Heluminator

Georgia Batson 2017

Design Brief

Cyclist safety on roads is a big issue. I aim to create a smart helmet that includes lights and indicators, to make a cyclist, and their intentions, more visible.

Research

Cycling is a common pastime among Australians. 17% of Australians cycle weekly, and 30% of children cycle regularly. Most of Australia's households have at least one bike.

According to Australian laws, bikes must have a white light on the front, and a red light and reflector on the rear of the bike. The lights can be flashing or steady, and be seen from over 200m away. Wheel spokes or rims must also have amber reflectors. When signalling, a rider must extend their arm in their turning direction.

Road cycling is one of the most dangerous forms of transport, with over 800 deaths yearly. Human error is the most commonly recorded cause for all incidents. 92% are due to motorists, the common causes being turning or emerging into a cyclist's path.

My helmet will make cyclists intentions clearer, especially at night. Lit indicators will draw the attention of motorists, reducing the dangers of riding.

The use of helmets reduces the likelihood of head injury by 65%. Active lighting also reduces accidents, and 2013 survey found that 30% of cyclists didn't have any lights. Accidents are most likely to occur to children and young people; the most dangerous times being dawn and dusk.

While researching helmet designs, I found a few similar helmets, both of which are still in kick-starter. One was Lumos Helmet, which is like my design, using LEDs on the back of a helmet, which are activated using a remote on the handlebars of the bike. Another similar design is the Classon smart bike helmet. It uses motion sensors to track arm movements, but also senses cars in blind spots, and can navigate, record and track your journey.

Both designs are custom built, making them more expensive. They are also bulkier and cumbersome. My design will use an accelerometer to interpret head movements and changes in speed, and will also be detachable, making it cheaper and versatile.

Construction

To begin construction, I first cut out paper guides to use to plan where the LEDs would go. I then used these to cut plastic backing from an old ice cream container. The plastic was the best solution to make the lights removable and durable, which I attached with pins. I then soldered them together.

Then, I started programming. Using Microsoft Visual Studio, I developed a program to control the various components.

I first programmed the lights to flash, toggling every 200 milliseconds. I programmed the indicators, using the 'switch' function to cycle between three settings; both on, one on and none on, changing every 400 milliseconds.

I then incorporated the data from the accelerometer, using a low-pass filter to eliminate noise and outlier values. I coded it to activate the indicator when a tilt of 30 degrees was detected to the corresponding side, turning off after 30 seconds. I also programmed it to cancel the indicator if a tilt in the opposite direction was detected.

The next thing I did was to program the red light on the back to become solid, similar to a car's brake lights, when it detected significant negative acceleration on the y-axis.

Then, I had to put it all together. I positioned the boards and lights, measured the correct length of wire, and soldered them together. I cut two amber LEDs to fit under the visor, to provide visual feedback to the rider.

I protected the components with blue tack and shrink wrap to make them neater and prevent damage.

Upon testing it, I found that it was a little heavier than normal, but the electronics didn't impact use. The tilt worked well on the road, and the brake component also worked as intended.

Evaluation

Modifications

One modification I made was to add a plastic backing to the LED components. My initial plan was to just stick the LED strips on, but this wouldn't work, as they couldn't be easily removed.

I initially planned to use paper, but that had many issues. My solution to add a plastic backing was sturdy and blended in well.

A second modification was to place two LEDs under the visor, to provide visual feedback to the user, making the helmet safer and easier to use.

A final modification was to have the rear component flash to 10%, rather than turning off completely. This was due to a problem with the board, but I used it in my design effectively, as there was always a light on at the back, which was still active.

Problems

I encountered a few issues while constructing and coding my design.

My first issue was that I had trouble attaching the components to the helmet, as it was old and the foam wouldn't stick to the tape of blue tack I initially used. My solution was to use sewing pins, which were small and light enough to work with the design.

Another issue was a problem with the board which meant that the red LEDs wouldn't turn off properly, and only go to about 10%, as there was still current flowing through them. I incorporated this by using it to provide a constant yet active light source.

A final issue was a bug in my program which caused the right indicator to flash as soon as the helmet turned on. I fixed it by telling the program to wait five seconds before reading values from the accelerometer, which solved the problem.

Mass Production

To mass produce my design, I would make a few changes.

I would create a custom board, with built in accelerometer and LED controls, to fit snugly in the helmet. This would protect it from damage, and not impact the helmet design.

I would also create a housing for the boards, to make everything neater and more contained, as well as changing the design for the components, combining them into one flexible, waterproof component.

Changes I Would Make

One change I could make would be to attach the components and boards to the helmets in a way that in simple and easy, and doesn’t impact the structure of the helmet. I would also internalise the electronics, placing them in spaces in the helmet or under the LEDs, which would be less impactful on the aerodynamics and protective elements of the helmet.

Bibliography

Classon. (2017). **CLASSON: Tech and Design for a Seamless Cycling Experience.** (Online). Available: https://www.kickstarter.com/projects/brooklyness/classon-tech-and-design-for-a-seamless-cycling-exp/description . 14/05/17

Lumos. (2017). **Lumos Helmet.** (online). Available: https://lumoshelmet.co/ . 14/05/17

Author unknown. (2017). **Bicycle Helmet Statistics.** (Online). Available: http://www.bhsi.org/stats.html 25/04/17

ROSPA. (2015). **Cycling Accidents Facts and Figures.** (Online). Available: The http://www.rospa.com/road-safety/advice/pedal-cyclists/facts-figures/ 25/04/17

Gough, D. (2014). Cycling Safety: The Statistics. **The Age.** 19 August. Retrieved from: http://www.theage.com.au/victoria/cycling-safety-the-statistics-20140818-105erb.html

Bicycle NSW. (2017). **5 Ways A Bicycle Will Improve Your New Year's Resolutions.** (online). Available: https://bicyclensw.org.au/category/e-advocacy/knowledgebase/research-statistics/ 25/04/17

Wheatstone, R and Scott, P. (2015). Cyclist deaths: Why you are 17 times likelier to be killed on a bike than in a car. **Mirror.** 17 July. Retrieved from: http://www.mirror.co.uk/news/uk-news/cyclist-deaths-you-17-times-6021412

Pedestrian and Bicycle Information Center. (2015). **Pedestrian and Bicyclist Crash Statistics.** (Online). Available: http://www.pedbikeinfo.org/data/factsheet_crash.cfm 25/04/17

Pucher J, Buehler R, Merom D, Bauman A. Walking and cycling in the United States, 2001–2009: Evidence from the National Household Travel Surveys. Am J Public Health 2011;101(S1):S310-S317).

Beck LF, Dellinger AM, O'Neil ME. Motor vehicle crash injury rates by mode of travel, United States: using exposure-based methods to quantify differences. Am J Epi 2007;166:212-8.

Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS). Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Available at http://www.cdc.gov/injury/wisqars. Accessed on 14/05/17.

National Highway Traffic Safety Administration. Traffic Safety Facts, 2013 data – bicyclists and other cyclists. Washington, DC: US Department of Transportation; 2015. (Publication no. DOT HS 812 151).

Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: a meta-analysis. Accid Anal Prev 2001;33:345-52.

National Highway Traffic Safety Administration. Countermeasures that work: A highway safety countermeasures guide for State Highway Safety Offices, 8th edition. (Report No. DOT HS 812 202). Washington, DC: National Highway Traffic Safety Administration. 2015.

Evershed, N. (2014). Cycling Accidents Rising in Australia. **The Guardian.** 23 June. Retrieved from: https://www.theguardian.com/news/datablog/2014/jun/23/cycling-accidents-rising-in-australia

Australian Cyclists Party. (2015). **The Facts.** (online). Available: https://australian-cyclists-party.org.au/the-facts/ 25/04/17

Queensland Department of Transport and Main Roads. (2017). **Cycling and Personal Safety.** (online). Available: http://www.tmr.qld.gov.au/Travel-and-transport/Cycling/Cycling-safety/Personal-safety 25/04/17

Queensland Department of Transport and Main Roads. (2017). **Safety Check.** (online). Available: http://www.tmr.qld.gov.au/Travel-and-transport/Cycling/Cycling-safety/Safety-check#lighting 25/04/17

Queensland Department of Transport and Main Roads. (2017). **Queensland Environments.** (online). Available: http://www.tmr.qld.gov.au/Travel-and-transport/Cycling/Cycling-safety/Queensland-environments#Night 25/04/17

Queensland Department of Transport and Main Roads. (2017). **Bicycle Road Rules and Safety.** (online). Available: https://www.qld.gov.au/transport/safety/rules/wheeled-devices/bicycle/index.html#signalling 25/04/17

Bhide, S. (2017). **Applying Low Pass Filter to Android Sensor's Readings - Built.io Blog.** (online). Available: https://www.built.io/blog/applying-low-pass-filter-to-android-sensor-s-readings. 17/06/17

Kircherelectronics. (2017). **Low-pass filter: the basics**. (online). Available: http://www.kircherelectronics.com/blog/index.php/11-android/sensors/8-low-pass-filter-the-basics. 17/06/17

Acknowledgements

My Dad showed me how to program the lights, and ordered the materials for me to use. He also taught me use the soldering iron.

Mrs Anderson helped to guide my ideas, and kept me motivated.

Lily Yang helped me with ideas, and with coding.