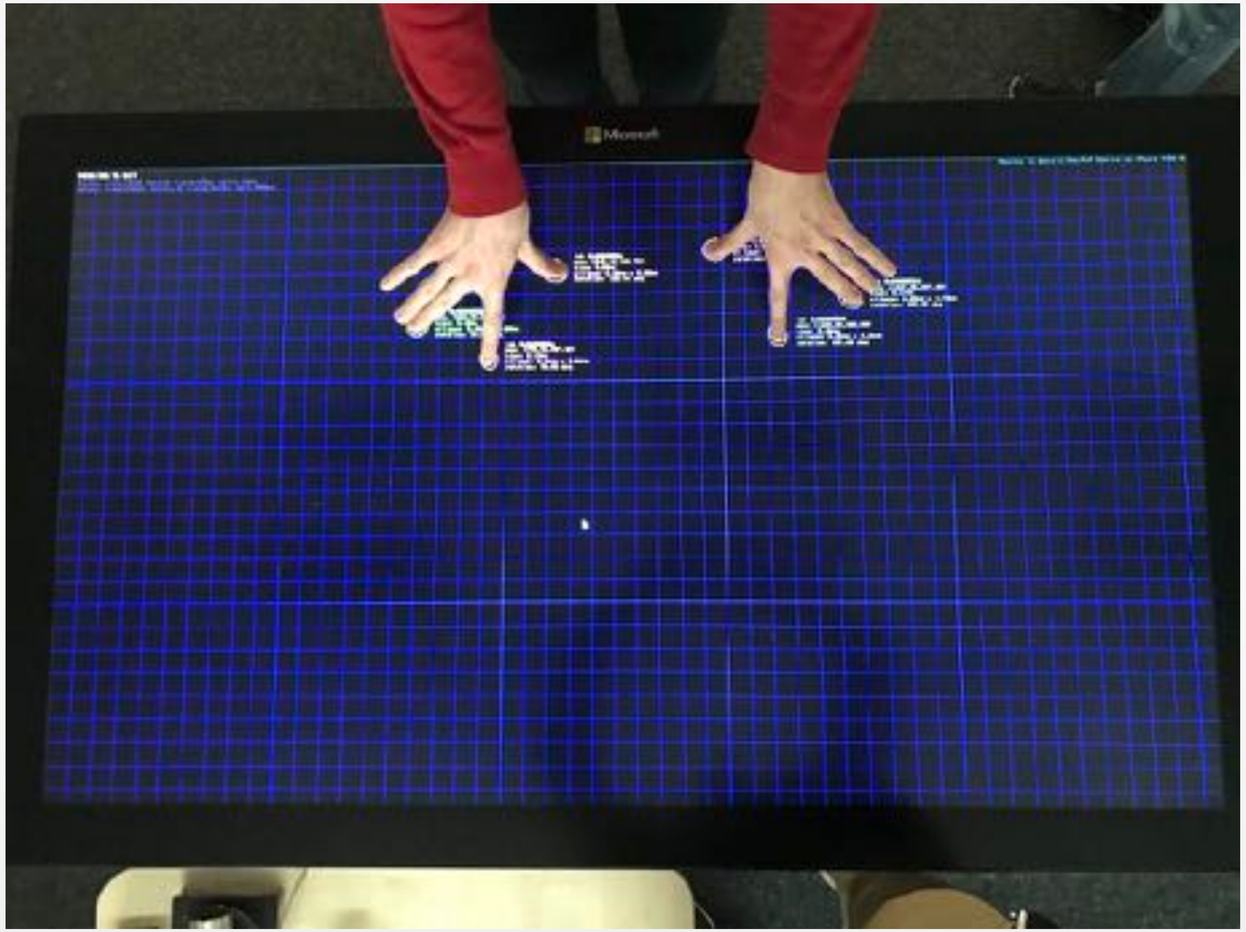
Demo Scene

- Well known game **Space Invaders**
  - Changing environment
  - Unavoidable bullets
- Requires controller with input/output



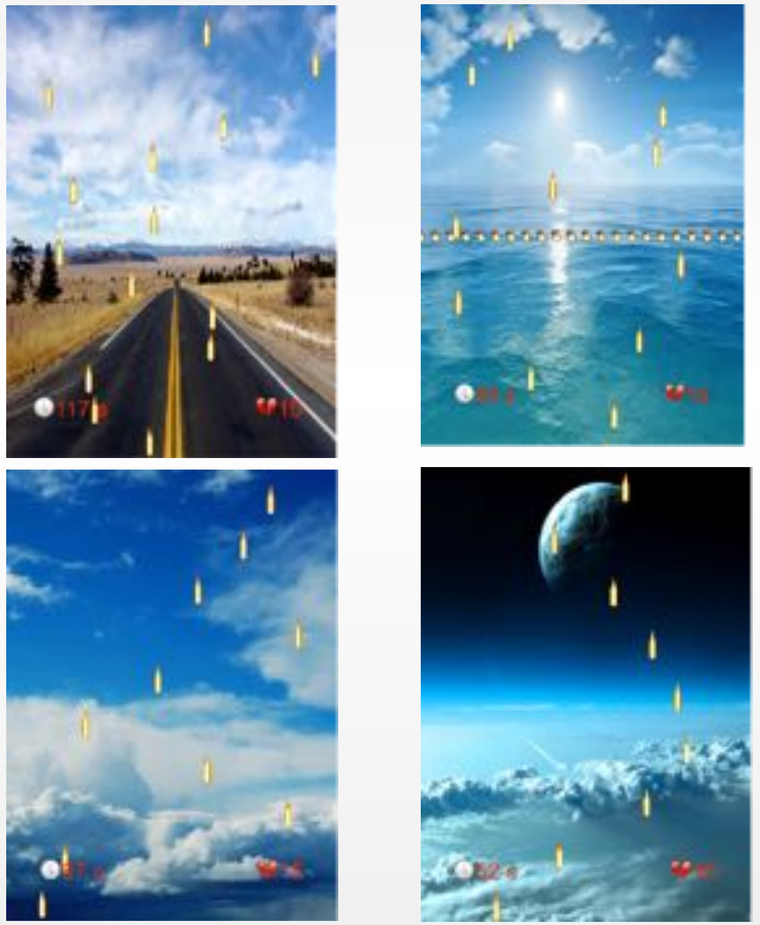
OS X - Objective C

- Touches get detected by virtual Windows machine
- MultiTouchKit makes Touchpoints usable for OS X deployment
  - developed by Rene Linden 2015
  - using Objective C



SpriteKit - RepeatActionForever

- creates parallelism
- used for
  - spawning Bullets
  - Countdown
  - Background



RepeatActionForever

- Environment changing in intervals:

```
SKAction *delayBackGround = [SKAction waitForDuration:15];
SKAction *chBackGround = [SKAction runBlock:^(void)
    {

    [self changeBackground];
    specialBulletSpeed = specialBulletSpeed - 0.2;
    BulletSpeed = BulletSpeed - 0.3;
    [self startCounter];

    }];

SKAction *sequenceBackGround = [SKAction sequence:@[delayBackGround, chBackGround]];
SKAction *repeatBackGround = [SKAction repeatActionForever:sequenceBackGround];
[self runAction:repeatBackGround];
```

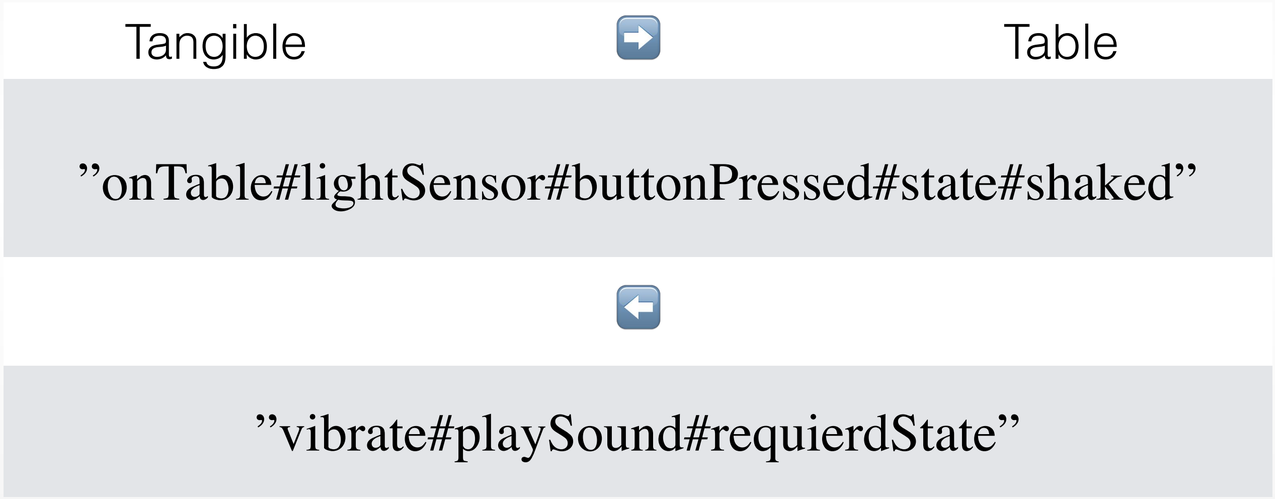
SpriteKit - Physics

- Adding physical behaviour

```
//for colision detection
_normalBullet.physicsBody = [SKPhysicsBody bodyWithRectangleOfSize:_normalBullet.frame.size];
_normalBullet.physicsBody.usesPreciseCollisionDetection = YES;
_normalBullet.physicsBody.affectedByGravity = NO;
_normalBullet.physicsBody.categoryBitMask = bulletCategory;
_normalBullet.physicsBody.mass = 2;
[self addChild:_normalBullet];
```

CoreBluetooth

- Connection set on demand
- Start up central Manager
- Search for advertising peripherals
  - peripherals broadcast some of the data they have
- Used CoreBluetooth & IOBluetooth
  - subscribing to a characteristic value



BLE Class

- Use CoreBluetooth & IOBluetooth

```
-(void) enableReadNotification:(CBPeripheral *)p
{
    CBUUID *uuid_service = [CBUUID UUIDWithString:@"FFE0"];
    CBUUID *uuid_char = [CBUUID UUIDWithString:@"FFE1"];

    [self notification:uuid_service characteristicUUID:uuid_char p:p on:YES];
}
```

```
-(void) write:(NSData *)d
{
    CBUUID *uuid_service = [CBUUID UUIDWithString:@"FFE0"];
    CBUUID *uuid_char = [CBUUID UUIDWithString:@"FFE1"];

    [self writeValue:uuid_service characteristicUUID:uuid_char p:activePeripheral data:d];
}
```

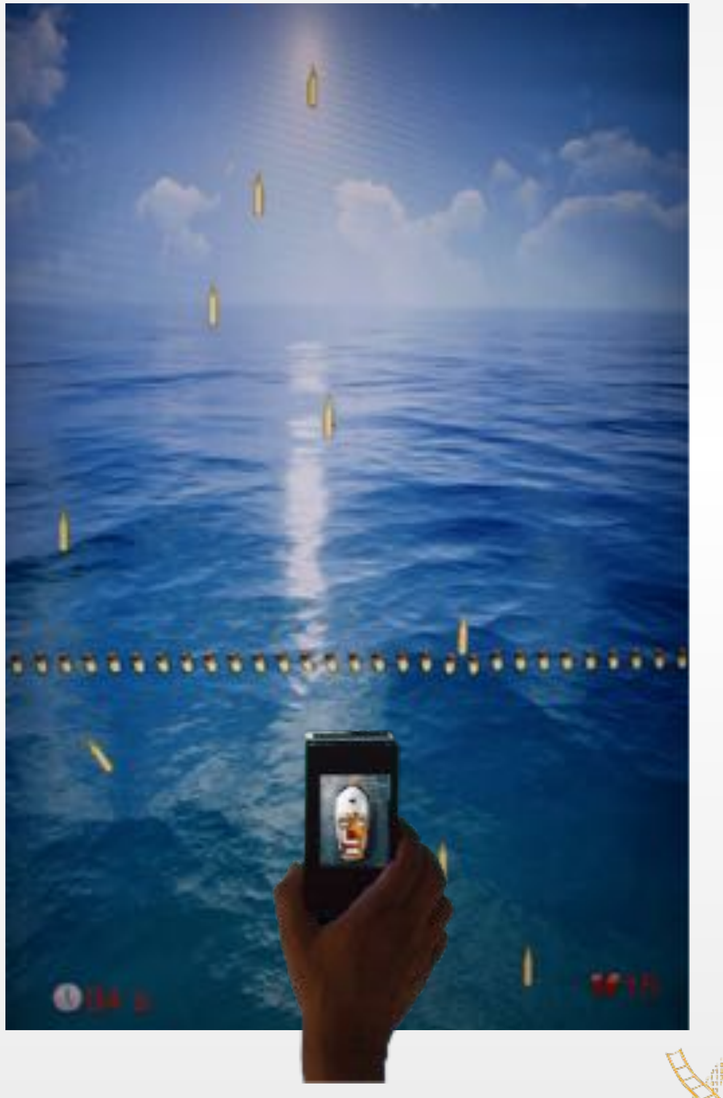
Bluetooth

- Using the predefined functions:

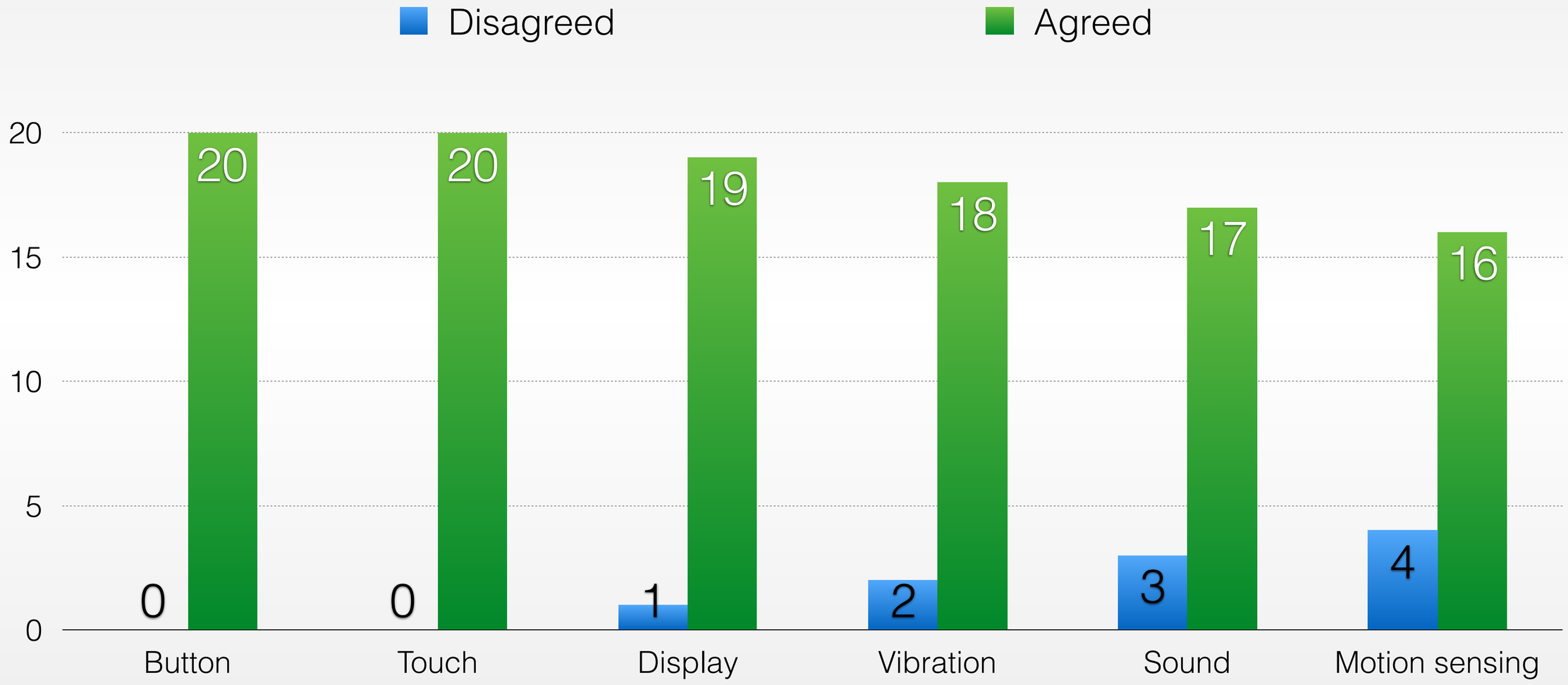
```
-(void)sendTextOut{
    NSLog(@"SEND TEXT OUT");
    UInt8 buf[20];
    NSString *str = [NSString stringWithFormat:@"%i%i%i", requierdState,vibrate, playSound];
    [str getCString:buf maxLength:20 encoding:NSUTF8StringEncoding];

    NSData *data = [[NSData alloc] initWithBytes:buf length:3];
    [_ble write:data];
}

-(void) bleDidReceiveData:(unsigned char *)data length:(int)length{
    NSLog(@"Message received with length: %d", length);
    (...)
```

Evaluation

- With user: **Model Extraction**
  - user tries to explains elements after using molT
  - user evaluates the system



Results



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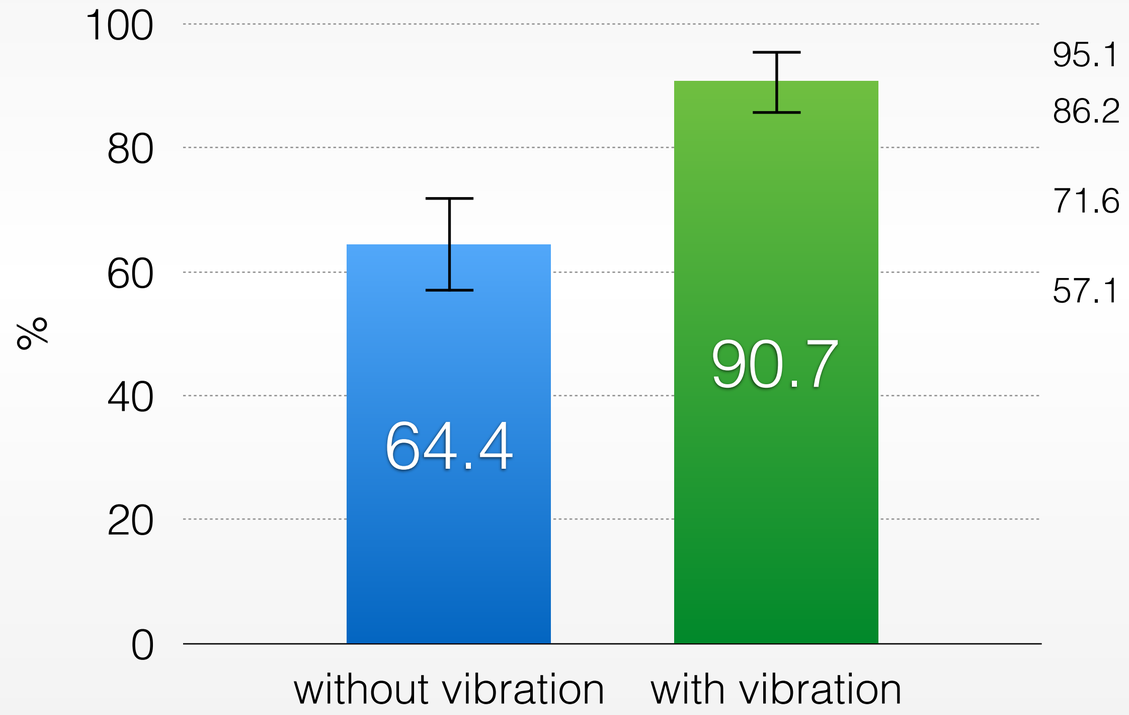
Evaluation - Haptic Feedback

- With user: **Controlled Experiment**
  - user plays one **with** and one **without vibration**
  - plays 2 minutes
  - asked how many collisions he had



Future Work

More use cases

- other than gaming
- more suitable

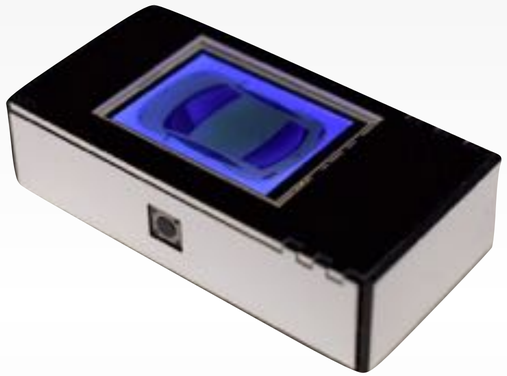
Enhanced Product

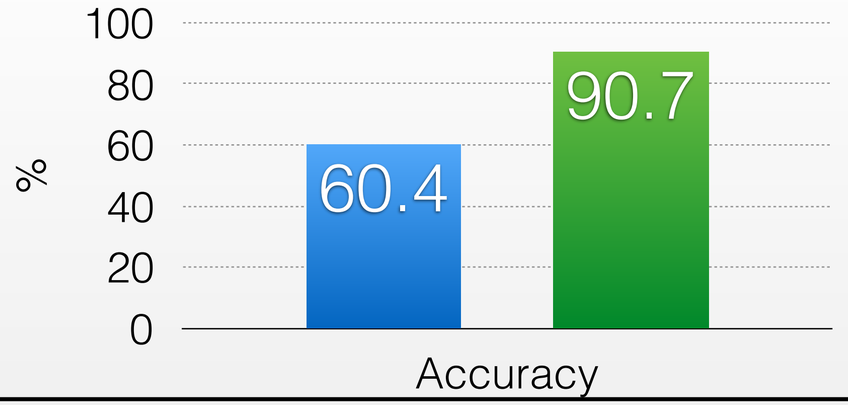
- smaller
- more powerful

More Input/Output

- Forcesensor
- mouse-wheel like input

Summary





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