# Full-scale design details and scale-up considerations

The full-scale design of the virtual prototype would have to be fairly different to our design for several reasons.

* **Environment**

The prototype was designed with testing in an indoor environment in mind, and as such it would not be suited to operation in a hostile environment like that in which the full-scale model would be used.

Countries with land mine problems tend to be dry and dusty, and a robotic device’s electronic systems would need to be fully enclosed to protect them from the elements. This was not considered in the prototype design, and indeed it would not have been feasible to include such a feature, due to the restrictions imposed with regards to budget. Any metallic part on the vehicle would also need to be protected against corrosion, so this would also have to be invested in when designing and implementing the full-scale model.

Another restriction of the prototype when upgrading to the full-scale model is the use of wheels as the robot’s transportation method. These were chosen over tracks for their low cost and high manoeuvrability, where the robot’s ability to overcome large obstacles was not necessary to cover the testing area. The full-scale model’s travel is unlikely to be this easy, as it would most likely be required to cover difficult areas such as savannah or sand where wheels would incapacitate the vehicle, so upgrading to tracks would definitely be considered. If there had been less budgetary constraints on the prototype, tracks would probably have been chosen for the travelling method.

* **Materials**

The materials that have been chosen in the prototype design were chosen for suitability to a testing and not a real-world environment. For example aluminium was chosen as the material for the chassis, as well as for the manufactured mounting plate. Aluminium is prone to corrosion, so it is probably not the best choice for a robot that operates outside, especially if there is no protective covering. Instead of aluminium, steel would be used for the full-scale model. It does not corrode, and is generally cheaper than aluminium. It is also denser, which is a plus when it comes to stability, so long as the weight restrictions in place in the full-scale robot are less constrictive.

* **Marking system**

The marking system that has been implemented in the virtual prototype design, consisting of a servo motor (electric rotary actuator) and paintbrush, while it suits the clients requirements quite well (marking simulated mines in a simulated minefield), would not work when it comes to the full-scale design.

For one thing, marking landmines potentially hidden under sand with a paintbrush would be implausible, as the sand would simply stick to the brush and no mark would be left behind at all. Again, if the vehicle was to operate in grasslands, leaving a small paint mark would be of no use at all. Then again, there is basically no way in which a prototype could be designed to mark mines in a manner satisfactory in a real-world scenario under the stipulated conditions and constraints of the project.

One option that would work in real life would be to use a paint spray can to mark the mines. This marking supply would not run out as fast, and would increase the time the vehicle could spend in the field at one time. Paint, perhaps pink for ease of visibility, could be sprayed in a ring around the detected location of a mine. Indeed, this idea was put forward and seriously considered in the design phase of the virtual prototype, and only rejected due to the constraints on budget and size, which would not, especially the latter, be of that much importance in the full-scale model.

Another viable option would be to implement a GPS tracking system. This would be accurate, however it would also be relatively expensive, and while it could obviously not be implemented in the virtual prototype design, as a physical marker was needed, however it may be worth investing in in the full-scale design.

* **Electronic considerations**

While the electronic configurations and choice of power supply work fine for the prototype, these things would likely have to be reconsidered when it comes to the full-scale model. A larger vehicle would need a larger battery to power it. Also, the magnetic sensors would likely have to be different, as in a real minefield the conditions would be different. The mines would be larger and hence have a greater magnetic charge, and there would also be other smaller objects that the robot might detect but not want to mark.

* **Discussion of full-scale design**

The full-scale design discussed here is based on a 1:5 scale-up of the virtual prototype. There are some parts of the design that require a full scale-up (such as the chassis, manufactured mounting plate, travelling apparatus and power system) , others that do not require a full scale-up (such as the Arduino and sensors), and yet others that may require more than a 1:5 scale-up (the paint supply for marking for instance). The full-scale model would enlarge upon the virtual prototype design, replacing tracks for wheels for adaptation to difficult terrain, and using a paint spray can system to mark mines to increase time spent in the field.

The marking system would consist of a rotary actuator similar to that in the prototype design, but more powerful to account for the increased load it would have to bear, and a paint spray can. The actuator would turn in a manner similar to that in the prototype’s marking system, but its motion would instead be used to trigger the spray can and thus mark the mine. This system would ensure that the vehicle would not run out of paint too fast, lengthening its service time. The increased cost would probably not be an issue, as for a larger model the budget would obviously be higher due to increased materials, and so more funds could be allocated to the marking system.

Apart from this, the details of the full-scale model would be pretty similar to those of the virtual prototype.

## REFERENCES

Spinning, W., 2020. [online] Wenzelmetalspinning.com. Available at: <https://www.wenzelmetalspinning.com/steel-vs-aluminum.html> [Accessed 1 June 2020].