Meet George

Building large LEGO® Robots

By Simon Burfield

As a child who loved Sci-Fi, I have always dreamed of building massive robots but never had the funds or skills to build anything. When I reached a grand old age of 23, my girlfriend at the time took me to LegoLand Windsor and bought me the LEGO® MINDSTORMS RIS 2.0 set. Boy was this a great set to get my imagination going. I worked as a programmer and so the concept of programming a LEGO Robot via my PC was a must!.

George V1

After a few years of playing, buying a house and collecting more LEGO than most, I decided to start building George (V1) which was a full size human shaped robot. I soon hit the massive issue that building a full size humanoid robot just can't be done (with my skill at the time). The leg joins where just snapping on me and that was just trying to make him stand in place. I had not even put arms or a head on him. George was retired while moving house.

T1 (Bob)

One of the robots that really fascinated me that I thought I could build was a T1 from Terminator 3. It was a tracked robot with twin mini-guns (another thing I wanted to build). So I went about building a rather large LEGO version for the 2010 Great Western LEGO Show which is our club's (Brickish) largest event.

More pictures can be found here:
http://www.flickr.com/photos/43790182@N04/sets/72157627744750853/

Bob suffered from a few major issues.

Weight

Due to its weight (well over 20KG) it could only turn on low friction floors. The base of it was nearly a meter square running double tracks each side powered by 4 XL motors (directly linked to sprockets). Going forward was very quick but turning just did not work well. I only actually found this out on the day of the show where I discovered the floor was anti-slip carpet.

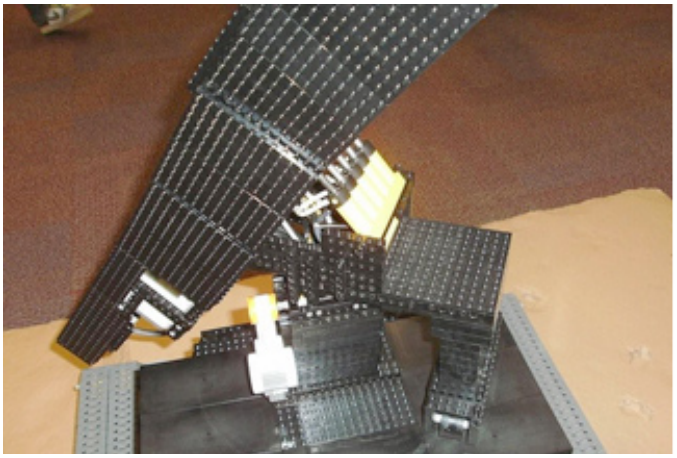
Communications

The robot had very clever communications in my opinion. It used 4 NXT's (2 slave, 2 master) which communicated via bluetooth. One set of NXT's had an accelerometer which when moved, would move one of the robots arms so that it would mimic the users moments. The other set of NXT's also had an accelerometer to control the other arm however it also had a mode button so that you could control the robot's other functions (moving, body rotation and lift, head movement) via the same accelerometer but in different modes. Each master NXT also had a fire button to fire the Zamor launchers on each arm.

The problem was that the bluetooth communication just was not stable enough and also suffered from lag and loss of data. You would put it in arm movement mode and it would instead move the tracks. There there would be a large amount of lag which meant the robot was always a few seconds behind. In practice, this caused the robot to drive itself in to a table 30 minutes after the show opened causing a partial rebuild in front of many people! Quite embarrassing.

The robot also had a large main body beam (around 4ft long) that had to be counter balanced via many boat/train weights which caused even more weight issues. This main beam actually snapped a few technic beams while it was being built. The main beam could rise up via 5 pneumatic rams. However it required over 30psi to start it off (see below). This caused other issues.

I also completely covered Bob in black plate, which had a habit of falling off and also added more weight.



George v2

After Bob, I decided to adapt the KISS approach (Keep it simple stupid)! My objective for the Great Western LEGO® Show 2011 was to make a Robot that worked, and worked well! It had to move and be able to turn on anti-slip carpet, easy to control and be strong enough to take knocks / drive in to tables without breaking.

George is a fully functional 5 foot 7" robot. Controlled via a PlayStation 2 controller, he can move about, rotate his upper body, move his arms / shoulders and grab items. His head also rotates, moves up and down and if you get too close, his eyes will roll.

More pictures can be found here:
http://www.flickr.com/photos/43790182@N04/sets/72157627552952944/

Videos:
http://www.youtube.com/watch?v=BHdphmqNR94&feature=mfu_in_order&list=UL

Communications

This time round I decided to scrap having multiply NXT's and went with the brilliant Mindsensors wireless Playstation 2 controller sensor pack. This allows you to control your NXT via a Playstation 2 controller which has a huge number of buttons / controls on it. Then I linked the NXT to a hiTechnic IR link so that the NXT could send commands to power functions infrared receivers (all 4 channels). This setup gave me a large number of possible functions (11 different motor channels). I used RobotC to program the NXT as I find it an amazing programming language.

Weight

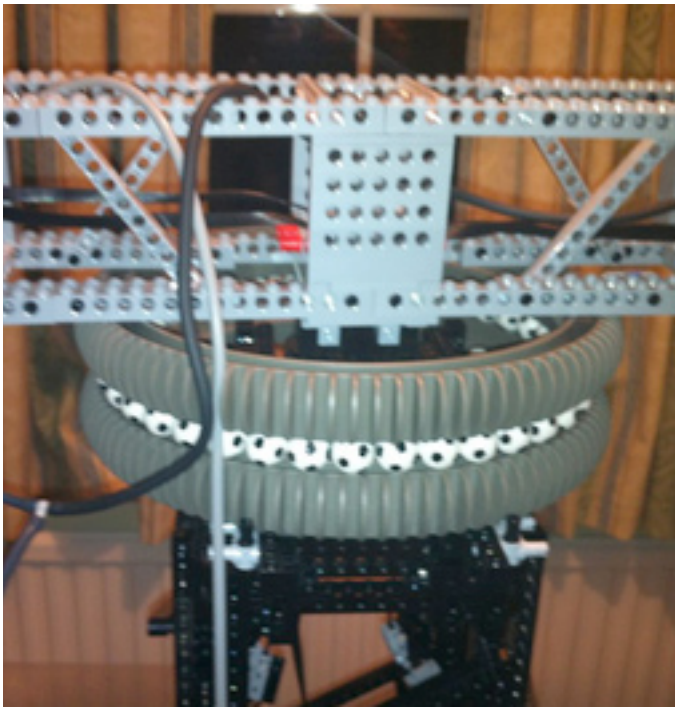
This robot had a large upright body beam. However it did not rise up and down so it did not require any counter balance weight. Also, it was not plated and only carried 1 NXT. This probably cut down a 3rd of the total weight of the robot, even though it was bigger than Bob (5 ft 7" tall).

Drive

The main base of the robot was smaller than the one on the previous robot which would naturally make it move a little easier, especially being lighter. Also the 4 XL motor driving it where geared down via a 8 to 24 tooth gearing. First time round, this just snapped the gears in half. The way around this was to use 2 sets of 8 to 24 tooth gears in parallel on the same axle per motor. Also, as a backup, in case the robot did not work on the show carpet, I could swap the 24 tooth gears for 40 tooth gears very easily which would give it even more driving power but at a cost to speed.

On the day

George was a huge success with the members of the public. Most people did not realise it moved and so jumped quite a bit when they released it did. This was very funny except for the odd small child that got rather scared. People even started getting pictures next to it and a few people tried to hug it.



Issues

Issues we a minimum really. After transporting George in more pieces than I hoped, I had to do a small tweak to the neck as the gears were slipping. Sadly I only had red technic with me for another one of my models and so it looked a little odd if you saw George from behind.

The main body bearing, as shown below just did not work on the day (well 2 days). I am not sure why it worked at home and then stopped but I could only get it to turn 1 way. Also the footballs kept falling out! I have since swapped them out and made a better version using wheels.

The only other issue which, to be fair, I already knew about, where that the large linear actuators (x3) in each shoulder joint made horrible noises (the built in clutches) and sometimes got jammed. LEGO® have made improvements to these actuators, but I have not got the newer version yet. I did try using pneumatics for the shoulder but that gives you little control.

The Future

I have already started work on 2 more large robots for next year (while also keeping George). The first will be called wheeler and is a giant wheeled robot. The start of it can be seen below.

The second robot will be based on Bob (T1) but avoiding all of the downfalls of it. I am looking forward to seeing people's faces when there are 3 giant robots running around.

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