Introduction to Robotics for Children

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Chapter 1

Electricity

1.1 Light a Bulb

You turned on the Light many times. You just throw the switch, and the light goes on.

1.1.1 Why does the bulb light up?

Because Electricity goes trough a tiny wire inside the glass. That makes the wire so hot that it starts to glow. That glow is what we see.

1.1.2 What is Electricity?

You can think that electricity is like water in a hose or a tube. You have to imagine the hose full of water for this to work. You can pour in more water on one side, and about the same amount of Water will come out on the other side.

Electricity Flow of Water
Electron A piece of Water
Wire Hose

Battery Pump
Solar Panel Pump
Light bulb Turbine

Circuit All the Pump's, turbines, hoses, pipes together

Electricity is kind of weird though. It never really "leaks out" onto the grass like a garden hose can. It always has to stay in a hose. If the hose ends, the electrons can't go out.

So, a Wire is like a hose. The light bulb has a tiny hose inside, too.

1.1.3 Why does it move?

Electricity stays always in the hose. So, why would it ever move and make the light go on?

It does that because there's a "pump" somewhere. A Battery is a "pump" for electricity. A power plant is a "pump" for electricity. A Solar Panel is a "pump" for electricity. We call them "Sources of electricity".

So, a battery always tries to push electricity trough the wire. When one wire is connected to one side of the light bulb, and the other wire is connected to the other side, the battery can push the electricity trough the light bulb and make it light up.

When the wires are not connected right, the light bulb won't light up.

1.1.4 A switch

Now we saw that in a broken circuit, the electrons can not light the bulb.

That's great news if we want to turn the light off! We just have to cut the cable somewhere, that will turn the light off. Now, you don't want to walk around with a wire cutter to turn off the light, so we put a Cutting machine in the circuit. Like so:

That can turn the lights off.

1.1.5 A motor

A motor turns one way when electricity comes trough one way, and the other way when it comes the other way. We'll build one sometime later.

Chapter 2

Programming

2.1 Tell the computer what to do

When you are programming, all you do is to tell the computer what to do.

Example: Dear Computer, please Write "Hello" on the screen. Then, write all the numbers from 0 to 10, each on their own line.

The Computer is really lazy, but also always does what you tell it to do. If you don't tell it to do something, it won't do it. If you are not really precise in telling it what to do, it will do something different from what you are expecting.

When you tell people to do something, you expect them to think. Like this:

- Close the Door! (Of course Only if it's open.)
- Wash the dishes! (The dirty ones of course, not the clean ones.)
- Vacuum! (The carpet, not the ceiling!)

If you don't tell the computer exactly what needs to be done, it will get confused, do the wrong thing, do nothing at all, or complain.

2.2 Computer Languages

Computer Languages are the only thing the Computer understands. They are made so that the computer can not "find excuses" to do something else from what you are telling it to do. They are Simple.

In a computer language

every Idea

or command

is on its own line.

Kind of like a shopping list. That makes it easier for you to understand. The computer does not really care.

There are many computer languages. They are all a bit different from each other, but not too much.

2.3 Python

```
Python is a computer language.

print "hello";

will write hello to the screen.

x = read;

will read what you type in.

What will this do?

print "What's your name"; x = read; print "Hello", x;
```

Chapter 3

Lessons

3.1 Electricity

Explain Electricity. Use Water equivalence.

3.1.1 Lesson

- Electricity always goes around in a circle. If there is an interruption somewhere, it does not go past.
- Explain Switches and electric "switching machines" like relays and transistors
- Sources: Explain danger of AC. Explain Batteries (water balloon) example. Explain what not to do, to keep batteries from exploding.
- Loads: Motors, coils (for relay), lights, and LED's. Note that direction of current makes a difference for LED's and Motors. Explain when and why things blow up.

3.1.2 Lab

- Do simple tasks, create circuit with wires, batteries, switches and loads. Encounter practical problems. Repeat.
- "Put a battery, a motor, a light bulb and 2 switches together so that you can turn everything off, or either the bulb or the motor on."
- \bullet "Use a switch to make the motor go backwards and forwards."

3.2 Programming

3.2.1 Lesson

- Pick simple language (which one? Logo? Basic?)
- Explain how computer does things (follow instructions).
- Have 1 Child be computer and one instructor, move ball from a to b.
- Show debugger of hello world (step trough).
- Maybe introduce loops

3.2.2 Lab

- Start Computers, write Hello World.
- Write small program that counts to 10 with loop
- Use debugger (?)

3.3 Put it together

3.3.1 Lesson

- Introduce new command that controls Hardware.
- Repeat lesson 1
- Repeat lesson 2
- Show example (debugger, lamp)

3.3.2 Lab

- Make lights blink with program.
- Make wheels turn with program.

3.4 Voltage and Current

3.4.1 Lesson

- What is a Voltage?
- What is a Current?
- What's analog/digital (on/off vs a little on or more on than off)
- \bullet How to measure Voltages and Currents

3.4.2 Lab

- Read back signals (analog and digital) and measurements into computer.
 Show them on screen.
- Measure Battery Voltages. Compare on screen. Add loads. !?!?
- Change outputs and read them back.

3.5 Resistors and Ohm's law

3.5.1 Lesson

- Why does the Voltage go down when the Motor runs?
- How to measure Resistance.
- U/R=I and derivatives.
- Resistors and Potentiometers

3.5.2 Lab

- Measure Potentiometers.
- Maybe: Use Pot to change Angle of a Motor. (first real Robotics thing).

3.6 Take things apart and wire them up

3.6.1 Lesson

- Review how to measure things, etc.
- How to cut cables without getting hurt.
- Measuring things that are not supposed to be measured.

3.6.2 Lab

- Take apart toy, measure internal voltages when it's working.
- Disconnect Wire and remote control from computer.

Appendix A

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