ADAPTIVE PROVISION OF GRAPHICAL COMMUNICATIONS IN DISPENSING ENVIRONMENTS

Abstract

A method for adapting and providing graphical communications in a dispensing environment is provided and can include receiving first data characterizing a vehicle in a dispensing environment and second data characterizing a vehicle operator. Vehicle attributes can be determined based on the first data and an identity of the operator can be determined based on the second data. Third data characterizing a graphical communication can be determined based on the attributes of the vehicle and the identity of the operator. The graphical communication can include graphical elements and can be determined for the operator based on fourth data characterizing a likelihood the operator will provide an input selecting a graphical element of the graphical elements included in the graphical communication. The graphical communication can displayed on a screen within the dispensing environment for viewing by the operator. Related systems and computer-readable mediums are also provided.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] The present application is a continuation of U.S. patent application Ser. No. 18/317,182 entitled "ADAPTIVE PROVISION OF GRAPHICAL COMMUNICATIONS IN DISPENSING ENVIRONMENTS" filed on May 15, 2023, the entire content of which is hereby incorporated by reference in its entirety.

FIELD
[0002] Methods and systems for adaptively determining and providing graphical communications in a dispensing environment are provided.
BACKGROUND
[0003] Dispensing environments can provide fuel, electricity, gas, or similar consumable products or energy-generating materials to vehicles via dispensers. Vehicle operators can enter the dispensing environment to purchase fuel, gas, or electricity for their vehicle. Often, dispensing environments offer other items or services for purchase, such as food, drinks, vehicle maintenance equipment, vacuum, air, repair services, or car washes.
[0004] Dispensing environment owners usually rely on traditional modes of marketing such as word of mouth, signage, flyers, posters, and social media to attract customers and command revenue/sales sufficient to sustain profitability. However, at times it can be difficult to reach potential customers via these traditional marketing channels. Marketing outreach can be limited by production of physical materials, lack of suitable display locations or resources to display promotions, and the physical configuration or geographical area in which the dispensing environment is located may not be conducive for effective advertising via traditional marketing methods. For example, promotions directed to car wash services can be difficult to generate maximum sales returns because car wash utilization can be hampered by the seasonal nature of the car wash business in some locations, car wash downtime due to repair or the lack of available operators, or car wash waiting times.
[0005] As a result, dispensing environment owners may wish to dynamically determine and provide promotional offers that are adapted to vehicle operators for a variety of food, products, and/or services in order to maximize revenue and sales, optimize resource usage and profits of various services within the dispensing environment, retain existing customers, and grow service offerings to new customers. Thus, there exists a need for dynamically providing promotional offers that are customized to users of a dispensing environment.
SUMMARY
[0006] Methods and systems for adaptively determining and providing graphical communications in a dispenser environment are provided. Related apparatus, techniques, and articles are also described.
[0007] In one aspect, a method for adapting and providing graphical communications in a dispensing environment is provided. In one embodiment, the method can include receiving first data characterizing a vehicle present within a dispensing environment and second data characterizing an operator of the vehicle. The method can also include determining one or more attributes of the vehicle based on the first data. The method can further include determining an identity of the operator based on the second data. The method can also include determining third data characterizing at least one graphical communication. The third data can be determined based on the determined one or more attributes of the vehicle and the identity of the operator. The

graphical communication can include one or more graphical elements and can be determined for the operator based on fourth data characterizing a likelihood the operator will provide an input selecting at least one graphical element of the one or more graphical elements included in the graphical communication. The method can further include providing the graphical communication on a display screen within the dispensing environment for viewing by the operator.

[0008] In another embodiment, the second data can include image or video data acquired by an image sensor within the dispensing environment, loyalty program data received from the operator when the vehicle is within the dispensing environment, or loyalty program data received from the operator when the vehicle is remote from the dispensing environment.

[0009] In another embodiment, the one or more attributes of the vehicle can further include a type of the vehicle, a size of the vehicle, or an amount of dirt on an exterior surface of the vehicle.

[0010] In another embodiment, the one or more attributes can be determined using a first predictive model trained in a first machine learning process based on first training data including image data or video data of vehicles.

[0011] In another embodiment, the third data can be determined using a second predictive model trained in a second machine learning process based on second training data including vehicle attribute data, the one or more graphical elements, the graphical communication, the likelihood the operator will provide the input selecting the at least one graphical element, and a frequency of operator inputs selecting the at least one graphical element included in the graphical communication.

[0012] In another embodiment, the at least one graphical element is associated with at least one of a car wash, a car wash discount, a food item, a food item discount, a volume of fuel, a fuel discount, a service, or a service discount.

[0013] In another embodiment, the second data can be received from a computing device in possession of the operator and the at least one graphical communication is transmitted to the computing device in possession of the operator.

[0014] In another embodiment, the at least one graphical communication can be adapted based on previous inputs provided by the operator selecting the at least one graphical element, previous graphical communications for which the operator did not select the at least one graphical communication element, previous graphical communications for which other vehicle operators provided inputs selecting the at least one graphical communication element, or previous graphical communications for which other vehicle operators did not provide inputs selecting the at least one graphical element.

[0015] In another embodiment, the receiving, the determining, and the providing can be performed by at least one data processor forming part of at least one computing system.

[0016] In another aspect, a system for adapting and providing graphical communications in a dispensing environment is provided. In an embodiment, the system can include a dispenser provided within a dispensing environment and configured to receive user inputs. The system can also include an image sensor communicatively coupled to the dispenser. The system can further include at least one data processor operatively coupled to the dispenser. The system can also include a memory storing instructions, which when executed, can cause the at least one data processor to perform operations including receiving first data characterizing a vehicle present within the dispensing environment and second data characterizing an operator of the vehicle. The first data can include image data acquired via the image sensor. The operations can also include determining one or more attributes of the vehicle based on the first data. The operations can further include determining an identity of the operator based on the second data. The operations can also include determining third data characterizing at least one graphical communication. The third data can be determined based the determined one or more attributes of the vehicle and the identity of the operator. The graphical communication can include one or more graphical elements and can be determined for the operator based on fourth data characterizing a likelihood the operator will

provide an input selecting at least one graphical element of the one or more graphical elements included in the graphical communication. The operations can also include providing the at least one graphical communication for display on a display screen of the dispenser for viewing by the operator.

[0017] In another embodiment, the second data can include image or video data acquired by the image sensor within the dispensing environment, loyalty program data received from the operator when the vehicle is within the dispensing environment, or loyalty program data received from the operator when the vehicle is remote from the dispensing environment.

[0018] In another embodiment, the one or more attributes of the vehicle can further include a type of the vehicle, a size of the vehicle, or an amount of dirt on an exterior surface of the vehicle.

[0019] In another embodiment, the one or more attributes can be determined using a first predictive model trained in a first machine learning process based on first training data including image data or video data of vehicles.

[0020] In another embodiment, the third data can be determined using a second predictive model trained in a second machine learning process based on second training data including vehicle attribute data, the one or more graphical elements, the graphical communication, the likelihood the operator will provide the input selecting the at least one graphical element, and a frequency of operator inputs selecting the at least one graphical element included in the graphical communication.

[0021] In another embodiment, the at least one graphical element is associated with at least one of a car wash, a car wash discount, a food item, a food item discount, a volume of fuel, a fuel discount, a service, or a service discount.

[0022] In another embodiment, the at least one graphical communications can be further determined based on at least one of an idle time of the vehicle within the dispensing environment, a time of day, a day of the week, a special event, a distance between the dispensing environment and a second dispensing environment, a location of the dispensing environment, a number of vehicle present within the dispensing environment, a car wash available time, or weather present at the dispensing environment.

[0023] In another embodiment, the second data can be received from a computing device in possession of the operator and the at least one graphical communication is transmitted to the computing device in possession of the operator.

[0024] In another embodiment, the at least one graphical communication can be adapted based on previous inputs provided by the operator selecting the at least one graphical element, previous graphical communications for which the operator did not select the at least one graphical communication element, previous graphical communications for which other vehicle operators provided inputs selecting the at least one graphical communication element, or previous graphical communications for which other vehicle operators did not provide inputs selecting the at least one graphical element.

[0025] In another embodiment, the receiving, the determining, and the providing can be performed by at least one data processor forming part of at least one computing system.

[0026] In another aspect, a computer-readable medium storing non-transitory computer-readable instructions for adapting and providing graphical communications in a dispensing environment is provided. The instructions, which when executed by a data processor, can cause the data processor to perform operations including receiving first data characterizing a vehicle present within a dispensing environment and second data characterizing an operator of the vehicle. The first data can include image data acquired via an image sensor communicatively coupled to a dispenser within the dispensing environment. The operations can also include determining one or more attributes of the vehicle based on the first data. The operations can further include determining an identity of the operator based on the second data. The operations can also include determining third data characterizing at least one graphical communication. The third data can be determined based

on the determined one or more attributes of the vehicle and the identity of the operator. The graphical communication can include one or more graphical elements and can be determined for the operator based on fourth data characterizing a likelihood the operator will provide an input selecting at least one graphical element of the one or more graphical elements included in the graphical communication. The operations can further include providing the at least one graphical communication for display on a display screen of the dispenser for viewing by the operator.

[0027] Non-transitory computer program products (i.e., physically embodied computer program products) are also described that store instructions, which when executed by one or more data processors of one or more computing systems, causes at least one data processor to perform operations herein. Similarly, computer systems are also described that may include one or more data processors and memory coupled to the one or more data processors. The memory may temporarily or permanently store instructions that cause at least one processor to perform one or more of the operations described herein. In addition, methods can be implemented by one or more data processors either within a single computing system or distributed among two or more computing systems. Such computing systems can be connected and can exchange data and/or commands or other instructions or the like via one or more connections, including a connection over a network (e.g. the Internet, a wireless wide area network, a local area network, a wide area network, a wired network, or the like), via a direct connection between one or more of the multiple computing systems, etc.

[0028] The details of one or more variations of the subject matter described herein are set forth in the accompanying drawings and the description below. Other features and advantages of the subject matter described herein will be apparent from the description and drawings, and from the claims.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0029] The embodiments described above will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings. The drawings are not intended to be drawn to scale. For purposes of clarity, not every component may be labeled in every drawing. In the drawings:

[0030] FIG. **1** is a process flow diagram illustrating an example method of adaptively determining, generating, and providing graphical communications within a dispensing environment;

[0031] FIG. **2** is a diagram illustrating an exemplary embodiment of a data processing architecture configured to perform the method of FIG. **1**;

[0032] FIG. **3** is a diagram illustrating an exemplary embodiment of a dataflow executed by performing the method of FIG. **1**;

[0033] FIG. **4** is a diagram illustrating an exemplary embodiment of a predictive algorithm used in the method of FIG. **1**;

[0034] FIG. **5** is a diagram illustrating an exemplary embodiment of a system for adaptively determining, generating, and providing graphical communications within a dispensing environment according to the method of FIG. **1**;

[0035] FIG. **6**A is a side perspective view of one embodiment of a dispenser;

[0036] FIG. **6**B is a front perspective view of the dispenser shown in FIG. **6**A;

[0037] FIG. **7** is a diagram showing internal components of the dispenser of FIGS. **6**A and **6**B;

[0038] FIG. **8** is a diagram illustrating components of an example system for the optimized utilization and promotion of car wash services;

[0039] FIG. **9** is a diagram illustrating components of an example system for the optimized utilization and promotion of car wash services including a sensor for detecting the presence of a vehicle in a car wash bay; and

[0040] FIG. **10** is a diagram of an exemplary computing system in accordance with an illustrative implementation of the system of FIG. **5**.

DETAILED DESCRIPTION

[0041] Certain exemplary embodiments will now be described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the devices and methods disclosed herein. One or more examples of these embodiments are illustrated in the accompanying drawings. Those skilled in the art will understand that the devices and methods specifically described herein and illustrated in the accompanying drawings are non-limiting exemplary embodiments and that the scope of the present invention is defined solely by the claims. The features illustrated or described in connection with one exemplary embodiment may be combined with the features of other embodiments. Such modifications and variations are intended to be included within the scope of the present invention.

[0042] Further, in the present disclosure, like-named components of the embodiments generally have similar features, and thus within a particular embodiment each feature of each like-named component is not necessarily fully elaborated upon. Additionally, to the extent that linear or circular dimensions are used in the description of the disclosed systems, devices, and methods, such dimensions are not intended to limit the types of shapes that can be used in conjunction with such systems, devices, and methods. A person skilled in the art will recognize that an equivalent to such linear and circular dimensions can easily be determined for any geometric shape. Sizes and shapes of the systems and devices, and the components thereof, can depend at least on the anatomy of the subject in which the systems and devices will be used, the size and shape of components with which the systems and devices will be used, and the methods and procedures in which the systems and devices will be used.

[0043] As described earlier, operators of dispensing environments seek to maximize sales and profits using existing resources in the most efficient manner possible. Traditional advertising and promotional marketing materials may fall short of capturing existing or new customers in order to increase sales and profits. Many traditional advertising and promotional materials and delivery methods provide generic materials to all users of the dispenser environment. As a result, users may be turned off by the promotional offers and fail to participate in the promotional offer. Thus, the probability a user will accept, agree, or otherwise participate or utilize a promotional offer may be low.

[0044] An improved promotional system would be able to adaptively determine and provide promotional offers based on specific characteristics of a user of the dispensing environment or the user's vehicle. For example, determining a user is a frequent visitor to a dispensing environment to purchase fuel, electricity, or gas, the system could determine that additional promotional offers could be provided to the user, such as a free car wash, or discounted product or service offering. The system, based on identifying the user, could adaptively determine and provide a graphical communication corresponding to a promotional offer that is specifically tailed for the identified user and/or their vehicle. Adaptively determining and providing promotional offers can increase sales and profits for dispensing environment operators where generic promotional and marketing techniques fall short to engage new and existing customers in a purchase. The likelihood or probability of the user accepting the promotional offer to make an unplanned or additional purchase can be used to determine a value of the promotion so that the user is presented with a promotion they are most likely to accept. The graphical communications can be displayed or provided to the user in a variety of manners described herein.

[0045] In general, a system for adaptively determining, generating, and providing graphical communications in a dispensing environment, and methods for use thereof, are provided. The graphical communications can correspond to advertisements, promotions, coupons, rebates, or marketing materials associated with product or service offerings available in the dispensing environment or in related locations or contexts associated with an operator of the dispensing

environment. The graphical communication could correspond to an offer for a fuel discount, an electricity discount, a gas discount, a car wash, a beverage, a diagnostic or repair service, or the like. The system can dynamically and adaptively determine promotional offers of varying values that can be presented to a user such that the user is most likely to accept the offer and the operator of the dispensing environment is most likely to accrue a sale or purchase that they may not have achieved in the absence of the graphical communication.

[0046] FIG. **1** is a process flow diagram illustrating an example process **100** of some implementations of the current subject matter that can provide for adaptive determination and provision of graphical communications in a dispensing environment.

[0047] At **110**, a first data characterizing a vehicle present within a dispensing environment can be received. The first data can include image data, such as still image data or video image data, which includes the vehicle within the fuel dispensing environment. Additionally, at **110**, second data characterizing an operator of the vehicle can also be received. The second data can include image data, such as still image data or video image data, which includes the operator of the vehicle. In some embodiments, the second data can include data characterizing the operator of the vehicle that is received prior to the operator's presence within the dispensing environment. In some embodiments, the vehicle can display a loyalty program identifier, such as a sticker or decal, on the vehicle that can be included in the image data. The loyalty program identifier can identify the vehicle and the operator of the vehicle.

[0048] In some embodiments, the first data and the second data can include non-image data. For example, the first data and the second data can include loyalty program data identifying the vehicle and the operator of the vehicle. The loyalty program data can be associated with the dispensing environment. In some embodiments, the loyalty program data can include a loyalty program account number, a credit card associated with the operator of the vehicle and the loyalty program account, a loyalty program status, and a purchase history of transactions performed by the operator of the vehicle. In some embodiments, the first data and the second data can be received prior to the vehicle entering the dispensing environment. For example, the first data and the second data can be received as a result of the operator of the vehicle logging into a loyalty program application configured on a computing device associated with the operator of the vehicle.

[0049] At **120**, one or more attributes of the vehicle can be determined based on the first data. The first data can include one or more attributes of the vehicle such as a make, model, size, shape, style, fuel-type, height, length, width, color, window style, type, age or condition of the vehicle.

[0050] The one or more attributes of the vehicle can be determined from the first data using a computer vision algorithm or the like configured to receive the first data as an input and to output attributes of the vehicle. In some embodiments, the computer vision algorithm can include an image classifier. The image classifier can perform pixel-wise classification and segmentation analysis of the first data to determine the attributes of the vehicle. In some embodiments, the image classifier can be implemented using one or more image classification methods, including template matching, low-order Markov chains, Hilbert space-filling curves, Markov meshes, or dependency trees.

[0051] In some embodiments, the one or more attributes of the vehicle can be determined using loyalty program data stored in a database. For example, upon receiving first data associated with a loyalty program of the dispensing environment, the one or more attributes of the vehicle can be determined based on the loyalty program data.

[0052] At **130**, an identity of the operator of the vehicle can be determined based on the second data. The identity of the operator can be determined from the second data using a computer vision algorithm configured to receive the second data as an input and to output the identity of the vehicle operator. In some embodiments, the computer vision algorithm can include an image classifier. The image classifier can perform pixel-wise classification and segmentation analysis of the second data to determine the attributes of the vehicle. In some embodiments, the image classifier can be

implemented using one or more image classification methods, including template matching, low-order Markov chains, Hilbert space-filling curves, Markov meshes, or dependency trees. In some embodiments, the identity of the operator can include a sex of the vehicle operator.

[0053] In some embodiments, the identity of the operator can be determined using loyalty program data stored in a database. For example, upon receiving second data associated with a loyalty program of the dispensing environment, the identity of the vehicle operator can be determined based on the loyalty program data.

[0054] At **140**, third data characterizing at least one graphical communication can be determined. The third data can be determined based on the one or more attributes of the vehicle and/or the identity of the vehicle operator. In some embodiments, a predictive algorithm can be configured to receive as inputs the determined attributes of the vehicle and the determined identity of the vehicle operator and to generate as outputs a graphical communication. In some embodiments, the third data can include a graphical communication associated with products or goods offered for sale within the dispensing environment. In other embodiments, the third data can include a graphical communications associated with good or services offered for sale outside of the dispensing environment, such as at a neighboring business location or a preferred partner/vendor location away from the location of the dispensing environment.

[0055] The predictive algorithm can also receive additional input data including, but not limited to a buying profile of the vehicle operator, a buying profile of the vehicle, weather data corresponding to a location at which the dispensing environment is located, and utilization or availability data associated with one or more products, services, or facilities included in the dispensing environment, such as a car wash facility. For example, the additional input data can include car wash availability data or car wash utilization data. The utilization and/or availability data can be obtained from a database or from sensors configured within the dispensing environment. A buying profile of the vehicle operator can include historical data associated with purchases the vehicle operator has made in the past. The buying profile of the vehicle operator can be associated with the vehicle to determine a buying profile of the vehicle. In some embodiments, the buying profile of the vehicle can be determined based on a buying or purchasing history associated with any occupant of the vehicle and need not necessarily be based on the buying or purchasing history of the vehicle operator. Based on historical data corresponding to previous purchases made by the vehicle operator or any of its occupants, graphical communications associated with goods or services can be provided when the vehicle is present within the dispensing environment.

[0056] The graphical communication can be determined for a particular operator of the vehicle based on fourth data characterizing a likelihood the operator of the vehicle will provide an input selecting at least one graphical element of those included in the graphical communication. The predictive algorithm can determine the graphical communication by determining a promotion probability score for a product or a service based on the first data, the second data, and/or additional data inputs including but not limited to the purchase history of the vehicle operator, the buying profile of the vehicle operator, the vehicle buying profile, weather data corresponding to the location at which the dispensing environment is located, and/or utilization or availability data associated with one or more services or facilities included in the dispensing environment, such as car wash availability data or car wash utilization data. The promotion probability score can correspond to a likelihood or probability that the vehicle operator will engage with a graphical communication and provide an input to engage with, select, or otherwise accept the contents of the graphical communication. Thus, the promotion probability score can reflect the likelihood that the vehicle operator will participate in the promotion and conduct a transaction for a product or service identified in the graphical communication.

[0057] In some embodiments, a single probability purchase score can be determined for a product or service. In other embodiments, multiple probability purchase scores can be determined for a product or service. For example, a range of promotion probability scores can be determined, such

as a high, medium, or low promotion probability score. Based on the determined promotion probability score, a promotion value can be determined by the predictive algorithm. The promotion value can be included in the graphical communication. For example, based on determining a low promotion probability score, the predictive algorithm can determine that a high promotion value should be provided. In this example, based on the first and second data, the predictive algorithm determined that there was a low probability the vehicle operator would engage with a graphical communication to participate in a promotional offer for a product or service. The predictive algorithm can then further determine that a high promotion value should be provided, such as offering the product or service at no-cost, for free, or as complimentary in order to influence the vehicle operator to participate in the promotion and engage with the graphical communication to purchase the product or service offered in the graphical communication. Lower promotion values can be associated with higher promotion probability scores and medium promotion values can be associated with medium promotion probability scores. Although, the aforementioned is described in broad categories, such as high, medium, and low, a variety of associative relationships between the promotion probability scores and promotion values can be envisioned without limit.

[0058] Based on determining the promotion value, a new or adapted graphical communication including the promotion and associated promotion value can be determined. The graphical communication can be associated with a promotion, advertisement, marketing offer, or the like for goods or services available within the dispensing environment. The graphical communication can identify the promotion being offered and can include graphical elements corresponding to a price, a location, a timing, a service, and/or a product or item associated with the promotion. The graphical elements can also include user-input selections configured to indicate the user has accepted or declined a promotion identified in the graphical communication. The graphical communication and/or the graphical elements can include textual data, graphical data, and/or computer-executable content, which when executed can cause a computing system to take further action. For example, upon receiving an input to a graphical element accepting a free car wash promotion, the graphical element can be configured to execute programmatic functionality to cause a voucher for the free car wash to be printed at a dispenser or a point-of-sale device within the dispensing environment, or transmitted to a computing device of the vehicle operator.

[0059] At **150**, the graphical communication can be provided on a display screen within the dispensing environment for viewing by the operator. For example, graphical communications can be displayed to the vehicle operator at a dispenser, a point-of-sale device or terminal, or a computing device viewable by the vehicle operator. In some embodiments, providing the graphical communication can include storing the graphical communication in a database. In some embodiments, the graphical communication can be provided on a display screen outside of the dispensing environment, such as on a computing device associated with the vehicle operator and/or a computing device configured with a loyalty program application associated with the dispensing environment.

[0060] FIG. **2** illustrates one exemplary embodiment of a data processing architecture **200** of the predictive algorithm described herein. As shown, identifier data (e.g., second data associated with the vehicle operator), vehicle data (e.g., first data associated with the vehicle driven by the vehicle operator), and additional input data (e.g., car wash data in this example), can be received and used to determine a promotion probability score. For example, the identifier data can include image data, digital fingerprint data, loyalty account number or ID data, credit card data, or license plate data which can identify the operator of the vehicle (or the vehicle). Having determined an identity of the vehicle operator, additional second data can be determined such as a buying history of the identified vehicle operator or a consumer profile buying history of vehicle operators who are determined to be similar to the vehicle operator. Buying or purchasing histories can include historical data associated with purchases made by a vehicle operator or a vehicle occupant based on identifying the vehicle operator or the vehicle. Purchase data can be associated with a vehicle

operator or vehicle based on identifying the vehicle operator or the vehicle using one or more sensors present within the dispensing environment. For example, one or more sensors configured in the dispensing environment can be configured to track the vehicle operator or occupants of the vehicle from a location in the forecourt of the dispensing environment to a point-of-sale device located in a facility adjacent to the forecourt, such as a convenience store.

[0061] Vehicle data can include a make, model, age, or condition of the vehicle, although a variety of other vehicle attributes can be included as the first data. Based on the vehicle data (e.g., the first data), a vehicle type buying probability and a vehicle condition buying probability can be determined. A vehicle type buying probability can be a probability that an operator of a vehicle being the same type as the vehicle determined via the first data will accept a promotion and provide an input as such to a graphical communication identifying the promotion. A vehicle condition buying probability can be a probability that an operator of a vehicle having the same condition as the vehicle condition determined via the first data will accept a promotion and provide an input as such to a graphical communication identifying the promotion, such as vehicles determined to have a condition that is clean or dirty.

[0062] Additional input data can include data that is specific to utilization or availability of a product or service. For example, as shown in FIG. **2**, car wash data can include a car wash availability (e.g., open, closed, waiting time, length of queue, or the like) and a car wash utilization (e.g., frequently used, moderately used, never used, or the like). Based on the utilization or availability data, a graphical communication associated with a promotion of goods or services of the dispensing environment can be generated. For example, if a car wash is busy, a graphical communication can be generated which can offer an incentive for the vehicle operator to wait to use the car wash. In another example, a graphical communication can be generated and can provide a promotion to increase a utilization of the car wash, perhaps if the car wash it not being utilized or is under-utilized for a particular period of time.

[0063] Based on the identifier data (e.g., the first data), the vehicle data (e.g., the second data), and additional input data a promotion probability score can be determined as shown in FIG. **2**. In some embodiments, the promotion probability score can be determined based on the buying history of the identified vehicle operator and/or the consumer profile buying history of vehicle operators who are determined to be similar to the vehicle operator. In some embodiments, the promotion probability score can be determined based on the vehicle type buying probability and/or the vehicle condition buying probability. In some embodiments, the promotion probability score can be determined based on indicator data associated with the additional input data corresponding to availability or utilization of a product, service, or facility associated with the dispensing environment. The indicator data can include data about the product for which the promotion probability score is being determined, such as whether or not the product has been purchased before, if the product has or is a complimentary product, availability of a product or service, as well as a particular need associated with the product.

[0064] A range of promotion probability scores can be determined, and for each promotion probability score, a corresponding promotion value can be determined. The promotion value can be incorporated into a graphical communication that has been adapted based on the first data, second data, and additional input data. The graphical communication can include one or more graphical elements providing additional content associated with the promotion. Additionally, a promotion profile success history can be determined for graphical communications determined according to the systems and methods described and stored, for example, in a database.

[0065] The promotion profile success history can include a record, for each graphical communication (e.g., associated with a particular promotion), identifying whether or not the vehicle operator accepted the promotion (e.g., provided an input selecting at least one graphical element in the graphical communication) or declined the promotion (e.g., did not provide an input selecting at least one graphical element in the graphical communication). Graphical

communications that are associated with particular promotions can be evaluated to determine which are more successful and least successful in view of particular input data. For example, graphical communications promoting wine sales may be more successful for vehicle types that are luxury automobiles, while graphical communications promoting beer sales may be less successful for luxury automobiles but more successful for vehicle types that are trucks. In another example, a graphical communication associated with a carwash having immediate availability may be less successful for a vehicle operator who frequently purchases a carwash, the vehicle type is a luxury automobile, and the car is dirty. In this way, the systems and methods herein can determine how different combinations of input data can determine a promotion profile success history.

[0066] FIG. **3** is a dataflow diagram corresponding to the method **100** described in relation to FIG. **1** using the exemplary data processing architecture **200** of FIG. **2**. The dataflow of FIG. **3** can be performed by the system **300**, which can include a user device **302**, a point-of-sale (POS) device **304**, one or more sensors **306**, a graphical communication (GC) generator **308**, and a database **310**. The system **300** can be configured to adaptively determine, generate, and provide graphical communications associated with promotions offered within a dispensing environment.

[0067] First data **312** characterizing a vehicle present within a dispensing environment can be provided to and/or received at the GC generator **308** from the user device **302**, the POS device **304**, one or more sensors **306** and/or the database **310**. Additionally, second data **314** characterizing an operator of the vehicle can be provided to and/or received from user device **302**, the POS device **304**, one or more sensors **306** and/or the database **310**. Additionally, or alternatively, the GC generator **308** can receive additional input data **316** from the POS device **304**, sensors **306**, and/or the database **310**. The GC generator can determine one or more vehicle attributes **318** based on the first data **312** and an identity **320** of the vehicle operator based on the second data **314**. In some embodiments, the one or more vehicle attributes **318** and the identity **320** of the vehicle operator can be provided to and/or received from the database **310**.

[0068] Responsive to determining the one or more vehicle attributes **318** and the identity **320** of the vehicle operator, the GC generator **308** can determine third data **322** including a graphical communication including graphical elements providing textual, graphical, and/or computer-executable content related to a promotion associated with the dispensing environment. In some embodiments, the third data **322** can be provided to and/or received from the database **310**. The GC generator **308** can determine fourth data **324** characterizing a likelihood the operator will provide an input selecting at least one graphical element in the graphical communication. In some embodiments, the additional input data **316** can be further used to determine the fourth data **324**. Based on the fourth data **324**, the GC generator **308** can determine the third data **322**. In some embodiments, the fourth data **324** can be provided to and/or received from the database **310**. The determined third data **322** can be provided to the POS device **304** and/or the user device **302** for viewing by the operator of the vehicle. The GC generator **308** can iteratively **326** perform one or more aspects of the dataflow based on new or updated first data **312** and/or second data **314** received from any of the user device **302**, the POS device **304**, sensors **306**, and/or the database **310**.

[0069] Referring now to FIG. **4**, illustrated is a diagram of an implementation of a machine learning model that can be provided as a predictive algorithm as described herein. The predictive algorithm can be implemented in the graphical communication generator **308** of the system **300** as described in relation to FIG. **3**. More specifically, illustrated is a diagram of one implementation of a convolutional neural network (CNN) **400** that can be configured to determine, generate, and output graphical communications as described herein. For purposes of illustration, the following description of CNN **400** will be with respect to an implementation of CNN **400** by the GC generator **308** described in relation to the system **300** of FIG. **3**. However, it will be understood that in some examples CNN **400** (e.g., one or more components of CNN **400**) can be implemented by other systems different from, or in addition to, the GC generator **308** such as a loyalty program

application, a dispensing environment promotion planning system, or a local dispensing environment management system. While CNN **400** includes certain features as described herein, these features are provided for the purpose of illustration and are not intended to limit the present disclosure.

[0070] CNN **400** includes a plurality of convolution layers including first convolution layer **402**, second convolution layer **406**, and convolution layer **408**. In some embodiments, CNN **400** includes sub-sampling layer **404** (sometimes referred to as a pooling layer). In some embodiments, sub-sampling layer **404** and/or other subsampling layers have a dimension (i.e., an amount of nodes) that is less than a dimension of an upstream system. By virtue of sub-sampling layer **404** having a dimension that is less than a dimension of an upstream layer, CNN **400** consolidates the amount of data associated with the initial input and/or the output of an upstream layer to thereby decrease the amount of computations necessary for CNN **400** to perform downstream convolution operations. Additionally, or alternatively, by virtue of sub-sampling layer **404** being associated with (e.g., configured to perform) at least one subsampling function, CNN **400** consolidates the amount of data associated with the initial input.

[0071] The GC generator **308** performs convolution operations based on system **300** providing respective inputs and/or outputs associated with each of first convolution layer **402**, second convolution layer **406**, and convolution layer **408** to generate respective outputs. In some examples, the GC generator **308** implements CNN **400** based on the GC generator **308** providing data as inputs to first convolution layer **402**, second convolution layer **406**, and convolution layer **408**. In such an example, the GC generator **308** provides the data as inputs to first convolution layer **402**, second convolution layer **406**, and convolution layer **408** based on the GC generator **308** receiving the first data **312**, second data **314**, and/or additional input data **316** from the user device **302**, the POS device **304**, the sensors **306**, and/or the database **310**.

[0072] In some embodiments, the GC generator **308** provides data associated with an input (referred to as an initial input) to first convolution layer **402** and the GC generator **308** generates data associated with an output using first convolution layer **402**. In some embodiments, the GC generator **308** provides an output generated by a convolution layer as input to a different convolution layer. For example, the GC generator **308** provides the output of first convolution layer **402** as input to sub-sampling layer **404**, second convolution layer **406**, and/or convolution layer **408**. In such an example, first convolution layer **402** is referred to as an upstream layer and sub-sampling layer **404**, second convolution layer **406**, and/or convolution layer **408** are referred to as downstream layers. Similarly, in some embodiments the GC generator **308** provides the output of sub-sampling layer **404** to second convolution layer **406** and/or convolution layer **408** and, in this example, sub-sampling layer **404** would be referred to as an upstream layer and second convolution layer **406** and/or convolution layer **408** would be referred to as downstream layers.

[0073] In some embodiments, the GC generator **308** processes the data associated with the input provided to CNN **400** before the GC generator **308** provides the input to CNN **400**. For example, the GC generator **308** processes the data associated with the input provided to CNN **400** based on the GC generator **308** normalizing sensor data (e.g., image data from sensors **306**, and/or the like).

[0074] In some embodiments, CNN **400** generates an output based on the GC generator **308** performing convolution operations associated with each convolution layer. In some examples, CNN **400** generates an output based on the GC generator **308** performing convolution operations associated with each convolution layer and an initial input. In some embodiments, the GC generator **308** generates the output and provides the output as fully connected layer **410**. In some examples, the GC generator **308** provides the output of convolution layer **408** as fully connected layer **410**, where fully connected layer **410** includes data associated with a plurality of feature values referred to as F1, F2. . . FN. In this example, the output of convolution layer **408** includes data associated with a plurality of output feature values that represent a prediction.

[0075] In some embodiments, the GC generator **308** identifies a prediction from among a plurality

of predictions based on the GC generator **308** identifying a feature value that is associated with the highest likelihood of being the correct prediction from among the plurality of predictions. For example, where fully connected layer **410** includes feature values F1, F2, . . . FN, and F1 is the greatest feature value, the GC generator **308** identifies the prediction associated with F1 as being the correct prediction from among the plurality of predictions. In some embodiments, the GC generator **308** trains CNN **400** to generate the prediction. In some examples, the GC generator **308** trains CNN **400** to generate the prediction based on the GC generator **308** providing training data associated with the prediction to CNN **400**.

[0076] Although, the predictive algorithm of the GC generator **308** is described in relation to a CNN, a variety of machine learning algorithms may selected for use including algorithms such as support vector regression, ordinary least squares regression (OLSR), linear regression, logistic regression, stepwise regression, multivariate adaptive regression splines (MARS), locally estimated scatterplot smoothing (LOESS), ordinal regression, Poisson regression, fast forest quantile regression, Bayesian linear regression, neural network regression, decision forest regression, boosted decision tree regression, artificial neural networks (ANN), Bayesian statistics, case-based reasoning, Gaussian process regression, inductive logic programming, learning automata, learning vector quantization, informal fuzzy networks, conditional random fields, genetic algorithms (GA), Information Theory, support vector machine (SVM), Averaged One-Dependence Estimators (AODE), Group method of data handling (GMDH), instance-based learning, lazy learning, and Maximum Information Spanning Trees (MIST).

[0077] FIG. **5** is a system diagram illustrating an example system **500** that incorporates some implementations of the current subject matter and that can provide for the same for adaptively determining and providing graphical communications within a dispensing environment. For example, the system **500** can correspond to the system **300** described in relation to FIGS. **3** and **4**. As shown in FIG. **5**, some components of the system **500** can be configured in a dispensing environment **502**, such as a retail location at which fuel is sold along with other products and services. Within the dispensing environment **502**, one or more computing devices **504** and a forecourt **506** can be provided. The computing devices **504** can be associated with a retail operation, such as a convenience store at which food products and automotive services can be sold. For example, the computing device **504** can correspond to the POS device **304** described in relation to FIG. **3**. In some embodiments, the computing device **504** may not be a POS device but can be a computing device arranged within the dispensing environment at which data associated with a vehicle or operator of the vehicle can be acquired.

[0078] In some embodiments, the computing device **504** can be a POS device associated with a carwash **508** configured within the dispensing environment **502**. The car wash **508** can include one or more sensors **510** that can exchange data with the computing device **504**. For example, the sensors **510** can convey car wash availability data and/or car wash utilization data to the computing device **504**. For example, the sensors **510** can include image sensors, flow rate sensors, or the like associated with operation and utilization of the car wash **508**. In some embodiments, the sensors **510** can generate image data used to determine one or more vehicle attributes and/or image data identifying an operator of a vehicle.

[0079] The computing device **504** can include a memory **512** storing computer-executable instructions, which when executed by a processor **514**, cause the processor to execute one or more applications associated with operation and control of the car wash, as well as car wash transactions. The computing device **504** can also include a display **516** configured to provide graphical communications as described herein. The computing device **504** can also include one or more input devices **518** such as a microphone, optical scanner, keypad, or the like at which a vehicle operator can provide inputs or data associated with the vehicle or their identity. In some embodiments, inputs can be provided by a user in regard to a graphical communication via the display **516** and/or the input devices **518**.

[0080] The dispensing environment **502** can also include a forecourt **506**. The forecourt **506** can include an area of the dispensing environment in which fuel bays are located for dispensing fuel via one or more dispensers **520**. In some embodiments, the dispensing environment **502** can include dispensers configured to dispense other types of "fuel" besides petroleum fuel. For example, the dispensers **520** can be configured to dispense electricity, gas (e.g., hydrogen, liquid propane gas (LPG) or compressed natural gas (CNG), water, or the like. It will be understood that the dispensing environment **502** and the dispensers **520** described herein are not limited to petroleum gasoline in liquid format and that other types of dispensers configured to dispense alternate types of "fuel" can be envisioned.

[0081] The dispenser **520** can include a computing device **522**. The computing device **522** can include at least one data processor **524** configured to perform one or more aspects of the functionality described herein, and memory **526** for storing computer-executable instructions for performing one or more aspects of the functionality described herein. The computing device **520** can also include an display **528** that is configured to present graphical communications to the dispenser user. The computing device **520** can also include one or more input devices **530** such as a microphone, optical scanner, keypad, or the like at which a vehicle operator can provide inputs and/or data associated with dispensing fuel. In some embodiments, inputs can be provided by a user via the display **528** and/or the input devices **530**.

[0082] In some implementations, as shown in FIG. **5**, the system **500** can include a computing device **532** associated with, corresponding to, or in possession of a vehicle operator. As shown, the computing device **532** can be located within the forecourt **506**, such as when the vehicle operator is dispensing fuel via the dispenser **520**. In other embodiments, the computing device **532** may not be located within the forecourt **506** or the dispensing environment **502**. The computing device **532** can include at least one data processor **534** configured to perform one or more aspects of the functionality described herein, and a memory **536** for storing instructions for performing one or more aspects of the functionality described herein. The computing device **532** can also include a screen or display **538** that is configured to present graphical communications and other data related to the dispensing environment **502**. The computing device **532** can also include one or more input devices **540** such as a microphone, optical scanner, camera, keypad, or the like at which a vehicle operator can provide inputs and/or data associated with operation of the computing device **532**. In some embodiments, inputs can be provided by the user via the display **538** and/or the input devices **540**. In some embodiments, the memory **536** may store a loyalty program application associated with the operator of the vehicle. The loyalty program application can include first data characterizing the vehicle and/or second data characterizing the identity of the vehicle operator.

[0083] The computing devices **504**, **522**, and **532** can be communicatively coupled to one another and to a server **546** via a network **544**. The network **544** can include, for example, any one or more of a personal area network (PAN), a local area network (LAN), a campus area network (CAN), a metropolitan area network (MAN), a wide area network (WAN), a broadband network (BBN), a virtual private network (VPN), the Internet, or the like. Further, the network **544** can include, but is not limited to, any one or more of the following network topologies, including a bus network, a star network, a ring network, a mesh network, a star-bus network, tree or hierarchical network, or the like.

[0084] In some embodiments, the dispenser **520** can be communicatively coupled to the network **544** via a forecourt controller **542**. The forecourt controller **542** can be configured to control operations of the dispenser **520**. In some embodiments, the dispenser **520** can be communicatively coupled to the network **544** without a forecourt controller **542**.

[0085] As further shown in FIG. **5**, the system **500** can include a server **546** that is configured to perform operations that adaptively determine, generate, and provide graphical communications associated with the dispensing environment **502**. In some embodiments, the server **546** (and/or the network **544**) can be configured within the dispensing environment **502**. The server **546** can

include at least one data processor **548** configured to perform one or more aspects of the functionality described herein, and a memory **550** for storing computer-executable instructions for performing one or more aspects of the functionality described herein. In some embodiments, the server **546** can include a database **552** (e.g., corresponding to database **310** of FIG. **3**), which can store data associated with the functionality described herein. For example, the database **552** can store first data **312**, second data **314**, additional input data **316**, as well as loyalty program data.

[0086] As explained in further detail below, the server **546** can include one or more modules **554** or programs of computer-executable instructions performing one or more aspects of the subject matter described herein using the at least one data processor. For example, in some implementations, the modules **554** can include one or more components of a machine learning architecture, such as the CNN **400** described in relation to FIG. **4** and the dataflow of FIG. **3**. The modules **554** can include one or more training algorithms that can be trained and deployed as predictive algorithms configured to adaptively determine, generate and provide graphical communications associated with promotions of the dispensing environment **502**. The modules **554** can include feature selectors configured to train a prediction algorithm using subsets of features associated with the first data, second data, and/or the loyalty program data.

[0087] The system and methods described herein can be implemented using an architecture that can be deployed in a variety of configurations. In one embodiment, aspects of the system can be deployed on premise within a dispensing environment, or the system could be deployed remotely from the dispensing environment. In some aspects, portions of the system can be deployed on premise and other portions can be deployed remotely. Latency benefits can be gained by deploying the system on premise but these configurations can also be more costly and can require specialized computing resources, such as accelerated hardware or processors. It can be advantageous to locate computing equipment configured with the predictive models or algorithms described herein on-premise, or remotely via a web-services or containerized or virtualized architecture depending on network availability and robustness.

[0088] FIGS. **6**A and **6**B illustrate one embodiment of a dispenser **600** that can be used in some implementations of the current subject matter, and FIG. **7** illustrates components of the dispenser **600**. The dispenser **600** can correspond to dispenser **520** described earlier. The fuel dispenser **600** can be configured to dispense liquid petroleum fuel and/or electricity. In general, the dispenser **600** includes a dispenser body **601** having an electronics compartment **602**, a pump compartment **604**, and an image sensor **622**. The pump compartment **604** houses a pump configured to pump fuel from a fuel tank or other reservoir, as well as one or more meters that can be configured to monitor fuel flow, flow of fuel additives, and/or flow of other components of the fuel. The pump compartment **604** can also include other components to facilitate fuel dispensing and mixing, such as motors and valves, a strainer/filtering system, a vapor recovery system, and the like. The pump compartment **604** is isolated from the electronics compartment **602** within the dispenser **600** to facilitate safety, security, and/or maintenance, as will be appreciated by a person skilled in the art. Fuel is thus not allowed to flow from the pump compartment **604** to the electronics compartment **602** and instead flows from the pump compartment **604** through hose **606** to a nozzle **608** for dispensing. As will be appreciated by a person skilled in the art, the nozzles **608** are each configured to dispense fuel from the dispenser **600** as pumped therefrom by the pump. The dispenser **600** also includes a nozzle receptacle **609** configured to store the nozzle **608** when not in use.

[0089] In some implementations, the dispenser **600** can include one or more components configured to send and/or receive data. For example, dispenser **600** can include a wireless transceiver **624** positioned on the electronics compartment **602** or elsewhere on the dispenser **600**, such as on the dispenser body **601**. The wireless transceiver **624** can be communicably coupled to the wireless communications module **618**. In some embodiments, the wireless transceiver **624** can be a Bluetooth wireless transceiver configured to exchange data with a computing device via short-

range radio signals. In some embodiments, one or more sensors **626** can be coupled to the dispenser **600**. For example, one or more sensors **626** can include image sensors configured to acquire image data associated with the vehicle or the operator of the vehicle at the dispenser **600**.

[0090] In some implementations, the dispenser **600** can be configured to dispense electricity and can include several components for dispensing the electricity. For example, dispenser **600** can be configured as an electric vehicle charger. In such embodiments, the dispenser **600** can include a charging cable **628** coupled to the dispenser body **601** at one end and configured to deliver electricity to a charging connector **630** coupled to an opposite end. The charging connector **630** can be configured to couple to a charging port of a vehicle (not shown) and to deliver the electricity provided by the dispenser **600**, via the charging cable **628**, to the vehicle when coupled to the charging port. When not in use, the charging connector **630** can be stored in a charger receptacle **632** formed on the dispenser body **601**.

[0091] Although the dispenser **600** is described in relation to dispensing petroleum-based fuels, some or all of the functionality discussed herein may be used to adaptively determine and provide graphical communications for presentation on an alternative dispenser. For example, in some embodiments, the dispenser **600** can include a hydrogen dispenser, a liquefied petroleum gas (LPG) dispenser, a compressed natural gas (CNG) dispenser, or the like.

[0092] The electronics compartment **602** houses electronics for facilitating payment for fuel, controlling operation of the dispenser to facilitate dispensing of fuel, and for providing graphical communications and receiving inputs from a vehicle operator selecting graphical elements included in the graphical communication. For example, the electronics compartment **602** can include a fuel controller **619** that, at least in some implementations, includes a data processor, memory, and storage forming part of at least one computing system. The fuel controller **619** is configured to control dispensing of the fuel from the pump compartment **604**. The electronics compartment **602** also includes a payment terminal **605** that is configured to provide a user with one or more options to create a desired fuel mixture, receive instructions characterizing the desired fuel mixture, receive payment information and/or user identification information from a user, transmit and receive the payment information and/or the user identification information with a POS system, and deliver fueling instructions to the fuel controller **619** to dispense fuel. The payment terminal **605** can also be configured to provide a user with information related to a status of fueling. For example, the payment terminal can display an amount of fuel that has been dispensed, and a corresponding fuel cost as the fuel mixture is dispensed.

[0093] The payment terminal **605** can be configured to facilitate communication between a user and the fuel controller **619**, and can include an interactive display **620** and an information module **610**. The information module **610** can, at least in some implementations include a data processor, memory, and storage, forming part of at least one computing system. The payment terminal **605** can also include one or more wired communication modules **616** and/or wireless communication modules **618** and a control module **612** that, at least in some implementations includes a data processor, memory, and storage, forming part of at least one computing system. The communication modules **616**, **618** can function to allow data to be transmitted to and from various components within the payment terminal **605** via wired and/or wireless communication, respectively. For example, the communication modules **616**, **618** can be configured to transmit and receive signals that can characterize, e.g., payment information, vehicle operator identification information, vehicle attribute data, loyalty program data, and/or information regarding a desired fuel selection, via wired and/or wireless communications, respectively. The wireless communication module **618** can include, e.g., a transceiver for communicating via Bluetooth protocol (e.g., wireless transceiver **624**), cellular protocol, WI-FI protocol, near field communication (NFC), and/or a radio frequency identification (RFID) protocol. Wired and/or wireless communication via the communication modules **616**, **618** can be according to any of a variety of communication protocols, e.g., TCP/IP, etc., as will be appreciated by a person skilled in

the art. The communication modules **616**, **618** are also in operable communication with the image sensors **622**, **626** and are configured to receive image data acquired by the image sensors **622**, **626**. The communication modules **616**, **618** can additionally transmit the received image data for further external processing as described elsewhere herein.

[0094] The interactive display **620**, which can be, or can include, a touchscreen. The interactive display **620** can be operably coupled to the control module **612** which can be used to control, dynamically rearrange, and/or update a graphical communication or a graphical user interface (GUI) rendered on the display **620**. The display **620** can be configured to show information (e.g., media content, fuel selection options, payment information, user or vehicle identification information, loyalty program data, or the like) in the form of one or more graphical elements, or graphical objects, receive input (e.g., instructions for a desired fuel mixture, user identification information, payment information, acceptance/denial of a promotion identified via the graphical communication etc.) thereon, and can deliver data characterizing the input to the control module **612** to be processed. Some examples of information that the display **620** can receive from the user are: total cost, desired fuel volume, desired fuel mixture, desired additives, an initiate fueling command, and a terminate fueling command. In some implementations, the user can provide user information, such as user preferences, contact information, etc., and/or information regarding a vehicle that will consume the fuel, such as vehicle make, model, mileage, and the like. The user can also be provided with a recommend fuel blend which they can choose to select. The control module **612** can be further configured to receive from and/or control the one or more sensors **622**, **626**.

[0095] To facilitate payment, the information module **610** can be configured to receive input such as, e.g., user identification information and/or payment information, and deliver the information to the control module **612**. For example, the information module **610** can include a barcode and/or QR code scanner, and/or a NFC contactless card reader for receiving payment information, user identification information, vehicle information, and/or loyalty program information.

[0096] In some embodiments, the information module **610** be operably coupled to the image sensors **622**, **626** for acquiring images of facial features of the user, barcode and/or QR code information (e.g., to scan a loyalty rewards card), vehicle features (e.g., vehicle make, model, color, etc.), license plate number, non-facial body features, and the like, which can be used as user identification information. As another example, the information module **610** can include a palm reader and or/fingerprint reader which can scan a palm and/or finger of the user to obtain user identification information. In some embodiments, the user identification information can be associated with a loyalty rewards identifier automatically. Accordingly, in some embodiments, a pre-determined payment method, and user preferences, can be determined based on user identification information.

[0097] As shown in FIG. **7**, the information module **610** can be operably coupled to the wired communication module **616** and/or the wireless communication module **618**. The wired and wireless communication modules **616**, **618** can allow the information module **610** to send and receive payment information and/or user identification information to and from a mobile device such as a smart phone, tablet, laptop, and the like, that is in electronic communication with the information module **610** via the wired and/or wireless communication modules **616, 618**. Although the wireless communication module **618** is shown to be located within the payment terminal, the wireless communication module **618** can be located elsewhere on, within, or in the vicinity of, the dispenser **600**. For example, the wireless communication module **618** can be mounted on top of the dispenser, which can facilitate retrofitting the wireless communication module **618** to existing dispensers and/or facilitate repair, upgrade, or other maintenance of the communication module **618**, as described in U.S. Pat. No. 10,577,237 filed on Jun. 14, 2016 and entitled "Methods and Devices for Fuel Dispenser Electronic Communication," which is incorporated by reference herein.

[0098] FIG. **8** is a schematic view illustrating components of an example system **800** for the optimized utilization and promotion of car wash services. As shown, the system **800** can include at

least one car wash unit **802** that is in operable configuration with the server **546** via the network **544**. The server **546** can be configured to determine and provide graphical communications associated with offers and/or discounts on car wash services to be performed by the at least one car wash unit **802**. The system **800** can also include an end user interface **806** that is in operable communication with the server **546** and configured to receive the offers and/or discounts and to automatically determine, from the offers and/or discounts, which of the offers and/or discounts is most suitable based on the vehicle and/or the operator of the vehicle.

[0099] The end user interface **806** can also include an input configured to permit the user to select a preferred offer within the graphical communication for transmission to the server **546**. The preferred offer can be transmitted to the at least one car wash unit **802**, which can perform at least one car wash service

[0100] FIG. **9** is a schematic view illustrating components of an example system **900** for the optimized utilization and promotion of car wash services. System **900** includes at least one car wash unit **902**, a server **546**, and end user interface **538** of device **532**, and an image/video sensor **510** capable of acquiring image or video data of the environs of the at least one car wash unit **902**. In some implementations, the image/video sensor **510** can acquire image or video data of the at least one car wash unit **902** and the area surrounding the at least one car wash unit **902**. The acquired image or video data can be processed by the server **546**, using image processing algorithms known in the art, for example, to determine the presence of a vehicle in the at least one car wash unit **902** and to transmit a signal indicating the presence of the vehicle in the at least one car wash unit **902** to the server **546**. Such processing can occur on a continuous basis or a discrete basis as needed. In some implementations, the processing can be performed by the at least one car wash unit **902** instead of, or in addition to, the server **546**.

[0101] Furthermore, upon processing the image or video data of the at least one car wash unit **302**, the car wash network **304** can analyze the processed data to determine various information items including, for example, the number of vehicles in line for the at least one car wash unit **302**, the approximate time each vehicle spends in a car wash bay, and so on. The car wash network **304** can utilize this information to calculate an estimated idle time, i.e., an estimated time a hypothetical vehicle would wait in line for a car wash, in conjunction with other factors in some cases (e.g., current and historical individual car wash bay usage data), as described in detail hereinabove. The car wash network **304** can provide the estimated idle time to the end user interface **306** to inform the user of the same. Furthermore, the car wash network **304** can control or modify the offers and/or discounts to the end user interface **306** based on the estimated idle time. For example, the car wash network **304** can issue greater discounts at times when the idle time is low (e.g., below a predefined threshold) to encourage users to visit while the car wash is not busy, thereby optimizing the utilization of the car wash.

[0102] FIG. **10** is a block diagram **1000** of a computing system **1010** suitable for use in implementing the computerized components described herein, such as a computing device **522** configured within the dispenser **520** or server **546** as shown in FIG. **5**. In broad overview, the computing system **1010** includes at least one processor **1050** for performing actions in accordance with instructions, and one or more memory devices **1060** and/or **1070** for storing instructions and data. The illustrated example computing system **1010** includes one or more processors **1050** in communication, via a bus **1015**, with memory **1070** and with at least one network interface controller **1020** with a network interface **1025** for connecting to external devices **1030**, e.g., a computing device (such as a computing device **522**, or server **546**). The one or more processors **1050** are also in communication, via the bus **1015**, with each other and with any I/O devices at one or more I/O interfaces **1040**, and any other devices **1080**. The processor **1050** illustrated incorporates, or is directly connected to, cache memory **1060**. Generally, a processor will execute instructions received from memory. In some embodiments, the computing system **1010** can be configured within a cloud computing environment, a virtual or containerized computing

environment, and/or a web-based microservices environment.

[0103] In more detail, the processor **1050** can be any logic circuitry that processes instructions, e.g., instructions fetched from the memory **1070** or cache **1060**. In many embodiments, the processor **1050** is an embedded processor, a microprocessor unit or special purpose processor. The computing system **1010** can be based on any processor, e.g., suitable digital signal processor (DSP), or set of processors, capable of operating as described herein. In some embodiments, the processor **1050** can be a single core or multi-core processor. In some embodiments, the processor **1050** can be composed of multiple processors.

[0104] The memory **570** can be any device suitable for storing computer readable data. The memory **1070** can be a device with fixed storage or a device for reading removable storage media. Examples include all forms of non-volatile memory, media and memory devices, semiconductor memory devices (e.g., EPROM, EEPROM, SDRAM, flash memory devices, and all types of solid state memory), magnetic disks, and magneto optical disks. A computing device **1010** can have any number of memory devices **1070**.

[0105] The cache memory **1060** is generally a form of high-speed computer memory placed in close proximity to the processor **1050** for fast read/write times. In some implementations, the cache memory **1060** is part of, or on the same chip as, the processor **1050**.

[0106] The network interface controller **1020** manages data exchanges via the network interface **1025**. The network interface controller **1020** handles the physical, media access control, and data link layers of the Open Systems Interconnect (OSI) model for network communication. In some implementations, some of the network interface controller's tasks are handled by the processor **1050**. In some implementations, the network interface controller **1020** is part of the processor **1050**. In some implementations, a computing device **1010** has multiple network interface controllers **1020**. In some implementations, the network interface **1025** is a connection point for a physical network link, e.g., an RJ 45 connector. In some implementations, the network interface controller **1020** supports wireless network connections and an interface port **1025** is a wireless Bluetooth transceiver. Generally, a computing device **1010** exchanges data with other network devices **1030**, such as computing device **1030**, via physical or wireless links to a network interface **1025**. In some implementations, the network interface controller **1020** implements a network protocol such as LTE, TCP/IP Ethernet, IEEE 802.11, IEEE 802.16, Bluetooth, or the like.

[0107] The other computing devices **1030** are connected to the computing device **1010** via a network interface port **1025**. The other computing device **1030** can be a peer computing device, a network device, a server, or any other computing device with network functionality. For example, a computing device **1030** can be a computing device **532** associated with a user of the dispenser **520**, a server **546**, or a network device **542** as illustrated in FIG. **5**. In some embodiments, the computing device **1030** can be a network device such as a hub, a bridge, a switch, or a router, connecting the computing device **1010** to a data network such as the Internet.

[0108] In some uses, the I/O interface **1040** supports an input device and/or an output device (not shown). In some uses, the input device and the output device are integrated into the same hardware, e.g., as in a touch screen. In some uses, such as in a server context, there is no I/O interface **1040** or the I/O interface **1040** is not used. In some uses, additional other components **1080** are in communication with the computer system **1010**, e.g., external devices connected via a universal serial bus (USB).

[0109] The other devices **1080** can include an I/O interface **1040**, external serial device ports, and any additional co-processors. For example, a computing system **1010** can include an interface (e.g., a universal serial bus (USB) interface, or the like) for connecting input devices (e.g., a keyboard, microphone, mouse, or other pointing device), output devices (e.g., video display, speaker, refreshable Braille terminal, or printer), or additional memory devices (e.g., portable flash drive or external media drive). In some implementations an I/O device is incorporated into the computing system **1010**, e.g., a touch screen on a tablet device. In some implementations, a computing device

1010 includes an additional device **1080** such as a co-processor, e.g., a math co-processor that can assist the processor **1050** with high precision or complex calculations.

[0110] Exemplary technical effects of the methods, systems, apparatuses, and non-transitory machine readable storage mediums described herein include, by way of non-limiting example, adaptively determining, generating, and providing graphical communications within a dispensing environment. This system and method can enable more effective generation and provision of graphical communications of promotional offers or advertisements associated with a dispensing environment that are customized for a vehicle operator and the operators vehicle. As a result, increased sales and revenue can be achieved while optimizing the utilization of services and product offering, such as car washes. Customer loyalty and brand recognition can be enhanced by providing curated graphical communications and vehicle operators can experience increased satisfaction about purchases and/or utilization of the dispensing environment.

[0111] Certain exemplary embodiments have been described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the systems, devices, and methods disclosed herein. One or more examples of these embodiments have been illustrated in the accompanying drawings. Those skilled in the art will understand that the systems, devices, and methods specifically described herein and illustrated in the accompanying drawings are non-limiting exemplary embodiments and that the scope of the present invention is defined solely by the claims. The features illustrated or described in connection with one exemplary embodiment may be combined with the features of other embodiments. Such modifications and variations are intended to be included within the scope of the present invention. Further, in the present disclosure, like-named components of the embodiments generally have similar features, and thus within a particular embodiment each feature of each like-named component is not necessarily fully elaborated upon.

[0112] The subject matter described herein can be implemented in analog electronic circuitry, digital electronic circuitry, and/or in computer software, firmware, or hardware, including the structural means disclosed in this specification and structural equivalents thereof, or in combinations of them. The subject matter described herein can be implemented as one or more computer program products, such as one or more computer programs tangibly embodied in an information carrier (e.g., in a machine readable storage device), or embodied in a propagated signal, for execution by, or to control the operation of, data processing apparatus (e.g., a programmable processor, a computer, or multiple computers). A computer program (also known as a program, software, software application, or code) can be written in any form of programming language, including compiled or interpreted languages, and it can be deployed in any form, including as a standalone program or as a module, component, subroutine, or other unit suitable for use in a computing environment. A computer program does not necessarily correspond to a file. A program can be stored in a portion of a file that holds other programs or data, in a single file dedicated to the program in question, or in multiple coordinated files (e.g., files that store one or more modules, sub programs, or portions of code). A computer program can be deployed to be executed on one computer or on multiple computers at one site or distributed across multiple sites and interconnected by a communication network.

[0113] The processes and logic flows described in this specification, including the method steps of the subject matter described herein, can be performed by one or more programmable processors executing one or more computer programs to perform functions of the subject matter described herein by operating on input data and generating output. The processes and logic flows can also be performed by, and apparatus of the subject matter described herein can be implemented as, special purpose logic circuitry, e.g., an FPGA (field programmable gate array) or an ASIC (application specific integrated circuit).

[0114] Processors suitable for the execution of a computer program include, by way of example, both general and special purpose microprocessors, and any one or more processor of any kind of

digital computer. Generally, a processor will receive instructions and data from a read only memory or a random access memory or both. The essential elements of a computer are a processor for executing instructions and one or more memory devices for storing instructions and data. Generally, a computer will also include, or be operatively coupled to receive data from or transfer data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto optical disks, or optical disks. Information carriers suitable for embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, (e.g., EPROM, EEPROM, and flash memory devices); magnetic disks, (e.g., internal hard disks or removable disks); magneto optical disks; and optical disks (e.g., CD and DVD disks). The processor and the memory can be supplemented by, or incorporated in, special purpose logic circuitry.

[0115] To provide for interaction with a user, the subject matter described herein can be implemented on a computer having a display device, e.g., a CRT (cathode ray tube) or LCD (liquid crystal display) monitor, for displaying information to the user and a keyboard and a pointing device, (e.g., a mouse or a trackball), by which the user can provide input to the computer. Other kinds of devices can be used to provide for interaction with a user as well. For example, feedback provided to the user can be any form of sensory feedback, (e.g., visual feedback, auditory feedback, or tactile feedback), and input from the user can be received in any form, including acoustic, speech, or tactile input.

[0116] The techniques described herein can be implemented using one or more modules. As used herein, the term "module" refers to computing software, firmware, hardware, and/or various combinations thereof. At a minimum, however, modules are not to be interpreted as software that is not implemented on hardware, firmware, or recorded on a non-transitory processor readable recordable storage medium (i.e., modules are not software per se). Indeed "module" is to be interpreted to always include at least some physical, non-transitory hardware such as a part of a processor or computer. Two different modules can share the same physical hardware (e.g., two different modules can use the same processor and network interface). The modules described herein can be combined, integrated, separated, and/or duplicated to support various applications. Also, a function described herein as being performed at a particular module can be performed at one or more other modules and/or by one or more other devices instead of or in addition to the function performed at the particular module. Further, the modules can be implemented across multiple devices and/or other components local or remote to one another. Additionally, the modules can be moved from one device and added to another device, and/or can be included in both devices.

[0117] The subject matter described herein can be implemented in a computing system that includes a back end component (e.g., a data server), a middleware component (e.g., an application server), or a front end component (e.g., a client computer having a graphical user interface or a web browser through which a user can interact with an implementation of the subject matter described herein), or any combination of such back end, middleware, and front end components. The components of the system can be interconnected by any form or medium of digital data communication, e.g., a communication network. Examples of communication networks include a local area network ("LAN") and a wide area network ("WAN"), e.g., the Internet.

[0118] Approximating language, as used herein throughout the specification and claims, may be applied to modify any quantitative representation that could permissibly vary without resulting in a change in the basic function to which it is related. Accordingly, a value modified by a term or terms, such as "about," "approximately," and "substantially," are not to be limited to the precise value specified. In at least some instances, the approximating language may correspond to the precision of an instrument for measuring the value. Here and throughout the specification and claims, range limitations may be combined and/or interchanged, such ranges are identified and include all the sub-ranges contained therein unless context or language indicates otherwise.

[0119] One skilled in the art will appreciate further features and advantages of the invention based

on the above-described embodiments. Accordingly, the present application is not to be limited by what has been particularly shown and described. except as indicated by the appended claims. All publications and references cited herein are expressly incorporated by reference in their entirety.

Claims

1. A method comprising: receiving first data characterizing an electric vehicle present within a dispensing environment including at least one electric vehicle charging station and second data characterizing an operator of the electric vehicle; determining one or more attributes of the electric vehicle based on the first data; determining an identity of the operator based on the second data; determining third data characterizing at least one graphical communication, the third data determined based on the determined one or more attributes of the electric vehicle and the identity of the operator, the graphical communication including one or more graphical elements and determined for the operator based on fourth data characterizing a likelihood the operator will provide an input selecting at least one graphical element of the one or more graphical elements included in the graphical communication, wherein the at least one graphical communication is adapted based on at least one of previous graphical communications for which other electric vehicle operators provided inputs selecting the at least one graphical communication element and previous graphical communications for which other electric vehicle operators did not provide inputs selecting the at least one graphical element; and providing the graphical communication on a display screen of the electric vehicle charging station for viewing by the operator.

2. The method of claim 1, wherein the second data includes image or video data acquired by an image sensor operably coupled to the electric vehicle charging station, loyalty program data received from the operator when the electric vehicle is within the dispensing environment, or loyalty program data received from the operator when the electric vehicle is remote from the dispensing environment.

3. The method of claim 1, wherein the one or more attributes of the electric vehicle further include a type of the electric vehicle, a size of the electric vehicle, or an amount of dirt on an exterior surface of the electric vehicle.

4. The method of claim 1, wherein the one or more attributes are determined using a first predictive model trained in a first machine learning process based on first training data including image data or video data of electric vehicles.

5. The method of claim 1, wherein the third data is determined using a second predictive model trained in a second machine learning process based on second training data including electric vehicle attribute data, the one or more graphical elements, the graphical communication, the likelihood the operator will provide the input selecting the at least one graphical element, and a frequency of operator inputs selecting the at least one graphical element included in the graphical communication.

6. The method of claim 1, wherein the at least one graphical element is associated with at least one of a car wash, a car wash discount, a food item, a food item discount, an amount of electricity dispensed by the electric vehicle charging station to the electric vehicle, a discount for electricity dispensed by the electric vehicle charging station to the electric vehicle, a service, or a service discount.

7. The method of claim 1, wherein the second data is received from a computing device in possession of the operator and the at least one graphical communication is transmitted to the computing device in possession of the operator.

8. The method of claim 1, wherein the at least one graphical communication is further adapted based on at least one of previous inputs provided by the operator selecting the at least one graphical element and previous graphical communications for which the operator did not select the at least one graphical communication element.

9. The method of claim 1, wherein the receiving, the determining, and the providing is performed by at least one data processor forming part of at least one computing system.

10. A system comprising: an electric vehicle charging station provided within a dispensing environment and configured to receive user inputs; an image sensor communicatively coupled to the electric vehicle charging station; at least one data processor operatively coupled to the dispenser; and a memory storing instructions, which when executed, cause the at least one data processor to perform operations comprising: receiving first data characterizing an electric vehicle present within the dispensing environment and second data characterizing an operator of the electric vehicle, the first data including image data acquired via the image sensor; determining one or more attributes of the electric vehicle based on the first data; determining an identity of the operator based on the second data; determining third data characterizing at least one graphical communication, the third data determined based on the determined one or more attributes of the electric vehicle and the identity of the operator, the graphical communication including one or more graphical elements and determined for the operator based on fourth data characterizing a likelihood the operator will provide an input selecting at least one graphical element of the one or more graphical elements included in the graphical communication, wherein the at least one graphical communication is adapted based on at least one of previous graphical communications for which other electric vehicle operators provided inputs selecting the at least one graphical communication element and previous graphical communications for which other electric vehicle operators did not provide inputs selecting the at least one graphical element; and providing the at least one graphical communication for display on a display screen of the electric vehicle charging station for viewing by the operator.

11. The system of claim **11**, wherein the second data includes image or video data acquired by the image sensor, loyalty program data received from the operator when the electric vehicle is within the dispensing environment, or loyalty program data received from the operator when the electric vehicle is remote from the dispensing environment.

12. The system of claim 11, wherein the one or more attributes of the electric vehicle further include a type of the electric vehicle, a size of the electric vehicle, or an amount of dirt on an exterior surface of the electric vehicle.

13. The system of claim 11, wherein the one or more attributes are determined using a first predictive model trained in a first machine learning process based on first training data including image data or video data of electric vehicles.

14. The system of claim 11, wherein third data is determined using a second predictive model trained in a second machine learning process based on second training data including electric vehicle attribute data, the one or more graphical elements, the graphical communication, the likelihood the operator will provide the input selecting the at least one graphical element, and a frequency of operator inputs selecting the at least one graphical element included in the graphical communication.

15. The system of claim 11, wherein the at least one graphical element is associated with at least one of a car wash, a car wash discount, a food item, a food item discount, an amount of electricity dispensed by the electric vehicle charging station, a discount for electricity dispensed by the electric vehicle charging station to the electric vehicle, a service, or a service discount.

16. The system of claim 11, wherein the at least one graphical communication is further determined based on at least one of an idle time of the electric vehicle within the dispensing environment, a time of day, a day of the week, a special event, a distance between the dispensing environment and a second dispensing environment, a location of the dispensing environment, a number of electric vehicles present within the dispensing environment, a car wash available time, or weather present at the dispensing environment.

17. The system of claim 11, wherein the second data is received from a computing device in possession of the operator and the at least one graphical communication is provided to the

computing device in possession of the operator.

18. The system of claim 11, wherein the at least one graphical communication is further adapted based on at least one of inputs provided by the operator selecting the at least one graphical element and previous graphical communications for which the operator did not select the at least one graphical communication element.

19. The system of claim 11, wherein responsive to providing the at least one graphical communication for display, the instructions are further configured to cause the at least one data processor to receive input data from the electric vehicle charging station, the input data provided by the operator selecting the at least one graphical element.

20. A computer-readable medium storing non-transitory computer-readable instructions, which when executed by a data processor, cause the data processor to perform operations comprising: receiving first data characterizing an electric vehicle present within a dispensing environment including at least one electric vehicle charging station and second data characterizing an operator of the electric vehicle, the first data including image data acquired via an image sensor communicatively coupled to the electric vehicle charging station; determining one or more attributes of the electric vehicle based on the first data; determining an identity of the operator based on the second data; determining third data characterizing at least one graphical communication, the third data determined based on the determined one or more attributes of the electric vehicle and the identity of the operator, the graphical communication including one or more graphical elements and determined for the operator based on fourth data characterizing a likelihood the operator will provide an input selecting at least one graphical element of the one or more graphical elements included in the graphical communication, wherein the at least one graphical communication is adapted based on at least one of previous graphical communications for which other electric vehicle operators provided inputs selecting the at least one graphical communication element and previous graphical communications for which other electric vehicle operators did not provide inputs selecting the at least one graphical element; and providing the at least one graphical communication for display on a display screen of the electric vehicle charging station for viewing by the operator.