A protective helmet system (10) that integrates turn signal light, brake signal light, motion sensors (710), Bluetooth connectivity and a remote control (180) is provided. The system (10) comprises a helmet (20) for providing protection and enhancing safety to a rider on a vehicle, and a remote control (180) for wirelessly controlling electronics in the helmet (20) to perform functions. The helmet (20) comprises a LED strip (60). The LED strip (60) comprises a flexible base (68) and a plurality of LEDs (62, 63, 64, 65, 66, 671, 672, 673) installed on the flexible base (68). In addition, the LED strip (60) is configured to produce light signals to cars and pedestrians surrounding the rider, causing the rider to be more visible to the surrounding cars and pedestrians to thereby promote safety to the rider.
FIELD OF THE INVENTION

[0002] The present invention relates to helmets and safety devices for protecting riders of vehicles, including bicycles and motorcycles.

BACKGROUND

[0003] The helmet is intended to protect the head in the event of impact. However, most bicycle helmets are not designed to prevent accidents that may result in head impacts or other bodily harm. According to the Boston Cyclist Safety Report 2013 published in May 2013 and by the City of Boston, the disclosure of which is incorporated by reference herein, 32% of bicycle accidents are due to motorists not seeing the cyclists; this includes 18% of bicycle accidents that result from “doorjams”, i.e. when a vehicle door is extended into cyclists (p. 17 of Boston Cyclist Safety Report 2013). Another 38% of bicycle accidents result from improper cyclist adherence to traffic rules such as running stop signs and riding into oncoming traffic (p. 17 of Boston Cyclist Safety Report 2013). Taken together, 70% of bicycle accidents are due to a combination of poor cyclist visibility and improper adherence to road rules. These accidents could be prevented if cyclists were more visible on the road and shared a common system to communicate their actions on the road. With bicycle ridership expected to increase significantly in the near term, particularly in urban environments with more traffic, it is important that cyclists are equipped with the proper gear to help prevent accidents proactively.

[0004] The conventional bicycle helmet is limited to reactively minimizing impact to the head. The conventional bike helmets are designed with an inner liner typically consisting of expanded polystyrene foam and a plastic outer shell that is adhered to the inner lining with glue and/or tape. This conventional design minimizes head trauma in the event of an impact, but it does not help cyclists avoid impact by being more visible on the road, especially in darkening or dark environments when most accidents occur. (From p. 14 of the Boston Cyclist Safety Report 2013, most accidents occur around 5 pm.)

[0005] Many cyclists attempt to address this problem by attaching lights or reflectors to their bicycles, helmets or clothing. These solutions are insufficient as most lights and reflectors are too small to be seen or are not bright enough to be seen from a safe following distance. Lamps or reflectors positioned on certain parts of the bicycle such as the wheel or underneath the seat are not visible to motorists on the road from certain angles or following distances. Furthermore, the placement of the lamps and reflectors is unique from cyclist to cyclist. The lack of a standardized, common lighting system can result in motorists, other cyclists and pedestrians not adequately seeing cyclists.

[0006] An integrated solution is therefore needed to provide both passive impact protection and also active protection for signaling to cyclists.

[0007] Furthermore, helmets have thus far not been well utilized as a platform for additional technology enhancements. As helmets are devices that are often worn in various circumstances, there is an opportunity to use helmets to solve more problems beyond just providing protection for the head.

[0008] Multiple ideas have existed to augment helmets with technologies. However, thus far, few have been brought to the market. One reason is that it is a non-trivial issue to be able to integrate electronics into a helmet while maintaining integrity of the helmet that enables it to meet its primary objective, i.e. providing protection to that person’s head. For example, bicycle helmets, depending on where one intends to sell them, must pass various standards such as EN1078 and the CPSC 16 C.F.R part 1203. The biggest components of these safety standards are the impact tests.

[0009] To incorporate technologies onto a helmet, space must be made to accommodate the electronics. In order to preserve a beautiful aesthetic design of the exterior of the helmet and the helmet in general, the electronics must be “hidden” inside the helmet. However, doing so effectively means removing protective material from the helmet, decreasing its ability to pass the impact tests required of the EN1078 and the CPSC 16 C.F.R part 1203.

[0010] There is a need in the art to have a smart helmet and a mechanical design enabled one to resolve the above-mentioned engineering challenge, allowing one to create a helmet that (1) incorporates electronics onto the helmet, (2) effectively hides the electronics from the user, and (3) still passes prevailing safety standards for bicycle helmets. Although the need to have the smart helmet and the mechanical design is evolved from analyzing the need for protecting bicycle riders, the smart helmet and the mechanical design are also useful for protecting riders of other vehicles such as motorcycles.

SUMMARY OF THE INVENTION

[0011] A first aspect of the present invention is to provide a helmet for protecting provision and enhancing safety to a rider on a vehicle.

[0012] The helmet comprises a light emitting diode (LED) strip installed on the helmet. The LED strip comprises a flexible base and a plurality of LEDs installed on the flexible base. In particular, the LED strip is configured to produce light signals to cars and pedestrians surrounding the rider, causing the rider to be more visible to the surrounding cars and pedestrians to thereby promote safety to the rider.

[0013] The helmet further comprises a liner configured to protect a head of the rider. The LED strip is integrated with the liner. Preferably, the liner is made from high-density impact-absorption foam, enabling the liner to protect the head of the rider.

[0014] The helmet further comprises an electronics and battery box having electronics for at least controlling the plurality of LEDs. The electronics and battery box is integrated with the liner. In one embodiment, the electronics and battery box comprises a bottom plastic housing and an upper plastic housing both configured to form an enclosure when the bottom plastic housing is fitted to the upper plastic housing. In another embodiment, the electronics and battery box comprises a magnetic charging port. Yet in another
embodiment, the electronics and battery box is configured with Bluetooth connectivity for communicating with an external Bluetooth-enabled device.

[0015] Preferably, the plurality of LEDs includes a front-right LED, a back-right LED, a back-left LED, a front-left LED, a left brim LED, a right brim LED and a center brim LED. In one realization, each of the front-right LED and the front-left LED is a super-bright dual-color orange and white LED, the back-right LED and the back-left LED are super-bright orange LEDs, the back LED is a super-bright red LED, the left brim LED and the right brim LED are orange LEDs, and the center brim LED is red. The electronics and battery box is configured to when the rider is biking straight, control the LED strip such that the back LED is blinking, causing the rider to become more visible to the surrounding cars and pedestrians.

[0016] In one option, the electronics and battery box comprises one or more proximity sensors, one or more speakers, and one or more vibration motors. Furthermore, the electronics and battery box is configured, when detecting an approaching vehicle via the one or more proximity sensors, to control the center brim LED to blink and increase the brightness of the LED strip, and to trigger the one or more vibration motors to vibrate and the one or more speakers to emit alarming sound thus to notify the rider.

[0017] The electronics and battery box may comprise one or more motion sensors. The electronics and battery box may be further configured to, when the one or more motion sensors senses deceleration of the vehicle, change the LED pattern such that the back led, the back LED, the back right LED are kept on until the vehicle comes to a stop.

[0018] Preferably, the helmet further comprises an upper shell and a bottom shell both for protecting the rider. It is also preferable that the helmet further comprises a harness for enabling the helmet to be fastened to a head of the rider.

[0019] A second aspect of the present invention is to provide a protective helmet system. The system comprises the helmet according to any embodiment disclosed in the first aspect of the present invention, and a remote control for wirelessly controlling electronics in the helmet to perform functions.

[0020] In one option, the remote control comprises a left button, a right button and a mount, where the left button and the right button are positioned on or over the mount. In another option, the remote control comprises a mount having two wired buttons as the left button and the right button.

[0021] Preferably, when the rider presses the left button to signal that the vehicle is turning left, the back LED, the left brim LED, the front-left LED and the back-left LED are kept blinking. When the rider presses the right button to signal that the vehicle is turning right, the back LED, the right brim LED, the front-right LED and the back-right LED are kept blinking.

[0022] A third aspect of the present invention is to provide a helmet for protecting and enhancing safety to a rider on a vehicle. The helmet comprises one or more electronics boxes. An individual electronics box comprises a cover, a bottom, a wing and a cavity. The wing protrudes from the cover and extends to contact the helmet for absorbing impact energy during an impact. The cavity is situated between the bottom and the helmet. The cavity is used for preventing compression of a foam of the helmet beneath the individual electronics box at an early stage of the impact.

[0023] Other aspects of the present invention are disclosed as illustrated by the embodiments hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. 1 is a schematic of a protective helmet system in accordance with an exemplary embodiment of the present invention.

[0025] FIGS. 2A, 2B and 2C depict different views of the protective helmet of FIG. 1, where FIG. 2A provides a perspective view while FIGS. 2B and 2C provide two different exploded views.

[0026] FIG. 3 is a perspective exploded view of the electronic box assembly of the helmet in accordance with one embodiment of the present invention.

[0027] FIGS. 4A, 4B and 4C give three views of a LED assembly of the helmet in accordance with one embodiment of the present invention, where FIG. 4A provides a perspective view, FIG. 4B gives a top view, and FIG. 4C gives a side view.

[0028] FIGS. 5A-5D show different versions of the remote control of the helmet according to one embodiment of the present invention.

[0029] FIG. 6 is a flowchart providing an example to illustrate a flow of steps implemented in a main printed circuit board (PCB) firmware program.

[0030] FIG. 7 is a flowchart providing an example to illustrate a flow of steps implemented in a remote control PCB firmware program.

[0031] FIGS. 8A, 8B and 8C depict the helmet with the electronic box featuring a wing design in accordance with one embodiment of the present invention, where FIGS. 8A, 8B and 8C provide a perspective exploded view, a bottom cross-section view and a side cross-section view, respectively.

DETAILED DESCRIPTION

[0032] The present invention provides a smart helmet and a mechanical design thereof, enabling one to create a helmet that (1) incorporates electronics onto the helmet in such a way that the electronics are effectively hidden from a user, and (3) still passes prevailing safety standards for helmets.

[0033] Although the invention is hereinafter described in embodiments predominantly based on an example application of the invention to a rider on a bicycle, the present invention is not limited only to applications to bicycles. The present invention is applicable to any vehicles, such as motorcycles, where riders on these vehicles wear helmets for safety and protection.

[0034] Exemplarily, the present invention is described by illustrating an exemplary embodiment of the smart helmet and its mechanical design as follows.

OVERVIEW OF THE PRESENT INVENTION

[0035] In accordance with the exemplary embodiment, a protective smart helmet is integrated with one or more brake lights, one or more turn signal lights, one or more motion sensors, one or more proximity sensors, a vibration motor, one or more speakers, a microphone, a camera, one or more wireless remote controls, and Bluetooth connectivity. In addition, this protective smart helmet system is configured such that a rider of a vehicle (especially a bicycle or a motorcycle) is enabled to:

[0036] be more visible on the road;
be able to communicate the rider’s turning intentions to other people around the rider;

control turn signals on the helmet wirelessly via a remote control;

be able to communicate the fact that the rider is slowing down to other people around the rider via using a brake signal light feature;

connect the helmet with the rider’s phone or another electronic device, and interact with other application software, activity tracking software, or software to change and control the pattern of lights on the helmet;

sense when the rider might have been in a crash, and automatically send a signal to a pre-selected emergency contact via a phone or other means through the Bluetooth connection;

receive audio, visual or haptic feedback via one or more proximity sensors if an object approaches the rider;

record photographs, video signals and/or audio signals of areas surrounding the rider via an integrated camera; and

have the rider’s head remain protected in an event of impact, the protecting having the same degree as specified and required for all helmets in one or more standards.

According to the exemplary embodiment, a mechanical design of a helmet that incorporates electronics into the design has the following features.

The helmet has a cavity housing the electronics.

In addition, the helmet has a plastic enclosure for enclosing the electronics so as to provide an aesthetic exterior outlook.

The helmet further includes an impact absorbing gel that sits between the enclosure and a liner of the helmet.

The plastic enclosure features a “wing” design that enables the enclosure to share, transfer and distribute stress from the impact to areas surrounding the enclosure, thereby maintaining the helmet’s ability to protect the rider’s head in an event of impact in order to satisfy the requisite safety standard required for the helmet.

**Construction Method of the Helmet**

**FIG. 1** is a schematic representation of a protective helmet system **10** according to the exemplary embodiment of the present invention. The helmet system **10** comprises a helmet **20** and a remote control **180**. The helmet **20** comprises an upper shell **31**, a bottom shell **32**, a harness **33**, a LED strip **60**, and an electronics and battery box **70**, all of which are integrated with a liner **40** to form the helmet **20** as described in further detail as follows. The upper shell **31** and the bottom shell **32** are made of hard materials and are means for protecting a rider who wears the helmet **20**. The harness **33** enables the helmet **20** to be fastened to the rider’s head. The LED strip **60** is installed on the helmet **20**, and has plural LEDs for producing light signals such that the rider becomes more visible to surrounding cars and pedestrians, thereby promoting safety to the rider. The electronics and battery box **70** is a place for housing (often visually-unbeautiful) electronics for operating the helmet **20** while maintaining a beautiful aesthetic outlook for the helmet **20**.

The upper shell **31** and the bottom shell **32** may be decorated to generate the beautiful aesthetic outlook.

**Construction of the helmet** **20** is explained as follows with the aid of FIGS. **2A-2C**. FIG. 2A provides a perspective view of the helmet **20** while FIGS. **2B and 2C** give two different exploded views thereof. The upper shell **31**, the LED strip **60**, the bottom shell **32** and the harness **33** are attached and integrated to the liner **40** so as to form the helmet **20**. Preferably, the upper shell **31** and the bottom shell **32** are vacuum-formed with plastic. The liner **40** is also preferably made from high-density impact-absorptive foam having multiple vent holes for ventilation, plural channels for embedding the LED strip **60**, plural wells for housing the electronics and battery box **70**, and holes for enabling the harness **33** to be fixed therein.

The electronics and battery box **70** is also deemed a control module for the helmet **20**. Hereinafter, the two terms “the electronics and battery box” and “the control module” are used interchangeably.

Furthermore, the liner **40** is configured to provide safety protection to a rider of the helmet system **10**. When the rider is impacted on his or her head, the liner **40** will be deformed, thus absorbing the energy of impact to protect the rider’s head.

**FIG. 3** depicts a perspective exploded view of the electronics and battery box **70** of the helmet **20** according to one embodiment of the present invention. The electronics and battery box **70** comprises a bottom plastic housing **75** and an upper plastic housing **76** both configured to form an enclosure when the bottom plastic housing **75** is fitted to the upper plastic housing **76**. The electronics and battery box **70** further comprises one or more proximity sensors **77**, one or more speakers **78**, one or more vibration motors **79** and one or more motion sensors **710**. In one implementation, a PCB board **73** is also installed in the electronics and battery box **70**. The electronics and battery box may also include a magnetic charging port **71**. In addition, the electronics and battery box **70** is configured to house a battery **74**.

**FIGS. **4A, 4B and 4C depict different views of the LED strip **60** in accordance with one embodiment of the present invention. The LED strip **60** comprises a flexible base **68**, and a plurality of LEDs installed on the flexible base **68**. Preferably, the plurality of LEDs includes a front-right LED **62**, a back-right LED **63**, a back LED **64**, a back-left LED **65**, a front-left LED **66**, a left brim LED **671**, a right brim LED **672** and a center brim LED **673**. In one preferred embodiment, each of the front-right LED **62** and the back-left LED **66** is preferably a super-bright dual-color orange and white LED; the back-right LED **63** and the back-left LED **65** are preferably super-bright orange LEDs; the back LED **64** is preferably a super bright RED LED; the left brim LED **671** and the right brim LED **672** are preferably orange LEDs; the center brim LED **673** is red.

**FIGS. **5A-5D** depict perspective views regarding different versions of the remote control **180** according to one embodiment of the present invention. Refer to the two versions shown in FIGS. **5A and 5B** first. The remote control **180** comprises a left button **51**, a right button **52**, an electronics box **50**, and a mount **53** that is attached to a handle bar of the bicycle (or a handle bar of any vehicle that the rider rides on). The left button **51** and right button **52** are preferably made of soft rubber plastic. It is also preferable that the casing is plastic. Preferably, the mount **53** is plastic. In each of the versions shown in FIGS. **5A and 5B**, the left
button 51 and the right button 52 are positioned on or over the mount 53. In FIGS. 5C and 5D, there are two other versions each of which has a mount 54 having two wired buttons as a left button and a right button.

[0057] The LED strip 60 is controlled by the control module 70. In the normal time when the rider is biking straight, the control module 70 will signal the LED strip 60 so that the back LED 64 is blinking. In this way, the rider will become more visible to surrounding cars and pedestrians.

[0058] The control module 70 also is configured with the Bluetooth connectivity for communicating with an external Bluetooth-enabled device in one embodiment. In one mode of operation, the control module 70 can connect to a smartphone, and communicate with a designated smartphone application through Bluetooth. The control module 70 can transmit the information about the battery 74 to the smartphone so that the remaining energy on the battery 74 can be displayed. The rider can also designate blinking patterns for the LED strip 60 under different situations. When the control module 70 detects occurrence of high impact on the helmet 20 through the one or more motion sensors 710, the control module 70 can also transmit signal to the smartphone to trigger emergency call or messaging function on the smartphone.

[0059] FIGS. 6 and 7 are two flowcharts showing examples of firmware programs implemented in the control module 70 and in the remote control 180, respectively.

[0060] Note that it is required to install electronics into the helmet 20 to provide functions therefor. In this regard, one or more electronic boxes, including the electronics and battery box 70, are included in the helmet 20. Advantageously, each electronic box may be designed with a further objective of providing protection to the rider against being impacted by electronic components in the electronic box in case of an accident.

[0061] FIGS. 8A, 8B and 8C depict a perspective exploded view, a bottom cross-section view and a side cross-section view, respectively, of a helmet with an electronic box having a wing design in accordance with one embodiment of the present invention. In particular, FIGS. 8A, 8B and 8C illustrate a method of integrating electronics into a helmet 82 with an electronics box 200 that features the wing design. In these figures, a cover 80 of the electronics box 200, a bottom 81 of the electronics box 200, the helmet 82 that the electronics are integrated in, and an exemplary PCB 83 that represents the electronics are shown. How this design enables the integration of electronics into the helmet 82 is through the following two ways.

[0062] First, a wing 91 protrudes from the cover 80 that extends the contact of the electronics box 200 to the surrounding helmet section of the helmet 82. During impact, the surrounding area absorbs the impact energy.

[0063] Second, a cavity 92 is situated between the bottom 81 of the electronics box 200 and the helmet 82. This cavity 92 prevents the compression of the foam of the helmet 82 beneath the electronics box 200 at the early stage of impact. During impact, the wing 91 transfers the impact energy to the area beneath the wing 91 first as the foam at this area collapse, this cavity 92 shrinks to a point that the foam beneath the bottom 81 of the electronics box 200 also starts to collapse and thus absorbs energy. If this cavity 92 were not there, the impact energy would pass to the foam beneath the bottom 81 of the electronics box 200 at the very first beginning of impact. Thus, more energy will be passed to this area where the foam is thinner because of the existence of the electronics box 200. This cavity 92 thus acts as a buffer to let the foam that surrounds the electronics box 200, which is thicker, absorb the energy first, thus decreasing the energy that the foam beneath the electronics box 200 need to absorb, and passing less energy to the head of the rider.

Operation Method

[0064] There are several events that can trigger a change of the light pattern of the LED strip 60.

[0065] 1. In one event that the rider is slowing down, the one or more motion sensors in the electronics and battery box 70 will sense the deceleration of the bike, and then changes the LED pattern such that the back left LED 65, the back LED 64, the back right LED 63 are kept on until the bicycle comes to a stop.

[0066] 2. In another event that the rider presses the left button 51 on the remote control 180 to signal to the surrounding that it is turning left, the back LED 64, the left brim LED 671, the front-left LED 66 and the back-left LED 65 keep blinking.

[0067] 3. In another event when the rider presses the right button 52 on the remote control 180 to signal to the surrounding that it is turning right, the back LED 64, the right brim LED 672, the front-right LED 66 and the back-right LED 65 keep blinking.

[0068] 4. In the event when the control module 70 detects an approaching vehicle via the one or more proximity sensors 77, the control module 70 will control the center brim LED 66 to blink and increase the brightness of the LED strip 60. The control module 70 will also trigger the one or more vibration motors 79 to vibrate and the one or more speakers 78 to emit alarming sound thus to notify the rider.

[0069] While the foregoing written description of the invention enables one of ordinary skill to make and use what is considered presently to be the best mode thereof, those of ordinary skill will understand and appreciate the existence of variations, combinations, and equivalents of the specific embodiment, method, and examples herein. The invention should therefore not be limited by the above described embodiment, method, and examples, but by all embodiments and methods within the scope and spirit of the invention as claimed.

1. A helmet for providing protection and enhancing safety to a rider on a vehicle, comprising:
   - a LED strip installed on the helmet, comprising a flexible base and a plurality of LEDs installed on the flexible base, wherein the LED strip is configured to produce light signals to cars and pedestrians surrounding the rider, causing the rider to be more visible to the surrounding cars and pedestrians to thereby promote safety to the rider.
   - The helmet of claim 1, further comprising:
     - a liner configured to protect a head of the rider, wherein the LED strip is integrated with the liner.
   - The helmet of claim 2, wherein the liner is made from high-density impact-absorption foam, enabling the liner to protect the head of the rider.

2. The helmet of claim 2, further comprising:
   - an electronics and battery box having electronics for at least controlling the plurality of LEDs, wherein the electronics and battery box is integrated with the liner.
5. The helmet of claim 4, wherein the electronics and battery box comprises:
   a bottom plastic housing and an upper plastic housing
   both configured to form an enclosure when the bottom
   plastic housing is fitted to the upper plastic housing.
6. The helmet of claim 4, wherein the electronics and battery box comprises:
   a magnetic charging port.
7. The helmet of claim 4, wherein the electronics and battery box is configured with Bluetooth connectivity for communicating with an external Bluetooth-enabled device.
8. The helmet of claim 4, wherein the plurality of LEDs includes a front-right LED, a back-right LED, a back LED, a back-left LED, a front-left LED, a left brim LED, a right brim LED and a center brim LED.
9. The helmet of claim 8, wherein:
   each of the front-right LED and the front-left LED is a
   super-bright dual-color orange and white LED;
   the back-right LED and the back-left LED are super
   bright orange LEDs;
   the back LED is a super bright red LED;
   the left brim LED and the right brim LED are orange
   LEDs; and
   the center brim LED is red.
10. The helmet of claim 8, wherein the electronics and battery box is configured to:
    when the rider is biking straight, control the LED strip
    such that the back LED is blinking, causing the rider to
    become more visible to the surrounding cars and pedestrians.
11. The helmet of claim 8, wherein:
    the electronics and battery box comprises one or more
    proximity sensors, one or more speakers, and one or
    more vibration motors; and
    the electronics and battery box is configured, when detecting
    an approaching vehicle via the one or more proximity
    sensors, to control the center brim LED to blink and
    increase the brightness of the LED strip, and to trigger
    the one or more vibration motors to vibrate and the
    one or more speakers to emit alarming sound thus
    to notify the rider.
12. The helmet of claim 8, wherein the electronics and battery box comprises:
    one or more motion sensors.
13. The helmet of claim 12, wherein the electronics and battery box is configured, when the one or more motion
    sensors senses deceleration of the vehicle, to keep the back
    left LED, the back LED, the back right LED on until the vehicle comes to a stop.
14. The helmet of claim 1, further comprising:
    an upper shell and a bottom shell both for protecting the
    rider.
15. The helmet of claim 1, further comprising:
    a harness for enabling the helmet to be fastened to a head
    of the rider.
16. A protective helmet system comprising:
    the helmet of any of claims 1-15; and
    a remote control for wirelessly controlling electronics in
    the helmet to perform functions.
17. A protective helmet system of claim 16, wherein the remote control comprises a left button, a right button and a mount, the left button and the right button being positioned on or over the mount.
18. A protective helmet system of claim 16, wherein the remote control comprises a mount having two wired buttons as a left button and a right button.
19. A protective helmet system comprising:
    the helmet of claim 8; and
    a remote control for wirelessly controlling electronics in the
    helmet to perform functions, the remote control comprising a left button and a right button;
    wherein the system is further configured such that:
    when the rider presses the left button to signal that the
    vehicle is turning left, the back LED, the left brim LED,
    the front-left LED and the back-left LED keep blinking; and
    when the rider presses the right button to signal that the
    vehicle is turning right, the back LED, the right brim
    LED, the front-right LED and the back-right LED keep
    blinking.
20. A helmet for providing protection and enhancing safety to a rider on a vehicle, comprising one or more electronics boxes, wherein an individual electronics box comprises:
    a cover;
    a bottom;
    a wing protruding from the cover and extending to contact
    the helmet for absorbing impact energy during an impact; and
    a cavity situated between the bottom and the helmet, for
    preventing compression of a foam of the helmet
    beneath the individual electronics box at an early stage of
    the impact.

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