tNear Infrared Spectroscopy handheld product development

Public Summary

Thijmen van der Hulst, Bachelor Industrial Design & Engineering, University of Twente, The Netherlands

In the thesis a Near Infrared Spectroscopy (NIRS) handheld was developed for the company Dynalynx, to target the agricultural sector. NIRS technology has become significantly popular among companies in the agricultural sector due to its non-destructive behaviour, the corresponding s/n ratio(sound versus noise), and the maturity that accompanies this technology. The technology is often used in multiple different type of sensors, ensuring a TRL(a type of measurement system to asses the level of maturity concerning a technology which was developed by NASA) value of 9. However, the applications in which these sensors are currently used aren't still fully developed, ensuring just a TRL value of 6. The company Dynalynx develops many NIRS applications, which are yet not mobile, but need to be integrated into installations. Customers of Dynalynx have issued that a mobile scanner using this NIRS technology is requested. Combining the wish of the customer and the potential of NIRS applications, the thesis would direct itself in designing an aesthetical and functional casing for this product, in which Dynalynx itself would focus on the technological aspects such as electronics and hardware.

In the thesis an analysis was executed using qualitative-, and quantitative research methods, focussing on background information concerning NIRS technology, the agricultural market, and the market position of Dynalynx. Furthermore design aspects such as material-, manufacturing-, financial-, and style aspects were research, in collaboration with Dynalynx, to obtain a clear insight in the wishes and expectations of the company.

With the given information the KANO model was used to set up a list of requirements. In the KANO model it is illustrated that the customer has basic-, performance and excitement needs. The basic requirements stated all expectations argued by Dynalynx, such as the fitting of mechanical components with specific dimensions, and the corresponding Ingress Protection Code(IP) value. The performance requirements are being characterized as the linear correlation between the level of satisfaction and the number of performance requirements which are met. The excitement features were those elements not expected by Dynalynx, in which inclusion would result in extra credit.

Using the list of requirements defined by using the KANO model, the detailed embodiment could start. At first the tools morphology and brainstorming were being used to obtain a wide range of potential ideas. During the morphology sessions existing elements were gathered concerning the different components of the product(handle, display and scanner). Being able to combine these elements, an high variety of ideas could be established. The morphological design approach was accompanied with the use of a tool named brainstorming. Brainstorming is a creativity techniques which was used to gather different perspectives and opportunities for the design process. The corresponding results were presented in the form of a mind map. All information provided by the morphological-, and brainstorming sessions were discussed with the company Dynalynx. Based on this discussion the different sketches were separated in 3 different selections in which the preferred design aspects of the different sketches were combined to develop 3 unique concepts.

Having the 3 different concepts, further detailing was required. Such as the ergonomic design aspects of the design. To optimize the ergonomic design all concepts were FDM printed and evaluated with the use of test subjects. The results gathered were used to redesign the different concepts. Also the choice of material and manufacturing processes needed to be determined for redesign/detailing. This was done using the tool GRANTA Edupack 2020. Using requirements stated with the use of the KANO model, the different materials, shaping manufacturing processes, and joining manufacturing

processes were filtered. In this selection process it was decided that the material Polycarbonate (PC) would be used, together with thermoplastic injection moulding as a shaping manufacturing process and the use of rigid adhesives/threaded fasteners for assemblage of the design. Given the redesigns based on the previously mentioned gathered data, the 3 different concepts were also exposed to a drop-, and static test, using the tool Solidworks 2019. In this test the Von Mises stresses and resultant displacement were measured to gain a better insight in the concept's quality. Places where the Von Mises stress would exceed the yield strength of the material Polycarbonate (PC) or where the resultant displacement was seen as too much, based on previously defined requirements, further redesign was executed. Also a financial feasibility check was accomplished in which all 3 different concepts were analysed based on the material required, it's size, production method and the complexity of the shape. Using this information a higher understanding about the costs structure and the accompanying expense was obtained. Having discussed these results with the company Dynalynx the final concept was chosen.