

Empathic Lighting

Fast responding personal Lighting
based on Sensors and LEDs



Complete working system



design & decision support systems
conference 2016

Empathic Lighting

Problem:

Lighting situations are regarded as static without the influence of a user.

Known concepts from virtual worlds (CAD):

- Ambient lighting (daylight)
- Light sources from a point (spot light)
- Personal lighting (device: flash-, head-lights etc.)

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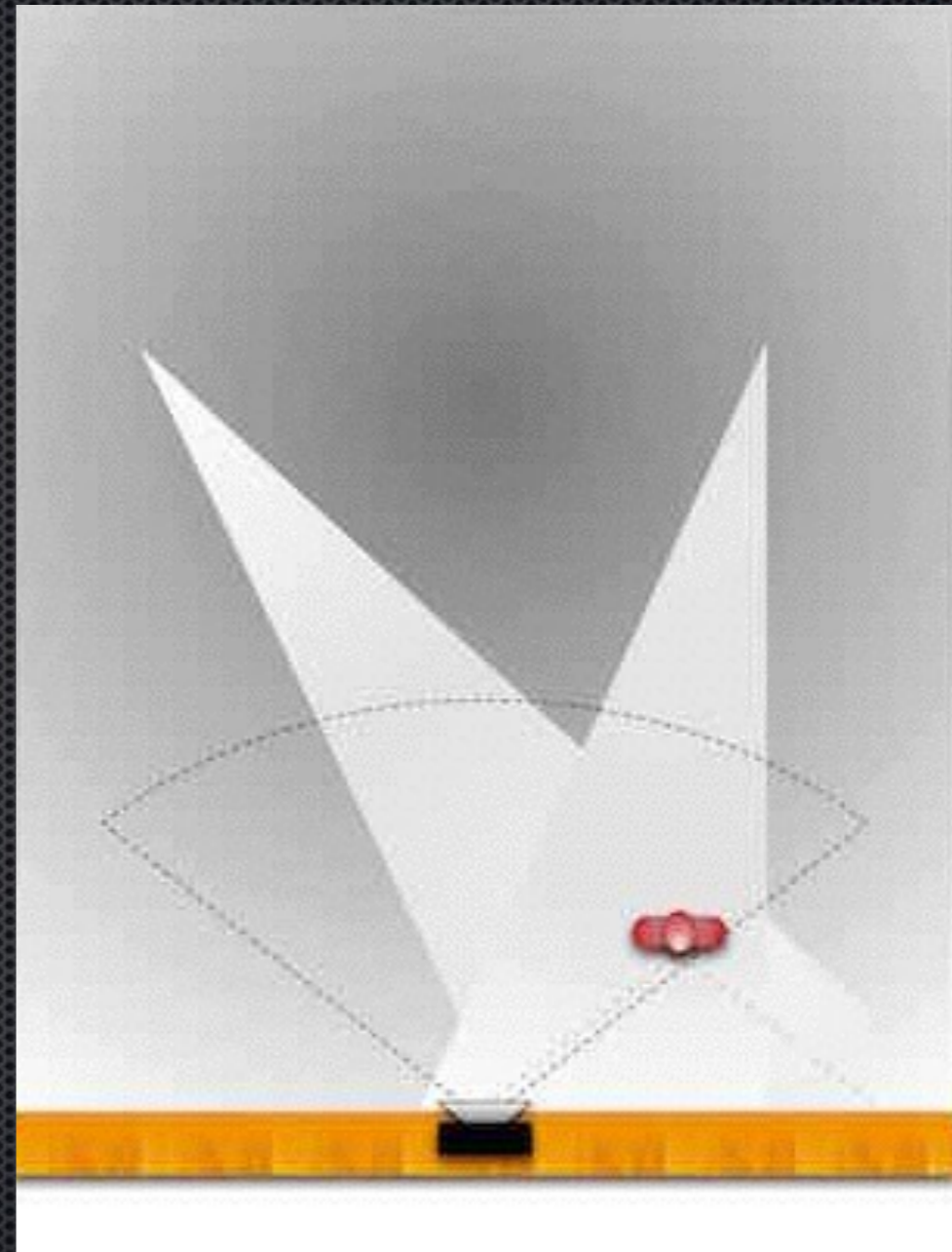
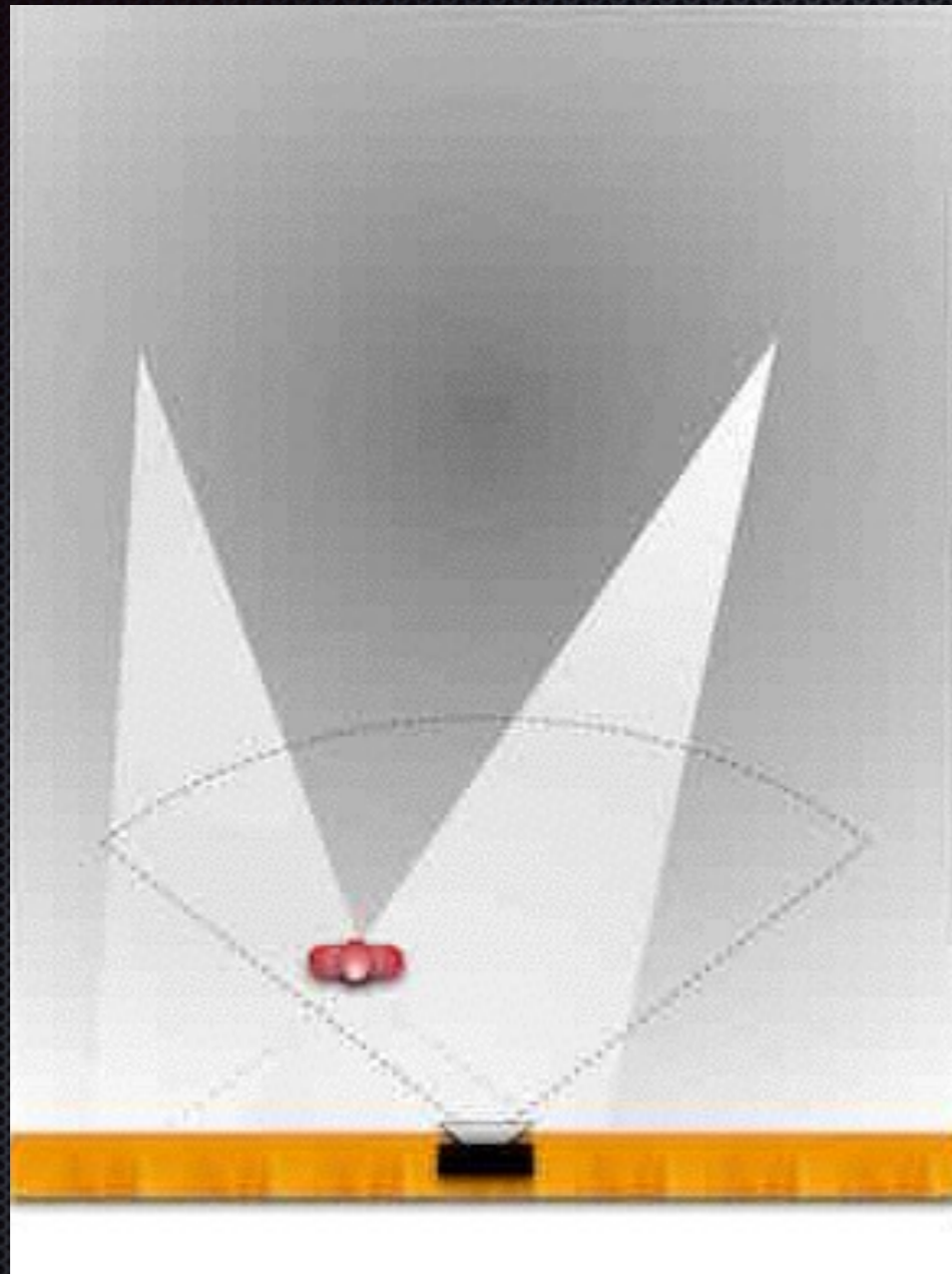
Idea:

Using an optical device to sense the optical intake of users.
Evaluate and determine their behaviour.
(Where are they looking at?)

Make a light source that enlightens (only) the area a user is looking at.
Correct the light in a way, that any influence of the environment
(shading) is eliminated. The object should always looking the same, for
any user

Sensor: Camera with face detection
Light sources: flexibly mounted RGB-lamps

Empathic Lighting



General idea:
viewer, object, camera and spot lights

Empathic Lighting

Makers:



[Maker Fair Kerkrade]

Empathic Lighting

Tools and techniques are from the makers' culture.

Vernacular architecture is well known. Buildings that fall into this category were just build without requirements to some theory or special design. The main reason for their existence is their practical usefulness.

The same applies to the projects of makers. They are made because of their obvious usefulness. The difference is that computers are involved, both as micro-controllers and as clouds, or as normal desktop or laptop computers in order to develop the software.

The usage remains still solely practical. Once it works, it works. If it can be enhanced, next time it will. That's it.

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Dale Dougherty's manifesto "The Maker Mindset":

"Maker Movement is spurred by the introduction of new technologies such as 3D printing and the Arduino micro-controller; new opportunities created by faster prototyping and fabrication tools as well as easier sourcing of parts and direct distribution of physical products online; and the increasing participation of all kinds of people in interconnected communities, defined by interests and skills online as well as hyper-local efforts to convene those who share common goals." (Dougherty, 2013)

It is one of the most comprehensive descriptions of Makers' Culture.

Empathic Lighting

Lighting Applications with LEDs

Advantages of LEDs

- Small size, even the wiring
- Although single wavelength, clustering is the way to add both brightness and colors.
- Each LED can be accessed in matters of milliseconds (PWM)

Most advanced: Sculptural lighting installations

Empathic Lighting

Building the lamp

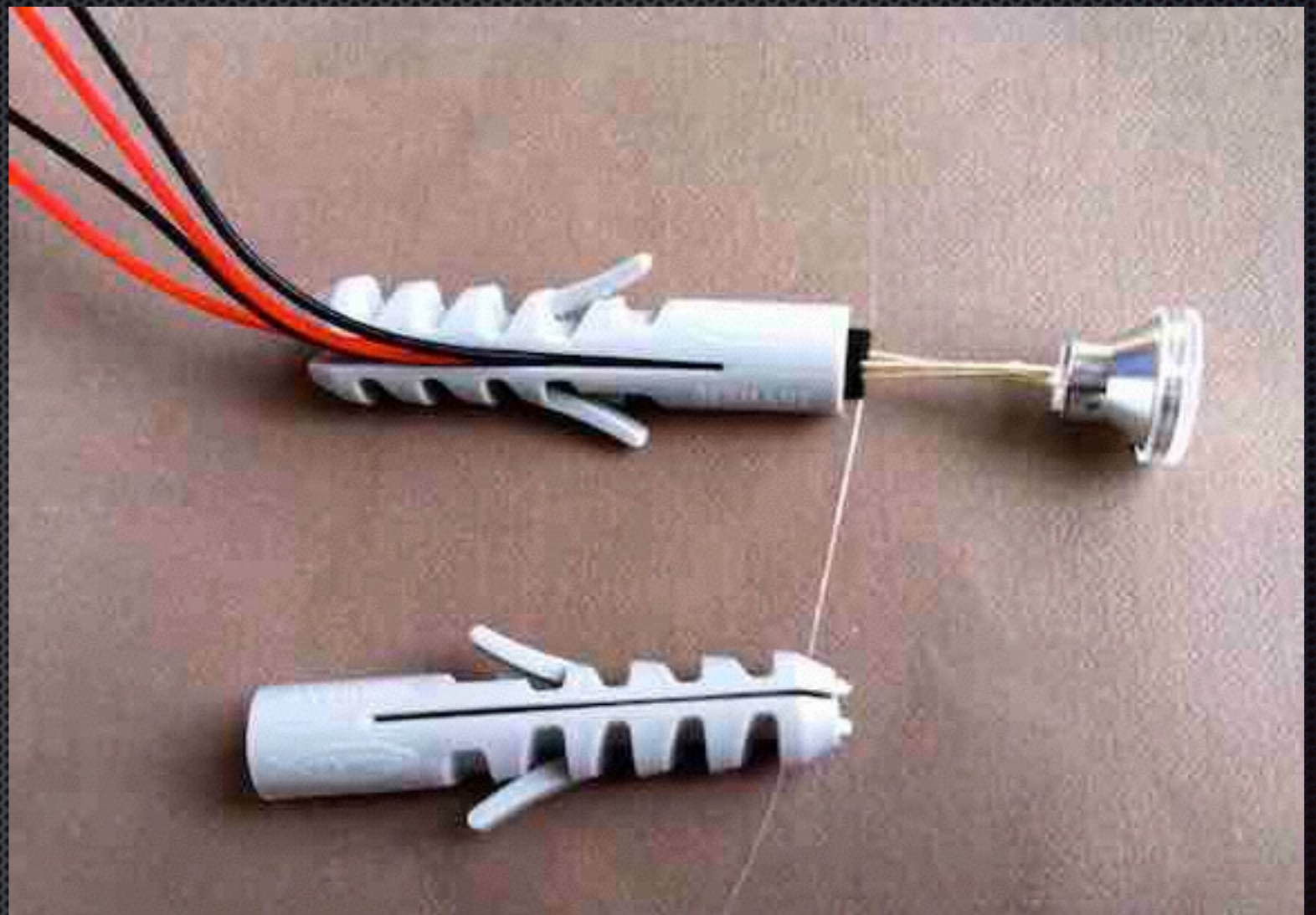
RGB-LED, reflector
and diffusor.



Empathic Lighting

Building the lamp

Assembled lamp
with a second dowel
pin



Empathic Lighting

Building the lamp

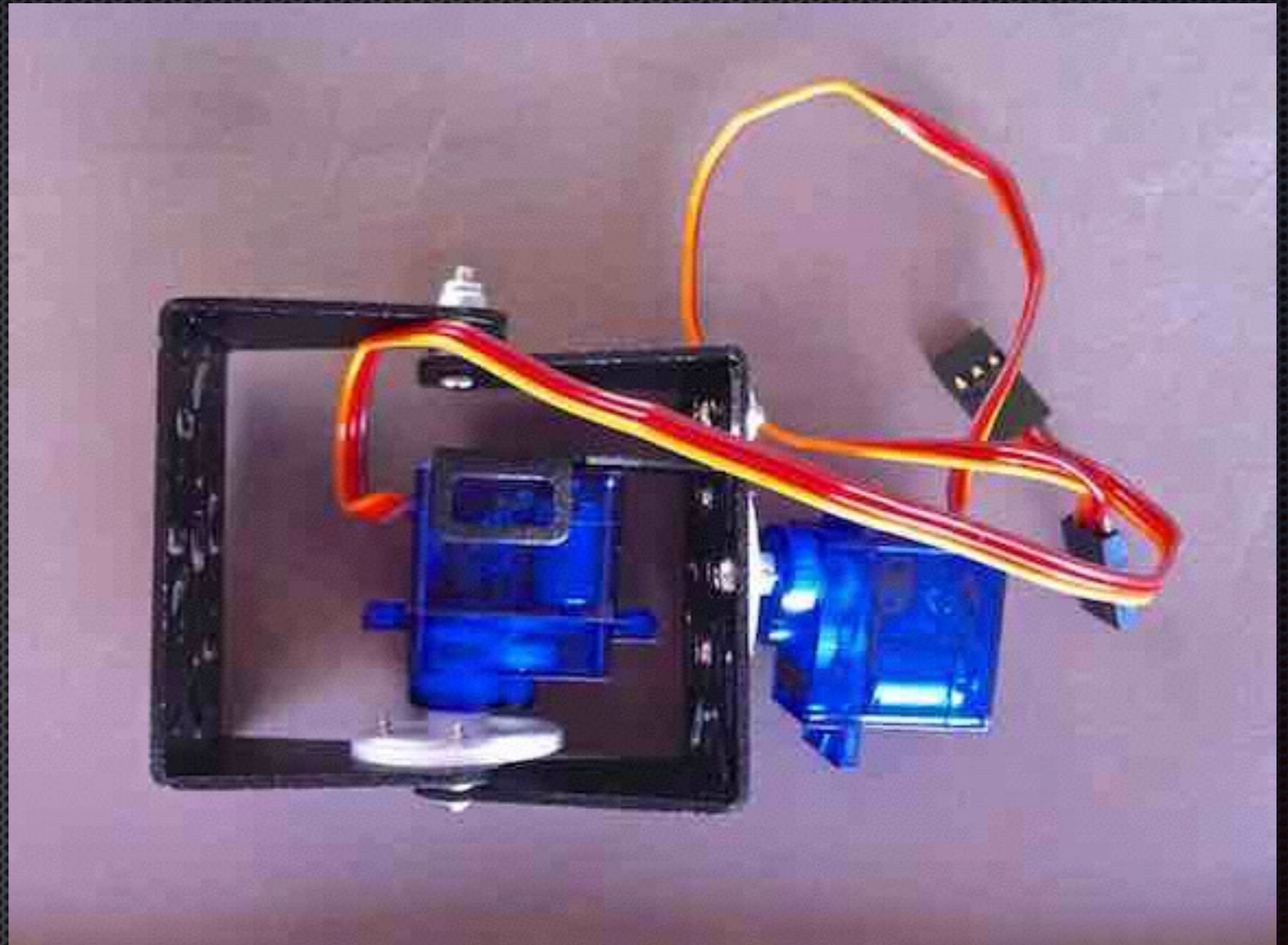
Two brackets and two servo motors, wheels, nuts and bolts



Empathic Lighting

Building the lamp

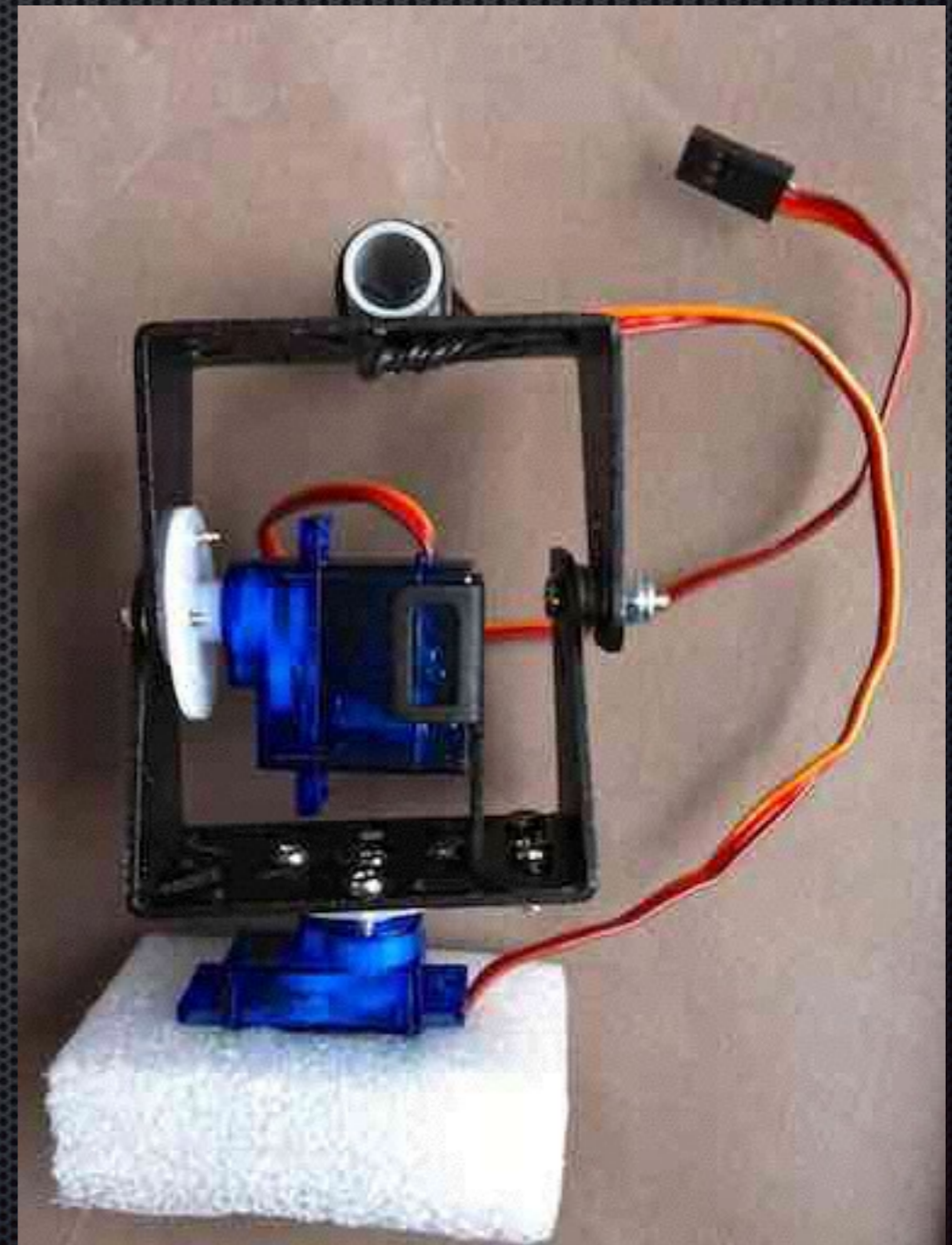
Motorized pan-tilt
bracket.



Empathic Lighting

Building the lamp

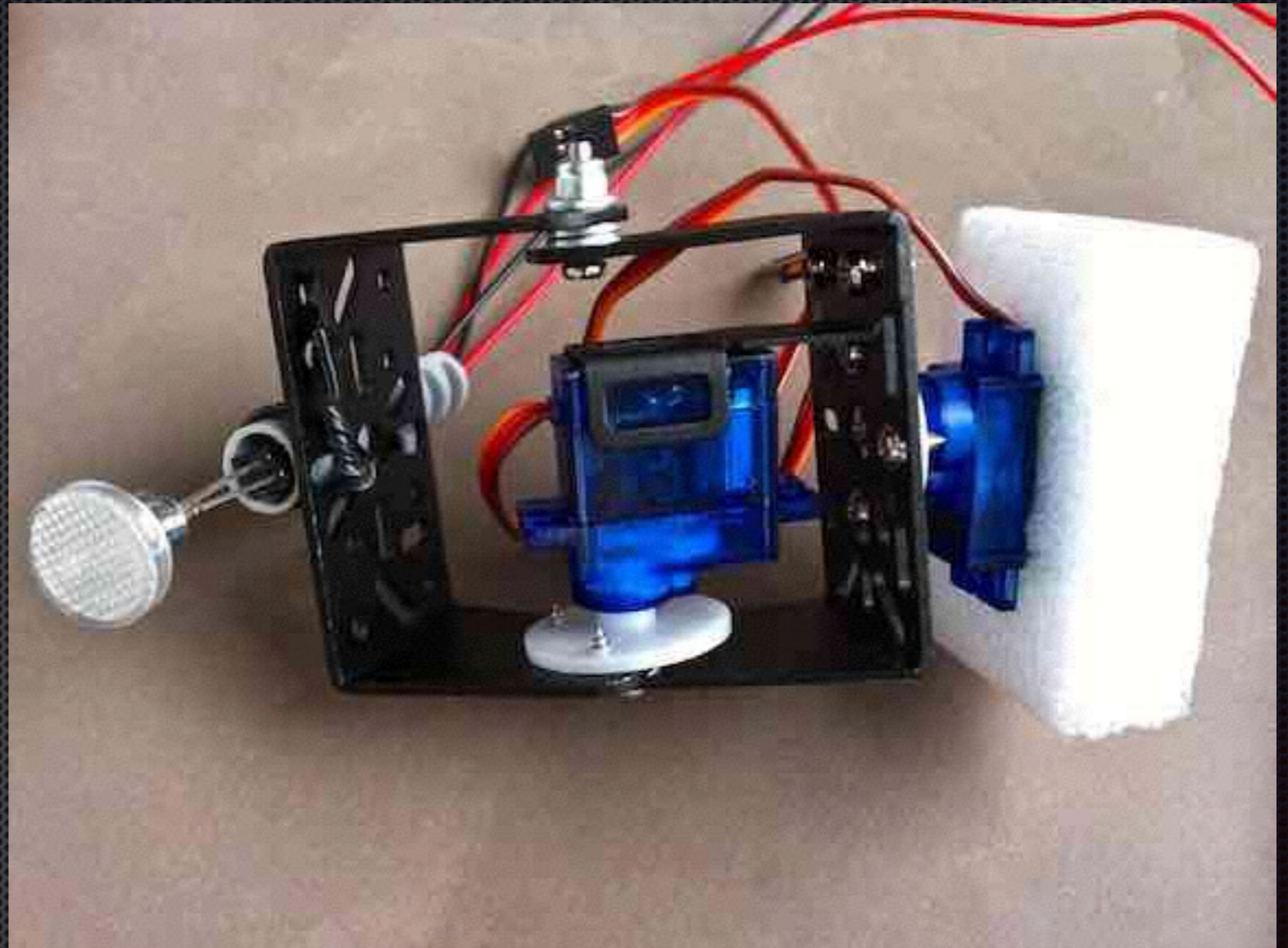
Making the mount



Empathic Lighting

Building the lamp

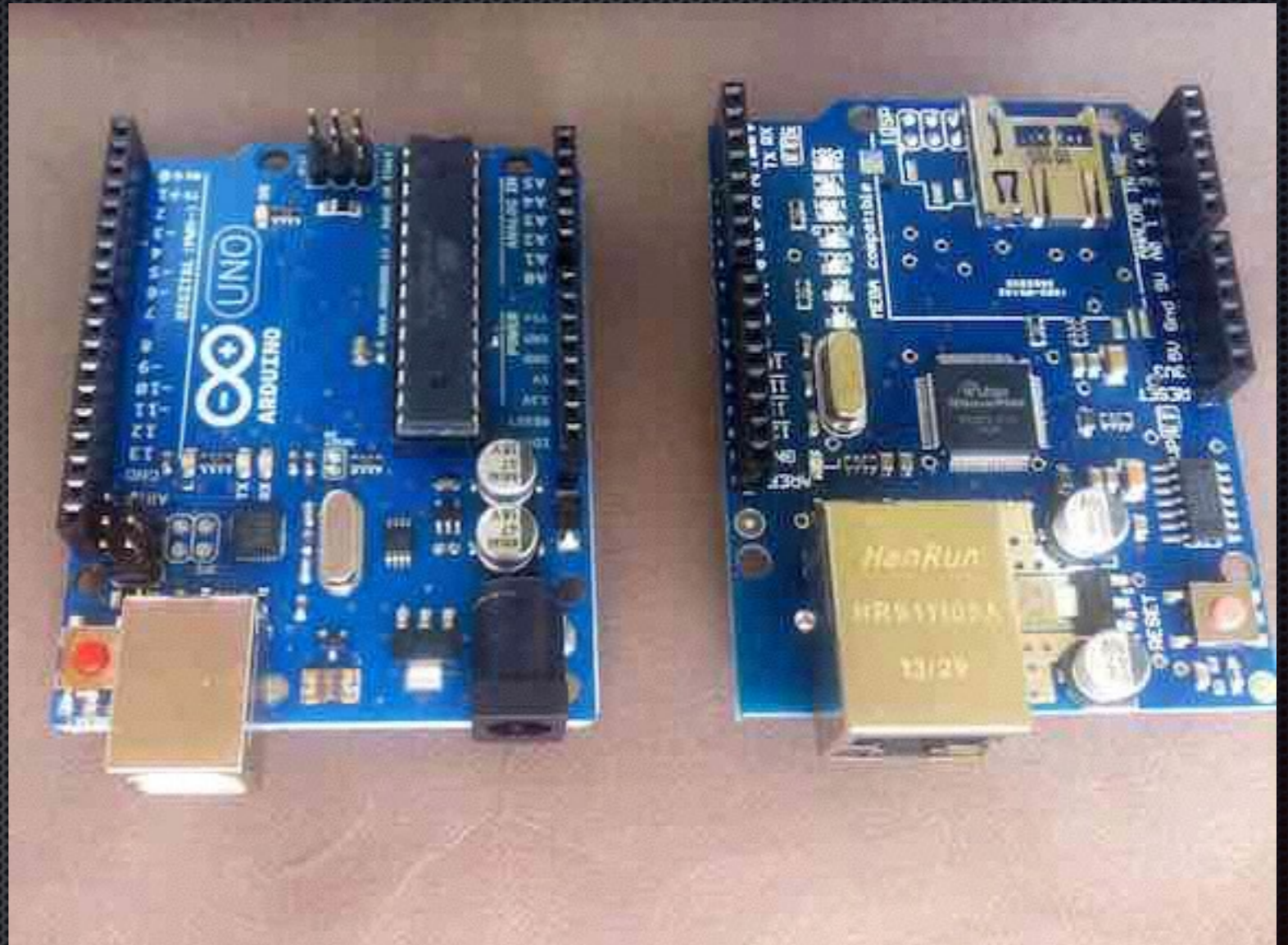
Complete lighting unit



Empathic Lighting

Building the lamp

Micro-controller board and Ethernet shield



Empathic Lighting

Building the lamp

Ethernet cables to
be connected to the
shields



Empathic Lighting

Building the lamp

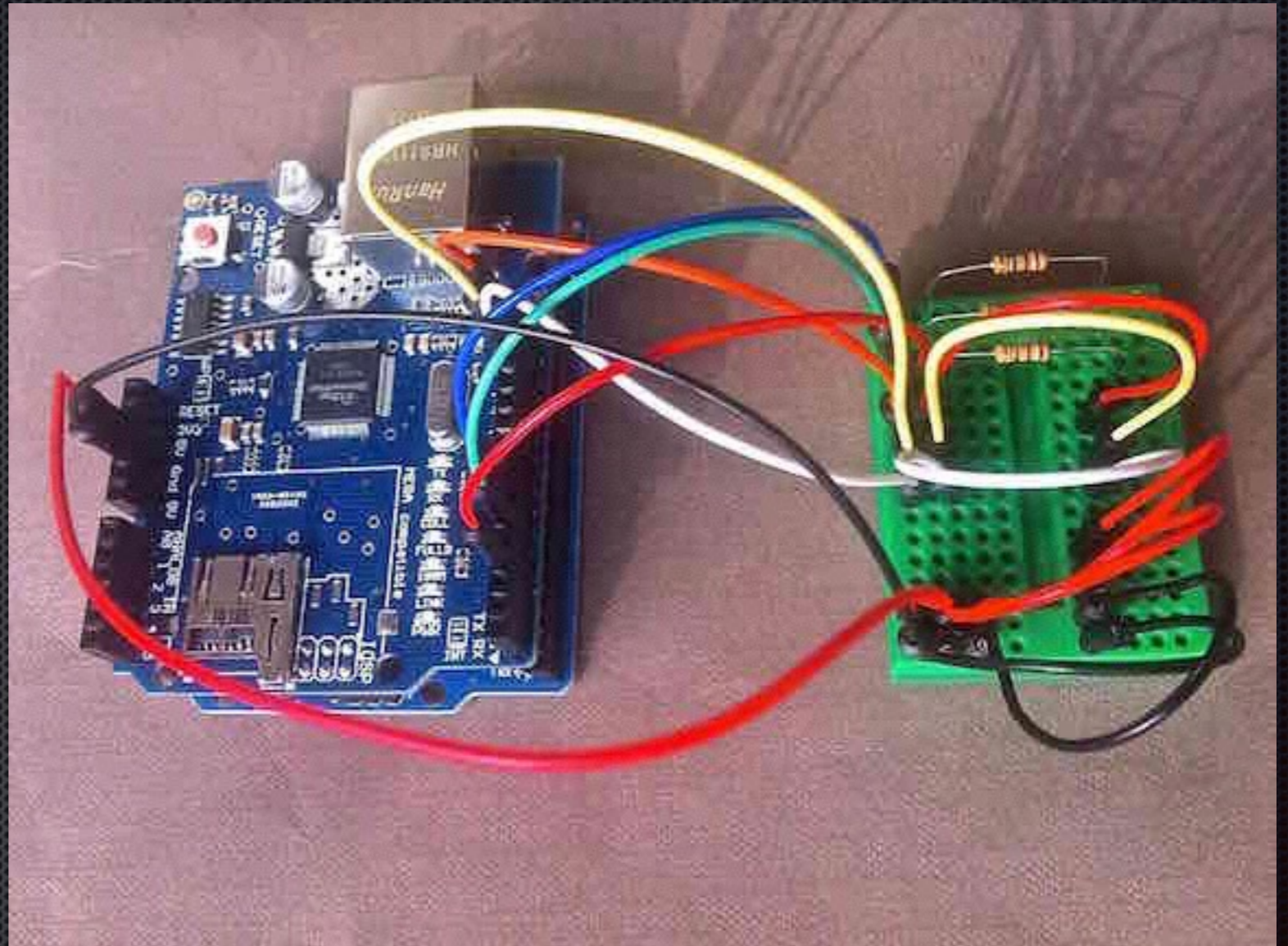
Simple Wifi-Router, enables Ethernet and wireless communication for the smart device.



Empathic Lighting

Building the lamp

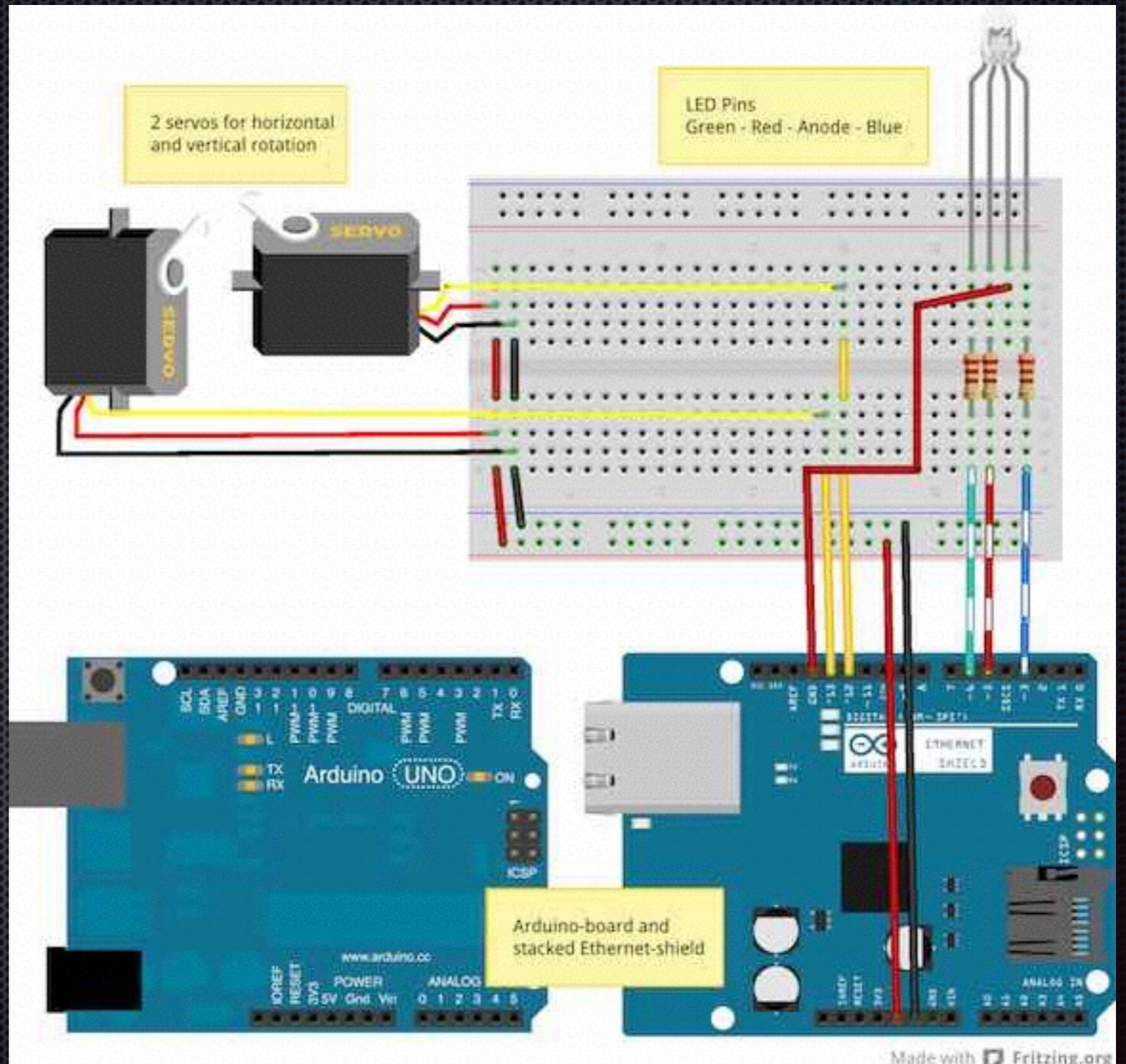
Stacked shields,
small breadboard
and wires



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Building the lamp

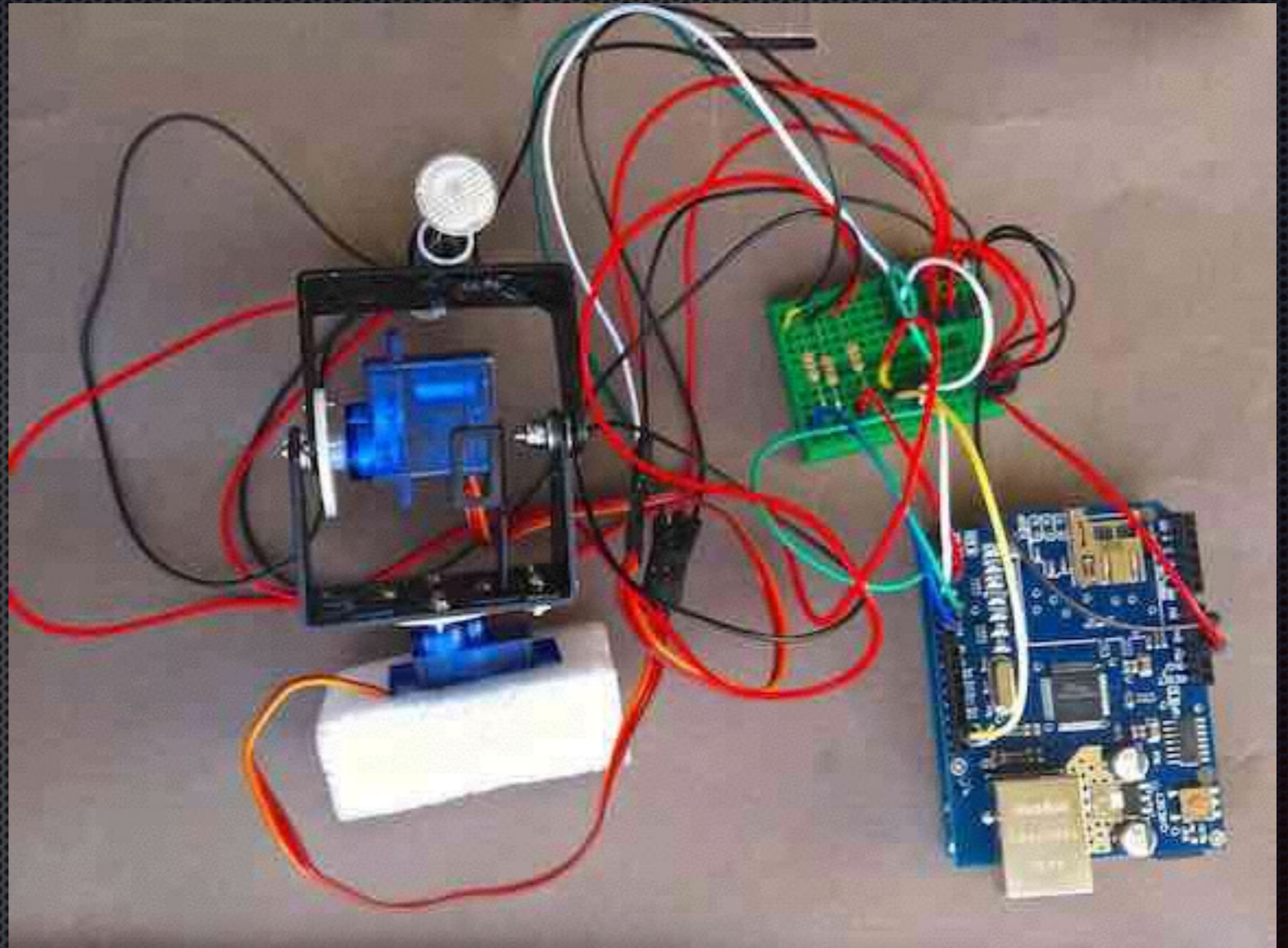
Schematic view of a single lighting unit.



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Building the lamp

Finished lighting unit



Empathic Lighting

Building the lamp

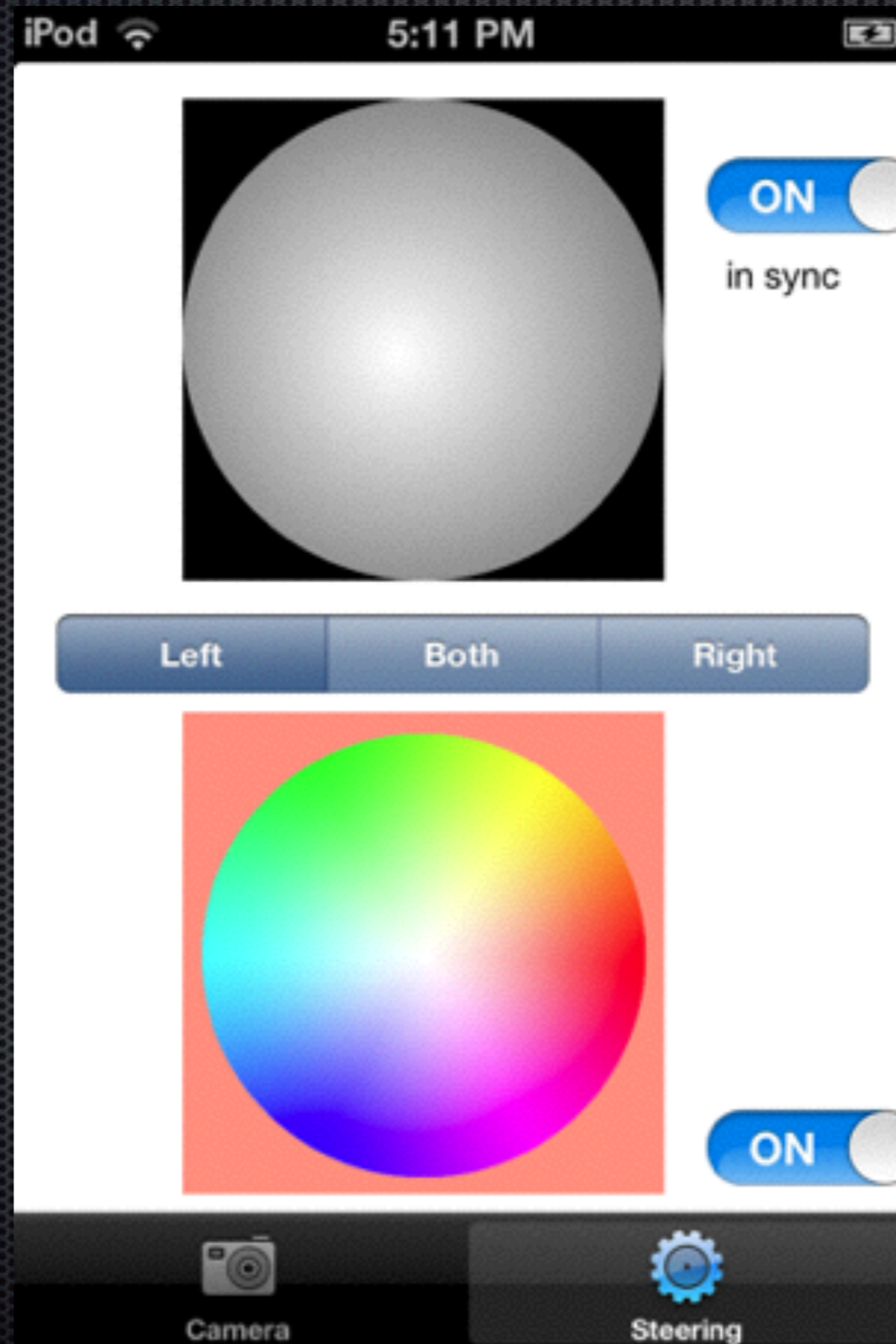
Smart device with camera, capable of face detection. In addition a UI is implemented.



Empathic Lighting

Building the lamp

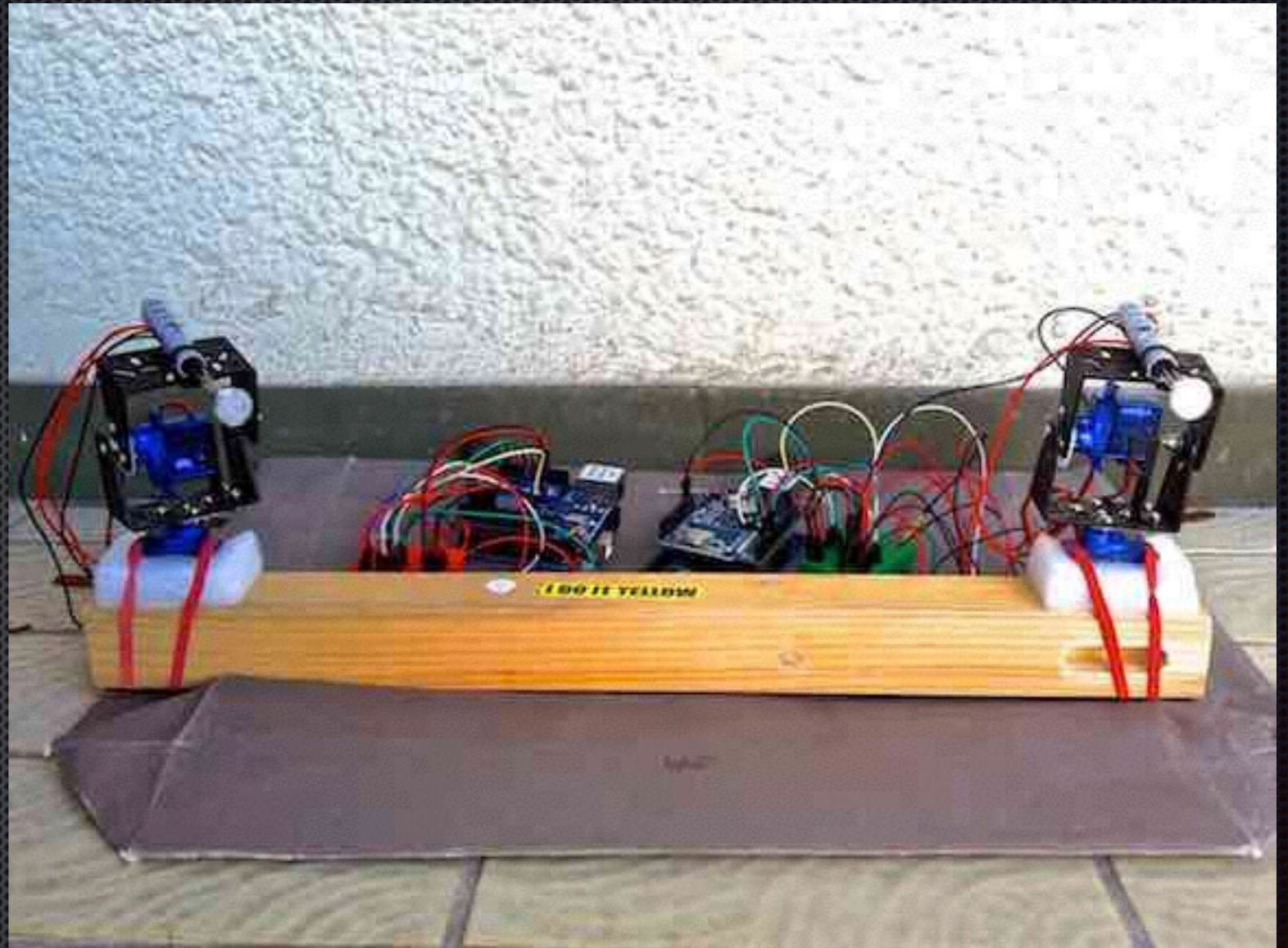
User-interface on a mobile device.



Empathic Lighting

Building the lamp

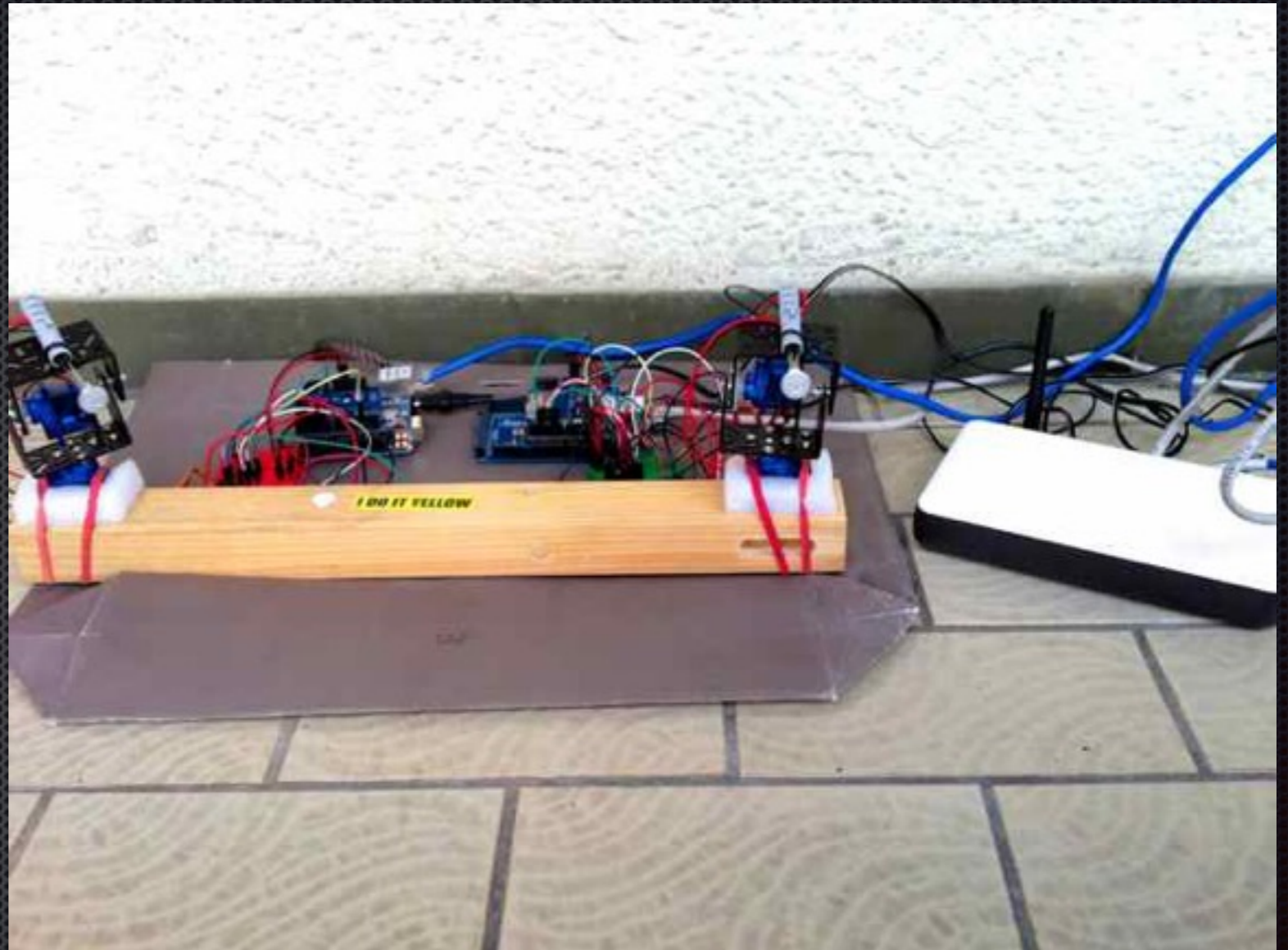
Two lights placed in a useful configuration for testing.



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Building the lamp

Complete system with wired connections and dedicated router.



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Other Projects

Smart Street Light
Outlet Spider

Empathic Lighting

Smart street light is the idea of a common shaped street light on a pole getting smart.



The concept combines different types of lighting, public lighting, emergency lighting and lighting as installation (art) into one single device.

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Making a smart street light:
white LEDs

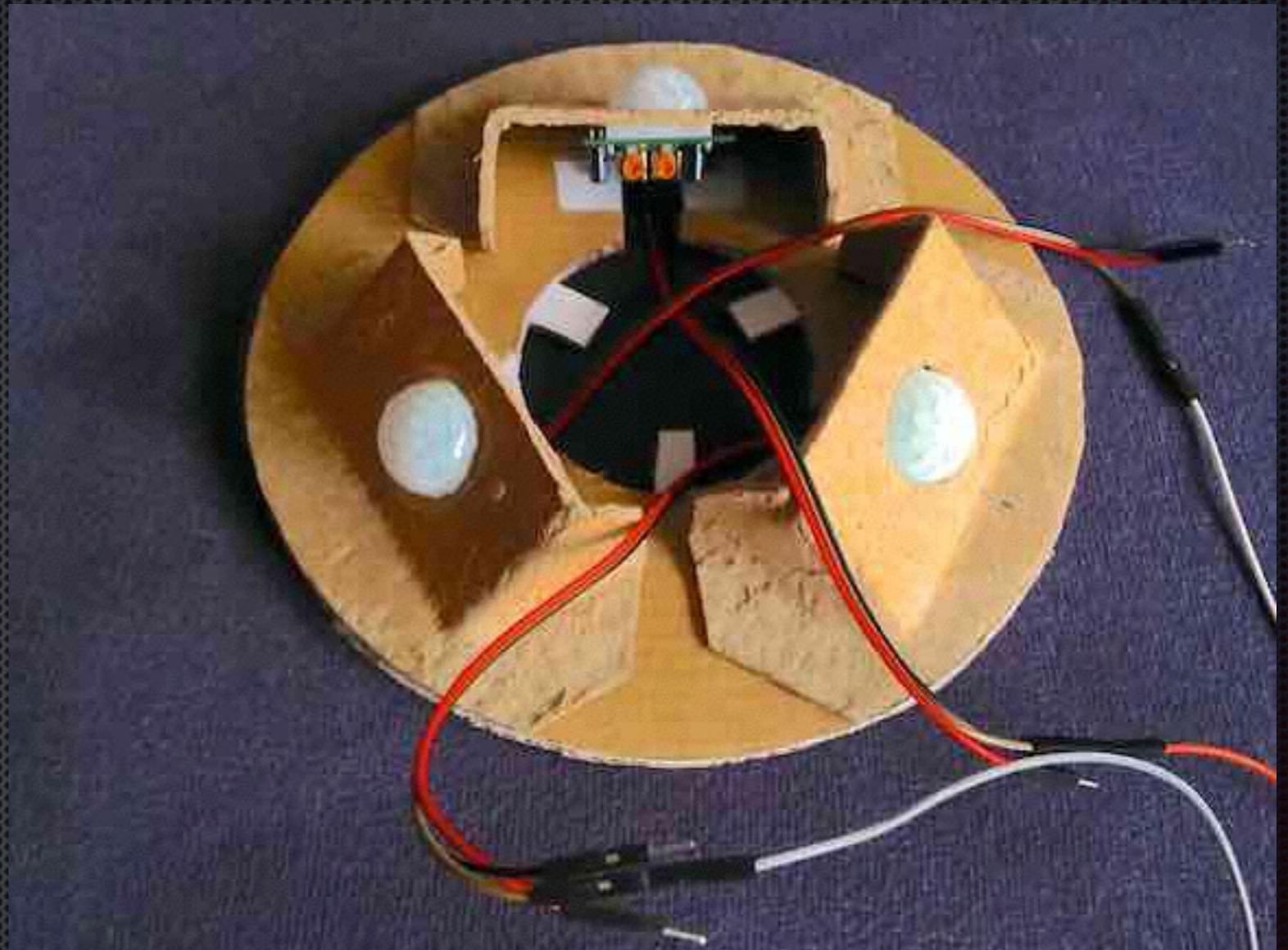
3 high power LED
mounted on heating
sink at 120 degree
each wired from the
inside of the pot.



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Making a smart street light:
Sensors

3 infrared based motion sensor, each mounted 45° vertically, 120° horizontally, wired through the inside of the lamp's pole.



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Making a smart street light:
RGB-LED

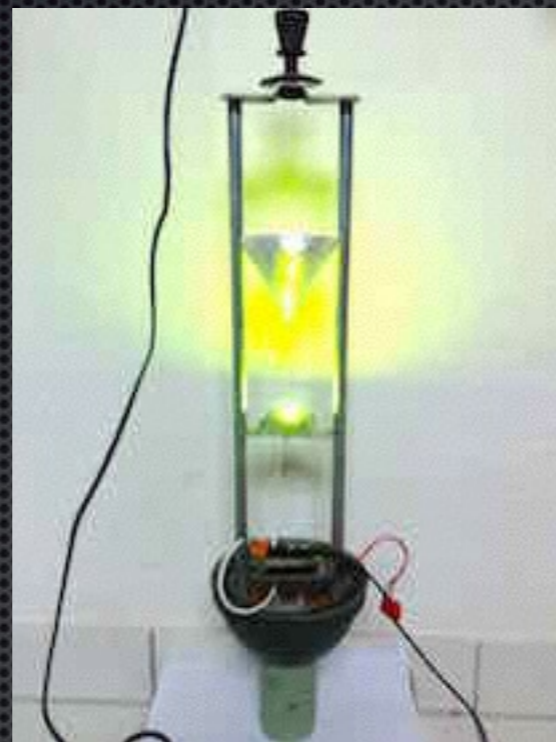
Single RGB-color LED mounted on the center of the rack.

On the bottom are the controlling boards.



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Making a smart street light: **Initial testing**



Tests with different colors and a really basic reflector.

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Making a smart street light:

Final result:

The fully assembled street light demonstrates the combination of a common style street light as enclosure with modern computational lighting techniques.



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Outlet Spider

The basic idea is that Wifi-enabled switches should not be plugged into outlets as switches or power bars, they should be integrated in buildings, similar to standard wirings.

And they should be programmable, integrated and controllable.

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Outlet Spider

Board with high-power relays and controller, power supply and wiring are placed into a junction box.



Empathic Architecture

Lighting



Motion



Empathic Architecture

How about a ceiling moving up and down?

A. (There will be no drawing)

B. Parts

- High-Power-Servos
- a fitting panel
- Controller (ok, done that before)
- Strings, wheels and hooks

C. Building it.

Empathic Architecture

Typical workflow

High-Power-Servos

- Google
- some robot shops
- pick some



Panel • Google -> 2-4 €/sqm from China

Strings and wheels • Google -> ???

... now we need a drawing

Empathic Architecture

Rem Koolhaas on intelligent Architecture

Now digital technology is no longer restricted to merely enabling design; it is rapidly integrating with architecture's essential physical components.[...] Looking at the traditional elements of architecture through a microscope, we saw the extent to which they had been penetrated, if not completely transformed, by new kinds of 'intelligence.'

For thousands of years, the elements of architecture were deaf and mute—they could be trusted. Now, many of them are listening, thinking, and talking back, collecting information and performing accordingly.

A Faraday cage will be a necessary component of any home—an electromagnetic shield offering a retreat from digital surveillance and preemption.

reference is in the paper

Empathic Architecture

Faraday cage ?

Sorry, but ...



Can a Tin Foil Hat Keep People (or Aliens)
From Reading Your Thoughts?

Empathic Architecture

Fears and anxiety can be countered through:

Knowledge & Practice

No further discussion.



Empathic Architecture

Shall we talk about clouds?

- Data clouds
- Messaging clouds
- Global clouds
- Local clouds (home servers)

Main problem is how to keep control,
and then who.

Empathic Architecture

**Computer Micro-computer and periphery
should be regarded as building materials.**

Coding is part of the design process

Empathic Architecture



Empathic Architecture



```
void loop() {
  float values[5];
  int i;

  // If there's any data available, read it.
  EthernetClient client = myServer.available();
  if (client) {
    char c;
    while(c != '?')
    {
      c = client.read();
      client.print(c);
    }

    for(i=0; i < 5; i++)
    {
      float value = client.parseFloat();

      if(i<3) //Color's
      {
        value = constrain(value, 0, 1);
        if(value>0)
          value = pow(2, ((9.0*value)-1.0));
      }
      else //Angle's
      {
        value = constrain(value, 0, 180.0);
      }
      values[i] = value;
      Serial.println(value);
    }

    setAllValues(values);
    client.stop();
  }
  else
  {
    Serial.println("No Server here!");
    delay(1000);
  }
}
```


Empathic Architecture

Future development

A lot of ideas.

HomeKit integration for mobile devices.

Smart phone is single centralised remote control

Research on sensing inhabitants:
How, when, what?

Describing possible, yet unknown use cases.



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Acknowledgement



people doing strange things with electricity in Aachen
<https://hci.rwth-aachen.de/dorkbot>

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Thank you!



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