Integrated Bike Lock-Helmet

Public Summary

The "Integrated Bike Lock-Helmet" Bachelor Thesis, proposed by Achmea and developed by Juan Diego Moreira, presents an exploration of an innovative concept aimed at enhancing safety and convenience for cyclists. The thesis explores the initial design challenge of integrating a bike lock into a helmet to reduce fatal traffic accidents involving Traumatic Brain Injuries. It offers valuable insights and solutions to the challenges faced in helmet usage due to the main resistance factor of having to carry a helmet around after you finish your ride. Hence, the aim of this research was to suppress that burden and give it an added function of locking your bike while improving cyclist safety.

The thesis started with a preconceived direction for the desired outcome, modifying a preexisting helmet design based on a foldable helmet called the Fender helmet, from the Chinese manufacturer Cairbull, in such a way that the lock chain structure and the locking mechanism were to be incorporated within the helmet, while maintaining a foldable design. The collaboration with an industry partner such as the company Closca, a visionary helmet producer from Spain, and the engagement with experts in materials science contributed to the identification of the design limitations that this preconceived idea carried along. The main obstacles encountered were on material properties, safety standards, and security ratings that had to be carefully researched and reflected upon the initial concept direction. Therefore, the initial design direction based on the Cairbull Fender design had to be discarded after a careful analysis of the information available. The research conducted in this thesis not only highlights the importance of integrating and respecting safety features into helmet design but also emphasizes the need of a thorough understanding on the mechanics of a helmet, and the active functionality of its components and materials to lessen the impact suffered during a crash. The opposite mechanical functions that a helmet and a chain lock have to fulfill in order to accomplish their intended mission, makes it a huge challenge to incorporate them together within one structure.

Throughout the literature research, it was discussed the need of a proper helmet to go under certain testing to reach a standard certificate proving it will be protective enough to be consider a good helmet and a useful purchase overall. Such protection comes out of the interaction of the materials of the helmet during the crash. The absorption properties of the EPS foam, combined with the shock dissipation of the PC ensure a minimum level of protection all helmets have to provide. On the other hand, chain locks also need to go under testing where they endure multiple attempts to break through the structure of the lock. Knowing that those two functions are in somewhat contradictory one against each other, it was important to consider the priorities of the target group to which the final product is aimed. The target demographic is elderly people using e-bikes and unaware youngsters. It is safe to say that the priority between both function will be the protection of the helmet against an unforeseen event or crash. After critically evaluating the initial concept designs and considering technical constraints the research moved towards exploring alternative design directions, that could go hand in hand with the safety standards for helmets, and security ratings for locks.

The direction of the project changed from incorporating the chain lock mechanism into the helmet to integrating the helmet into the lock mechanism. With this in mind, the requirements for the new direction were set with an emphasis on safety, reliability, maintenance, costs, legal requirements, and social impact. The final sections of the report demonstrate a walkthrough of three alternative solutions at a concept stage level, given that the creative and ideation phase had to start all over again. These concept directions work exclusively in combination with the use of a Closca helmet given their shape and collapsable structure. The main setbacks during the initial concept iterations were the safety

concerns raised by the change in materials, the shape of the helmet, and the lack of reliable information about standard ratings on the Fender helmet, which served as the foundation for the concept. Working directly with a helmet that has already been thoroughly tested and proven to be completely safe, resulted in fewer safety issues. As such, three concept directions for a container-lock mechanism were presented in the thesis. The main goal of such concepts is to encourage helmet use among bike users, and to keep it running smoothly within the daily routine of the users. The concepts provide the opportunity to carry a chain lock nice and tight in the container while using the bike and wearing the helmet. When the bike is no longer used, the helmet can be stored in the container, which also serves as a lock itself, and the chain lock can be taken out to secure the bike. This combination ensures a proper use of at least two bike locks with an appropriate security rating, needed to comply with the specifications provided by insurance companies.