DESIGN OF A MODULAR CONNECTION METHOD FOR VARIOUS SENSORS ON AGRICULTURAL BOOM SPRAYERS

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BBLeap is a company that provides precision spray systems for agricultural boom sprayers. Boom sprayers provide herbicides or fertilizers by riding with the agricultural machine over the acre. The spraying system that is produced by BBLeap is called the LeapBox. This is a PWM system that regulates the right dosage independent of the pressure or driving speed. After mastering the spraying technology, the company wants to treat every plant individually by implementing sensors. These sensors are the LeapEye (camera module), LeapCat (GPS) and the LeapZero (wind sensor). The LeapEye will be placed every 3m, while the LeapCat and LeapZero are placed on stable parts towards each boom tip. By using these sensors, the spraying will be adapted live based on the observations of the sensors.

The LeapBox is mostly installed as an aftermarket product. The LeapBox is installed on all sorts of brands and models of sprayers, with all different spray boom geometries. When implementing the sensors, during the growth of the number of installations, there should come a universal connection method to connect these sensors efficiently to all these booms. Besides that, the sensors should be placed at a specific location where the sensors and the boom folding function at an optimal and don't interrupt each other. Finding this universal design was the main assignment. This has been split into an analysis phase, a design phase and a realisation phase.
To find out what location possibilities there are, an analysis has been done on the geometry of the about 50 most important sprayer booms. Firstly, there had to be determined what aspects of the boom are important to analyse, these were called factors. This way, general guidelines for design requirements were made. These factors are assessed by going by several farmers, asking dealers, asking within the company and finding online. All the data was gathered and categorized into 5 categories of booms and later even more narrowed down to 2 categories. From was concluded that the top beam of the boom will be the main attachment location, because of an optimal for the folding of the booms in combination with the working of the sensors.

During the design phase, a clamping mechanism was thought out, which is adaptable according to the top beam dimensions, with filling pieces of hard plastic to adapt to curved when needed. The beam is clamped horizontally [green] with two bolts above the beam. A vertical adjustment possibility [yellow]

is provided to the security part [2 times 3] at the bottom. The first designs consist of a clamp, a base part connected to the clamp and a sensor-specific part that connects the sensor with the base part.
The base part comes on top of the beam and brings the sensor level on skewed booms, with the help of a toothed disk [5]. The clamp and the base part were merged later into one piece [2].
A sensor-specific part will be placed on the toothed disk, which holds the sensor, which is visible in figure 2. For the GPS and the wind sensor, a bent aluminium plate will manage this. In the case of the camera, a U-profile will bring the camera to the right height. The connection between the U-profile and the camera makes an adjustment possible in the horizontal viewing angle, but is fixed in the vertical viewing angle. These adjustments are necessary in case 3m spacing is not feasible with the available space. This connection method would work in approximately 80% of the analysed sprayers.

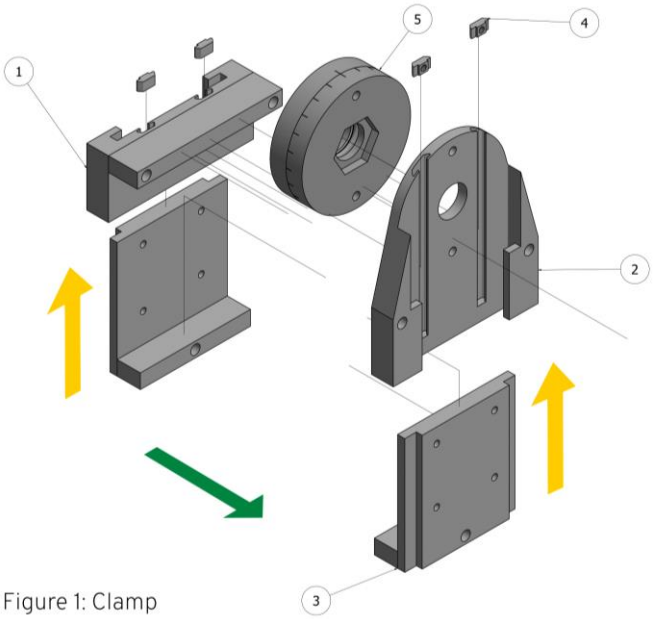

Figure 1: Clamp

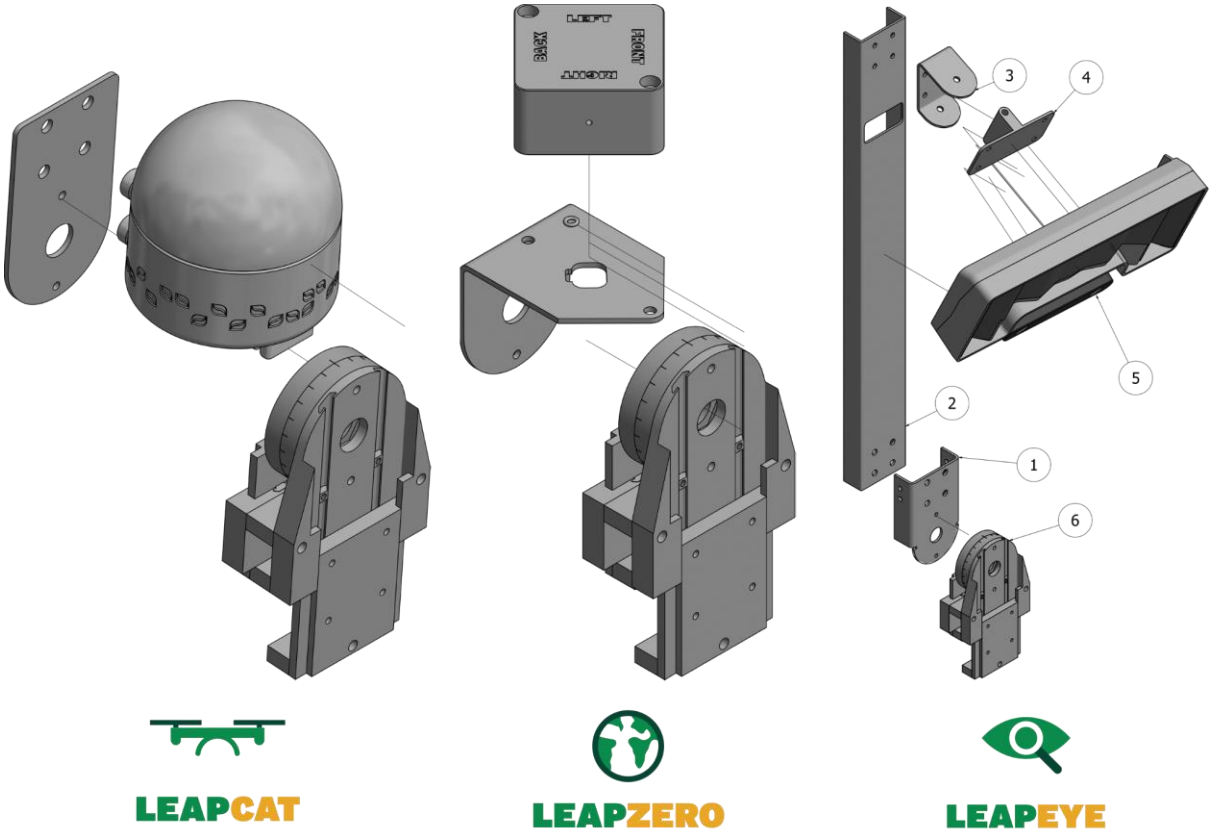

Figure 2

During the realisation phase, a model in CAD has been made. This led to a prototype-ready product. Recommendations about the production are the result of the realisation. The production of the

clamping parts will start with milling. However, the design should be tested, improved and increased in number to make it possible to cast. Improvements, for now, will be about mass reduction balanced against the number of assembly actions. Furthermore, the working of the sensor should be tested, to find out if the angling of the toothed disc, clamping and the positions of the sensors satisfy. Finally, the product will be reshaped to fit aesthetically better in the product range of BBLeap.