

Welcome to CONTROL+

by Jetro

CONTROL+

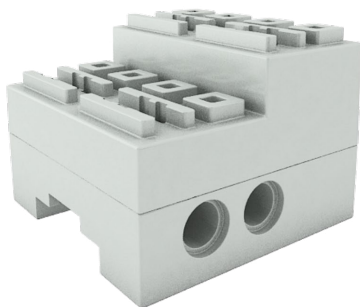
There are many different types of LEGO® Technic fans. Some just want to build sets, others just want to build MOCs. Some prefer full remote control vehicles and others would rather see mechanical innovation. Some want it all...

The introduction of Power Functions in 2007 brought new functionality to LEGO® Technic. The flagship set of that year, the 8275 motorized bulldozer was a fully remote controlled set with a piece count of 1382 parts which included 4 motors, 2 IR-receivers, 2 remote controls and 1 battery box. Suddenly possibilities were endless: motors could be paired or controlled individually, the introduction of the train remote (#64227) also allowed for precise speed control.



The one big drawback to the system was the communication method. Infrared works fine at short distances and in closed spaces, but gets disrupted by direct sunlight and can't handle bigger distances.

The first solution to that problem was provided by a 3rd party project - sBrick - a substitution of the IR receiver that works with bluetooth. This of course also made the physical remotes obsolete (for use with that platform), but used profiles on a smartphone as a remote controller.



In 2018 LEGO® started rolling out Powered Up, the successor to Power Functions. This new platform no longer relies on infrared communication, but rather uses bluetooth, specifically BLuetooth Low Energy (BLE). Receiver and battery box are placed in the same housing and, as before with Power Functions, the first Powered Up hub has 2 motor/sensor ports. The big hardware difference (besides the connection method) is the fact that motors can no longer be stacked. Each motor requires its own port. In addition, the system uses new plugs, breaking compatibility with Powered Up and its predecessor 9V.

What is CONTROL+

The Powered Up platform comes with a physical remote (e.g. used in Train sets) but also allows you to use an app on your phone to control your Powered Up creations. Two motor ports is very little for a Technic set, and 2019 brought the introduction of new hardware, with a new name: CONTROL+, a platform aimed at integration in LEGO® Technic. The hub is larger and takes 6 AA batteries (instead of the 6 AAA batteries in the smaller Powered Up hub) and has 4 ports (named A, B, C and D)[1]. Despite the new name, CONTROL+ really is just another manifestation of Powered Up. The plugs are the same and the hub and motors can be addressed from the Powered Up app.

CONTROL+ also has its own app. This means that to the untrained eye it may look like this is the (only) way to connect to CONTROL+ models. The CONTROL+ app is quite big and requires a relatively new smart device (phone or tablet) with a decent amount of RAM memory. It contains specific profiles for the sets that contain CONTROL+ elements and comes with advanced control options for those sets. More about that later on in the article.



[1] Four ports is actually not entirely new. LEGO® Boost, launched in 2017) is also part of the Powered Up family. The Boost hub contains 2 internal motors with encoders, named A and B and has 2 external ports that can take additional motors or sensors, named C and D.

42099 - 4x4 X-Treme Off-Roader

The first set with the new CONTROL+ elements to come out was the 42099 - 4x4 X-Treme Off-Roader. The set comes with the new CONTROL+ hub and introduced 2 new motor types: Motor No. 2 (L) and Motor No. 3 (XL)



This is not where the innovation stopped. The set also includes a new geared hub with a speed reduction of 5:1 and corresponding CV joints. While this simplifies the build a similar reduction could have been achieved with existing elements: portal hubs and gears. This was exactly the way this problem was solved in the set's predecessor 9398 Crawler. The gearing necessary to get the required torque introduced considerable backlash into the drive train and so the new geared wheel hub is a welcome innovation



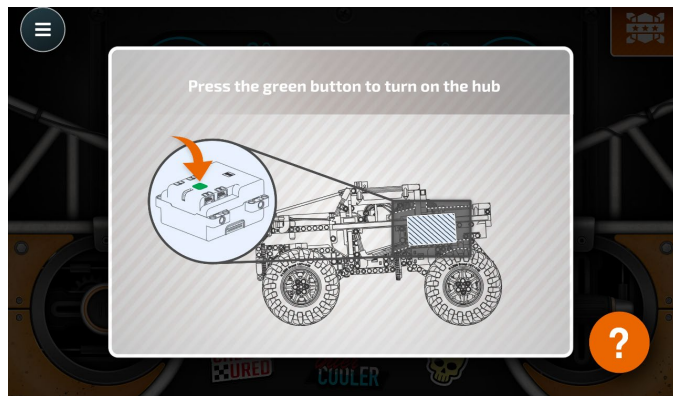
Another cool feature of this set is the fact that the body can easily be separated from the chassis. This means it is also fairly simple to create your own body to go with the model.



42099 app control

The CONTROL+ app has very nice graphics for each of the available models. Once you select the model you have the it will load the profile for that set. This is where you need to pass the first hurdle.

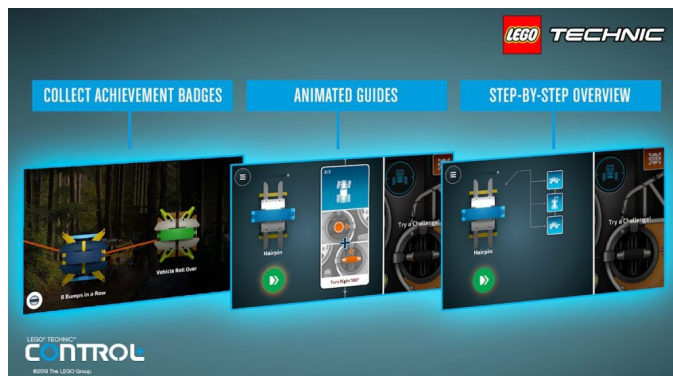
The app asks you to start the CONTROL+ hub that is inside the model.



If for some reason you have incorrectly connected any of the cables (e.g. you connected a motor to port D that should be in port A) the profile will not load! In itself, this makes sense, but there is nothing in the app or in the instructions that alerts you to this. For the Off-Roader this is no big deal as you have a single hub and 3 motors.

Things are not likely to go wrong. Or are they? Rule number 1 after getting a new set is to try and improve it. Do you have a Powered Up LED light cable handy? Since the model has a spare hub port the logical thing would be to connect the lights to the remaining port. But if you do so, the app will no longer load the profile as it detects something is different from the way the set was designed.

After passing this hurdle, the control options and challenges inside the app should provide kids inspiration for many hours of play.



An interesting feature of the app is that when you first connect to the Off-Roader it runs a short calibration of the steering. The app looks for the left and right steering limits and then finds the central position which, at least in my case, was quite accurate. The CONTROL+ motors are smart motors with built-in tachometer.

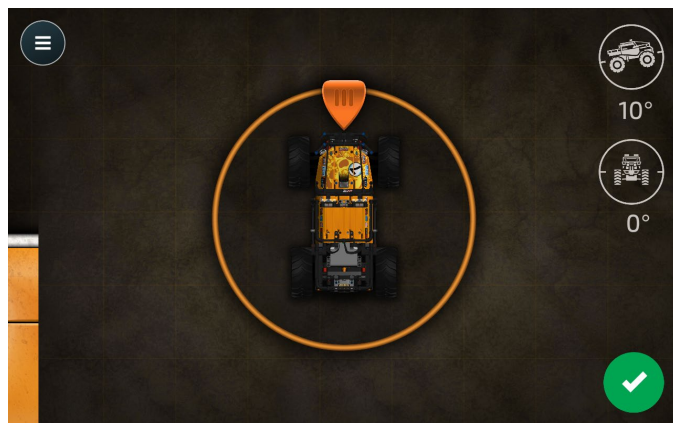
While they do not have a fixed zero position (like the Power Functions servo motor) they can be used to perform the same task, e.g. steering a vehicle like the Off-Roader.

The main control profile is fairly basic, although it includes all the necessary elements. It also shows that there is more to the hub than just moving motors: you can see the pitch and roll of the model thanks to the built-in gyro sensor in the hub.

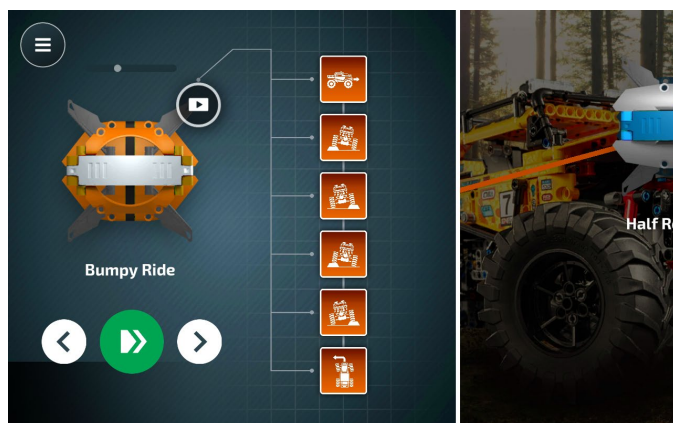


Sliding the control profile to the left you get access to a different kind of control profile for this same model. After confirming the relative position of the model (compared to the image on the smart device) you can make the model move by simply clicking on the area of the screen where you want the Off-Roader to drive.

Moving the model by hand confirms this profile makes use of a built-in gyro: the model on the screen turns exactly in the same way the physical model turns if you move it by hand.



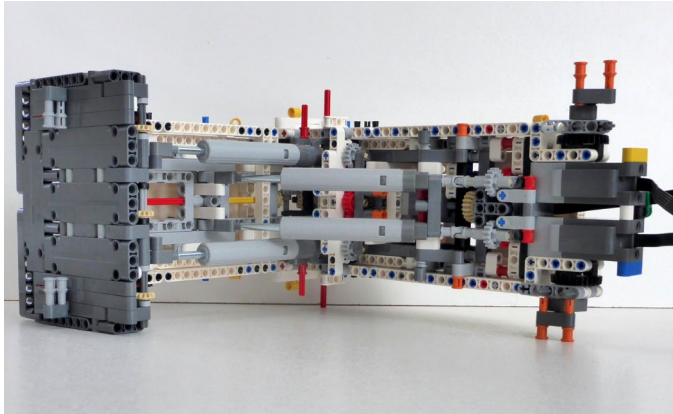
A third option involves completing a number of challenges. Unfortunately my tablet doesn't have a lot of RAM memory and while I have no problem playing videos in any format, the videos included in the CONTROL+ app for this profile appear to be so heavily compressed or encrypted that I have not been able to watch a single one of them without the image freezing up.



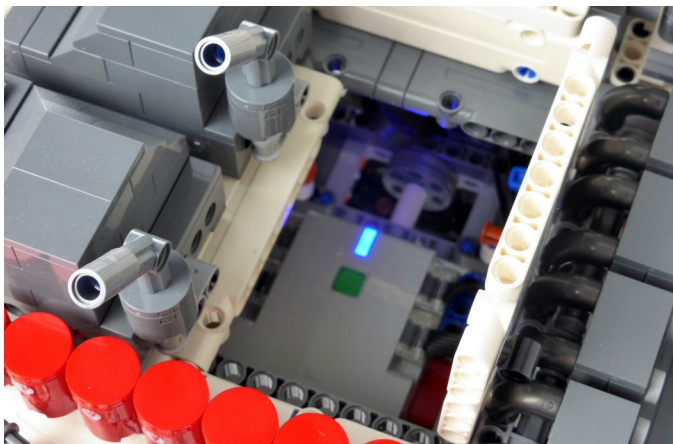
42100 - Liebherr R 9800

The second and largest CONTROL+ enabled set to date is the 42100 Liebherr R 9800. With over 4100 pieces and 7 motors it is the largest and most heavily motorised LEGO® TEchnic set to date. The fact that it is the largest set doesn't mean it is the one that takes up the most space. Both the Big Wheel excavator and the Rough Terrain Crane require more space when fully extended, but even so, the Liebherr R 9800 excavator looks and feels massive. As mentioned previously, the CONTROL+ hub has 4 ports, so there are 2 hubs included in this set to accommodate the 7 motors.

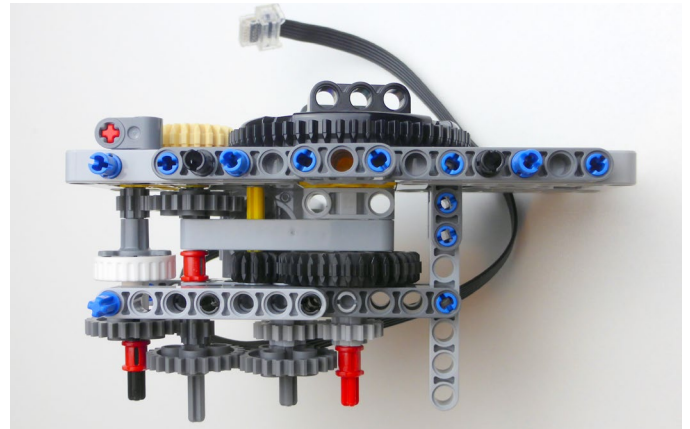
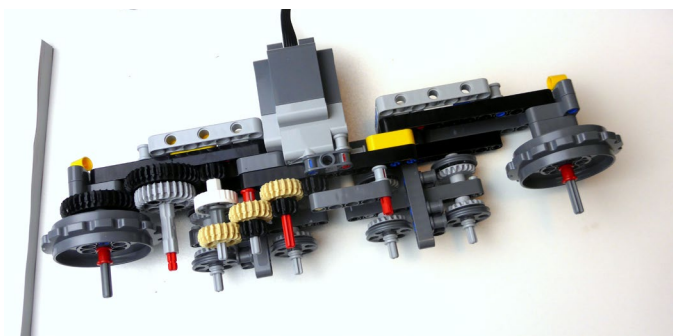
3 of the motors go into the base and are connected to the left and right tracks and to the turntable that rotates the upper structure. The remaining 4 motors are used to articulate the arm and open and close the bucket.



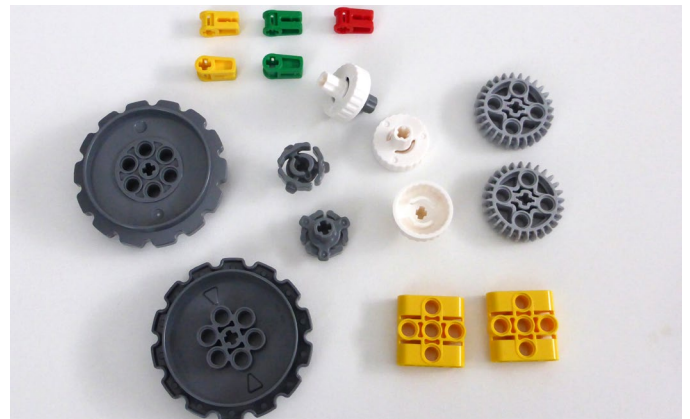
The bottom hub is easily accessed in the base. For the top hub there is a little door in the top of the upper structure to allow access.



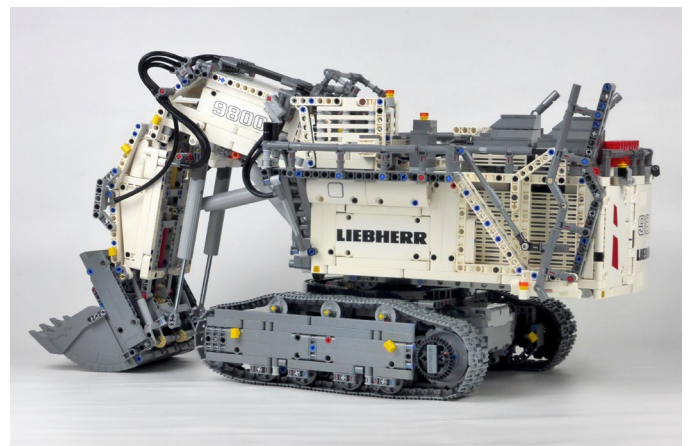
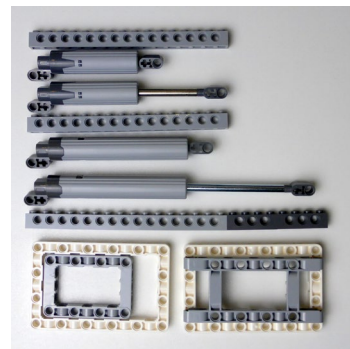
In addition to all the Technic structure, the model is quite detailed and faithful to the original. And despite the fact that, like most motorised models, the gear trains are not particularly complex, the build was quite entertaining. The most complex gearing can be found around the drivetrain and in the gear reduction for the turntable



A model this size of course also required some new engineering and this time LEGO® provided a new clutch gear mechanism to limit the torque the motors can exercise on the transmission. Other new elements include cable clips to route the wires from the new motors and larger sprocket wheels, to accommodate the size of the model.



The set also includes new linear actuators (compared to the old ones in the picture) and larger frames to make it easier to build large structures.



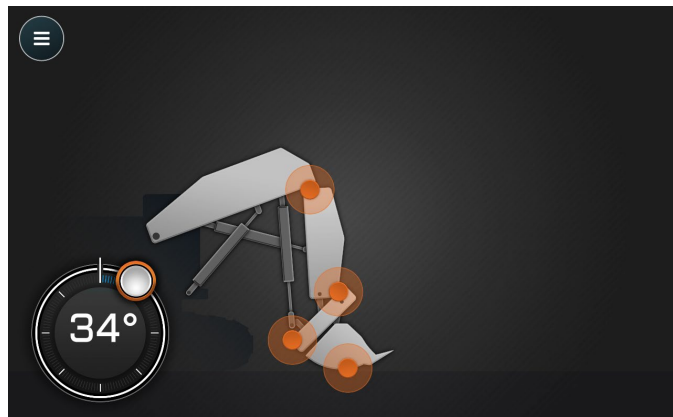
42100 app control

The CONTROL+ profile for the 42100 Liebherr R 9800 adds another layer of complexity. Aside from the addition of a second hub, precise control over the arm of the excavator requires keeping track of its position. This is where the new smart motors come in. The app needs to know the exact position of the arm and so it will calibrate each segment of the arm one by one by extending the linear actuators to their maximum position and count back from there. After the initial calibration, the app can be used to place the arm in a specific position all by itself! Calibration should only be necessary once, but if for some reason the model gets out of synch you can easily access the calibration process from the options menu.

After the initial calibration and a quick tour of the main functions of the interface, the control profile for this model is very complete and - after some training - relatively easy and comfortable to use.



If that is too complicated for you, or you simply want an alternative scenario, there is a sophisticated second profile that allows you to move the arm and upper structure by simply dragging key connection points to new locations. The physical model will then mimic the configuration of the arm in the app.



It is even possible to program actions in a palette with model specific programming blocks to move the different motorised parts of the model a specific number of degrees.

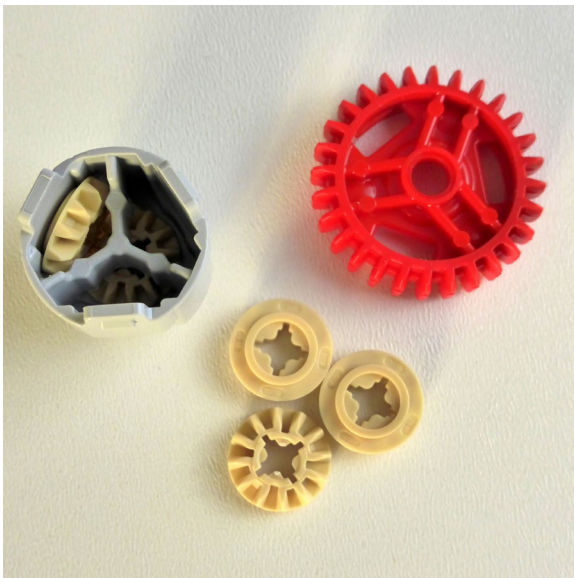
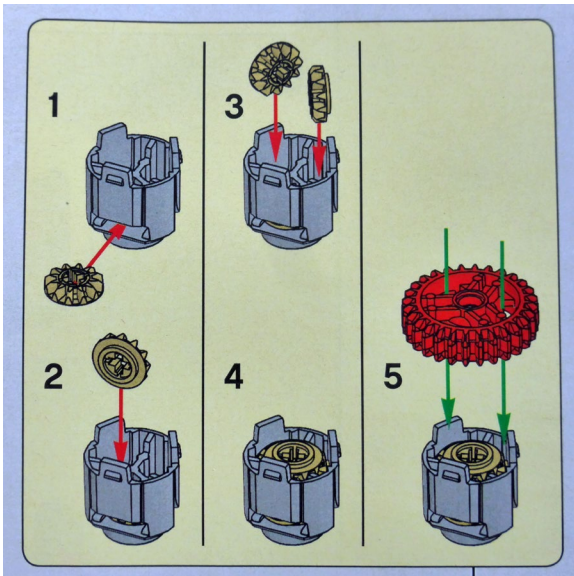


Finally, like in the previous model, there is a series of challenges you can go through with the model. All in all there are plenty of play opportunities with this model. It can take a while to learn how to control it well and the round bricks that come with the set are not the best material to practice with. A smaller grain (coffee, chickpeas) or even sand or sand-like materials make for much more realistic and satisfying practice, but of course those could not be packed together with a LEGO® set.

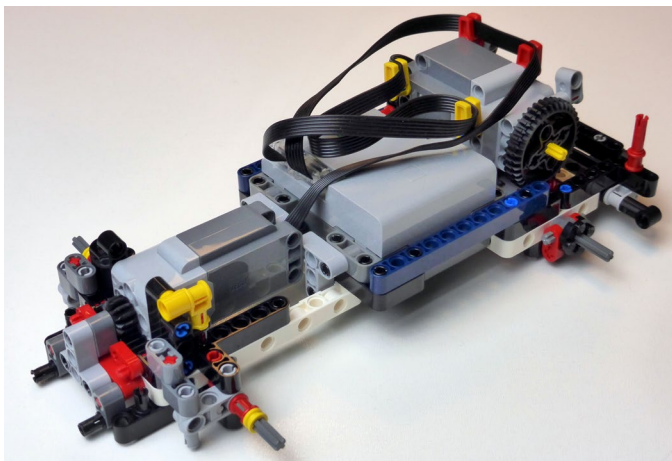


42109 - App-Controlled Top Gear Rally Car

2020 added a third and much smaller model to the CONTROL+ family, the App-Controlled Top Gear Rally Car. This set contains the bare basics for a remote controlled car: 1 motor for power and 1 motor for steering. Once again the power of the motors needs to be factored in and so LEGO® has engineered a new, reinforced differential.



The motors are placed in the most direct way possible and gear trains reduced to the absolute minimum:



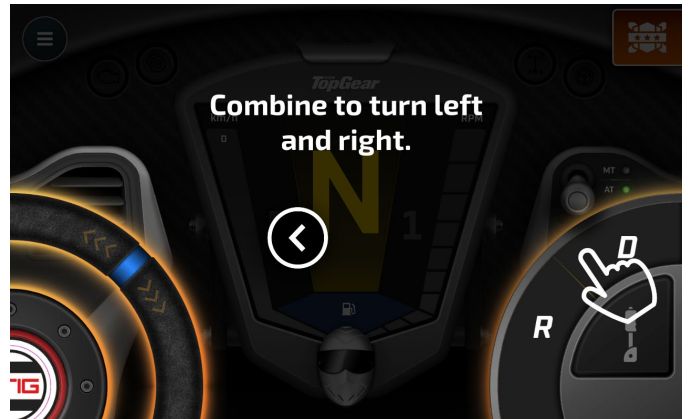
The result is a relatively fast build and a very fast car. I am not especially happy with the looks of the car, nor am I a fan of sticker heavy models. Quite frankly, even though I like Top Gear, the license doesn't provide any additional incentive to me. On the contrary, from my perspective all it does is add cost. Even so, this is the cheapest introduction to CONTROL+ to date and the model has everything that is required to make a remote controlled car.



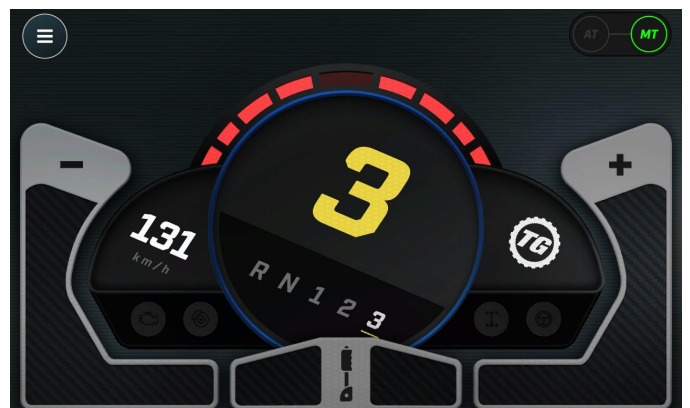
42109 app control

Once again, the profile for this model consists of several parts.

The main profile has steering on the left and speed plus brakes on the right. As with all profiles, the first time you use a set there is a simple tutorial to show you how to use it.



The second profile controls a racecar cockpit simulation, with pedals for speed and breaks and it uses the gyro sensor of your smart device to control the direction of the car: you need to tilt your smart device left or right to make the car turn in the desired direction.



Conclusions

So far there are 3 CONTROL+ models and each model has its strengths and weaknesses. The 42100 Liebherr R 9800 is by far the most complete (and complex) model, but it is also quite expensive. 42109 is the cheapest option, and may be the most appealing to the youngest public. The model itself is not particularly inspiring, but it does what is expected of it and the app provides good play value. 42099 is somewhere in the middle and, in my opinion, combines the best of both: it has great play value, is not overly simple and fun to play with.

All three models have the same basic shortcomings.

- There is no B-model for any of the sets. This in itself is slightly off-putting since traditionally (almost) all Technic sets come with a second model meaning you get two builds for the price of one. Considering the comparatively high price of these models a secondary model would have been a great option.
- The control profiles are not flexible. This means that connecting a single motor to the wrong port will cause an error. In the best case functions will be inverted. In the worst case the app will refuse to connect without providing any feedback as to why. Unless everything is connected as expected the app will refuse to connect to the hub.
- This lack of flexibility also means that even if there are unused ports on the hub, these cannot be used for additional functions. Simply connecting a PoweredUp LED light means the app will no longer connect.

Fortunately there is a way around those last two obstacles. The Powered Up app now also connects to the CONTROL+ hub and in theory you can create your own profiles control creations. In practice things are not quite as simple. It is no trivial task to program any of the templates in the Powered Up app to do something as seemingly simple as control the 42109 rally Car. Hopefully the Powered Up team will provide some mode guidance and template to overcome this serious hurdle.

For now CONTROL+ is a very powerful system but the sets are hard to wield outside the dedicated app. Fortunately there are several 3rd party fan solutions (like BrickController2 or PU Tools) that offer a simple solution, but LEGO® really needs to up it's (PoweredUp) game to change these CONTROL+ sets from "build this RC model" to "a toolbox for creating your own RC models with CONTROL+ technology.

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