

# Concept development of a household robot platform

The first robotic lawnmower appeared on the market in 1995 and since then, consumer interest and revenue for domestic aide robots have been rapidly increasing. However, even with increased interest and accelerating technology, the robots of Star Wars seem distant. What is then the next step in consumer robotics?

As the concept of IoT progresses, one could argue that the use of single purpose machines, such as a traditional robotic lawnmower available today soon is a thing of the past. This thesis was done for Additude Innovation and covers a concept development process of a modular, multi-purpose autonomous household robot. The focus user group is consumers, and it is aimed towards domestic purposes with two foundational requirements. It should be able to mow a lawn, without the need of a perimeter wire.

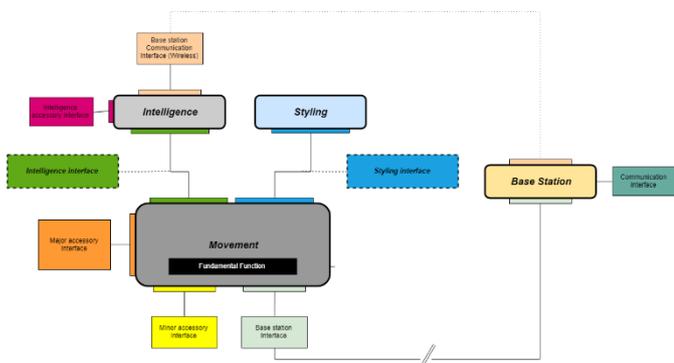


Figure 1. Concept Architecture

The final concept architecture is illustrated in figure 1 above and consists of an intelligence platform which is handling positioning, computing and connectivity. The intelligence module is generic for all product variations, which is then implemented on top of a movement module, which is specific for one, or several, application areas such as lawn mowing, vacuuming, and so forth. The movement module handles the basic functionality and movement, while also providing interfaces for several accessory modules.

The architecture was designed from the bottom to top, where the functions determined which modules were needed to achieve the tasks, and the specific modules set the requirements for the movement module. Accessory modules and movement module in turn combined with fundamental requirements, such as navigation without boundary wire, sets requirements for the intelligence module.

So, in order to assess which functions are interesting to the customer, an internet survey was distributed on Facebook groups. The survey was marketed and made available to ~51.000 profiles. In total 393 questionnaires were submitted. The result was used as basis when selecting which functions to prioritize in the development process and translated into concept solutions that could be implemented in a module platform. These concepts were then used to define the movement module and overall architecture. From this follows that the movement modules are specific for the different application fields and include the basic functionality of that field, such as mowing a lawn. The accessory interfaces allow function specific modules to be mechanically and electrically

attached to the movement module, according to the user's current needs. This architecture simplifies development and introduction of added functional modules. Examples of this is illustrated in Figure 2 and 3.

The product appearance, referred to as styling module in figure 1 can either be tailored according to customer needs, application fields or be generic throughout the product family. In the example of figure 2 and 3 a movement module for the application of domestic lawns are shown.

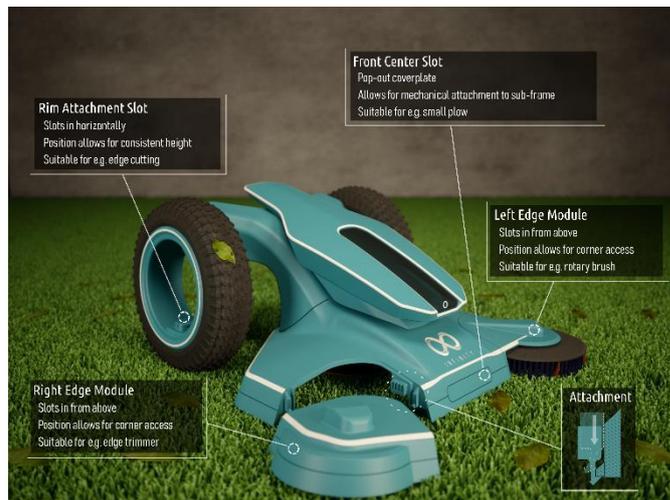


Figure 2. Lawncare Unit with module attachments displayed, Front view.



Figure 3. Lawncare Unit with module attachments displayed, Rear view.

Since the intelligence module should be generic for all product variations, a special sensor concept was developed. The concept requires image processing for the positioning and obstacle recognition. However, as real-time positioning is not a criterion due to the low velocities and the possibility for the rover to take short pauses in order to establish its position, computational requirement is reduced. Especially, in a case where dead reckoning is used in between known positions, the real-time criteria can be eliminated without the need for frequent stops. Utilising a cloud solution and off-loading the data for external computing alleviates the processing requirements of the physical platform while simultaneously providing a centralized software system, implying scale benefits regarding feature recognition and software change.