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# DONGBU ROBOTS

# HOVIS LITE

## New robot kid on the block hits the sweet spot!

It's hard to believe that it's been eight years since the very first humanoid robot kit hit the market. The first robots were amazing, but to operate and keep them running took a lot of dedication, hard work, and often involved a measure of frustration. Over the years the new robot kits that were offered for sale became more professional. With each succeeding product generation the robots would get better and better as the manufacturers learned from each other, including what mistakes not to repeat.

The most recent humanoid robot to enter the market is the HOVIS Lite from Dongbu in Korea, and it's really making a 'Grand Entrance.' I had the pleasure to assemble, test, and review one of the early units, and I can say without any fear of contradiction, that it hits the sweet spot for robotics education, research labs, and hobbyists of all ages and experience levels.

HOVIS Lite stands 13.7 inches tall and weighs 3.2 pounds with the battery pack installed. An IR remote control is included and is useful to put the robot through its motions, though you have to be careful to make sure that the IR sensor mounted on the robot's shoulder is in clear line of sight with the remote control IR transmitter.

The robot body, which comes in four colors - green, blue, red, and yellow - is quite attractive and professionally executed.



All the kit parts, servos, manual, and other components come packed in a large tool case that's easy to organize and store in a classroom or lab. The HOVIS Lite software includes 3D simulation for motion creation and editing.

All of the main body parts, frames, and brackets are injection molded and are designed with lots of available holes that could be used to mount additional sensors or accessories for custom experiments. While it might be challenging, but not impossible, to make major modifications to the body, the HOVIS Lite design is perfect for students, researchers, and hobbyists that want to focus on learning humanoid robotics, sensors, motion creation, and software development without having to struggle with the mechanical aspects.

### UPGRADEABLE RIGHT OUT OF THE BOX

The standard configuration features 16 degrees of freedom and can be expanded to up to 24 servos. As shipped, HOVIS Lite uses Dongbu DRS-0101 servos rated at 12 Kgf.cm torque (166.8 oz-in). While this is certainly more than sufficient for typical users, customers with more demanding requirements may want to upgrade some of the servos to Dongbu's DRS-0201 series rated at 24 Kgf.cm torque (333.6 oz-in). For example, a user that expects the robot to do a lot of walking, deep knee bends, or extreme Kung-Fu moves for extended periods of time has the option of replacing the key foot, leg, and hip servos that carry most of the robot's weight.



The standard HOVIS Lite configuration uses HerkuleX DRS-0101 servos.

Both the DRS-0101 and DRS-0201 servos utilize PID control and share identical case design and mounting dimensions. While their published gear reduction ratios are the same at 1/266, the DRS-0201 servos have a slightly higher maximum speed rating.

### SERVO SPECIFICATIONS

**DRS-0101:** Stall Torque of 166.8 oz-in (12kg.cm); 0.166s/60 @7.4V; super engineering plastic gearing; bushing

**DRS-0201:** Stall Torque of 333.6 oz-in (24Kg.cm); 0.147s/60 @7.4V; heavy duty metal gearing; ball bearing

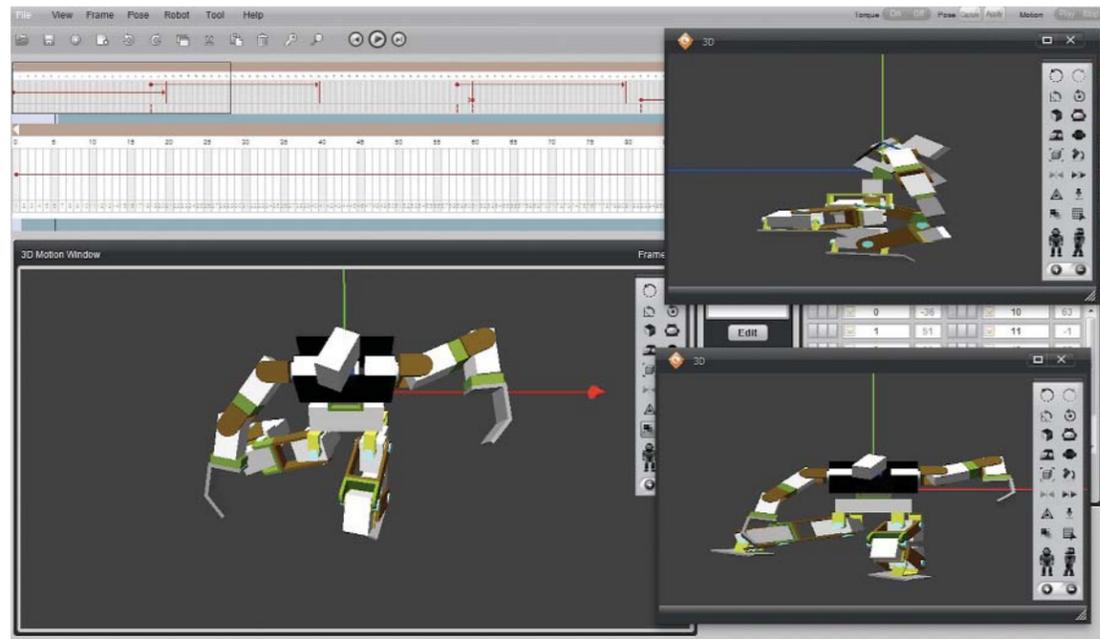
The implication is that some minor adjustments or fine tuning of previously created motions may be required when upgrading from one series to the other, but the impact should be minor. The robot's onboard controller incorporates an Atmega 128 MCU microprocessor. Operating power is supplied by a 7.4V 2800mAh Li-Po battery pack that can be recharged while installed on the robot.

### SENSING THE WORLD AROUND IT

A PSD distance sensor is included with the standard configuration enabling the robot to sense objects in its path and take appropriate evasive moves. An optional gyro sensor can be plugged into the DRC control unit, and the sensor output is used as feedback to stabilize the robots balance, especially when walking. Just keep in mind that there are times when you will want to turn off, or ignore, the gyro sensor feedback. For example, when bending over or doing some gymnastic or Kung-Fu moves.

In addition to the IR remote control provided with the robot, Dongbu plans to release a ZigBee-based wireless control option. As of the time of our review, the ZigBee option wasn't available so we were unable to test it.



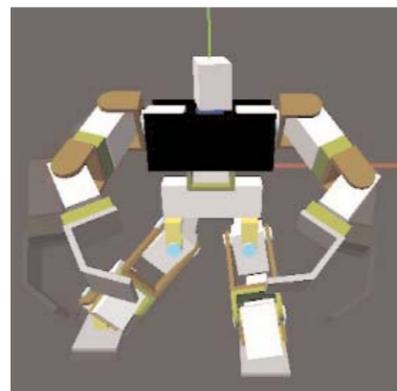


**THE SOFTWARE  
SIDE OF THE STORY**

Basic software included with the robot kit includes DR-Sim (3D simulator program) and DR-Visual Logic (a task editor). Both applications are well thought out and feature rich. DR-Sim makes it easy for the novice, or experienced humanoid user, to create new motions or edit/modify existing routines. The user interface is graphical and interactive enabling you to see the results of any edits or changes immediately. Like other humanoid robots in this category, the DR-Sim application connects with the robot so that you can play the created motions or capture motions from the robot.

The DR-Visual Logic application takes things to the next level using an easy to understand graphic programming environment allowing users to work with the graphic interface, or to switch to a C-like language. Future enhancements, according to the company, will include upgraded DRC functionality, robot motion modules, and integrated simulation.

The HOVIS Lite software story doesn't end there. All the interfaces, internal registers, and protocols are open and well documented so that users can develop their own applications using a wide variety of operating systems and environments.



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**WHERE IT REALLY SHINES**

Attention to detail is where the HOVIS Lite really shines. Every assembly detail was well documented and illustrated with detailed drawings in the assembly manual. For assembly steps where things like bracket orientation or assembly sequence might be confusing for a novice, the manual includes multiple views and appropriate alerts. The same level of attention was applied to the software documentation as well.

That's not to say that the assembly process is simple or trivial. It isn't. A humanoid robot contains hundreds of individual parts, body components, servos, brackets, and cables in additions to a wealth of screws, nuts, and bolts of various sizes. Realizing the challenge that users would face, especially if they are trying to assemble the robot by themselves, the Dongbu engineers designed the kit so that all the parts come in clearly labeled plastic bags. 1:1 scale drawings of the different screw, nut, and bolt types are included in the manual, and often repeated on the relevant manual pages, so that if you become confused about what screw is what, you can easily compare it to the 1:1 part drawing.



Some of the body subassemblies are built by mounting two servos back to back with the provided brackets.

Assembling the robot was very straight forward. From the time we opened the case, unpacked and laid out all the parts, constructed each sub-assembly, installed the DRC control unit, and plugged in the battery pack, to the

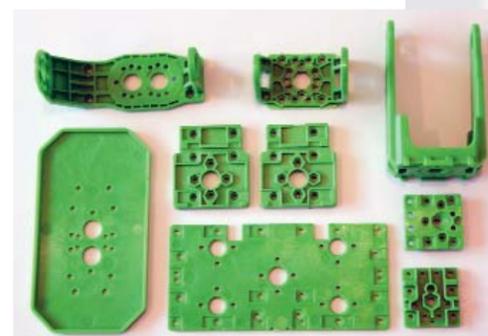


moment when we flipped on the robot's power switch for the first time, it took just over six hours. This included several breaks to take photos of the process for this review.

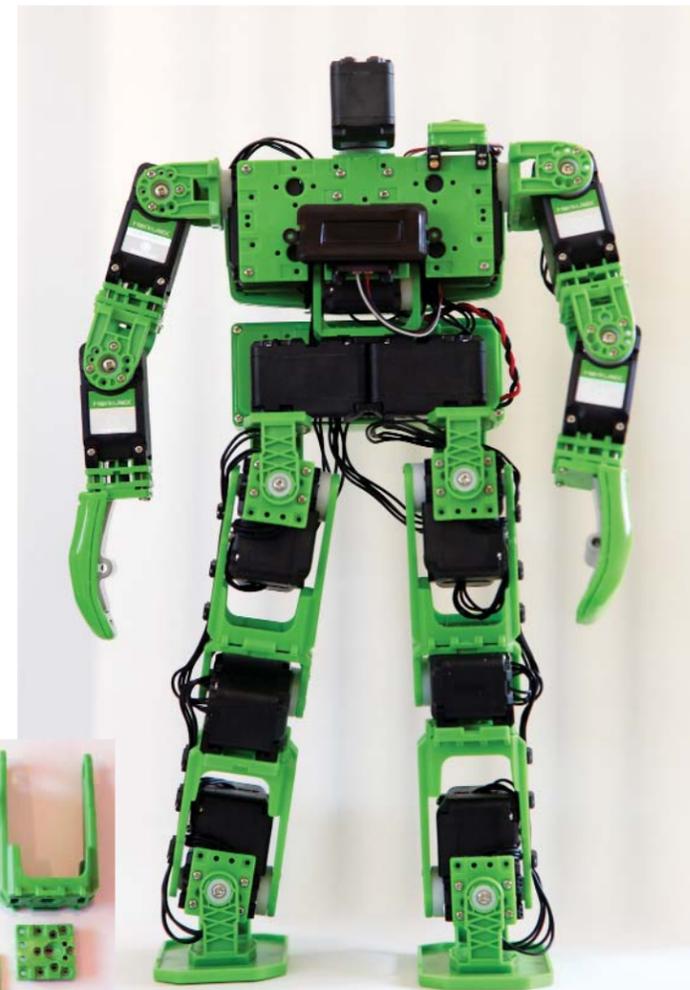
I did make a couple of assembly mistakes that were easy to recover from. For example, after finishing the right arm assembly including the robot's hand, I realized that the hand was installed the wrong way around. It only took a few minutes to remove the screws, pop off the hand, and reverse it. Of course, I took extensive notes and photos of each step, especially when I ran into any difficulty. After the robot was completely assembled I sent all my notes to Dongbu for review, and I'm happy to report that they responded quickly, were very open to the feedback, and used it to improve the documentation so that other users wouldn't run into the same challenges.

**EDUCATION & CURRICULUM**

Dongbu feels that a major target market for the HOVIS Lite humanoid robot is in education. The documentation references an available curriculum for teaching purposes, though I did not include the curriculum as a part of this review. According to my contacts at Dongbu, the HOVIS kits have



The robot plates and frames are injection molded plastic with lots of extra mounting holes for experimentation and custom modules.

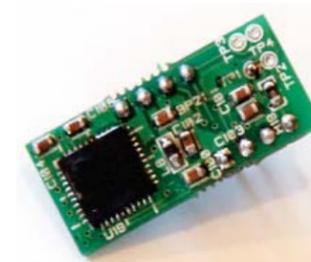


been received quite positively by teachers and educators in Korea and are in active classroom and laboratory use.

**THE BUILD**

One real strong point of the HOVIS Lite kit is its flexibility and expandability. The evaluation unit I received included a large number of additional parts, above and beyond those required to assemble the kit as a humanoid. In addition to extra screws, plates, and frames, the kit also included wheels. The published specifications state that up to 27 different robot configurations can be assembled with the parts provided in the standard kit.

Of course, having all the extra parts initially made the assembly process a little confusing. At first it was a little like trying to put together a jigsaw puzzle with a handful of extra pieces thrown into the box. But, I soon figured out what was going on. Spending a few minutes upfront to go through the detailed parts list, setting aside any unnecessary parts quickly cleared up the confusion. After that the assembly went quite smoothly.



The gyro sensor plugs into one of the onboard controller external connectors without having any disassembly of the robot.



The onboard control unit includes function buttons, status LEDs, a light sensor, and plug-in connectors for sensors including a gyro.



A full function IR remote control is provided with the standard kit.

**DETAILS**

Like all humanoid robots, it's very important to make sure that the servo horns are installed on the mating servo drive shafts with the correct orientation. The Dongbu Herkulex servos have a small ridge on the servo body just above the drive shaft, and there is a small dimple in the shaft itself to aid in the orientation process. Unfortunately the servo cases are dark black, so you need to look closely and use lots of good lighting to make sure the marks are aligned properly. A similar challenge occurs with the servo horns. They have a slight raised ridge indicating the proper orientation, but the horns are pure white plastic or nylon, so the marking can be a little difficult to make out.

**DRC CONTROLLER**

The DRC controller includes a number of useful controls, tests and task modes. The Navi Key pad supports checking the battery level, running self tests, switching from wired to wireless operation, starting autonomous movement, and other functions. Six LEDs provide a visual indication of the controller status, data transmission, and task execution as well as a programmable spare.

The optional sensors plug into slots in the DRC controller body. This is a really nice touch because it allows users, including students, to change sensors and configurations without having to do any disassembly of the robot. This could be a read benefit in a classroom environment, or for users that just want to focus on the sensing or software development aspects.



The careful cable layout and brackets are just one indication of the amount of attention Dongbu paid to detail in designing the robot.



**CONCLUSION**

The HOVIS Lite humanoid robot kit is easily the best product in the category I have seen in quite a few years. And, over time, it will just continue to get better and better as the word gets around and it builds a strong user community and fan base.

Links  
 Dongbu Robots, [www.dongburobot.com/jsp/cms/view.jsp?code=100795](http://www.dongburobot.com/jsp/cms/view.jsp?code=100795)

Herkulex Servo Specifications,  
[www.herkulex.com/Specifications/index.html](http://www.herkulex.com/Specifications/index.html)

Robots Dreams, [www.robots-dreams.com](http://www.robots-dreams.com)

For more information, please see our source guide on page \_\_.