EXHIBIT B2

LEGO A/S Ex. 2104
Rubicon Communications, LP v. LEGO A/S
IPR2016-01187

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http://www.philohome.com/mindstorms.htm Go

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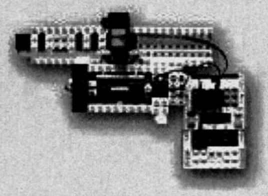
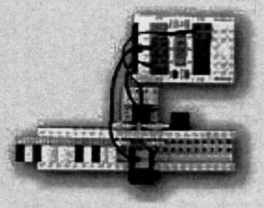
LEGO® MINDSTORMS™ & LEGO Technic

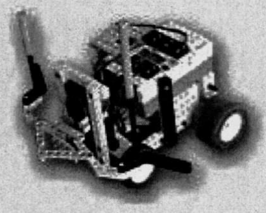
My own creations...



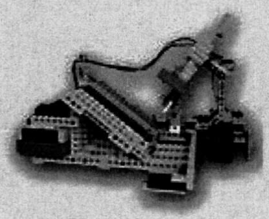
Card Reader
Read values on LEGO binary cards.



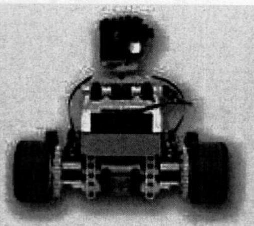
Card Reader 2
Improved, faster version of Card Reader.



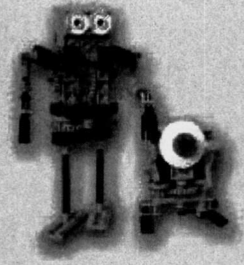
Radar Car
slows in front of obstacles and avoids them.



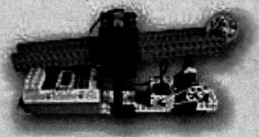
Brick Mixer
Orders bricks on a conveyor belt according to the value read on a card.



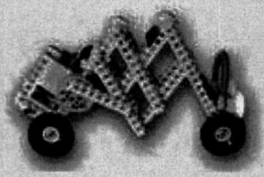
Wall Follower
RoverBot that follows a wall using my GP2D12 distance sensor.



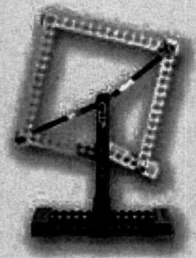
Gonsuke and MedamaOyaji
Two tiny walking robots, designed by Hiroki Shirakawa. I created building instructions...



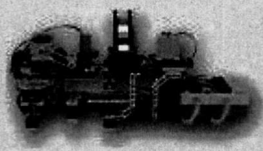
See-Saw
Not fancy as a LEGO construction, but interesting control program challenge.



Creeping Caterpillar
A strangely moving vehicle, fun to watch

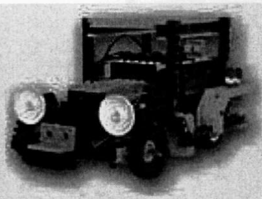


Peaucellier Cell
Converts rotation motion to linear motion

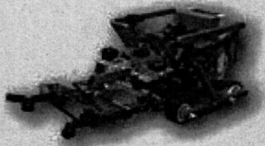


Brick sorters - Three generations of brick sorters, the latest one includes full building instructions and supports my color sensor.

Brick sorter 1 - **Brick sorter 2** - **Brick sorter 3**

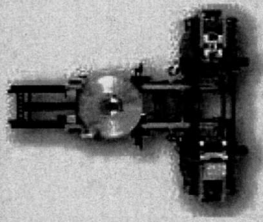


Rack and Pinion Steering Car



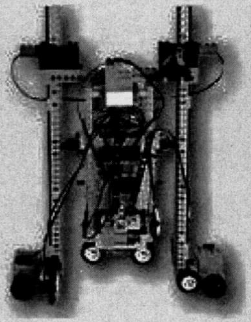
Barrel Collector Robot

Thanks to its laser sensor, this robot detects barrels up to 3 meters away, goes straight to them, grab them with its arm and collect them in a basket.



Hammerhead, the CD thrower

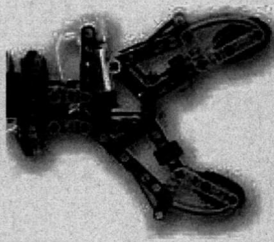
My entry for the **Mindstorms COMMUNITY CONTEST # 2: Discus**.
This beast throws Compact Disks 15 feet away and more!



P'titgneugneu the stair climber

My entry for the **Mindstorms COMMUNITY CONTEST # 3: Stairs**.

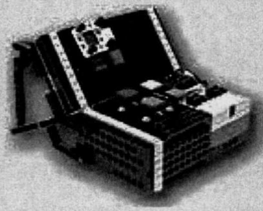
A bit too flimsy, but nonetheless won the contest!



Pneumatic Arm

A fully pneumatic arm, loosely built after the human arm.

Update October 2004: Now includes LDraw files

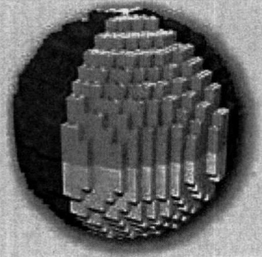


Brick Simon, a memory game

My entry for the **Mindstorms COMMUNITY CONTEST # 6: Simon**.
Also includes a simplified version that can be built with Robotics Invention System set only.
New: October 2004.

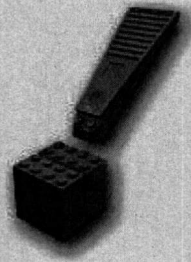
Other LEGO stuff

A visit to **LEGOLAND® Deutschland**



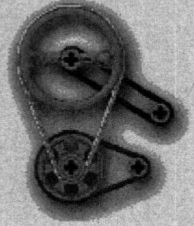
Sphere Sculpture

Building a multicolored LEGO sphere with a single "Blue Tub"



Brick Remover

An imaged tutorial on the use of this little thing.



Rubber belts modeling

DAT files to create rubber belts in you favorite CAD program.

Unofficial LeoCAD parts updates

Parts updates for LeoCAD, corresponding to recent LDraw updates

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LEGO has its own homepage: www.lego.com, and a page on the Mindstorms system: mindstorms.lego.com.

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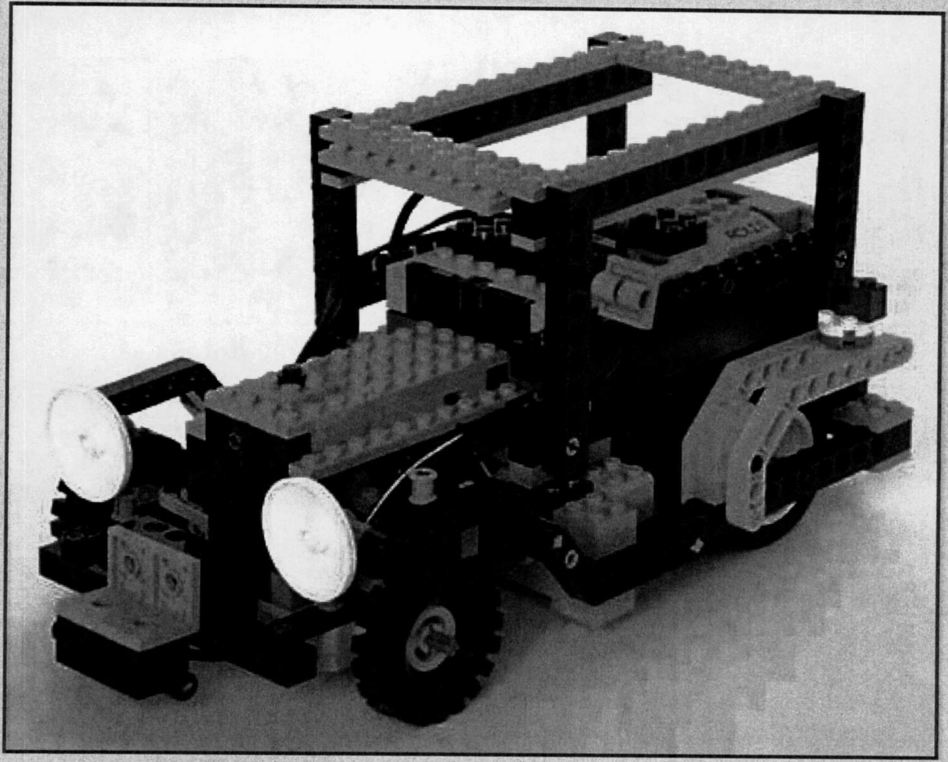
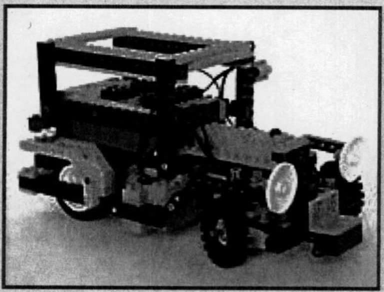
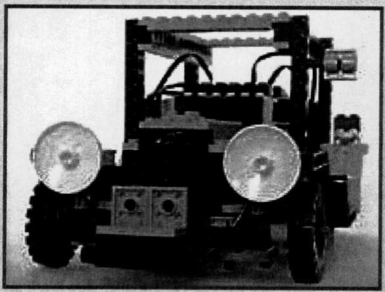
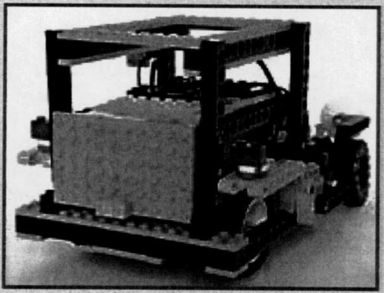
Rack and Pinion Steering Car



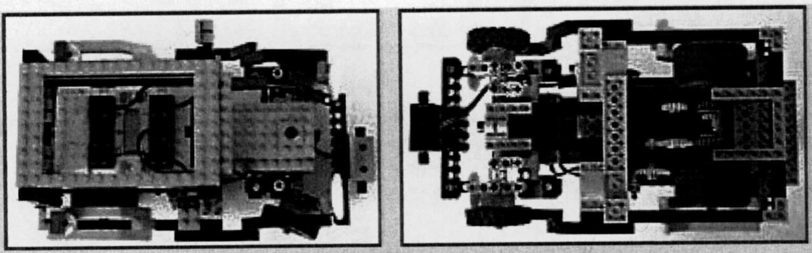
This rack and pinion steering car was borne as a test vehicule for my wire guidance sensor, but it can be also used with many other sensor configurations. This car uses only parts included in Robotics Invention System box (with the exception of red rear lights - RIS contains no red parts!). Originally intended to be a simple chassis, I soon found that it's "cubic" structure was closer to old jalopy than to modern cars, and I added bells and whistles to reinforce this look.



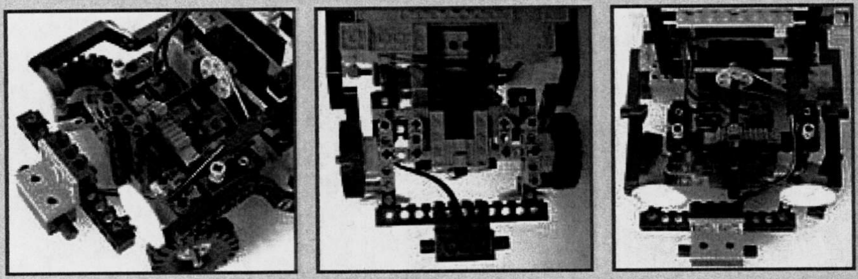




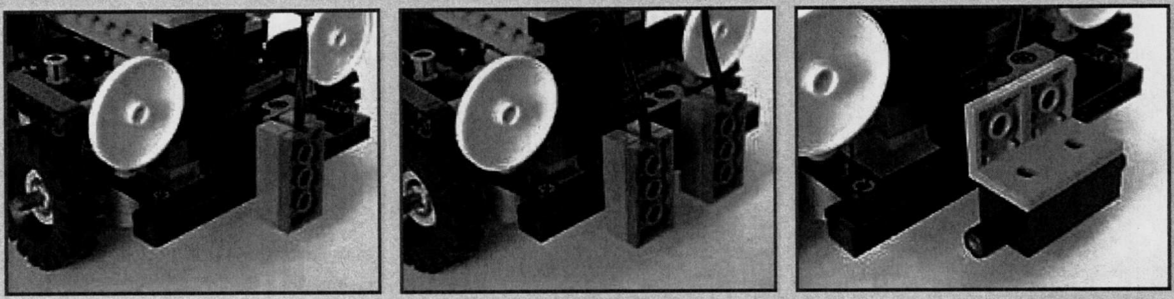
Guided tour...



Top and bottom view.
It is fairly easy to modify gear train to change car speed.



Steering assembly details.
Two touch sensors are activated when steering is at full stroke, but I seldom used them as the belt driven mechanism slips in that case.



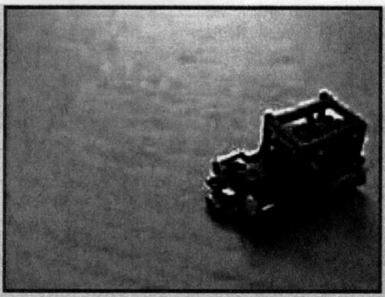
Sensor equipment.
The car can be easily equipped with one or two touch sensors for line following. And of course it can use my wire guidance sensor!
The sensors are placed on the front bumper, and driven by steering mechanism. This provides better direction control.

- **Step by step construction instructions**

  LeoCad design files are available here.

- **Programs**
  Get HQC program:
  - One light sensor
  - Two light sensors
  - Wire guidance sensor

- **Steering Car with Wire Guidance sensor in action:** QuickTime movie. (Movie courtesy of Pascal Bréard)



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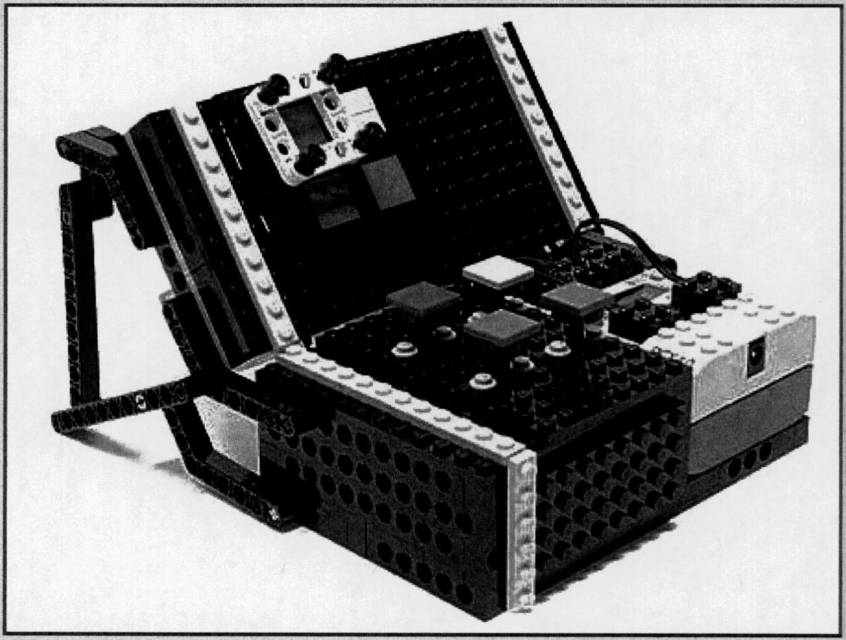
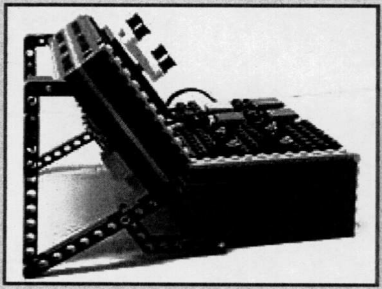
Brick Simon, a memory game

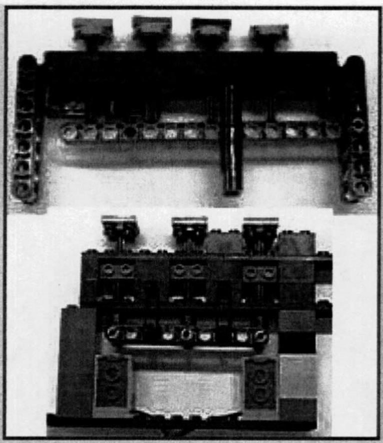


Brick Simon was placed second in CC6: Simon contest



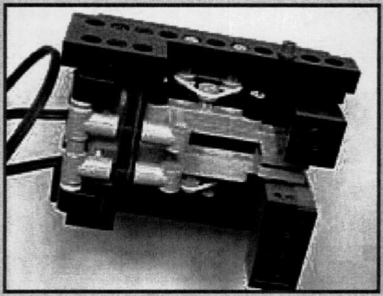
Here is my entry for the **Mindstorms COMMUNITY CONTEST # 6: Simon**.

You may have a look to other contestant's clever entries here.

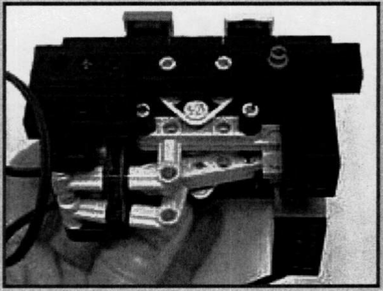


I wished to keep a true 4 keys keyboard for ease of use. A few constructions later, I was convinced that I needed all three sensors to get a reliable keyboard.

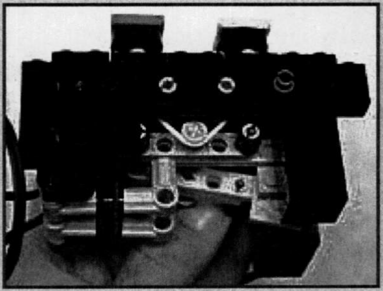
No sensors left for the display function!



So I built this keyboard module. Keys are linked two by two by a rubber band loaded lever to keep them up.

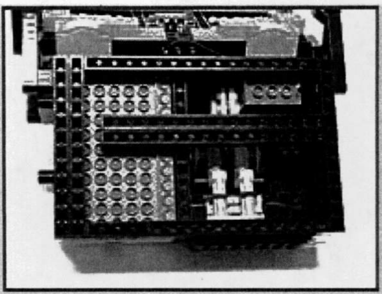


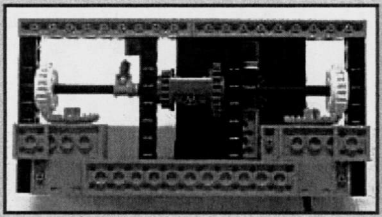
The two keys on the left release the pressure on two touch sensors.



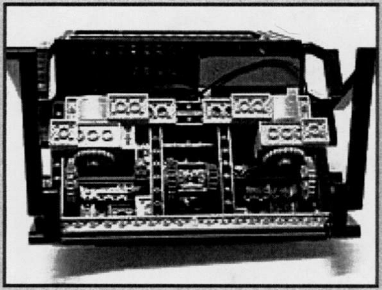
The light sensor on the right sees black when no key is pressed, grey or yellow when one of them is pressed.

The keyboard unit, integrated in Brick Simon.





This prototype of the display unit shows how I obtained 4 states: the left motor can make one turn, the right motor only a half turn. The differential adds these movements, when both motors are on a stop its body can have 4 positions: 0 turn, 1/4 turn, 1/2 turn and 3/4 turn. Originally, I used white clutch gears, but they were still too stiff and I had to use very low motor power settings (0 and 1). You may have to increase these values to 1 and 2 if you use the new 43362 motors with higher friction.



The display module, integrated in Brick Simon.

- **Brick Simon User's manual**

1) Compile and download Simon.nqc in program slot 1, and InitHighScore.nqc in program slot 2. This can be done using BricxCC, you can get it from http://bricxcc.sourceforge.net/.

2) Run program 2, this will initialize all high scores to 5, then automatically launch Brick Simon program (slot 1). This initialization should be performed only once to preserve high scores between runs, after that launch program 1 directly.

3) Brick Simon will first ask for the play difficulty level. RCX LCD shows a walking 1234 pattern, waiting for a key to be pressed.

- Level 1 (blue key): The easy one. The random color chooser is biased to produce regular sequences. The same color can't happen twice successively. High time out on the keyboard (20 seconds)
- Level 2 (red key): The same color can't happen twice successively. Keyboard time out = 2s
- Level 3 (yellow key): Color order is truely random. Keyboard time out = 1s
- Level 4 (green key): The hardest level. Color order is truely random. Keyboard time out = 0.4s

A separate high score is kept for each difficulty level.

The chosen difficulty level is then displayed as 1111, 2222, 3333 or 4444, the RCX plays a little tune and the game begins.

4) Simon asks you to repeat a longer and longer color sequence (a new color is added at the end of sequence after you repeat it successfully on the keyboard). Its hand turns on the dial to show colors and plays a note (different for each color). You then have to key in the sequence in order. RCX LCD displays current sequence length (2 digits left) and high score sequence length to beat (2 digits right), separated by a dot.

When you reach high score, Brick Simon plays a short tune to tell you...

5) When you finally lose, either because you hit a wrong key or waited too long (doh sound), program is halted. Press RCX Run button to start a new game!

- **Program**

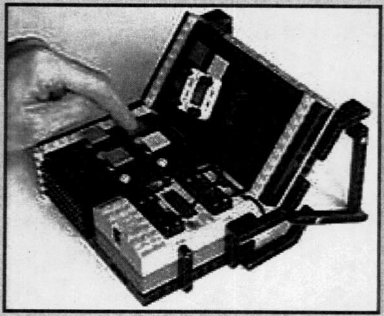
The programs were written in NQC.

Get the high score initialization program, and the Brick Simon program.

Tips and tricks used by this program:
- in NQC, static variables (declared outside all program modules) are remembered even when the RCX is off. This is how high scores are kept. Moreover, the compiler assigns static variables in successive order, so Simon.nqc can use the values set by InitHighScore.nqc.

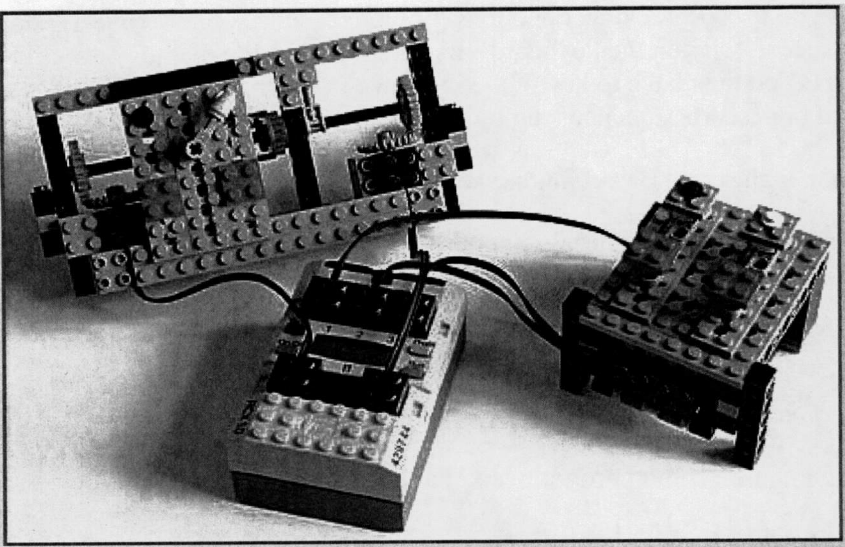
- There is no need to remember the random color sequence. Each time the color sequence must be generated again, NQC random number generator is re-initialized using the same seed, with SetRandomSeed(Seed_value) instruction.

- **Movie**
(AVI movies, Divx 5.1 compression)



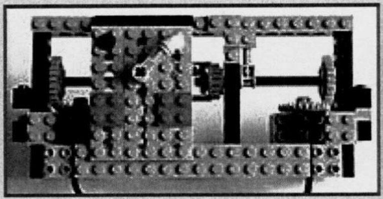
Brick Simon in action... (900 kb).

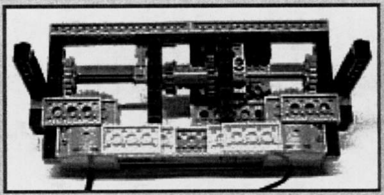
RIS Simon



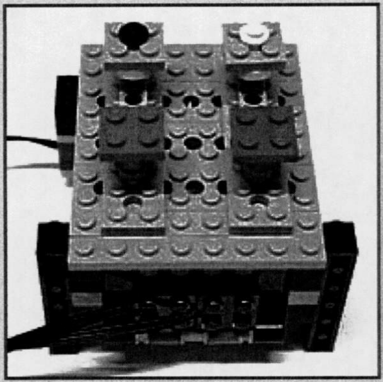
As no fancy parts were used in Brick Simon, it was not too difficult to build a simplified version using only parts included in Robotics Invention System. This version comes in three separate units (keyboard, display, RCX). Unfortunately, RIS does not contain colored tiles, so the display is a bit... dull!

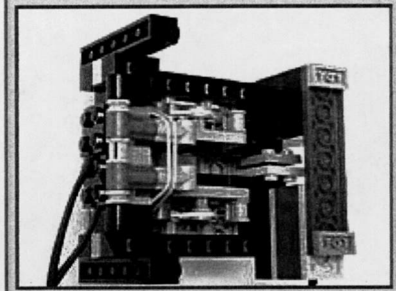
RIS Simon uses the same programs as his elder brother.





RIS Simon display unit.

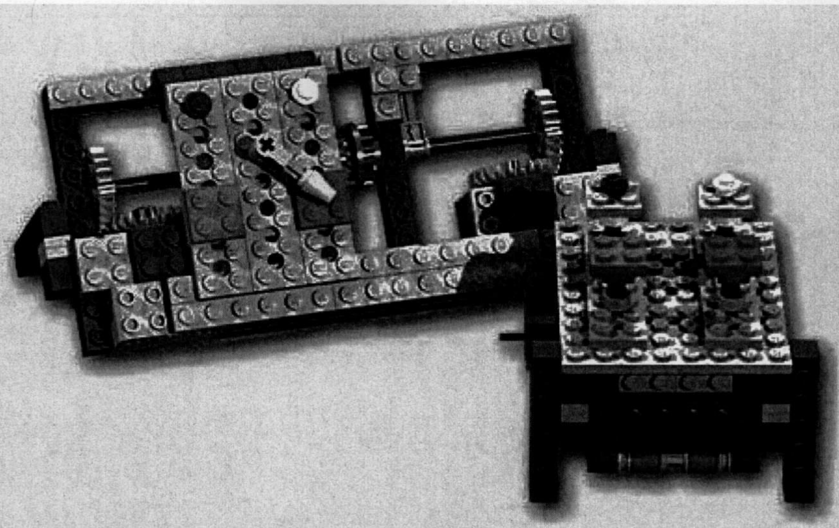




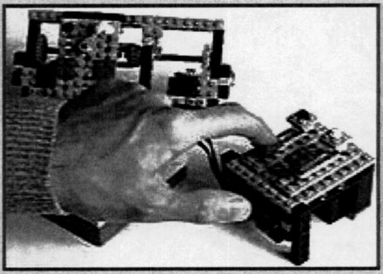
RIS Simon keyboard unit.

- **Cad design files**

  Get LeoCad files or MLCad files.



- **Movie**
  (AVI movie, Divx 5.1 compression)



RIS Simon in action... (1 Mb).

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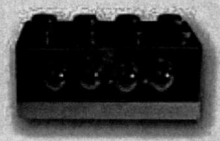
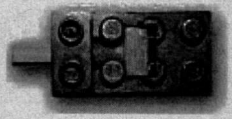
LEGO Mindstorms® compatible devices

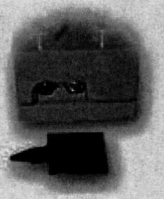
For more informations, visit Michael Gasperi's MindStorms RCX Sensor Input Page !



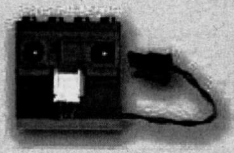
Infra-Red Lamp
Useful for IR radar 'bots. Also shows my solution to the "Lego connection problem".



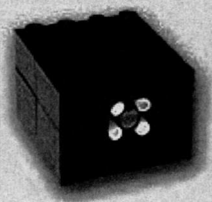
Build a **Lego Mindstorms compatible rotation sensor**



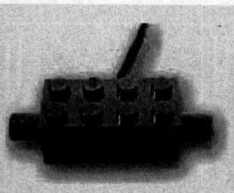
Improving Infra-Red sensitivity of the MindStorms light detector



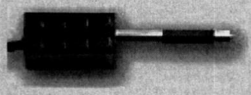
GP2D12 distance sensor
with it RCX can read distances between 10 and 80 cm.



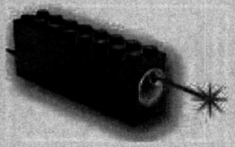
Color sensor
enables RCX to see color of objects.



Wire Guidance Sensor
Guide your robot reliably along a wire track.



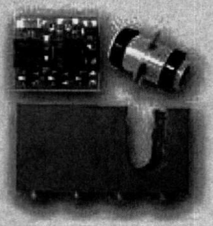
Building a RCX™-compatible temperature sensor



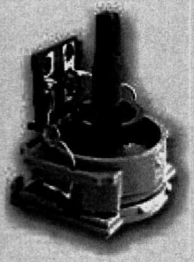
Laser Target Finder sensor
Detect reflecting targets several meters away with this laser-based sensor

Not so New : December 2003

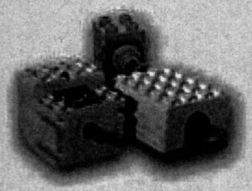
LEGO technical information



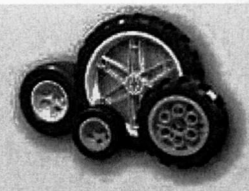
Lego Rotation Sensor Internals
Photos, schematics, detailed operation and low speed improvement.



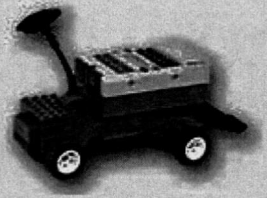
Lego® Technic Motor 43362 internals
What's inside the new type of 9V mini-motor.



Lego® 9V Technic Motors compared characteristics



Wheels, Tyres and Traction
Traction performance of Lego® wheels.



RC Nitro Flash and RCX
RC nitro flash internals, and an experiment of RCX control.

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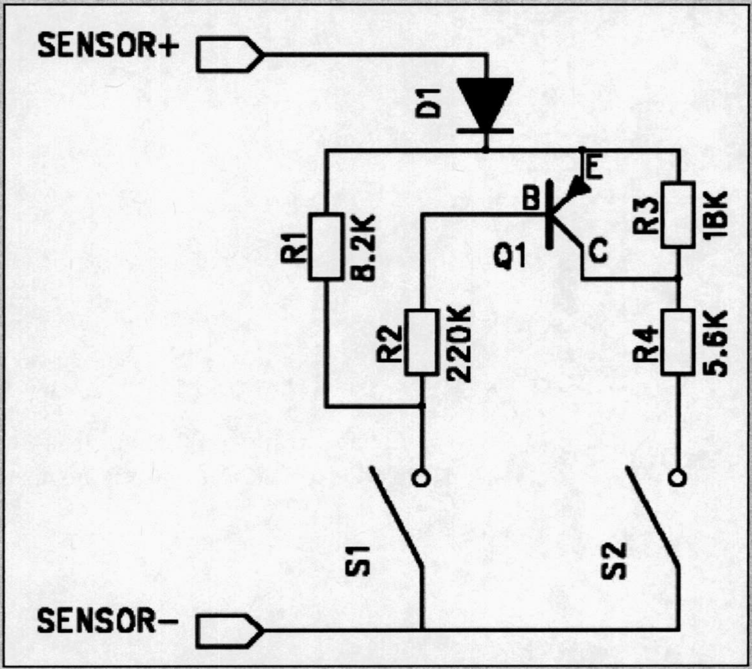
Lego compatible, compact rotation sensor

This rotation sensor is based on a Bourns 3315 mechanical quadrature encoder. The small size of this encoder makes possible to cram the entire rotation sensor in a hollowed 2x3 brick (Bourns makes an even smaller device, referenced 3375 - see the Acrobat datasheet- but I couln't get one). It is also cheap, about $2.

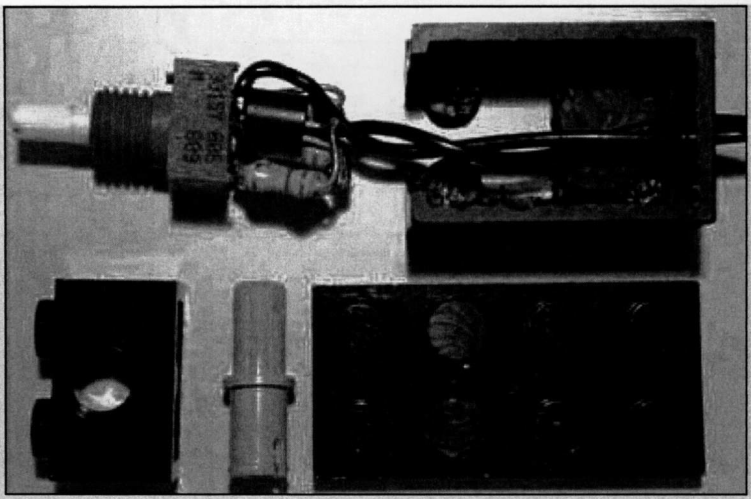
The main difficulty was to obtain the right electrical levels to be fully compatible with a Lego rotation sensor. The first try I made was to simply use a 10K ohms resistor for S1 and a 22K ohms for S2, but the level obtained with S1 and S2 closed was too high, and the RCX counted pulses strangely. So I came up with this design which gives exactely the same electrical levels than the Lego sensor. It works fine, but two problems remains :

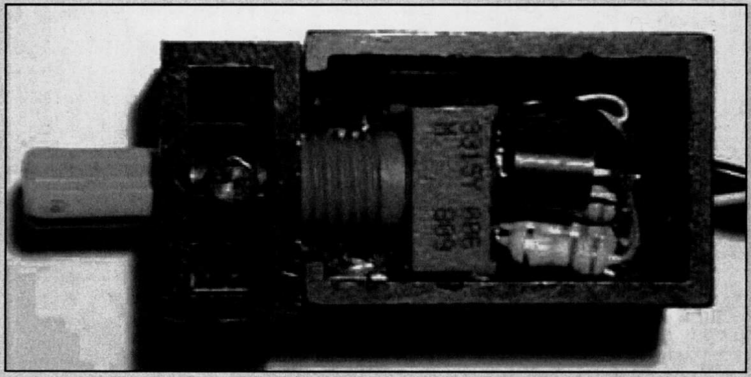
- the torque it needs to rotate is rather high
- the mechanical contacts sometimes bounce and the RCX counts wrong. I tried to debounce the switches but found no simple solution. I will rather try optical forks to solve both problems.



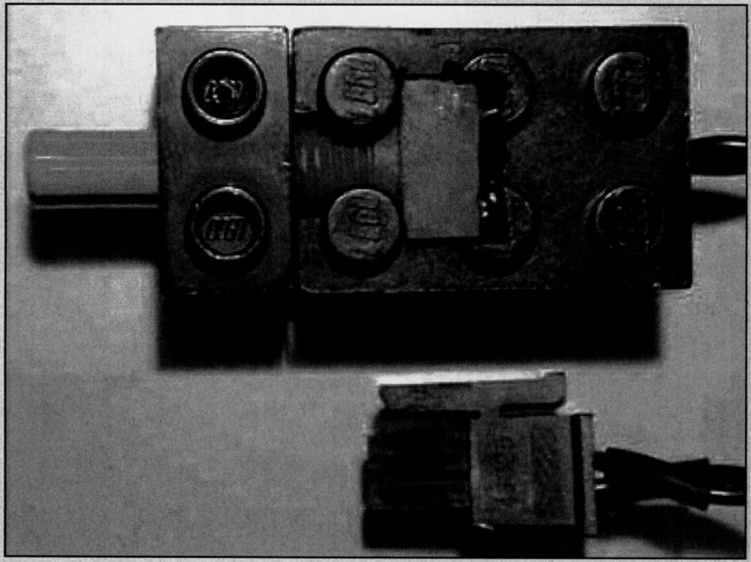
Here is the schematics. S1/S2 represents the encoder, Q1 is a small signal PNP transistor (i.e. BC558) and D1 a signal diode (1N4148 for example) which protects from power reversal. The sensor is thus polarised - no room enough to use a full bridge rectifier !-

The axle of the encoder fits nicely inside an axle pin whose hole has been slightly enlarged (verify that the axle pin rotates freely in the 2x1 brick hole with the encoder inserted). It is not necessary to glue it.



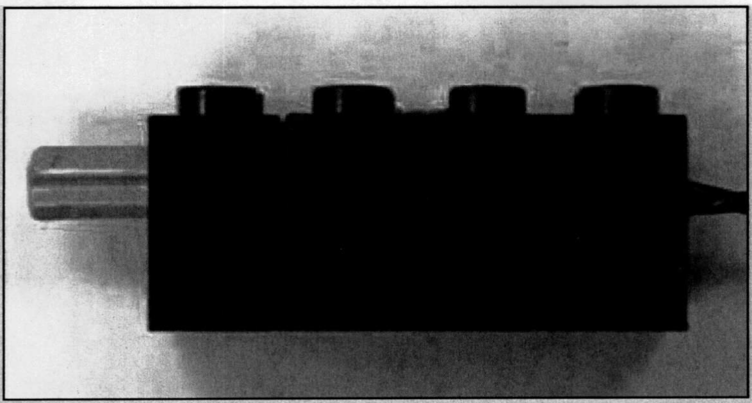


Pretty crowded isn't it ?



You have to file out 0.5 mm from the top of the encoder so that it is entirely inside the brick - or use a 3375 device -

Side view, showing the 2x4 plate closing the sensor.



With the same mechanical construction, I also built an angle sensor, using a potentiometer instead of the encoder. For another implementation of angle sensor, see Michael Gasperi Simple Angle Sensor

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