Story by Harry Mueller

RCMART

NX-25Q

A spritely newcomer to humanoid robotics

We're all familiar with the popular cliché "bigger is better," with North American tastes largely driven by this or similar convictions. Just look around and you'll see examples of this behavior involving most consumer goods involved in daily life, from the houses we live in to the cars we drive, even to the fast foods we eat. Small things exist yet they are often just curiosities or special function items that just don't work in a large size.

Closer to our sphere of interest, larger robots seem to have more impact while the small ones are relegated to the research labs where white-frocked technicians ponder the latest flavor of nanobot. Closer to my area of interest, the humanoid robots, the big money has been guided to larger robots like Honda's ASIMO, South Korea's HUBO and the now abandoned QRIO from Sony. On a somewhat smaller scale, we've got the whole ROBO-ONE scene where the robots generally weigh a bit over 3 lbs. and are over a foot tall.

I'd heard rumors about a few smaller humanoids coming to market and had viewed a few videos about beta versions but hadn't seen a production model yet.

Well that has all changed now. RCMart International Inc. from Taiwan has just put out a diminutive little humanoid called the NX-25Q and at just over 9 in. tall and weighing in at 19 oz. including batteries, it's the smallest sophisticated servo-driven humanoid I've seen to date.

LESS IS MORE

What really excites me about small humanoids is the low mass and inertia. This should enable all sorts of wild gymnastics without risking damage to the servos or structures of the robot. The NX-25Q has 17 degrees of freedom (DOF) and uses a Renasa microcontroller (0260F6A U5 5321A). The servos are specifically designed for this robot and have just over 4 kg.cm. (55.55 oz.-in.) of torque at a speed of .11 sec/60 degrees, both at 6 volts. The stock bot (reviewed) comes with analog servos but digital servos in the same size are also available. So let's get busy and wring this little guy out to see what he can do.

FIRST IMPRESSIONS

First of all, a big thanks to folks at RCMart who, without knowing that I'm all thumbs, have sent a version of the NX-25Q that had already been assembled. My understanding is that the robot is available in both assembled and kit versions. If ordering the

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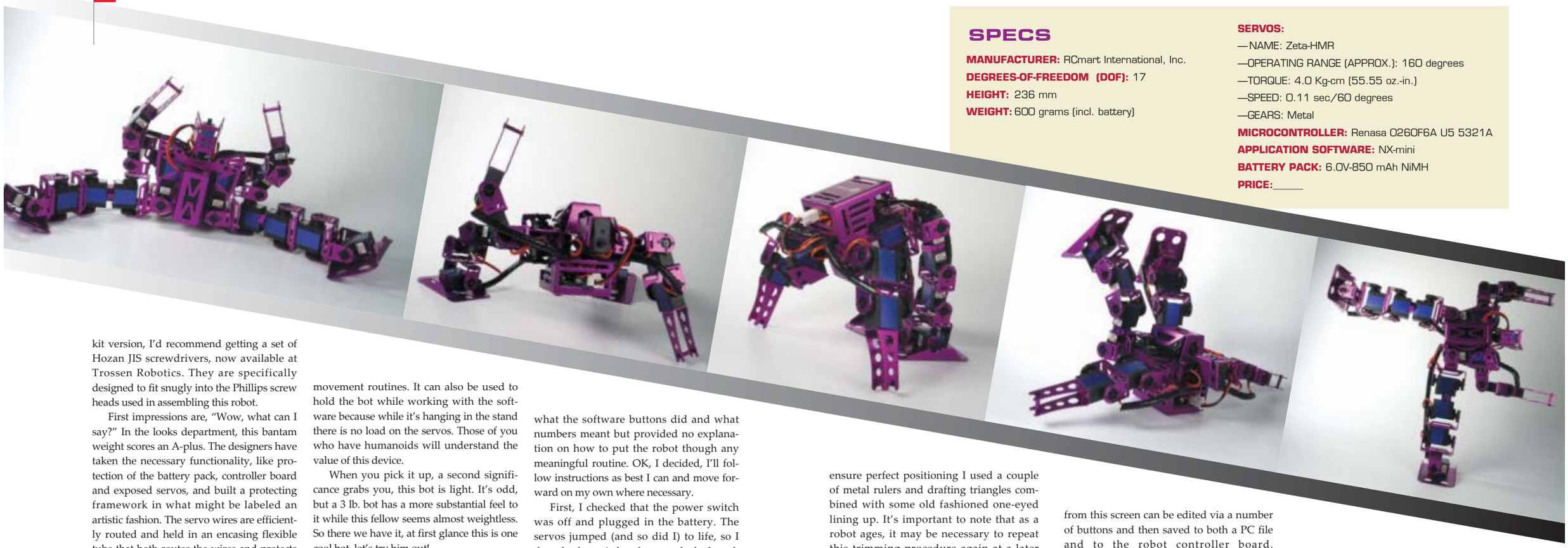

SPECS

MANUFACTURER: RCmart International, Inc.
DEGREES-OF-FREEDOM (DOF): 17
HEIGHT: 236 mm
WEIGHT: 600 grams (incl. battery)

SERVOS:
—NAME: Zeta-HMR
—OPERATING RANGE (APPROX.): 160 degrees
—TORQUE: 4.0 Kg-cm (55.55 oz.-in.)
—SPEED: 0.11 sec/60 degrees
—GEARS: Metal
MICROCONTROLLER: Renasa 0260F6A U5 5321A
APPLICATION SOFTWARE: NX-mini
BATTERY PACK: 6.0V-850 mAh NiMH
PRICE:_____

kit version, I'd recommend getting a set of Hozan JIS screwdrivers, now available at Trossen Robotics. They are specifically designed to fit snugly into the Phillips screw heads used in assembling this robot.

First impressions are, "Wow, what can I say?" In the looks department, this bantam weight scores an A-plus. The designers have taken the necessary functionality, like protection of the battery pack, controller board and exposed servos, and built a protecting framework in what might be labeled an artistic fashion. The servo wires are efficiently routed and held in an encasing flexible tube that both routes the wires and protects them, all in an attractive package. In short, this thing rocks in the looks department. The packaging of the robot kit is also A-plus; everything is well protected and compartmentalized, all in a very small box. The NX-25Q comes with the standard assortment of accessories like 6.0V 850 mAH NiMH battery pack, 200 mA wall charger and RS232 cable or optional USB cable to connect the robot to a computer.

Of real interest to me were some additional accessories not usually found in humanoid robot kits. One, a little gizmo that takes a battery lead and a servo lead and, with the press of a button, centers the servo at 1500 uS or, as RCMart designates servo center, 90 degrees. This is a great time saver as I usually have to hook up an RC receiver or the robot board and software to accomplish this essential early step. The second is a little bag of spare parts that might make losing that little screw or breaking that servo horn during construction a non-event. Third is a robot stand that allows the robot to be held up and stabilized while working out movement routines. It can also be used to hold the bot while working with the software because while it's hanging in the stand there is no load on the servos. Those of you who have humanoids will understand the value of this device.

When you pick it up, a second significance grabs you, this bot is light. It's odd, but a 3 lb. bot has a more substantial feel to it while this fellow seems almost weightless. So there we have it, at first glance this is one cool bot, let's try him out!

POWER UP

The battery had earlier been put on the charger where a red light indicated the battery needed charging. After a short time, less than 20 minutes, a green light indicated a fully charged pack. The pack, as received, was likely near full, an empty pack would likely take in the order of four to five hours to fully charge. Keep this in mind when ordering your bot, a Li-Po battery with quick charger is optional. If you'd rather work with the NiMH's, a second battery pack would be helpful for those long programming sessions. The included CD comes with a well-illustrated robot construction manual, a 14-page software instruction manual, required software and an assortment of canned routines. I looked through the manuals to ensure correct RS232 hookup and to load some of the demonstration programs. This is where my exuberance took a slight detour, as the software instructions were somewhat sketchy and operational guidance was non-existent. Instructions dealt with what the software buttons did and what numbers meant but provided no explanation on how to put the robot though any meaningful routine. OK, I decided, I'll follow instructions as best I can and move forward on my own where necessary.

First, I checked that the power switch was off and plugged in the battery. The servos jumped (and so did I) to life, so I thought the switch only controls the board, something I found a bit unusual. However after checking with RCMart engineers it was explained this was a self-depletion design feature required for the Japanese market and current flows only for a brief instant after which there is no current going to the servos. Then, following instructions, I turned the power switch on twice as instructed; this is a safety feature to prevent the robot from being accidentally powered up. After the double switch the robot jumped erect with arms out perpendicular to its sides. It's always a great accomplishment when you can reach this benchmark without any indication of smoke. Success…NX-25Q is operational!

Next in line is another very important step in the process, setting up the base position for the robot, where all the servos are adjusted to ensure the frame is perfectly symmetrical. A program called Trim-Adjust is included with the software and the procedure is fairly well documented. The robot's limbs are carefully lined up as shown in the position editing screen. To ensure perfect positioning I used a couple of metal rulers and drafting triangles combined with some old fashioned one-eyed lining up. It's important to note that as a robot ages, it may be necessary to repeat this trimming procedure again at a later date. Getting out of shape as we age isn't just related to humans.

SOFTWARE

Next it's on to the main software package, the place where everything comes together and the really neat things can happen. The opening screen of the NX-mini software is the position editing window where, through the RS232 connection, individual servos can be manipulated and changes to both servo position and speed of rotation can be made. The position can be named if desired and the completed robot stance then saved.

Using the drop-down menu on the screen, we can now move to the next function, named the Motion Form. Here a number of robot "positions" created in the previous screen can be assembled to make "movement routines." It appears that up to 40 of these routines can be created but as yet I have no idea how many positions can be saved in each routine, although the number appears to be considerable. The data from this screen can be edited via a number of buttons and then saved to both a PC file and to the robot controller board. Something I don't like is that the numbering system employed for the servos on this screen is different than that used on the previous position editing screen. I had to set up a robot movement sequence to determine the relationship between the two numbering systems and then created a table that transposed one set into the other.

Next on the menu is a home position window whose functionality is not obvious to me. It may be related to the trimmed position but I'm not sure what the advantage of having multiple trim positions or the ability to change them on the fly would be. For those who wish to do so, it may provide a way of storing and recalling several different starting positions for the various motion routines.

The last screen is called the Edit Scenario screen and is used to run concurrent motion forms in up to four different scenarios. These scenarios can also be edited and saved to file.

Included on the instructional CD are a number of movement routines, from dancing demonstrations to turns, side-stepping, getting up and forward and backward flips. The kind folks at RCMart also provided a series of additional routines that they're working on for me to check out. As with most canned software, some were spectacular, others functional and some just didn't seem to work well. The spectacular moves were the flips; this little guy was just born to do somersaults. He also has a unique way of getting up that would be unlikely in any of the larger humanoids. Even the few routines that didn't work quite as planned can be edited in the software to work with your particular NX-25Q.

ROBOT TESTING

During my testing, I ran into a couple of issues that the RCMart engineers have acknowledged and explained. One is a slight, periodic fluttering in one of the servos that is apparently quite harmless. This happens because the metal servo cases, designed as heat dissipaters, increase the likelihood of noise effects within the servo

control board. Another is a periodic change in the neutral or home position and is caused by a bug in the present version of the board and will be fixed in the next version scheduled for early June. RCMart has displayed an eagerness to solve any apparent problems and seems eager to implement continual improvements in their product.

Another thing to avoid is low voltages in the battery; I would recommend buying two batteries when ordering this bot, one to run it and the other to sit on the charger. When low voltages are encountered all sorts of weird things begin to happen and servos can be damaged. As soon as anything odd happens, the first thing to suspect is the charge of the battery pack. If it is below 6 volts (no load) that is likely what is causing the oddities. Before I figured this out, I had a servo lock into an extreme position in a low voltage situation and it burned out before I could shut the robot off. Staff engineers are working on a current-limiting circuit that will eliminate this problem in the future.

At this break in the action, I could disassemble the servo since it was obviously not repairable. The servo cannot be taken apart normally since it isn't held together with screws but must be teased apart with a little force. Once the innards were exposed, I was again really impressed, this gear train is all metal and has bearings on the output shaft; the quality and ruggedness of the servo is obvious.

My robot continued to fall with the canned walking routine, but rather than trying to modify the program that came with the CD I thought I'd try to create my own walking routine. This was both a test run of the software and also my first attempt at creating my own movement routine.

CREATE A ROUTINE

Despite there being no specific instructions on how to create a routine, the whole process was actually quite intuitive and in the end, easily understood. I'll go through a quick explanation of what I did.

The first screen, shown in figure 1, is the Position Editor. By creating individual robot stances or positions on this screen and then saving them to the appropriate position in the next screen, the Motion Form, complete motion routines can be generated. All that can be done on this first screen is to pose the robot using the slider or the < or > symbols to move the servo horn and to set the speed of the servos, with 7 being the slowest and 0 the fastest speed. This configuration is then either added to the motion list or overwrites an item from the motion list. This process is then repeated until the motion routine has been completed.

The Motion Form shown in figure 2 has six positions in it that have been created to produce one step by the robot. These positions can be edited, copied, moved, deleted and saved, all of which I had to do to create this walking routine. Also, once a routine has been generated it can be examined and edited one step at a time for fine tuning. The whole motion routine consisted of a starting position, the step and an ending position, all of which will be visible in the Scenario Editing window shown in figure 3.

In the Scenario Editing screen the various motion routines are assembled in whichever fashion you want them to appear. Here I have put together an initial position followed by five steps and then ending in the neutral or home position. This scenario can be run by loading it into the controller and pressing the run button on the robot for about three seconds. Any routine that your imagination conjures can be assembled and run in a similar fashion.

I've also corresponded with the people at RCMart about future developments and the list is impressive. I'm chomping at the bit to get some of these goodies onto the NX-25Q. Aside from a commitment to improve the present configuration they also have some of the following accessories in various stages of development:

- Both Bluetooth and Telbee wireless control
- Stand alone remote controller
- CMOS camera module
- MP3 player
- Various sensors like sonar, IR, compass, gyros and accelerometers

Plans are also in place to release the software source code to allow those interested to really start playing with all the possibilities this allows. With an impending list like that it's pretty hard not to get impatient even though there is still a lot of territory to explore with the basic package. Who said bigger is better? ◎

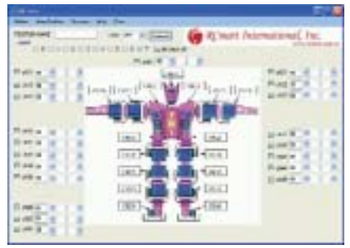

FIGURE 1: Position editing screen

FIGURE 2: Motion form screen

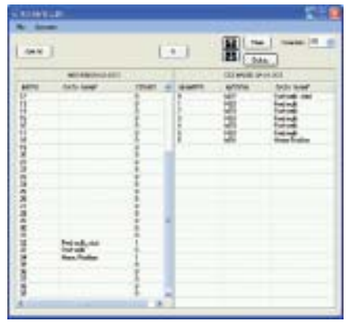

FIGURE 3: Scenario edit screen

Links
RCmart,
www.rcmart.com.tw

For more information, please see our source guide on pg. ___.