MS-HCI Project Proposal Approval Form & PERMIT 6998

This form is for students enrolled in the Master of Science in Human-Computer Interaction (MS-HCI) Program. The semester prior to undertaking the project, the student must find a faculty member willing to supervise the project and develop a project proposal. Complete this form in consultation with the faculty member who will be responsible for supervising your project and assigning your grade. The faculty member should sign in both signature areas. Bring the completed form to Carrie Bruce or Richard Henneman.

Your proposal should include the following and may include other components according to your project needs:

- Introduction/Background
- Potential Solution
- Expected Methodology
- Expected Resources
- Schedule of Work

The attached proposal was developed under the advisement of a faculty member and is a fair representation of the work I expect to accomplish to complete the MS-HCI Project.

Student Name (please print): STEVE JONES

GT ID Number: ~~905902~~ 902905280 **E-mail:** STEVEJONES@GATECH.EDU

Semester: ☐ Spring ☑ Fall **Year:** 20____

School: ☑ CS ☐ ID ☐ PSYCH ☐ LMC

Project Title: SMART MOTORCYCLE HELMET **Credit Hours:** 3

Student's Signature: [signature] **Date:** 4/26/17

Faculty Approval for Project Supervision:

I agree to supervise this student in the performance of a Masters project during the specified term.

Faculty Advisor (please print): Bruce Walker

Signature: [signature] **Date:** 4/30/17

MS-HCI PROJECT PERMIT – 6998 CS/ ID/ LMC/ PSYC

Faculty Approval for Project Credits:

I agree to be the assigned faculty member for 6998 project credits during the specified term, and certify that the proposed work represents an appropriate effort for the credit hours awarded. Each credit hour must represent AT LEAST 50-60 hours of work by the student.

Faculty Advisor (please print): Bruce Walker

Signature: [signature] **Date:** 4/30/17

MS-HCI Project Proposal

Steve Jones
Project Advisor: Dr. Bruce Walker

Table of Contents

1 - Introduction/Background

Statement of user problem this project will address, why it is a problem, intended user characteristics. Describe the general application domain: what else has been done, what is the context of thinking and making things in which your work is situated? How do users currently go about addressing this problem?

Motorcycle Demographics

As of the most recent report by the Department of Transportation, there were 8,410,255 motorcycles registered in the United States by private citizens and commercial organizations in 2011. This is a substantial amount, at 14% of households with a motorcycle or scooter. However, the US is one of the lower percentage countries in terms of motorcycle/scooter ownership compared to countries like Thailand (87%), China (60%), and India (47%).[1] An estimated 200 million motorcycles, including mopeds, motor scooters, motorised bicycles, and other powered two and three-wheelers, are in use worldwide.[2]

For many riders, a motorcycle is a cheaper and more convenient form of transportation that results in less commuter congestion and less environmental impact than driving an automobile. Some are drawn to motorcycles for recreation and the intimate connection between the rider, the bike, and the road. Seeking the freedom of two wheels and the immersive presence in the environment, being exposed to the sun and the surrounding smells, listening to the melodic tune of an exhaust note, and the feeling of cruising through the open air.

Motorcycle Safety

However, this convenience and freedom has significant compromises. According to the US National Highway Traffic Safety Administration (NHTSA), in 2015 per 100 million miles traveled there were 451 motorcycle injuries, compared to 97 injuries in passenger cars. Even more significant, motorcyclists' risk of a fatal crash is 29 times greater than those of automobile passengers (25.38 vs 0.89 per 100 million miles traveled).[3]

As the auto industry and legislation in the US has advanced to successfully improve automobile safety, the same trend has not been seen with motorcycle safety. Passenger vehicle and large truck fatality rates have been decreasing since the 1970's, but motorcycle fatality rates have not experienced steady decline.[4]

Motorcycles & Technology

As technology and cell phones continue to become an increasingly ubiquitous presence in our life, many motorcyclists are connected to their devices while riding. Many riders use devices for navigation, playing music, making phone calls, or even texting and other interactions while riding. Some riders mount their phone on a location on their bike where they can see or touch it. Other riders store their phone in a pocket and may retrieve it.

Although there is no available statistical evidence, it is obvious that interacting with these devices can contribute to a crash that may result in injury or fatality. According to the National Safety Council, in 2014 cell phone use was estimated to be involved in 26 percent of all motor vehicle crashes.[5] Cell phone usage for motorcyclists is arguable far more dangerous because of the increased physical and mental requirements of riding.

Many riders try to make being connected to their devices safer by installing a mount so they can view the device hands-free. However, this usually means looking down at the device mounted on the bike rather than viewing their environment and the road ahead. Some riders use speakers, headphones, or wireless connected speakers in helmets. These are often used for music but also for navigational audio to lessen the need to look at their device.

Unlike automobiles, connected technology and safety technology has only recently began to escalate in the world of motorcycles. Research and commercialization of the motorcycle tech safety industry is in its infancy.

Motorcycles Safety Solutions

One solution to decrease the distraction and dangerous use of devices while riding is a head-up display (HUD). HUDs are often used in situations where a user needs to be able to view their surroundings but also see important information displayed. They are commonly used in aircrafts, and increasingly in

automobiles. In recent years HUD use has been experimented in new uses such as the personal HUD in Google Glass.

Some companies have experimented and commercialized HUDs for motorcycle helmets. BMW with DigiLens Inc., showed its first HUD helmet concept at the 2016 Consumer Electronics Show in Las Vegas.[6] NUVIZ, Inc. is a company that in 2013 began developing HUD accessory to be attached to a helmet, and they claim it will be commercially available at some point in 2017.[7] LiveMap is a company that is prototyping a helmet that uses a HUD to project an augmented reality interface.[8]

The most popular commercial helmet with a HUD was the Skully AR-1 whose pre-orders raised more than $2.4 million on Indiegogo, making it the most successful wearable tech campaign of all time on the crowdfunding site. However, even after closing $11 million in Series A financing in February 2015 the company filed for bankruptcy and shut down. A lawsuit by a former employee who was responsible for the company's bookkeeping claimed company was a “sham” and the founders expensed their lavish lifestyles until the company's money ran out. Few of the thousands who pre-ordered received the helmet.[9]

It’s clear that there is an interest and a market for a motorcycle helmet HUD solution, but there has yet to be a successful commercial product and there is no available research to demonstrate the safety effects of such a product. The large interest in a helmet HUD to increase a riders safety, convenience, and enjoyment, along with the opportunity to validate the safety impact makes developing and researching solutions a valuable endeavor.

2 - Potential Solution

What is the general nature of the solution? What is the general functionality? The platform?
I will research and build a prototype of a helmet with a HUD to provide the rider with pertinent information that would otherwise require a glance away from the road. The system will likely include bluetooth audio integration and possibly be connected to a mobile application to control the system and manage settings.

I’ve listed all existing smart motorcycle helmet solutions below. Although there are slight differences in each solution, most have similar features. Audio is particular area in existing solutions that has plenty of room to explore and advance. Auditory information and alerts have the benefit of the rider not needing to take their eyes off the road. They also are not disrupted by movement and vibrations that may make visual information difficult to examine. I plan to differentiate my solution by researching existing and potential other features including audio. This research will allow me to create a taxonomy of these features and a hierarchy of their importance.

I will reach out to some of the companies who have prototyped solutions and see if they are interested in exploring more in the auditory aspect of their solution. The support of one of these companies could potentially help lessen the amount of time dedicated to producing a prototype.

NUVIZ

Website: https://www.ridenuviz.com/
Video: https://www.kickstarter.com/projects/nuviz/the-first-head-up-display-for-motorcycle-helmets
Mobile Application

- RideCloud Mobile Application

- Control HUD Info
- Record & Track Routes
- Share Photos & Video

Audio
- Phone Calls
- Music

Controls
- Smartphone App

Motorcycle Information / Instrument Panel
- Telemetry
- Race Track Data

Other Display Info
- Phone Calls
- Weather
- Music

Road / Navigation
- Navigation
- Tracking

Cameras
- Photo & Video

Collision Detection
- None

LiveMap

Website: https://livemap.info/
Video:
- https://www.youtube.com/watch?v=wCfjX-KEWmA
- https://www.youtube.com/watch?v=_bwkjautqVI

Mobile Application
- None

Audio
- Notifications About Route
- Speed & Other Parameters
- Music

Controls
- Siri & Google Now Integration

Motorcycle Information / Instrument Panel
- Speed & Other Parameters

Road / Navigation
- Augmented Reality Interface
- GPS Route

Other Display Info
- Customizable Alerts & Calls

Cameras
- Video Capture

Collision Detection
- None

BMW / DigiLens

Website: http://www.digilens.com/digilens-takes-motorcycle-head-up-displays-miles-down-the-road/
Video: https://www.youtube.com/watch?v=Vkhp8Z1lloQ

Audio

- Integrated Speakers

Controls

- Multicontroller Fitted at the Left Side of the Handlebars

Motorcycle Information / Instrument Panel

- Gear indicator
- Speed
- Temperature
- Fuel Level
- Tire Pressures
- Oil Level

Road / Navigation

- Speed Limit
- Traffic Updates

Cameras

- Rear-View Camera
- Forward-Facing Cameras

Collision Detection

- Future V2V (Vehicle-to-Vehicle) Communication

Skully AR-1

Video: https://www.youtube.com/watch?v=ZdcWd594lRw

Mobile Application

- Bluetooth Connectivity to Smartphone Application

Audio

- Music Streaming

Controls

- Voice-Activated Navigation & Music

Motorcycle Information / Instrument Panel

- Speed Display

Road / Navigation

- Fuel Level

Cameras

- 180-Degree Rearview Camera

Collision Detection

- None

Other

- Electrochromatic Visor

Intelligent Cranium iC-R

Website: http://www.intelligentcraniumhelmets.com/
http://newatlas.com/intelligent-cranium-helmet-ic-r/38165/
Video: https://www.youtube.com/watch?v=30EHI4S38u4

- twin full-colour LED heads-up displays

Mobile Application
- Connected mobile application

Audio
- Bluetooth Communications
- Helmet-to-Helmet Communications with Other Riders

Controls
- Voice Controls

Motorcycle Information / Instrument Panel
- Speed
- Telemetry
- Media Information
- Call Data

Road / Navigation
- Navigation

Cameras
- Twin Rear-Facing Cameras for 210-Degree View

Collision Detection
- LiDAR Rear-End Collision Warnings
- Interior LED, Sound, & Vibration for Alerts

Other
- Solar Panel Charging
- Electrochromatic Visor
- Open SDK

Reevu
Website: http://www.reevu.com/
Video:

Audio
- Unknown

Controls
- Unknown

Motorcycle Information / Instrument Panel
- Connect the HUD to the Motorcycle's ECU or Diagnostics System
- RPM
- Fuel Consumption Data
- Indicator Signals

Road / Navigation
- Racetrack-Focused Lap and Split Timers

Cameras
- Rear Vision System

BikeHUD by BikeSystems
http://newatlas.com/bikehud-motorcycle-hud-heads-up-display-review/33884/
Website: http://www.bike-hud.com/
Video:

Audio
- Music

Controls

- Handlebar-Mounted GPS Sensor that Also Acts as Four-Button Control Interface

Motorcycle Information / Instrument Panel

- BikeHUD ECU
- Fuel Indication

Road / Navigation

- MapQuest Mapping
- Speed Camera Warnings

Cameras

- None

Collision Detection

- None

3 - Expected Methods

What will you do in each stage of the project (many of the steps listed in the schedule will be discussed in this section. How will you understand your users and their needs? How will you test the prototype? The functional system?)

Understanding Users and their Needs & Defining Functionality

User Behavior & Design Requirements Survey

- Understand rider behavior including use of technology and devices
- Understand interest in safety technology & HUD
- Understand what features riders want in a HUD system

Rough Prototype

- Build a physical helmet HUD system prototype
- Design HUD interface and audio
- Design & develop mobile application to manage HUD system

User Testing: Rough Prototype

- Test HUD interface and audio using interactive designs (e.g. InVision)
- Test mobile application design interactive designs (e.g. InVision)

User Testing of Functional System

- Recruit motorcycle riders and perform user tests
- Observe & understand user's interaction with the HUD system prototype helmet

4 - Expected Resources

Description of computing/testing resources you will need, and how you will obtain them.

Surveys

- Google Forms or Qualtrics
- Will likely incentivize users to perform surveys by raffling a gift card to a random respondent

Helmet

- Although I have a helmet I will likely have to purchase a helmet to modify so I won't have to use a partially modified prototype

Bluetooth Helmet Speaker

- I own a Sena 10R that I can transfer to the prototype helmet when testing

HUD

- Purchase parts

Battery

- Purchase battery & wiring to place in/on helmet

Camera

- Purchase camera if implementing rear-view display features

5 - Schedule

Understanding Users and their Needs

Week #1

Due: August 23rd at 11:59pm

- ❏ Literature Review & Competitive Analysis
- ❏ Draft: User Behavior & Design Requirements Survey

Week #2

Due: August 30th at 11:59pm

- ❏ Release: User Behavior & Design Requirements Survey

Defining Functionality

Week #3

Due: September 6th at 11:59pm

- ❏ Analyze Survey Data & Define Design Requirements / Feature Taxonomy

Defining Final User Testing Processes

Week #4

Due: September 13th at 11:59pm

- ❏ Design User Research Tests
- ❏ Submission to IRB (Institutional Review Board)

Rough Prototype

Week #5

Due: September 20th at 11:59pm

- ❏ HUD Interface & Audio

Week #6

Due: September 27th at 11:59pm

- ❏ Stage #1: Helmet Physical HUD Device Prototype

Week #7

Due: October 4th at 11:59pm

- ❏ Stage #1: Mobile Application Interactive Design Prototype

User Testing: Rough Prototype

Week #8

Due: October 11th at 11:59pm

- ❏ Design User Test: HUD Interface
- ❏ Design User Test: Mobile App Interactive Design Prototype

Week #9

Due: October 18th at 11:59pm

- ❏ User Testing: HUD Interface
- ❏ User Testing: Mobile App Interactive Design Prototype

Week #10

Due: October 25th at 11:59pm

- ❏ GVU Showcase Poster

Week #11

Due: November 1st at 11:59pm

- ❏ Stage #2: Helmet Physical HUD Device Prototype

Week #12

Due: November 8th at 11:59pm

- ❏ Stage #3: Helmet Physical HUD Device Prototype

Week #13

Due: November 15th at 11:59pm

- ❏ Final: Helmet Physical HUD Device Prototype

Week #14

Due: November 22nd at 11:59pm

- ❏ Stage #2: Mobile Application Prototype

Week #15

Due: November 29th at 11:59pm

- ❏ Stage #3: Mobile Application Prototype

Week #16

Due: December 6th at 11:59pm

- ❏ Final: Mobile Application Prototype

User Testing of Functional System

Week #17

Due: January 10th at 11:59pm

- ❏ Design User Test

Week #18

Due: January 17th at 11:59pm

- ❏ Perform User Tests

Week #19

Due: January 24th at 11:59pm

- ❏ Perform User Tests

Week #20

Due: January 31st at 11:59pm

- ❏ Perform User Tests

Week #21

Due: February 7th at 11:59pm

- ❏ Interactivity Poster

Week #22

Due: February 14th at 11:59pm

- ❏ Analyze User Test Data

Final Report

Week #23

Due: February 21st at 11:59pm

- ❏ Draft #1: Final Report

Week #24

Due: February 28th at 11:59pm

- ❏ Draft #2: Final Report
- ❏ Submit Report Draft to Dr. Walker

Week #25

Due: March 7th at 11:59pm

- ❏ Final Draft: Final Report

Week #26

Due: March 14th at 11:59pm

- ❏ Draft #1: Video

Week #27

Due: March 28th at 11:59pm

- ❏ Final Draft: Video

Presentation to MS-HCI Faculty Advisors & Students

Week #28

Due: April 4th at 11:59pm

- ❏ Draft: Presentation

Week #29

Due: April 11th at 11:59pm

- ❏ Final: Presentation
- ❏ GVU Showcase Poster

Bibliography

[1] *Transportation Topline*. Publication. PEW RESEARCH CENTER, n.d. Web. 16 Apr. 2017. <http://assets.pewresearch.org/wp-content/uploads/sites/2/2015/04/Transportation-Topline.pdf>.

[2] Shuhei, Adachi (2006). "Fuel Cell Powered Motorcycles". Journal of the Society of Automotive Engineers of Japan. 60 (1): 90–93. ISSN 0385-7298

[3] *Traffic Safety Facts 2015*. Publication no. 812 353. National Highway Traffic Safety Administration, Mar. 2017. Web. 16 Apr. 2017. <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812353>.

[4] National Highway Traffic Safety Administration. (2011). Traffic Safety Facts 2011. (DOT HS 811 754). Washington, D.C.

[5] *NSC Releases Latest Injury and Fatality Statistics and Trends*. Rep. National Safety Council, 25 Mar. 2014. Web. 16 Apr. 2017. <http://www.nsc.org/NewsDocuments/2014-Press-Release-Archive/3-25-2014-Injury-Facts-release.pdf>.

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[9] Kendall, Marisa. "Bay Area Start-up Skully Was a ‘sham,’ Ex-employee Says." Los Angeles Times. Los Angeles Times, 10 Aug. 2016. Web. 16 Apr. 2017. <http://www.latimes.com/business/la-fi-tn-skully-20160810-snap-story.html>.