M.A.S.Q. Motorcycle Safety System

Martino Caldarella
CpE, mcaldare@uci.edu

Adria Razaghi Benito
EE, adriarb10@gmail.com

Sergio Panjoj Sucuqui
CSE, spanjojs@uci.edu

Qihao Yu
CpE, qihaoy@uci.edu

Professor Quoc-Viet Dang
Department of Electrical Engineering and Computer Science

Background

Every year, thousands of people die in motorcycle accidents, and many more are severely injured [1]. Common causes include lane changes, speeding, driving under the influence, lane splitting, sudden stops, unsafe or Inexperienced riders, car drivers who do not see the motorcycles or motorcyclists who do not see the cars. In most cases, the motorcycle riders are seriously injured and require immediate assistance.

The M.A.S.Q. Motorcycle Safety System is designed to keep the rider updated on his or her surroundings, as well as to contact emergency personnel in the event of an accident.

Milestones: < Fall 2019 > < Winter 2020 >

- System design, hardware purchase, system feasibility analysis
- Accident recognition software design and distance algorithm draft
- First helmet system prototype implemented to get acceleration data, LED system installed
- First motorcycle system prototype, emergency call software
- Implementing/testing Deep Learning, Distance Detecting software, Accident Recognition testing
- Implementing and reliability testing for wireless communication system
- Final testing and parameter adjustment, make system accident proof

Problem

Problem	Solution
Full face or modular helmet offer less side visibility	Side ultrasonic sensors detect vehicles
Small rear-view mirrors do not provide much visibility	Back cameras used to detect vehicles and their distance
Riding the motorcycle with the helmet not properly buckled	Sound notification and motorcycle started disabled
Delay in emergency assistance due to panic, hit and run, no witnesses, etc.	Accident detection system and automatic emergency call/text
Helmet HUDs are helpful but the displays can be an additional source of distraction	LEDs signal the presence of vehicles.

Design

- Two Cores, one on helmet, one on motorcycle, connected wirelessly using ZigBee protocol (Fig. 1 and 4)
- Accident recognition is based on real time acceleration data
- GPS location sent to emergency contact or 9-11, depending on rider's post-accident response
- Vehicle recognition using Stereoscopic vision and Deep Learning (Fig. 2)
- Simple and not distracting LED notifications. Their position and blinking rate correspond to vehicle position and distance respectively (Fig. 3)
- Backup battery on motorcycle Core

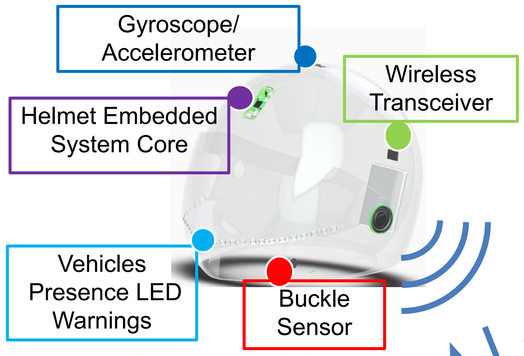

***Figure 1**: Helmet System*

(a) vehicle behind/left
(b) vehicle behind
(c) vehicle behind/left and on the right
(d) vehicle on the right

***Figure 3**: Example of functionality*

***Figure 2**: Vehicle/Distance Recognition Software Output*

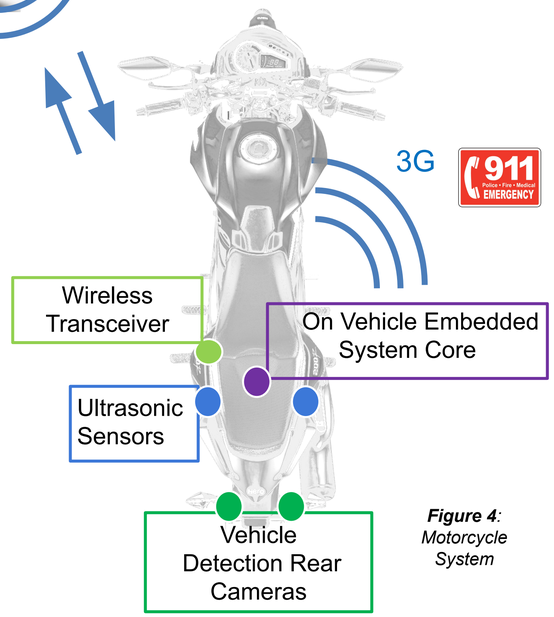

***Figure 4**: Motorcycle System*

Software Features

- Real Time Accident Recognition [2]
- Deep Learning Vehicle Recognition
- Real Time Relative Position and Velocity Measurements
- Internet of Things for Embedded System
- ZigBee Wireless Communication Protocol
- Independent automated text/call system

Hardware Features

- Motorcycle Core: Stereo Pi (1.2GHz compute module)
- Helmet Core: Raspberry Pi Zero (1GHz single-core CPU, 512MB RAM)
- XBee WiFi Modules (2.4 GHz, up to 1000m) [3]
- Battery backup
- Pi Noir Infrared Cameras V2
- Waterproof side Ultrasonic sensors

References

[1] P. Tara, "Motorcyclist Traffic Fatalities by State," *Governors Highway Safety Association*, 2017. [Online]. Available: www.ghsa.org

[2] Manaf, A.M. Amera, L, Faris, A.K, "*Object Distance Measurement by Stereo VISION,*" International Journal of Science and Applied Information Technology (IJSAIT), 2013. [Online].

[3] ZigBee Standards Organization. ZigBee Specification. ZigBee Document 053474r20, 2012. [Online].

Helmet model in figure 3 property of HJC Corp.
Motorcycle picture in figure 4 property of Hero MotoCorp Ltd