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Inventor(s)	Newville; Taylor Rae

DEPLOYABLE TRAFFIC MITIGATORS WITH A NETWORK ARRAY

Abstract

Systems and methods for mitigating traffic are disclosed herein. In some embodiments, a traffic mitigation system includes a plurality of traffic mitigation devices. Each traffic mitigation device can include a base, a cap movably coupled to the base, a motor coupled to move the cap between a flush position and a raised position, a battery coupled to the motor, a power generator coupled to the battery, and an electronics unit housed in the base. The electronics unit comprises a control circuit coupled to control operation of the motor and a communication module operably coupled to the control circuit. The communication modules can receive signals indicating desired operating times from an operator device. The control circuits can then synchronously switch the traffic mitigation devices between the flush and raised positions. The communication modules can also communicate with each other to further synchronize movement of the caps.

Inventors: **Newville; Taylor Rae (San Diego, CA)**

Applicant: **Newville; Taylor Rae** (San Diego, CA)

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION [0001] This application is a continuation of U.S. application Ser. No. 18/387,429, filed Nov. 6, 2023, which is incorporated herein by reference in its entirety

TECHNICAL FIELD
[0002] This disclosure is generally directed to deployable networked traffic mitigators and associated systems and methods.
BACKGROUND
[0003] Certain roads require periodic traffic control, but employing such control at all times throughout the day may be undesirable. For example, school zones need systems to slow down vehicles when students are present (e.g., in the morning, after classes or activities end), but such systems can needlessly interfere with traffic at other times. Conventional systems for traffic control, such as traffic signs (e.g., speed limit signs) and speed bumps, are either not followed or unable to selectively control traffic. Thus, there is a need for traffic mitigators that can control traffic at desired times and are convenient to install and operate.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0004] FIGS. **1**A and **1**B are perspective views of a traffic mitigation system in a lowered position and a raised position, respectively.
[0005] FIGS. **2**A and **2**B are perspective views of a traffic mitigation device in a lowered position and a raised position, respectively.
[0006] FIG. **3** is a perspective view of a traffic mitigation device with one or more locking features.
[0007] FIGS. **4**A and **4**B are top and bottom perspective exploded views, respectively, of an example traffic mitigation device.
[0008] FIG. **5** is a top view of the partially assembled traffic mitigation device of FIG. **4**A.
[0009] FIGS. **6**A and **6**B are side cross-sectional views of the traffic mitigation device of FIG. **4**A in a lowered position and in a raised position, respectively.
[0010] FIG. **7** is a perspective view of a traffic mitigation system and an operator magnet.
[0011] FIG. **8** is a perspective view of a traffic mitigation system in a listening mode.
[0012] FIG. **9** is a flowchart illustrating a method of mitigating traffic.
[0013] FIG. **10** is a block diagram illustrating an overview of devices on which some implementations of the disclosed technology can operate.
[0014] FIG. **11** is a block diagram illustrating an overview of an environment in which some implementations of the disclosed technology can operate.
[0015] FIG. **12** is a block diagram illustrating components that, in some implementations, can be used in a system employing the disclosed technology.
[0016] The techniques introduced here may be better understood by referring to the following Detailed Description in conjunction with the accompanying drawings, in which like reference numerals indicate identical or functionally similar elements.
DETAILED DESCRIPTION
I. Overview

[0017] At least some aspects of the present disclosure are directed to individual traffic mitigators with a network array. Some roads, such as those near schools and event stadiums, require traffic control during busy periods to increase safety, but having such traffic control 24/7 can needlessly interfere with traffic during non-busy periods, causing unnecessary traffic congestion and driver frustration. Conventional speed bumps in the form of raised, rounded humps, which are made from asphalt, concrete, or rubber, are static and cannot easily be removed during non-busy periods. Conventional systems for slowing traffic also include speed limits (including radar speed signs), but such speed limits can be costly to enforce on every road and are often ignored. Conventional systems for traffic management further include roundabouts or road narrowing, but these solutions require road reconstruction and also remain static like conventional speed bumps. Thus, traffic mitigators that can be controlled to mitigate traffic only during desired time periods (e.g., busy periods, school zone hours, etc.) and are convenient to install and operate are needed.

[0018] In some embodiments, a traffic mitigation system can include at least one controller and a plurality of individually deployable speed bumps. The speed bumps can be configured to actuate between different configurations. The configurations can include, for example, a lowered configuration for being positioned within a roadway, a raised configuration for protruding upwardly from the roadway, and/or other configurations for affecting traffic. The speed bumps can be flush or below the roadway surface when in the lowered position. For example, the speed bumps can remain in the raised configuration while vehicles drive across them without damaging the vehicles (e.g., without damaging suspension, tires, etc.).

[0019] The deployable speed bumps can be programmed to communicate (e.g., via a network) to coordinate operation (e.g., actuation, deployment, etc.) of all or some of the speed bumps. The speed bumps can be spaced apart (e.g., horizontally spaced apart, laterally spaced apart, etc.) across one or more lanes of a roadway. The speed bumps can collectively define a speed bump zone having a generally polygonal shape (e.g., rectangular shape), strip, crosswalk shape, or other configuration or other shape selected by the installer. The speed bumps can be, for example, actuated electronically, pneumatically, hydraulically, and/or using any other suitable actuation means.

[0020] In some embodiments, a traffic mitigation system includes a plurality of traffic mitigation devices in the form of electronic speed bumps. When the speed bumps are in a raised or deployed state, they can extend upwardly from the roadway surface to encourage drivers to slow down. Each traffic mitigation device can include a base, a cap movably coupled to the base, and a motor coupled to move the cap between a lowered or flush position and a raised position. When the traffic mitigation device is in the flush position, the cap is generally flush with a road surface such that drivers can drive vehicles over the traffic mitigation device without slowing down. When the traffic mitigation device is in the raised position, the cap is at an elevated position relative to the road surface and protrudes out such that drivers are induced to slow down or stop. Each traffic mitigation device can further include a battery coupled to the motor, a power generator coupled to the battery, and an electronics unit housed in the base. The power generator is configured to generate electricity and charge the battery with the generated electricity. The power generator can comprise a piezoelectric element, a solar array, or other power generating mechanism. The electronics unit comprises a control circuit coupled to control operation of the motor and a communication module operably coupled to the control circuit.

[0021] The communication modules can be configured to receive signals from a nearby or remote operator device. The signals can include authentication information, desired operating times such as when to switch between the flush position and the raised position, the current date and time, etc. In some embodiments, a portion of the traffic mitigation devices (e.g., fewer than all of the devices included in the system) receive the signals and then transmit the signals to the remaining ones of the traffic mitigation devices such that the operator device need not upload data to each and every device included in the system. In some embodiments, the communication modules include one or more transmitters and receivers. The transmitters can transmit, for example, signals, instructions, data, or information. The receivers can receive signals, instructions, data, or information from other communication modules of other mitigation devices.

[0022] During operation, the control circuits can synchronously switch the traffic mitigation devices between the flush position and the raised position based on the received desired operating times. In some embodiments, the traffic mitigation devices can further synchronize their movements by communicating with one another at or around the desired operating times. Synchronizing movement can include switching between the flush position and the raised position simultaneously, in a pattern, etc. The traffic mitigation devices can be programmed to operate autonomously based on, for example, one or more user settings, schedules, or the like. For example, the traffic mitigation devices can automatically move between a selected number of positions, including a lowered position, an intermediate position, a partially raised position, and a fully raised position. The height of the traffic mitigation device extending above the roadway can be selected based on the desired reduction in speed of vehicles.

[0023] In some embodiments, the traffic mitigation device includes a locking feature coupled to the base and configured to secure the traffic mitigation device in the road (e.g., in a socket in the road). In some embodiments, the traffic mitigation device includes a magnet switch that can be toggled when an operator magnet is in close proximity in order to switch the traffic mitigation device between a listening mode and a reduced power mode.

[0024] In some embodiments, in each traffic mitigation device, the base has a base sidewall including first threads, and the cap has a cap sidewall including second threads and at least one rib. Each device further includes a pinion coupled to the motor and a rotator rotatably positioned in the base. The rotator includes a ring gear positioned to engage the pinion and at least one slot positioned to engage the at least one rib. Operation of the motor rotates the pinion along a motor axis, which then rotates the ring gear, and thereby the rotator and the at least one slot, about a vertical axis. Rotating the at least one slot rotates the at least one rib, and thereby the cap, about the vertical axis. Rotating the cap causes the second threads to engage the first threads and thereby move the cap between the flush position and the raised position.

II. Traffic Mitigation System

[0025] FIGS. **1**A and **1**B are perspective views of a traffic mitigation system **102** in a flush position (also referred to as “the lowered configuration”) and a raised position (also referred to as “the raised configuration”), respectively. The traffic mitigation system **102** includes a plurality of traffic mitigation devices **100** (also referred to as “the plurality of individually deployable speed bumps **100**”) embedded on or positioned within a roadway or road **20**. The number of traffic mitigation devices **100** included in the traffic mitigation system **102** can be any number between 1 and 100, or more. In the illustrated embodiment, the traffic mitigation system **102** includes traffic mitigation devices **100** that are adjacent to one another on the road **20**. In other embodiments, the traffic mitigation system **102** includes traffic mitigation devices **100** that are not adjacent to one another on the road **20** and/or positioned on different roads. For example, the traffic mitigation system **102** for a school can include multiple groups of traffic mitigation devices **100** with each group located on a different road around the school such that the entire school area can be managed via a single traffic mitigation system controller.

[0026] Each traffic mitigation device **100** can be installed in a corresponding socket **22** that is cut, stamped, or otherwise formed into the road **20**. Each traffic mitigation device **100** can be secured in the corresponding socket **22** using adhesives, press-fit, fasteners, locking features included in the traffic mitigation device **100**, and/or other mechanisms. This allows installation of the traffic mitigation devices **100** along existing roadways without, for example, resurfacing the entire roadway, damaging the surrounding material of the roadway, or the like. Additionally, the traffic mitigation devices (or portions or parts of the traffic mitigation devices) can be removed from the roadway. For example, the traffic mitigation devices **100** can be removed from the roadway without damaging the surrounding material of the roadway in order to perform maintenance, replace the mitigation device **100** (or replace components of the mitigation devices), or perform other operations. In some embodiments, each traffic mitigation device **100** is removably secured in the corresponding socket **22** such that the traffic mitigation device **100** can be removed for maintenance or replacement with ease. The traffic mitigation devices **100** can be spaced apart (e.g., laterally) across at least one lane of the road **20**, as shown. In some embodiments, the traffic mitigation devices **100** are spaced apart (e.g., evenly spaced apart, unevenly spaced apart, etc.) to collectively define a speed bump zone extending partially or completely across the road **20**. In some embodiments, the speed bump zone has a generally rectangular shape and extends generally perpendicular to, for example, a lengthwise direction of the lane on the roadway, direction of traffic travel, etc. The number of traffic mitigation devices **100** per area can be selected based on a targeted reduction of speed, configuration of the mitigation devices, or the like. For example, a roadway can have a speed bump zone with at least 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 15 mitigation devices per area, such as 1 ft.sup.2, 1 m.sup.2, etc. The pattern, spacing, and number of traffic mitigation devices **100** can be selected based on the size and/or shape of the speed bump zone.

[0027] As shown in FIG. **1**A, the traffic mitigation devices **100** are flush with the upper surface of the road **20** when in the flush position. The traffic mitigation devices **100** can therefore cooperate with the surrounding upper surface of the roadway to define a generally smooth, continuous driving surface for allowing vehicle **10** (e.g., car, motorcycle, truck, semi-truck) to drive over without slowing down. As shown in FIG. **1**B, the traffic mitigation devices **100** protrude upwardly from the road **20** when in the raised position. In the raised position, the traffic mitigation devices **100** effectively mitigate traffic by visually indicating to a driver that the vehicle **10** should slow down before being driven over. As will be described further herein, the traffic mitigation devices **100** can be controlled and/or programmed to move between the flush position (FIG. **1**A) and the raised position (FIG. **1**B) on command, at predetermined times, and/or autonomously.

[0028] FIGS. **2**A and **2**B are perspective views of a traffic mitigation device **200** in a flush position and a raised position, respectively. The traffic mitigation device **200** can be an example of the traffic mitigation device **100** illustrated in FIGS. **1**A and **1**B, and can be included in a traffic mitigation system comprising multiple traffic mitigation devices **200**. The traffic mitigation device **200** includes a base **202** having a cavity **204**, a cap **206** positioned at least partially in the cavity **204**, a power generator **210**, a battery **220**, a motor **230** (or other height adjustment feature), and an electronics unit **240**. The power generator **210**, the battery **220**, the motor **230**, and the electronics unit **240** can be housed between the base **202** and the cap **206** (e.g., within the cavity **204**) for protection. In some embodiments, the base **202** and the cap **206** form a weatherproof, heatproof, and/or waterproof housing.

[0029] The base **202** and the cap **206** can be made from plastic, metal (e.g., steel, aluminum), or other material that is able to both withstand the expected forces during operation (e.g., a portion of a vehicle's weight) and allow wireless transmission of signals through. In the illustrated embodiment, the base **202** and the cap **206** each has a cylindrical form factor and a circular cross-section. In other embodiments, the base **202** and the cap **206** have other cross-sections such as elliptical, triangular, rectangular, hexagonal, etc. Moreover, while the cap **206** is nested inside the base **202** in the illustrated embodiment, in other embodiments, the base **202** can be nested inside the cap **206**, the base **202** and the cap **206** may not be nested, etc. A cross-sectional dimension of the traffic mitigation device **200** (e.g., diameter) can be about 1 inch, 2 inches, 3 inches, 4 inches, 5 inches, 6 inches, 7 inches, 8 inches, 9 inches, 10 inches, 11 inches, 12 inches, or greater. A vertical dimension or height H**1** (FIG. **2**A) of the traffic mitigation device **200** when in the flush position can be about 1 inch, 2 inches, 3 inches, 4 inches, 5 inches, 6 inches, 7 inches, 8 inches, 9 inches, 10 inches, 11 inches, 12 inches, or greater. A vertical dimension or height H**2** (FIG. **2**B) of the traffic mitigation device **200** when in the raised position can be about 3 inches, 4 inches, 5 inches, 6 inches, 7 inches, 8 inches, 9 inches, 10 inches, 11 inches, 12 inches, 13 inches, 14 inches, or greater. The height H.sub.p (FIG. **2**B) of the protruding portion can be 1 inch, 2 inches, 3 inches, 4 inches, 5 inches, or other desired heights.

[0030] In some embodiments, the motor **230** (or other height adjustment feature) can be operated such that a vertical dimension of the cap **206** relative to the top of the base **202** or the surface of the road when the traffic mitigation device **200** is in the raised position (FIG. **2**B) can be adjusted to correlate with a speed limit. For example, the cap **206** can be at a first distance from the surface of the road to provide a first effective speed limit (e.g., 35 miles per hour), then the motor **230** can be operated such that the cap **206** is at a second distance from the surface of the road that is greater than the first distance to provide a second effective speed limit that is lower than the first effective speed limit (e.g., 20 miles per hour). The vertical dimension of the cap **206** relative to the top of the base **202** or the surface of the road when the traffic mitigation device **200** is in the raised position can be about 1 inch, 2 inches, 3 inches, 4 inches, 5 inches, 6 inches, 7 inches, 8 inches, 9 inches, 10 inches, 11 inches, 12 inches, or greater.

[0031] The power generator **210** can generate electricity to power the motor **230** and the electronics unit **240**. The power generator **210** can comprise a piezoelectric element (as described in further detail below with respect to FIGS. **4**A-**6**B), a solar array, or other power generating mechanism. The battery **220** can be coupled to receive and store the energy generated by the power generator **210**, and deliver the energy to the motor **230** and/or the electronics unit **240** as needed. The motor **230** can be coupled to move the cap **206** between the flush position and the raised position. In some embodiments, the motor **230** comprises a self-centering motor biased to keep the cap **206** in the flush position or the raised position when not actively powered. This can be advantageous when the traffic mitigation device **200** runs out of power and it is desirable to keep the traffic mitigation device **200** in either the flush position or the raised position by default.

[0032] The electronics unit **240** can include various components for managing operation of the motor **230**. For example, the electronics unit **240** can include at least one controller or control circuit operably coupled to control operation of the motor **230** and a communication module operably coupled to the control circuit. The control circuit can be programmed to store a schedule (e.g., a deployment and retraction schedule). In some embodiments, the control circuit is programmed to store height settings in the raised position, where the height settings are adjustable to increase or decrease height of the traffic mitigation device **200** in the raised position to correspondingly decrease or increase speeds of the vehicles traveling across. The communication module can be configured to communicate with other devices, such as an operator device external to the traffic mitigation system or communication modules of adjacent traffic mitigation devices. The control circuit and/or communication module can be programmed to send an alert (e.g., to a user device or an operator device) in response to malfunctioning of one or more of the traffic mitigation devices **200**. In some embodiments, the electronics unit **240** includes an electronic storage medium comprising computer-executable instructions and one or more processors in electronic communication with the electronic storage medium and configured to execute the computer-executable instructions in order to operate the traffic mitigation device **200**. In some embodiments, the electronics unit **240** can store information in memory, and the stored information can include, but is not limited to, schedules, grouping of traffic mitigation devices **200**, configurations of traffic mitigation devices **200** (e.g., height of raised position, height of partially raised position, etc.), data collected by the traffic mitigation devices **200** (e.g., weight of vehicles, traffic data, speed of vehicles, images of vehicles, traffic times, images of the roadway, etc.), communication data (e.g., protocols, authentication information, tokens, and/or settings). In some embodiments, the collected data can include, for example, weight of vehicle data, speed of vehicle data, component operation data, or the like.

[0033] In some embodiments, the traffic mitigation device **200** includes additional or alternative components. For example, the traffic mitigation device **200** can include a lighting component (e.g., an LED) positioned proximate to the cap **206** and operably coupled to the electronics unit **240**. The control circuit can be used to control the lighting component (e.g., turning it on and off, changing brightness or color) such that the traffic mitigation device **200** can emit light and thereby warn drivers that the traffic mitigation devices **200** are in the raised position (e.g., by emitting a bright light), are switching between the flush position and the raised position (e.g., by flashing light), etc. In some embodiments, the communication modules can communicate with existing infrastructure, such as pedestrian crossing buttons, such that the cap **206** can be moved to the raised position and/or the lighting component can be turned on as a way to signal to drivers that, for example, people are crossing the street (e.g., by configuring the lighting component to flash red). In some embodiments, the traffic mitigation device **200** automatically locks in the raised position to prevent collapse of the traffic mitigation device **200** when driven upon by vehicles.

[0034] FIG. **3** is a perspective view of a traffic mitigation device **300** with one or more locking features **303** coupled to an exterior surface of a base **302**. The one or more locking features **303** can comprise protrusion, threads, détentes, cutouts, fasteners, or other mechanisms to permanently or releasably secure the base **302** in a road socket (e.g., the socket **22** illustrated in FIGS. **1**A and **1**B). During operation of the traffic mitigation device **300**, the one or more locking features **303** can keep the base **302** fixed in position relative to the road while a cap **306** moves relative to the base **302** in order to selectively mitigate traffic as desired.

III. Traffic Mitigation Device

[0035] FIGS. **4**A and **4**B are top and bottom perspective exploded views, respectively, of a traffic mitigation device **400**. The traffic mitigation device **400** can be an example of the traffic mitigation device **100** illustrated in FIGS. **1**A and **1**B, and can be included in a traffic mitigation system comprising multiple traffic mitigation devices **400**. The traffic mitigation device **400** includes a cap **410**, a piezoelectric element **420**, a support **430**, a motor **440**, an electronics unit **450**, a power source or battery **460** (e.g., one or more recharge batteries), a rotator **470**, and a base **480**. One skilled in the art will appreciate that the traffic mitigation device **400** can include additional, fewer, and/or alternative components.

[0036] The cap **410** can include a flexible top **412** (FIG. **4**A) and a sidewall with threads **414** on the outside and at least one rib **416** on the inside. The piezoelectric element **420** can be coupled to a wire **422** that extends to the motor **440** and/or the battery **460**. The support **430** can include an aperture **432** through which the wire **422** extends. The support **430** can be coupled to the cap **410** such that the support **430** moves with the cap **410** when the traffic mitigation device **400** moves between the flush position and the raised position. The piezoelectric element **420** can be positioned between the flexible top **412** of the cap **410** and the support **430**.

[0037] The motor **440** can be mechanically coupled to the base **480** and electrically coupled to the piezoelectric element **420** (e.g., via the wire **422**) and/or the battery **460**. A pinion **442** can be coupled to the motor **440**. In some embodiments, the electronics unit **450** includes a control circuit coupled to control operation of the motor **440** and a communication module operably coupled to the control circuit. The communication module can be configured to communicate with other devices, such as an operator device external to a traffic mitigation system or communication modules of adjacent traffic mitigation devices. In some embodiments, the electronics unit **450** includes an electronic storage medium comprising computer-executable instructions and one or more processors in electronic communication with the electronic storage medium and configured to execute the computer-executable instructions in order to operate the traffic mitigation device **400**. The battery **460** can be coupled to the piezoelectric element **420** (e.g., via the wire **422**) and/or the motor **440**. Each of the electronics unit **450** (and its components) and the battery **460** can be mechanically coupled to the motor **440** and/or the base **480**.

[0038] The rotator **470** has a cylindrical or annular shape, and can be positioned in the base **480**. The rotator **470** can include a ring gear **472** and at least one slot **474** on the outer surface and positioned to engage the corresponding at least one rib **416**. The base **480** can include a sidewall with threads **482** on the inner surface, a locking feature **484** (e.g., an elongate protrusion, threads) on the outer surface configured to secure the base **480** in a road socket, and a cylindrical protrusion or wall **486** extending upward from the bottom surface of the base **480**. The cylindrical wall **486** can have a diameter such that the rotator **470** can be positioned and can rotate around the cylindrical wall **486**.

[0039] FIG. **5** is a top view of the traffic mitigation device **400** partially assembled, with the cap **410**, the piezoelectric element **420**, and the support **430** removed so as not to obscure certain features. As shown, the motor **440**, the electronics unit **450**, and the battery **460** are coupled to the base **480**, such as within the cylindrical wall **486**. Because the base **480** remains stationary relative to the road during operation, the motor **440**, the electronics unit **450**, and the battery **460** also remain stationary during operation of the traffic mitigation device **400**. The rotator **470** is positioned around the cylindrical wall **486** and the ring gear **472** is engaged with the pinion **442**. As shown, the cylindrical wall **486** can include a flat edge on either end of the motor **440** to allow space for the pinion **442** and wires (partially shown) extending from the motor **440**. In some embodiments, the rotator **470** is not directly coupled to the base **480** such that the rotator **470** is free to rotate around the cylindrical wall **486**, but remains on the bottom surface of the base **480** due to its weight.

[0040] Referring to FIGS. **4**A, **4**B, and **5** together, to fully assemble the traffic mitigation device **400**, the support **430** can be coupled to the cap **410**, the piezoelectric element **420** can be positioned between the flexible top **412** of the cap **410** and the support **430**, and the wire **422** can be extended through the aperture **432** and connected to the motor **440**, the electronics unit **450**, and/or the battery **460**. The sidewalls of the cap **410** can then be inserted in the gap between the rotator **470** and the base **480** such that the at least one rib **416** of the cap **410** is slid into the corresponding at least one slot **474**. The cap **410** is then rotated such that the threads **414** engage the threads **482** until the cap **410** is securely coupled to the base **480**. When rotating the cap **410** into the base **480**, the rotator **470** also rotates by virtue of the at least one rib **416** interlocked with the at least one slot **474**.

[0041] FIGS. **6**A and **6**B are side cross-sectional views of the traffic mitigation device **400** in the flush position and in the raised position, respectively. In FIG. **6**A, the threads **414** are fully engaged with the threads **482** such that the cap **410** is positioned proximate to the bottom surface of the base **480**. The pinion **442** is engaged with the ring gear **472** while the rotator **470** sits atop the bottom surface of the base **480** and around the motor **440**. In FIG. **6**B, the cap **410** is raised and positioned farther from the bottom surface of the base **480**, and the threads **414** are not fully engaged with the threads **482**. Because the support **430** is coupled to the cap **410**, the support **430** and the piezoelectric element **420** are raised with the cap **410**. However, the motor **440**, the electronics unit **450**, and the battery **460** remain proximate to the bottom surface of the base **480**. The rotator **470** also remains proximate to the bottom surface of the base **480**, although it has rotated with the cap **410**.

[0042] During operation of the traffic mitigation device **400**, the electronics unit **450** can control operation of the motor **440** to rotate the pinion **442** in a desired direction, at a desired rate, and by a desired angle. Rotation of the pinion **442** causes the rotator **470** to rotate about a vertical axis (e.g., an axis extending from the center of the bottom surface of the base **480** to the center of the flexible top **412**) by virtue of the interlocked ring gear **472**. Rotation of the rotator **470** causes the cap **410** to rotate by virtue of the engaged at least one rib **416**, and rotation of the cap **410** raises or lowers the cap **410** by virtue of the interlocked threads **414** and **482**, depending on the direction of the motor **440**. The electronics unit **450** can therefore switch the traffic mitigation device **400** between the flush position (FIG. **6**A), which allows vehicles to travel over the cap **410**, and the raised position (FIG. **6**B), which induces vehicle operators to slow down or stop the vehicle.

[0043] Referring to FIG. **6**A, when the traffic mitigation device **400** is installed in a road and in the flush position (as seen in FIG. **1**A), the top of the base **480** can be positioned flush with the road surface while the flexible top **412** of the cap **410** protrudes beyond the road surface. This allows the flexible top **412** to be depressed by the weight of vehicles traveling over the traffic mitigation device **400** and to apply a force on the piezoelectric element **420**, allowing the piezoelectric element **420** to be compressed between the flexible top **412** and the support **430**. The force acting on the piezoelectric element **420** thereby generates electricity and induces current to flow through the wire to power the motor **440** and the electronics unit **450**, and/or charge the battery **460**.

[0044] In some embodiments, the traffic mitigation device **400** can additionally or alternatively include a transparent top and a solar array positioned underneath the transparent top. The traffic mitigation device **400** can generate electricity using the solar array while the transparent top allows light to pass through and protects the solar array from damage.

[0045] In some embodiments, the traffic mitigation device includes a different mechanism to switch between the flush position and the raised position. For example, the traffic mitigation device can include a scissor jack coupled between the base and the cap, and the motor can be coupled to operate the scissor jack to move the cap between the flush position and the raised position. In another example, the traffic mitigation device can include a pinion coupled to the motor and a linear rack coupled to the cap, and the motor can be coupled to move the linear rack to move the cap between the flush position and the raised position. In yet another example, the traffic mitigation device can include wedges moveably coupled to the base and/or the cap, and the motor can be coupled to move the wedges closer together or farther apart to move the cap between the flush position and the raised position. In pneumatic or hydraulic embodiments, the traffic mitigation device can include one or more pumps, fluid devices (e.g., valves, flow restrictors), sensors (e.g., pressure sensors), or the like. For example, a vehicle can apply pressure when driving over a traffic mitigation device to drive fluid flow by, for example, applying pressure to a flexible cap. The fluid can be force into a valve-controlled reservoir. The vehicle can also push the cap down and re-pressurize the reservoir. In the manner, the traffic mitigation can be repressurized any number of times for actuation.

[0046] FIG. **7** is a perspective view of a traffic mitigation system **702** including a plurality of traffic mitigation devices **700** (e.g., the traffic mitigation device **100**, **200**, **300**, or **400**). Each traffic mitigation device **700** can include a magnetic switch **790** included in an electronics unit and operably coupled to a communication module. The magnetic switch **790** can be configurable between an on state and an off state. In some embodiments, the magnetic switch **790** is configured to switch to the on state when it detects an operator magnet **30** in proximity, and switch back to the off state after a predetermined period of time (e.g., 5 minutes, 15 minutes, 30 minutes, 45 minutes, 60 minutes, 120 minutes, etc.).

[0047] When toggled to the on state, the magnetic switch configures the communication module to enter a listening mode. When in the listening mode, the communication module searches for signals indicating desired operating times (e.g., a schedule) such as when to switch between the flush position and the raised position. When toggled to the off state, the magnetic switch configures the communication module to exit the listening mode and enter a reduced power mode. When in the reduced power mode, the communication module searches for signals with less frequency or does not search for signals at all. The ability to switch between the listening mode and the reduced power mode enables the communication module to save power compared to when the communication module is configured to always be in the listening mode. In some embodiments, a human operator can carry the operator magnet **30** across the traffic mitigation system **702** to activate the magnetic switches **790** prior to sending signals to one or more of the traffic mitigation devices **700**.

[0048] FIG. **8** is a perspective view of a traffic mitigation system **802** including a plurality of traffic mitigation devices **800***a* . . . *n* (collectively referred to as “traffic mitigation devices **800**”) (e.g., the traffic mitigation device **100**, **200**, **300**, or **400**) in a listening mode. As discussed above with respect to FIG. **7**, when the traffic mitigation device **800** is in the listening mode, the communication module is searching for signals indicating desired operating times (e.g., a schedule) such as when to switch between the flush position and the raised position, the current date and time, etc. The controller or control circuit in the traffic mitigation devices **800** can be wirelessly programmed by at least one of a remote computing system via a wide area network, a user device or operator device **40**, etc. In the illustrated embodiment, a first traffic mitigation device **800***a* receives signals from the operator device **40** (e.g., wirelessly). In some embodiments, multiple traffic mitigation devices (e.g., **800***a*, **800***b*, and **800***c*) receive signals from the operator device **40**. The communication modules of the traffic mitigation devices **800** then communicate with one another such that the signals are transmitted from the one or more traffic mitigation devices **800** that received the signals from the operator device **40** to the remaining ones of the traffic mitigation devices **800**.

[0049] In some embodiments, each of the traffic mitigation devices **800** is programmed to maintain and communicate via a network (e.g., a wireless network, a mesh network, a wide area network, wired network, etc.) to coordinate actuation of all or some of the traffic mitigation devices **800** based on the schedule. For example, the controller or control circuit in the traffic mitigation devices **800** can be programmed to command (e.g., via a wireless network) a set of the traffic mitigation devices **800** to be locked in the raised position for a speed reduction time period in the schedule, and to be in the flush position for a non-traffic mitigation time period in the schedule. In some embodiments, the programmed traffic mitigation devices **800** can communicate with each other independently of any remote server device for forming a wireless mesh network operable to coordinate operation of the networked traffic mitigation devices **800**. In some embodiments, the programmed traffic mitigation devices **800** can communicate with each other independently via cloud communications routed by a remote server device.

[0050] By configuring a portion of the traffic mitigation system **802** to receive signals from the operator device **40** and configuring the traffic mitigation devices **800** to share information, the total amount of data transfer to the traffic mitigation system **802** can be significantly reduced. For example, the operator device **40** may only need to upload the desired operating times to the first traffic mitigation device **800***a* instead of having to upload to each traffic mitigation device **800***a* . . . *n*. Moreover, the traffic mitigation devices **800** can communicate with each other to also synchronize their operations such that traffic mitigation devices **800** switch between the flush position and the raised position simultaneously, in a pattern, etc. For example, the traffic mitigation devices **800** can communicate to one another signals comprising an indication of when each cap is about to move between the flush position and the raised position.

[0051] FIG. **9** is a flowchart illustrating a method **900** of mitigating traffic. The method **900** can be performed by a computer-implemented system comprising a plurality of traffic mitigation devices (e.g., device **200**). Each device can include an electronic storage medium comprising computer-executable instructions and one or more processors in electronic communication with the electronic storage medium and configured to execute the computer-executable instructions in order to perform the method **900**.

[0052] The method **900** can include receiving, by at least one of the traffic mitigation devices of the computer-implemented system, desired operation times from an operator device (process portion **910**). The method **900** can then include transmitting, by the computer-implemented system, the desired operating times to the remaining ones of the traffic mitigation devices (process portion **920**). In some embodiments, each device includes a base, a cap movably coupled to the base, a motor coupled to move the cap between a flush position and a raised position, and a battery coupled to the motor.

[0053] The method **900** can then include operating, by the computer-implemented system, the motor of each device to move the cap from the flush position to the raised position at a first one of the desired operating times (process portion **930**). For example, if the traffic mitigation devices are installed around a school, the first one of the desired operating times can be 7:00 a.m. every weekday, excluding holidays and vacation days, corresponding to when students begin commuting to school and student traffic begins to rise. The method **900** can then include operating, by the computer-implemented system, the motor of each device to move the cap from the raised position to the flush position at a second one of the desired operating times (process portion **940**). For example, if the traffic mitigation devices are installed around a school, the second one of the desired operating times can be 9:00 am every weekday excluding holidays and vacation days, corresponding to when classes begin and student traffic has generally dropped to near zero.

IV. Computer Systems and Environment

[0054] Several implementations are discussed below in more detail in reference to the figures. FIG. **10** is a block diagram illustrating an overview of electronic units on which some implementations of the disclosed technology can operate. The electronic unit or device **1000** can comprise hardware components that execute instructions to receive and/or transmit signals, operate motors, etc. The description of the electronic unit **1000** applies to the electronics unit **240** of FIGS. **2**A and **2**B and other electronic units and traffic mitigation devices disclosed herein.

[0055] The electronic unit **1000** can include one or more input devices **1020** that provide input to the processor(s) **1010** (e.g., CPU(s), GPU(s), HPU(s), etc.), notifying it of actions. The actions can be mediated by a hardware controller that interprets the signals received from the input device and communicates the information to the processors **1010** using a communication protocol. Input devices **1020** include, for example, a touchscreen, an infrared sensor, a magnetic sensor, a touchpad, a camera-or image-based input device, a microphone, a transceiver, or other user input devices. In some embodiments, a touchscreen can be located along the bottom of the traffic mitigation device. During installation, the touchscreen can be used to input information that is stored by the traffic mitigator. In some embodiments, the input device can include one or more cameras that capture images of vehicles (e.g., approaching vehicles, overpassing vehicles, and/or departing vehicles), pedestrians, environmental conditions (e.g., weather, light conditions, visibility conditions, etc.), etc. The images can be collected to monitor traffic, detect mitigation effects, or the like. The number and configuration of the input devices can be selected based on the environment in which the traffic mitigation devices are installed.

[0056] Processors **1010** can be a single processing unit or multiple processing units in a device or distributed across multiple devices. Processors **1010** can be coupled to other hardware devices, for example, with the use of a bus, such as a PCI bus or SCSI bus. The processors **1010** can communicate with a hardware controller for devices, such as for a display **1030**. Display **1030** can be used to display color light (e.g., flashing light, continuous light, etc.), as discussed in connection with lighting of device **200**.

[0057] In some implementations, the device **1000** also includes a communication device capable of communicating wirelessly or wire-based with a network node. The communication device can communicate with another device or a server through a network using, for example, TCP/IP protocols and other protocols, including mesh protocols. Device **1000** can utilize the communication device to distribute operations across multiple network devices.

[0058] The processors **1010** can have access to a memory **1050** in a device or distributed across multiple devices. A memory includes one or more of various hardware devices for volatile and non-volatile storage, and can include both read-only and writable memory. For example, a memory can comprise random access memory (RAM), various caches, CPU registers, read-only memory (ROM), and writable non-volatile memory, such as flash memory, hard drives, floppy disks, CDs, DVDs, magnetic storage devices, tape drives, and so forth. A memory is not a propagating signal divorced from underlying hardware; a memory is thus non-transitory. Memory **1050** can include program memory **1060** that stores programs and software, such as an operating system **1062** and other application programs **1064**. Memory **1050** can also include data memory **1070**, storing data, information, settings, protocols, programs, etc.

[0059] FIG. **11** is a block diagram illustrating an overview of an environment **1100** in which some implementations of the disclosed technology can operate. Environment **1100** can include one or more user devices or operator computing devices **1105**A-D (collectively referred to as "operator computing devices **1105**"), examples of which can include smartphones, computers, tablets, and/or operator device **40** (FIG. **8**). Client computing devices **1105** can operate in a networked environment using logical connections through network **1130** to one or more remote computers, such as a server computing device. Similarly, traffic mitigation device **1108** (e.g., the device **1000**) can operate in the networked environment using logical connections through network **1130** to one or more remote computers, such as a server computing device. In some embodiments, the traffic mitigation device **1108** communicates with the client computing devices **1105** via local communication. In some embodiments, the traffic mitigation device **1108** communications can be based on one of various types of communication protocols or standards, such as a Bluetooth® standard, a Wi-Fi Direct standard, a NFC standard, a ZigBee® standard, Z-wave standards, Matter standards, a 6LoWPAN standard, etc.

[0060] In some implementations, server **1110** can be an edge server which receives client requests and coordinates fulfillment of those requests through other servers, such as servers **1120**A-C. Server computing devices **1110** and **1120** can comprise computing systems. Though each server computing device **1110** and **1120** is displayed logically as a single server, server computing devices can each be a distributed computing environment encompassing multiple computing devices located at the same or at geographically disparate physical locations. In some implementations, each server **1120** corresponds to a group of servers.

[0061] Client computing devices **1105**, traffic mitigation device **1108**, and server computing devices **1110** and **1120** can each act as a server or client to other server/client devices. Server **1110** can connect to a database **1115**. Servers **1120**A-C can each connect to a corresponding database **1125**A-C. As discussed above, each server **1120** can correspond to a group of servers, and each of these servers can share a database or can have their own database. Databases **1115** and **1125** can warehouse (e.g., store) information such as table data, column data, value filter data, user interface data, database element data, selection data, root table data, code snippet data, join query data, query template data, connection data. Though databases **1115** and **1125** are displayed logically as single units, databases **1115** and **1125** can each be a distributed computing environment encompassing multiple computing devices, can be located within their corresponding server, or can be located at the same or at geographically disparate physical locations.

[0062] Network **1130** can be a local area network (LAN) or a wide area network (WAN), but can also be other wired or wireless networks. Network **1130** may be the Internet or some other public or private network. Client computing devices **1105** can be connected to network **1130** through a network interface, such as by wired or wireless communication. While the connections between server **1110** and servers **1120** are shown as separate connections, these connections can be any kind of local, wide area, wired, or wireless network, including network **1130** or a separate public or private network. As described in further detail herein, the client computing devices **1105** can operate according to an edge computing protocol (e.g., an edge computing decryption protocol).

[0063] FIG. **12** is a block diagram illustrating components **1200** which, in some implementations, can be used in a system employing the disclosed technology. In some implementations, some or all of the components **1200** can be included in a traffic mitigation device. The components **1200** include hardware **1202**, general software **1220**, and specialized components **1240**. As discussed above, a system implementing the disclosed technology can use various hardware including processing units **1204** (e.g., CPUs, GPUs, APUs, etc.), working memory **1206**, storage memory **1208** (local storage or as an interface to remote storage, such as storage **1115** or **1125**), and input and output devices **1210**. In various implementations, storage memory **1208** can be one or more of: local devices, interfaces to remote storage devices, or combinations thereof. For example, storage memory **1208** can be a set of one or more hard drives (e.g., a redundant array of independent disks (RAID)) accessible through a system bus or can be a cloud storage provider or other network storage accessible via one or more communications networks (e.g., a network accessible storage

(NAS) device, such as storage **1115** or storage provided through another server **1120**). Components **1200** can include a machine-readable storage medium having machine executable instructions stored thereon. Components **1200** can be implemented in a traffic mitigation device such as device **1000**, traffic mitigation device **1108**, or on a server computing device, such as server computing device **1110** or **1120**.

[0064] General software **1220** can include various applications including an operating system **1222**, local programs **1224**, and a basic input output system (BIOS) **1226**. Specialized components **1240** can be subcomponents of a general software application **1220**, such as local programs **1224**. Specialized components **1240** can include control circuit **1244**, synchronization module **1246**, communication module **1248**, and power module **1250**, and components which can be used for providing user interfaces, transferring data, and controlling the specialized components, such as interfaces **1242**. In some implementations, components **1200** can be in a computing system that is distributed across multiple computing devices or can be an interface to a server-based application executing one or more of specialized components **1240**. Although depicted as separate components, specialized components **1240** may be logical or other nonphysical differentiations of functions and/or may be submodules or code-blocks of one or more applications.

[0065] In some implementations, the control circuit **1244** is configured to control operation of a motor to switch the traffic mitigation device between a flush position and a raised position. The control circuit **1244** can control the direction, rate, and angle of the motor rotation. In pneumatic or hydraulic embodiments, the control circuit **1244** can control one or more pumps, fluid devices (e.g., valves, flow restrictors), sensors (e.g., pressure sensors), or the like. For example, a vehicle can apply pressure when driving over a traffic mitigation device to drive fluid flow by, for example, applying pressure to a flexible cap. The fluid can be force into a valve-controlled reservoir. The control circuit **1244** can operate (e.g., open) a valve to allow the pressure to lift a cap. The vehicle can also push the cap down and re-pressurize the reservoir. In the manner, the traffic mitigation can be repressurized any number of times for actuation. In some embodiments, the fluid flow can be controlled using mechanical components without any control circuit.

[0066] In some implementations, the synchronization module **1246** is configured to synchronize the rise and fall of the cap (e.g., the cap **206**) with the caps of other traffic mitigation devices when the traffic mitigation devices are switched between the flush position and the raised position. As discussed above with respect to FIG. **8**, synchronizing multiple the operations of multiple devices can be advantageous by allowing the traffic mitigation devices **800** to switch between the flush position and the raised position simultaneously, in a pattern, etc.

[0067] In some implementations, the communication module **1248** is configured to receive and transmit various signals to and from operator devices (e.g., the operator device **40**, the operator computing devices **1105**) and/or other traffic mitigation devices. The signals can include desired operating times such as when to switch between the flush position and the raised position, the current date and time, etc. As discussed above with respect to FIG. **11**, the communication module **1248** can communicate over a network, via local communication, etc. For example, the communication module **1248** and other communication devices can be configured to communicate using, for example, a mesh network protocol, a ZigBee® communication protocol, a Z-Wave® communication protocol, Matter protocol, a wireless local area network, a home wireless communication protocol, a IoT protocol, or another communication protocol, such as 802.11.

[0068] In some implementations, the power module **1250** is configured to manage the power of the traffic mitigation device. The power module **1250** can receive signals or other indications relating to the power generator (e.g., how much power the piezoelectric element or the solar array is generating), the battery (e.g., charge level, battery life), and other electronic components (e.g., power usage distribution). In some implementations, the power module **1250** can override any operation modes and instruct the control circuit **1244** to return the traffic mitigation device in the flush position when the battery level is low such that the traffic mitigation device does not unnecessarily impede traffic and can charge the battery.

[0069] Those skilled in the art will appreciate that the components illustrated in FIGS. **10-12** described above, and the flow diagrams discussed above, may be altered in a variety of ways. For example, the order of the logic may be rearranged, substeps may be performed in parallel, illustrated logic may be omitted, other logic may be included, etc. In some implementations, one or more of the components described above can execute one or more of the processes described below.

V. Conclusion

[0070] Several implementations of the disclosed technology are described above in reference to the figures. The computing devices on which the described technology may be implemented can include one or more central processing units, memory, input devices (e.g., keyboard and pointing devices), output devices (e.g., display devices), storage devices (e.g., disk drives), and network devices (e.g., network interfaces). The memory and storage devices are computer-readable storage media that can store instructions that implement at least portions of the described technology. In addition, the data structures and message structures can be stored or transmitted via a data transmission medium, such as a signal on a communications link. Various communications links can be used, such as the Internet, a local area network, a wide area network, or a point-to-point dial-up connection. Thus, computer-readable media can comprise computer-readable storage media (e.g., "non-transitory" media) and computer-readable transmission media.

[0071] Reference in this specification to "embodiments" or "implementations" (e.g., "some implementations," "various implementations," "one implementation," "an implementation," etc.) means that a particular feature, structure, or characteristic described in connection with the implementation is included in at least one implementation of the disclosure. The appearances of these phrases in various places in the specification are not necessarily all referring to the same implementation, nor are separate or alternative implementations mutually exclusive of other implementations. Moreover, various features are described which may be exhibited by some implementations and not by others. Similarly, various requirements are described which may be requirements for some implementations but not for other implementations.

[0072] As used herein, being above a threshold means that a value for an item under comparison is above a specified other value, that an item under comparison is among a certain specified number of items with the largest value, or that an item under comparison has a value within a specified top percentage value. As used herein, being below a threshold means that a value for an item under comparison is below a specified other value, that an item under comparison is among a certain specified number of items with the smallest value, or that an item under comparison has a value within a specified bottom percentage value. As used herein, being within a threshold means that a value for an item under comparison is between two specified other values, that an item under comparison is among a middle specified number of items, or that an item under comparison has a value within a middle specified percentage range. Relative terms, such as high or unimportant, when not otherwise defined, can be understood as assigning a value and determining how that value compares to an established threshold. For example, the phrase "selecting a fast connection" can be understood to mean selecting a connection that has a value assigned corresponding to its connection speed that is above a threshold.

[0073] As used herein, the word "or" refers to any possible permutation of a set of items. For example, the phrase "A, B, or C" refers to at least one of A, B, C, or any combination thereof, such as any of: A; B; C; A and B; A and C; B and C; A, B, and C; or multiple of any item such as A and A; B, B, and C; A, A, B, C, and C; etc.

[0074] Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Specific embodiments and implementations have been described herein for purposes of illustration, but various modifications can be made without deviating from the scope of the embodiments and implementations. The specific features and acts described above are disclosed as example forms of implementing the claims that follow. Accordingly, the embodiments and implementations are not limited except as by the appended claims.

[0075] Any patents, patent applications, and other references noted above are incorporated herein by reference. Aspects can be modified, if necessary, to employ the systems, functions, and concepts of the various references described above to provide yet further implementations. If statements or subject matter in a document incorporated by reference conflicts with statements or subject matter of this application, then this application shall control.

Claims

1-20. (canceled)

21. A method comprising: forming a plurality of sockets in a roadway; and installing a plurality of traffic mitigation devices in corresponding ones of the sockets, wherein each of the traffic mitigation devices includes: a base extending below an upper surface of the roadway; a cap; a rechargeable power supply; a motor configured to receive energy from the rechargeable power supply and to move the cap relative to the base between (i) a lowered position in which the cap is substantially flush with or below the upper surface of the roadway and (ii) a raised position in which the cap protrudes above the upper surface of the roadway; and a control circuit operably coupled to the motor, wherein the control circuit is configured to (i) cause recharging of the rechargeable power supply based on vehicles traveling over the traffic mitigation device and (ii) operate the motor to move the cap between the lowered position and the raised position.

22. The method of claim 21, wherein one or more of the sockets has a circular cross section viewed from above, and wherein each of the traffic mitigation devices is self-contained in the respective socket.

23. The method of claim 21, wherein the control circuit is programmed with a schedule for moving the cap between the lowered position and the raised position.

24. The method of claim 21, wherein installing the plurality of traffic mitigation devices comprises placing the traffic mitigation devices in the corresponding ones of the sockets without physically connecting each of the traffic mitigation devices to any other component.

25. The method of claim 21, wherein installing the plurality of traffic mitigation devices comprises placing the traffic mitigation devices in the corresponding ones of the sockets without communicably connecting each of the traffic mitigation devices to any other component.

26. The method of claim 21, wherein the base includes a locking feature, and wherein installing the plurality of traffic mitigation devices comprises securing the base of each of the traffic mitigation devices in the corresponding socket using the respective locking feature.

27. The method of claim 24, wherein the locking feature includes threads coupled to an external surface of the base.

28. The method of claim 21, wherein installing the plurality of traffic mitigation devices comprises securing the base of each of the traffic mitigation devices in the corresponding socket via a press-fit.

29. The method of claim 21, wherein each of the traffic mitigation devices further includes a power generator electrically coupled to the rechargeable power supply, wherein the power generator is configured to generate electricity and charge the rechargeable power supply with the generated electricity.

30. The method of claim 21, wherein the cap includes one or more ribs, and wherein each of the traffic mitigation devices further includes: a pinion coupled to the motor; and a rotator rotatably positioned in the base, the rotator including a ring gear positioned to engage the pinion and one or more slots positioned to engage corresponding ones of the one or more ribs, wherein the motor is

configured to rotate the cap relative to the base by (i) rotating the rotator via engagement between the pinion and the ring gear and (ii) rotating the cap via engagement between the one or more slots and the one or more ribs.
31. The method of claim 21, wherein forming the plurality of sockets comprises cutting away a plurality of cylindrical recesses in the roadway such that each of the cylindrical recesses is fully enclosed except at a side facing the roadway.
32. A self-contained traffic mitigation device installable in a roadway, the traffic mitigation device comprising: a base extending below an upper surface of the roadway; a cap; a rechargeable power supply; a motor configured to receive energy from the rechargeable power supply and to move the cap relative to the base between (i) a lowered position in which the cap is substantially flush with or below the upper surface of the roadway and (ii) a raised position in which the cap protrudes above the upper surface of the roadway; and a control circuit operably coupled to the motor, wherein the control circuit is configured to (i) cause recharging of the rechargeable power supply based on vehicles traveling over the traffic mitigation device and (ii) operate the motor to move the cap between the lowered position and the raised position.
33. The traffic mitigation device of claim 32, wherein the traffic mitigation device is not physically coupled to any other traffic mitigation device.
34. The traffic mitigation device of claim 32, wherein the traffic mitigation device is not communicably coupled to any other traffic mitigation device.
35. The traffic mitigation device of claim 32, wherein the cap includes one or more ribs, and wherein the traffic mitigation devices further comprises: a pinion coupled to the motor; and a rotator rotatably positioned in the base, the rotator including a ring gear positioned to engage the pinion and one or more slots positioned to engage corresponding ones of the one or more ribs, wherein the motor is configured to rotate the cap relative to the base by (i) rotating the rotator via engagement between the pinion and the ring gear and (ii) rotating the cap via engagement between the one or more slots and the one or more ribs.
36. The traffic mitigation device of claim 32, further comprising: a battery positioned between the base and the cap, wherein the battery is electrically coupled to the motor; and a power generator positioned between the base and the cap, wherein the power generator is electrically coupled to the battery, and wherein the power generator is configured to generate electricity and charge the battery with the generated electricity.
37. The traffic mitigation device of claim 36, wherein: the cap includes a flexible top, the power generator includes at least one piezoelectric element positioned underneath the flexible top, and when the cap is in the lowered position, the flexible top is positioned to be depressed by a weight of a vehicle traversing the roadway, thereby applying a force on the piezoelectric element to cause energy to be generated by the power generator.
38. The traffic mitigation device of claim 32, wherein the cap is configured to automatically lock in the raised configuration to prevent collapse of the traffic mitigation device when driven upon by vehicles.
39. A method for operating a traffic mitigation device installed in a roadway, the method comprising: based on a predetermined schedule stored in the traffic mitigation device: operating, at a first time, a motor to rotate a cap relative to a base from (i) a lowered position in which the cap is substantially flush with the roadway and (ii) a raised position in which the cap protrudes above the roadway; and operating, at a second time different from the first time, the motor to rotate the cap relative to the base from the raised position to the lowered position.
40. The method of claim 39, wherein operating at the first time comprises operating the motor in sync with another traffic mitigation device operating another motor at the first time based on the predetermined schedule without communicating with the other traffic mitigation device.
41. The method of claim 39, wherein operating at the first time comprises operating the motor to rotate a pinion operably coupled to the motor, thereby rotate a rotator operably coupled to the

pinion, and thereby rotate the cap operably coupled to the rotator.
42. The method of claim 39, further comprising: receiving a force from a vehicle moving over the cap; and generating electrical power from the force, wherein the electrical power at least partially charges the rechargeable power supply.