Surf's up! Exploring the possibility of a tether-free dead man's switch

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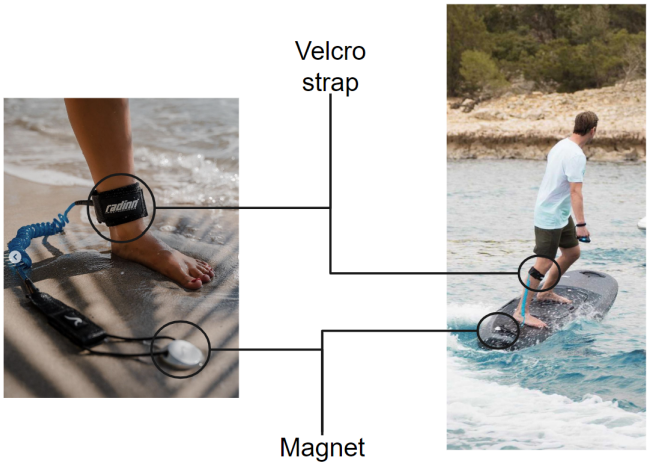
Many devices require a constant human presence for safe operation, often utilizing dead man's switches (DMS) to intervene and disable the device when an operator is absent. These conventional safety mechanisms, such as leashes or buttons, can sometimes compromise user convenience and equipment design. By conducting a user study, the demand for a tether-free DMS was evaluated, investigating the DMS on a jet-surfboard and how it impacts the user experience. In smaller personal devices equipped with brushless DC motors, like jet-propelled surfboards, an opportunity arises by enabling the evaluation of motor data in real-time. Through the use of machine learning, this study aimed to identify patterns in the data that could indicate the absence of an operator.

A Radinn board is a battery-powered jet surfboard, maneuvered by shifting your body like a regular surfboard but with acceleration controlled using a hand controller. Like jetskis and motor boats, the Radinn board is equipped with a dead man's switch system to avoid hazards when the surfer has fallen off. By requiring the surfers to attach a magnet to the board in order to enable the motor, a leash that is connected between the surfer and the magnet will cause the magnet to detach and the motor to be disabled when the surfer falls off. Despite its simplicity and importance in regards to safety, this solution can negatively affect the user experience; surfers might experience discomfort from the Velcro strap or inconvenience from the coiled leash. By interviewing and surveying jet-surfers, we investigated exactly how the leash affects users and if the user experience could be improved by adding a leash-free option.



Interviews with the test surfers The user study revealed that some had strong opinions about the leash, while others were more indifferent. It was apparent that those who quickly got up and stood on the board found the leash less annoying and less of an impediment than those who struggled more to get on their feet. Furthermore, other issues became more evident regarding the current leash-based solution. Such problems included the leash accidentally detaching due to unintentional dragging in the water. However, some users also expressed interest in replacing the current solution with a "tether-free" version.

To investigate the feasibility of a tether-free dead man's switch, data generated by the motor was analyzed using machine learning classification. The intention was to see whether you could tell from how the motor behaved whether or not the surfer was on-board. To do this, two separate approaches were explored: detecting when someone is falling off and detecting when the board is running with no one on-board.

The models showed some promise, in that they could correctly distinguish someone falling off **up to 72.3% of the time** and an empty board **up to 92.3% of the time**. Unfortunately, in order to act as a dead man's switch, the model needs to be nearly perfect, a level which none of the machine learning models were able to achieve. In addition, performance was skewed; models were especially prone to thinking the board was empty, even when a surfer had been on-board. The results indicated two possible areas of improvement: the need for a fast sample rate that can capture a fall-off no matter how quick it is, and the need for a finer categorization of the data that was analyzed.

A surfboard with no attachments to the body, relying solely on the motor data, could potentially provide a heightened sense of freedom and thereby enhancing the user experience of jet-propelled surfboards. Achieving the level of precision required for a tether-free prototype to be comparable to the current solution would necessitate further development, developments that could include different sensor data. This is an interesting area of exploration for future researchers.