M.A.S.Q. Motorcycle Safety System

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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.

Problem

Full face or modular helmet offer less side visibility
Small rear-view mirrors do not provide much visibility
Riding the motorcycle with the helmet not properly buckled
Delay in emergency assistance due to panic, hit and run, no witnesses, etc.
Helmet HUDs are helpful but the displays can be an additional source of distraction

Solution

Ultrasonic sensors detect vehicles in near proximity
Back cameras used to detect vehicles and their distance
Sound notification and option of disabling motorcycle starter
Accident detection system and automatic emergency text
LEDs signal the presence of vehicles, their distance, and type of vehicle (Fig. 1)

Design

- Two Cores, one on helmet, one on motorcycle, connected wirelessly (Fig. 2 and 5)
- Accident recognition is based on real time acceleration data
- GPS location sent to emergency contact or emergency service, depending on rider's post-accident response
- Vehicle recognition using Stereoscopic vision and Deep Learning (Fig. 3)
- Simple and not distracting LED notifications. Their position correspond to vehicle position and number of LEDs represents vehicle's distance (Fig. 1)
- LEDs brightness adjusted automatically, battery level indicator

Detection method	Ultrasonic Sensors	Cameras	Cameras	Cameras
	x < 4m	4m < x < 15m	15m < x < 30m	x > 30m
Left Lane	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o
Central Lane	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o
Right Lane	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o	o o o o o o o o o o o o o o o o

FIgure 1: *Vehicle Detection display using LEDs (*o = OFF, o = ON*). Based on type of the vehicle, distance, and position, the helmet embedded system turns on the corresponding LEDs. Red LEDs indicate large vehicles, orange LEDs indicate cars, and yellow LEDs indicate motorcycles. The example in the picture shows the detection of a large vehicle approaching on the right lane between 15 and 30 m and a car behind at more than 30m.*

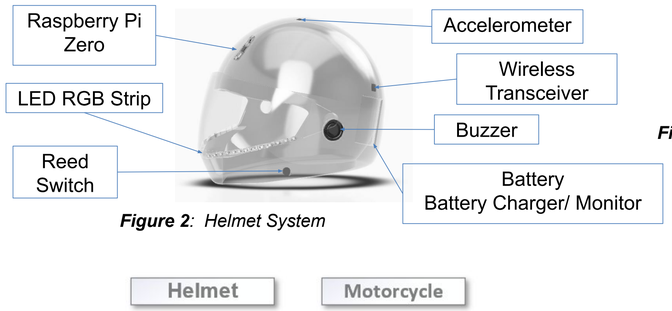

Figure 2*: Helmet System*

Figure 3.1*: Difference between Left and Right implies Distance*

Figure 3.2*: Left: Vehicle Detection, Right: CityScape Segment Detection*

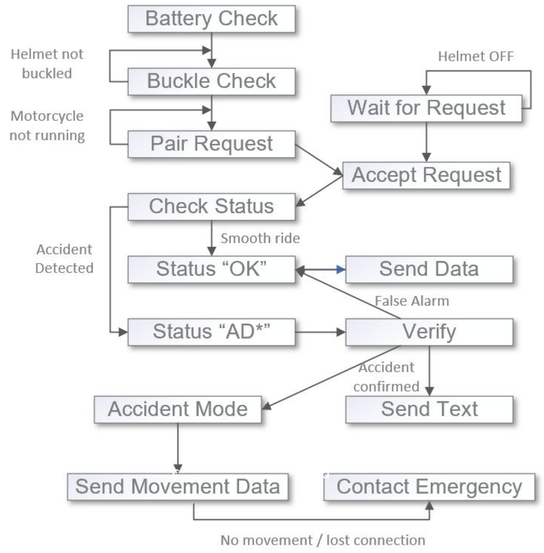

Figure 4*: System Functionality*
**AD = Accident Detected*

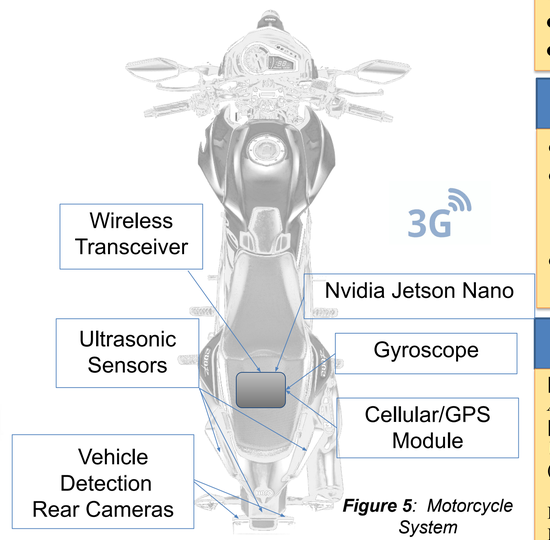

Figure 5*: Motorcycle System*

Software Features

- Real Time Accident Recognition
- Deep Learning Vehicle Recognition [2]
- Internet of Things for Embedded System
- Encrypted Wireless Communication
- Independent automated text system

Hardware Features

- Motorcycle Core: Nvidia Jetson Nano (CPU:Quad-core ARM A57 @ 1.43 GHz, GPU: 128-core Maxwell)
- Helmet Core: Raspberry Pi Zero (1GHz single-core CPU, 512MB RAM)
- Adafruit Fona GPS/3G Modem
- Battery monitor and Light sensor
- Stereo Camera Input and 3 Ultrasonic sensors

Improvements

- System could be also used as anti-theft system
- Additional camera on helmet could be added to record videos during sudden decelerations, and in case of accidents used for insurance purposes
- More LEDs on helmet or basic HUD to add precision on vehicles distance

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].

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