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**Krishnappa et al.**

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(54) **SECURE COMMUNICATIONS BETWEEN FUELING STATION COMPONENTS**

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(51) **Int. Cl.**

| | |
|---|---|
| ***G06Q 20/32*** | (2012.01) |
| ***G06K 7/10*** | (2006.01) |
| ***G06K 7/14*** | (2006.01) |
| *G06F 3/0488* | (2022.01) |

(52) **U.S. Cl.**

CPC ..... ***G06Q 20/3276*** (2013.01); ***G06K 7/10722*** (2013.01); ***G06K 7/1417*** (2013.01); *G06F 3/0488* (2013.01)

(58) **Field of Classification Search**

CPC ..... G06Q 20/3276; G06K 7/10722; G06K 7/1417; G06F 3/0488

See application file for complete search history.

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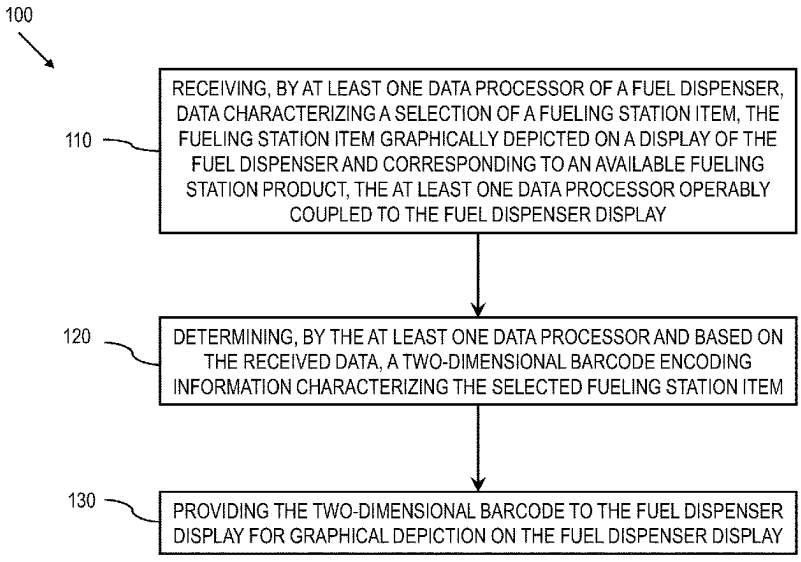
(57) **ABSTRACT**

A selection of a fueling station item, graphically depicted on a display of a fuel dispenser and corresponding to an available fueling station product, can be received by at least one data processor of a fuel dispenser. A two dimensional barcode based on the selected fueling station item can be determined. The two dimensional barcode can be provided to the fuel dispenser display for graphical depiction on the fuel dispenser display.

**15 Claims, 5 Drawing Sheets**



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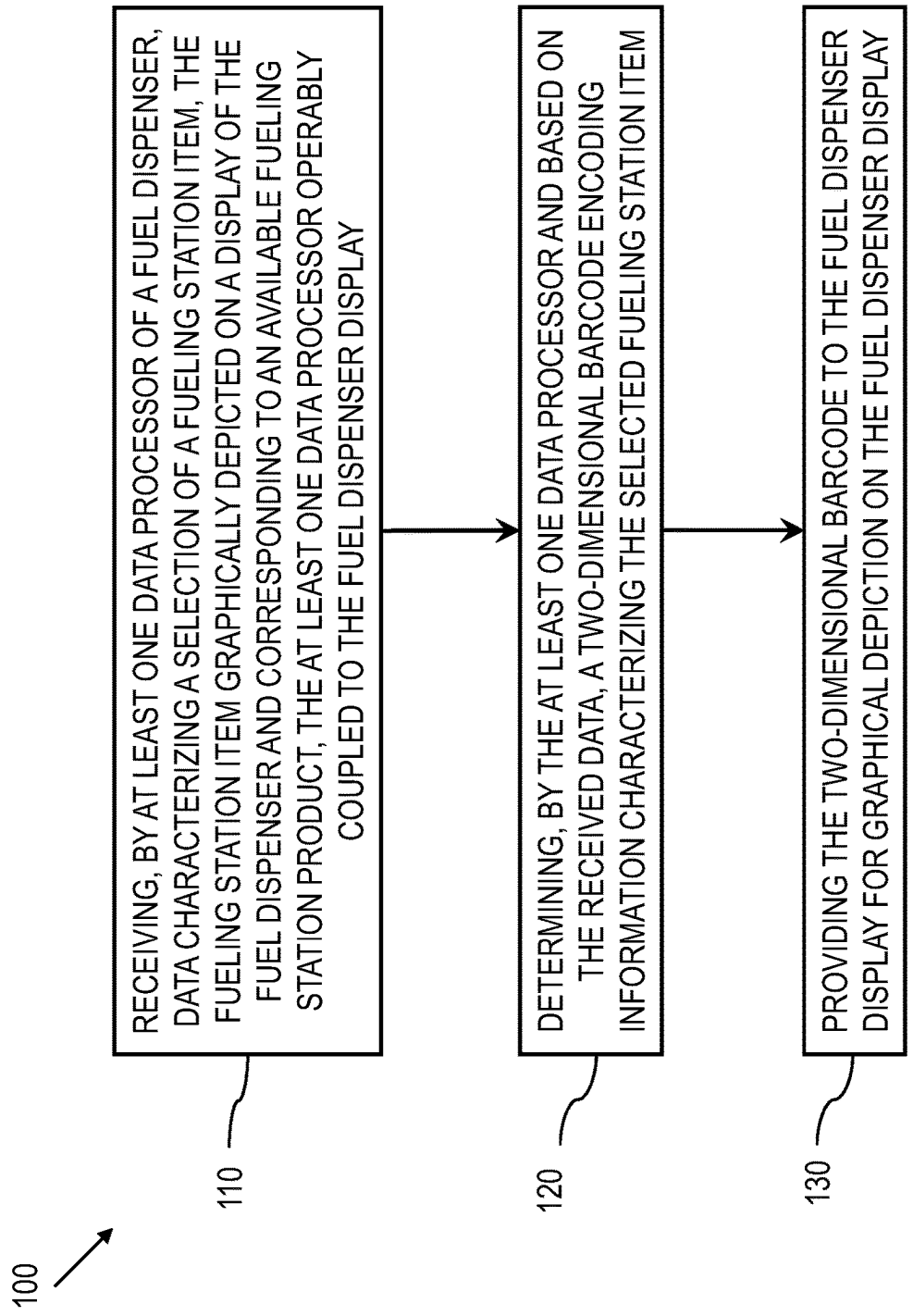
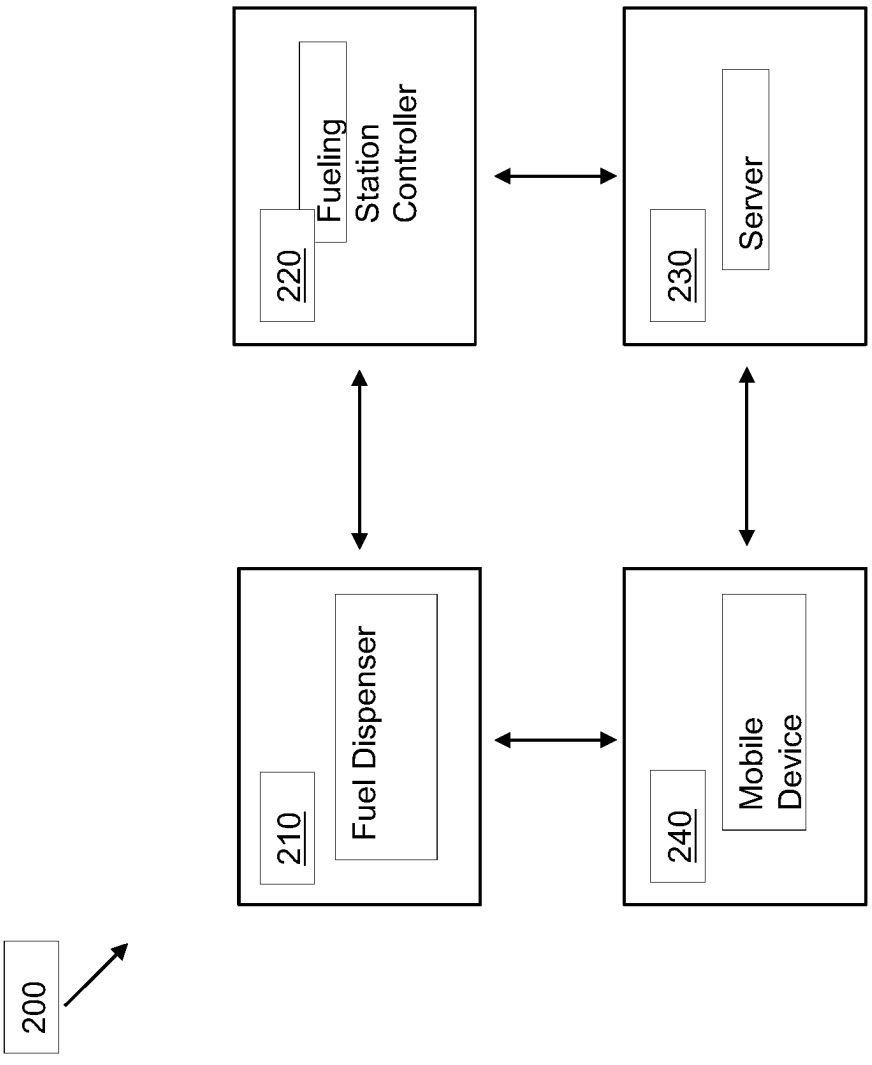

100
110
RECEIVING, BY AT LEAST ONE DATA PROCESSOR OF A FUEL DISPENSER, DATA CHARACTERIZING A SELECTION OF A FUELING STATION ITEM, THE FUELING STATION ITEM GRAPHICALLY DEPICTED ON A DISPLAY OF THE FUEL DISPENSER AND CORRESPONDING TO AN AVAILABLE FUELING STATION PRODUCT, THE AT LEAST ONE DATA PROCESSOR OPERABLY COUPLED TO THE FUEL DISPENSER DISPLAY
120
DETERMINING, BY THE AT LEAST ONE DATA PROCESSOR AND BASED ON THE RECEIVED DATA, A TWO-DIMENSIONAL BARCODE ENCODING INFORMATION CHARACTERIZING THE SELECTED FUELING STATION ITEM
130
PROVIDING THE TWO-DIMENSIONAL BARCODE TO THE FUEL DISPENSER DISPLAY FOR GRAPHICAL DEPICTION ON THE FUEL DISPENSER DISPLAY

FIG. 1

FIG. 2


200
210
Fuel Dispenser
220
Fueling Station Controller
230
Server
240
Mobile Device

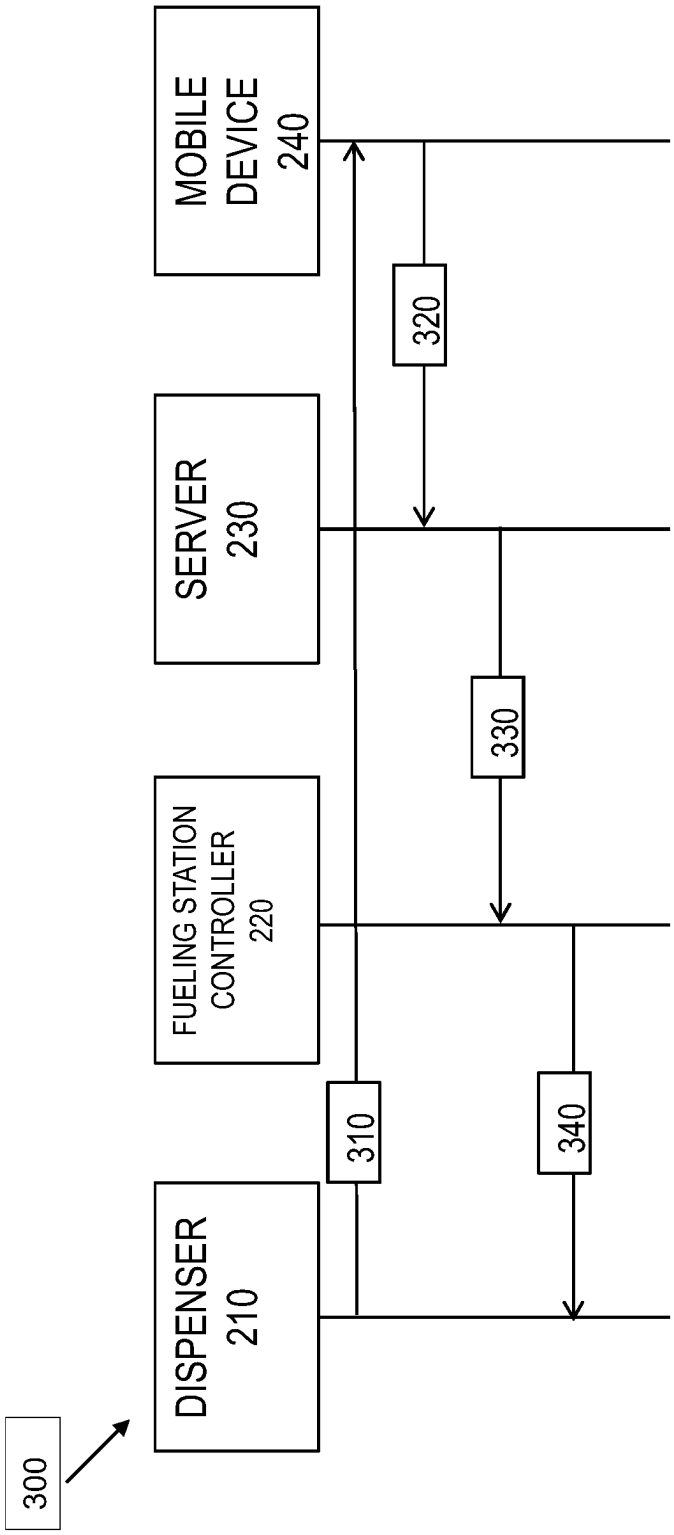

MOBILE DEVICE 240
SERVER 230
FUELING STATION CONTROLLER 220
DISPENSER 210
300
310
320
330
340

FIG. 3

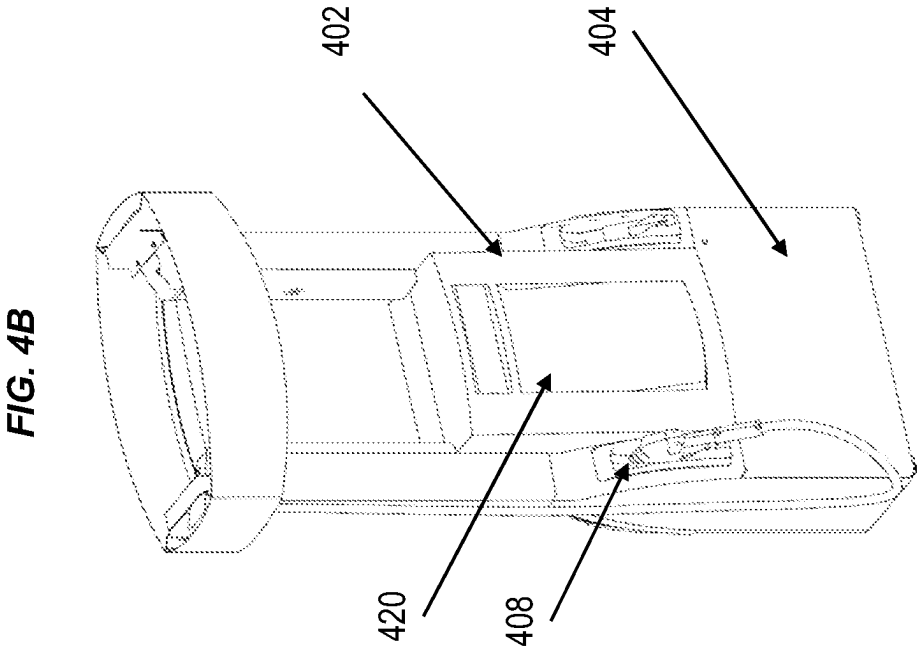



FIG. 4B

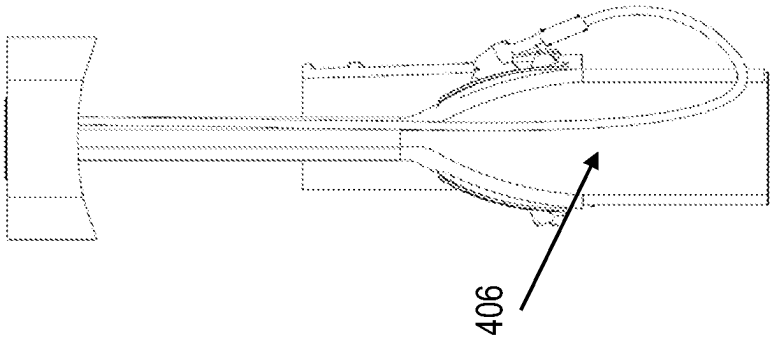



FIG. 4A

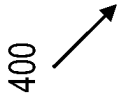
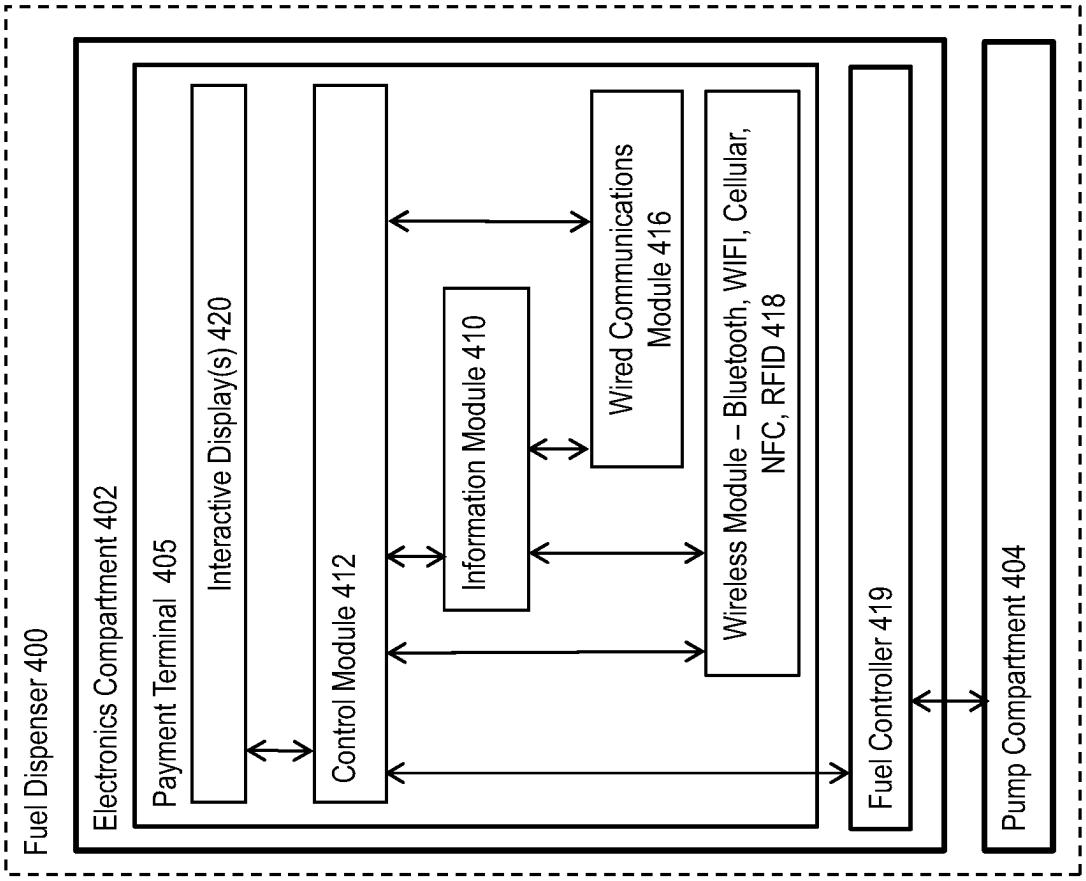


FIG. 5


Fuel Dispenser 400
Electronics Compartment 402
Payment Terminal 405
Interactive Display(s) 420
Control Module 412
Information Module 410
Wired Communications Module 416
Wireless Module – Bluetooth, WIFI, Cellular, NFC, RFID 418
Fuel Controller 419
Pump Compartment 404

# SECURE COMMUNICATIONS BETWEEN FUELING STATION COMPONENTS

## CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 16/985,726 entitled "SECURE COMMUNICATIONS BETWEEN FUELING STATION COMPONENTS" filed on Aug. 5, 2020, the entire content of which is hereby incorporated by reference in its entirety.

## FIELD

The current subject matter relates to secure communications between fueling station components.

## BACKGROUND

Some current fueling environments rely on traditional methods of communication between fueling transaction components such as a fuel dispenser and a payment information device (e.g., debit/credit card, radio frequency identification (RFID) key fob encoding payment information, and the like). However, these methods have some security vulnerabilities as would-be identity thieves can install payment information interception devices on fuel dispensers and thereby intercept a customer's information.

In addition, fueling stations typically rely on traditional modes of media delivery, such as signage, flyers, posters, and social media to attract customers. It is difficult to deliver media pertaining to secondary products available at fueling stations, such as convenience store sales and on-site car washes, to customers at fueling stations that are solely purchasing fuel. In addition, at times, customers may visit a fueling station to purchase fuel, only to find that all fuel dispensers at the fueling station are occupied, which can result in customer frustration and/or a loss of business in the event the customer is unable or unwilling to wait for a fuel dispenser to become available.

## SUMMARY

Methods and systems for secure communications between fueling station components are provided. Related apparatus, systems, techniques, and articles are also described.

In one aspect, data characterizing a selection of a fueling station item graphically depicted on a display of a fuel dispenser and corresponding to an available fueling station product, can be received by at least one data processor of a fuel dispenser. The at least one data processor can be operably coupled to the fuel dispenser display. A two-dimensional barcode encoding information characterizing the selected fueling station item can be determined by the at least one data processor and based on the received data. The two-dimensional barcode can be provided to the fuel dispenser display for graphical depiction on the fuel dispenser display.

One or more of the following features can be included in any feasible combination. For example, the two-dimensional barcode depicted on the fuel dispenser display can be received at a camera of an end user device, a data packet characterizing a status of a fueling station transaction can be received at the end user device, a second two-dimensional barcode, based on the two-dimensional barcode and the data packet and characterizing the fueling station transaction status and the selected fueling station item, can be determined at the end user device, and the second two-dimensional barcode can be provided to a display of the end user device for depiction on the end user device display. For example, the fueling station item can include one or more of a type of fuel, a grade of fuel, and an amount of fuel. For example, the fueling station item can include a usage of an air compressor. For example, the fueling station item can include a usage of an on-site car wash. For example, the fueling station item can include one or more convenience store items. For example, the two-dimensional barcode can be a quick reference code. For example, the second two dimensional barcode can be a quick reference code. For example, the fuel dispenser display can include a touchscreen. For example, the second two-dimensional barcode can encode information characterizing a coupon stored in a memory of the end user device.

In another aspect, a system is provided and can include at least one data processor and memory storing instructions configured to cause the at least one data processor to perform operations described herein. The operations can include receiving, by at least one data processor of a fuel dispenser, data characterizing a selection of a fueling station item, the fueling station item graphically depicted on a display of the fuel dispenser and corresponding to an available fueling station product, the at least one data processor operably coupled to the fuel dispenser display, determining, by the at least one data processor and based on the received data, a two-dimensional barcode encoding information characterizing the selected fueling station item, and providing the two-dimensional barcode to the fuel dispenser display for graphical depiction on the fuel dispenser display.

One or more of the following features can be included in any feasible combination. For example, the operations can further include receiving, at a camera of an end user device, the two-dimensional barcode depicted on the fuel dispenser display, receiving, at the end user device, a data packet, the data packet characterizing a status of a fueling station transaction, determining, based on the two-dimensional barcode and the data packet, and at the end user device, a second two-dimensional barcode, the second two-dimensional barcode encoding information characterizing the fueling station transaction status and the selected fueling station item, and providing the second two-dimensional barcode to a display of the end user device for depiction on the end user device display. For example, the fueling station item can include one or more of a type of fuel, a grade of fuel, and an amount of fuel. For example, the fueling station item can include a usage of an air compressor. For example, the fueling station item can include a usage of an on-site car wash. For example, the fueling station item can include one or more convenience store items. For example, the two-dimensional barcode can be a quick reference code. For example, the second two dimensional barcode can be a quick reference code. For example, the fuel dispenser display can include a touchscreen. For example, the second two-dimensional barcode can encode information characterizing a coupon stored in a memory of the end user device.

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.

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.

## BRIEF DESCRIPTION OF DRAWINGS

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:

FIG. **1** is a process flow diagram illustrating an example process of some implementations of the current subject matter that can provide for secure payments and active marketing in fuel dispensing transactions;

FIG. **2** is a system diagram illustrating an example system of some implementations of the current subject matter that can provide for secure payments and active marketing in fuel dispensing transactions;

FIG. **3** is a data flow diagram illustrating the transfer of data between the system components illustrated in FIG. **2**;

FIG. **4**A is a side perspective view of one embodiment of a fuel dispenser;

FIG. **4**B is a front perspective view of the fuel dispenser shown in FIG. **4**A; and

FIG. **5** is a diagram showing internal components of the fuel dispenser of FIGS. **4**A and **4**B.

## DETAILED DESCRIPTION

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.

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.

In general, a system for secure communication at fueling stations, and methods for use thereof, are provided. In some implementations, the system can include a fuel dispenser with a two-dimensional barcode generator that is configured to generate a two-dimensional barcode for use in communicating with a mobile device of a fuel dispenser user. After the fuel dispenser has selected various items, such as fuel, food and beverages, and/or the usage of such on-site services as the compressed air and car wash stations by interacting with a display of the fuel dispenser, the two-dimensional barcode generator can determine the two-dimensional barcode, which encodes information characterizing the selected items. The fuel dispenser can depict the two-dimensional barcode on a display of the fuel dispenser. A user can, by use of a camera on a mobile device, acquire an image of the displayed two-dimensional barcode, and an application on the mobile device can decode the information encoded in the two-dimensional barcode, perform further processing using the information (e.g., communicate with one or more remote servers for storage and/or logging data characterizing fueling station usage, etc.), thereby allowing for secure communications between components at a fueling station.

FIG. **1** is a process flow diagram illustrating an example process **100** of some implementations of the current subject matter that can provide for secure communications between components at a fueling station, and FIG. **2** is a system diagram illustrating an example system **200** that incorporates some implementations of the current subject matter and that can provide for the same. As shown in FIG. **2**, the system **200** includes a fuel dispenser **210** configured to dispense fuel and having at least one data processor configured to perform the functionality described herein; a fueling station **220** in operable communication with the fuel dispenser **210** that is configured to manage the dispensation of fuel from the fuel dispenser **210** and the purchase of fueling station items that are unrelated to the purchase of fuel; a server **230** in operable communication with the fueling station controller **220**; and a mobile device **240** in operable communication with the fuel dispenser **210** and the server **230** and including an application configured to provide the functionality described herein.

Referring to both FIGS. **1** and **2**, at **110**, data characterizing a selection of a fueling station item can be received by at least one data processor of a fuel dispenser, such as fuel dispenser **210**. In some implementations, the fueling station item can be a graphical object depicted on a display of the fuel dispenser that is operably coupled to the at least one data processor, and the at least one data processor can be configured to generate the fueling station item for depiction on the display. In some implementations, the display can be an interactive or touchscreen display wherein the user can touch or otherwise interact with the display to make the selection of the fueling station item.

In some implementations, the fueling station item can correspond to an available fueling station product that is presented to the user. In some implementations, the available fueling station product can include a type and/or grade of fuel selected by the user for dispensation from the fuel dispenser. In some implementations, the available fueling station product can include one or more convenience store items (e.g., food, beverage, automotive supplies, etc.). In some implementations, the available fueling station product can include one or more supplemental services (e.g., air

compressor usage, on-site car wash services, etc.) that are available for purchase at the fuel dispenser.

In some implementations, the at least one data processor can include an input/output device configured to receive the selected fueling station item, a memory configured to store the selected fueling station item, and a processor configured to perform operations on the selected fueling station item, as discussed in further detail below. In some implementations, the at least one data processor can be a component of the fuel dispenser and housed therein. In some implementations, the at least one data processor can be located in at least one computing system at the fueling station, outside of the fuel dispenser. In some implementations, the at least one data processor can be located at a remote location, away from the fueling station and the fuel dispenser.

For example, in use, a user can arrive at the fueling station and park their vehicle in front of a fuel dispenser. The user can interact with the interactive display of the fuel dispenser by navigating through the interface to select one or more graphical objects depicted on the interactive display that correspond to a fueling station item (e.g., a type/grade of fuel available at the fuel dispenser; convenience store items, such as food, beverages, and/or automotive supplies available at the fueling station; and/or vehicle services, such as air compressor time and on-site car wash services, etc.). If the interactive display is a touchscreen, the user can touch the portion of the display that corresponds to the graphical object and thereby select their desired fueling station items.

At **120**, a two-dimensional barcode can be determined by the at least one data processor based on the first data packet. The two-dimensional barcode can encode information that characterizes the selected fueling station item. In some implementations, the processor of the at least one data processor can access the memory of the at least one data processor to retrieve and convert the selected fueling station item into the two-dimensional barcode, which can be a graphical representation characterizing the selected fueling station item. For example, in some implementations, the processor of the at least one data processor can convert the selected fueling station item into a binary-type code, which can then be graphically represented (e.g., white portion for "0", black portion for "1"). In some implementations, the at least one data processor can convert the selected fueling station item into a quick reference code. In some implementations, data characterizing the selected fueling station item can be provided in a string or text format (e.g., American Standard Code for Information Interchange (ASCII) or other format) to the at least one data processor for conversion into the two-dimensional barcode. In some implementations, data characterizing the selected fueling station item can be transmitted between fueling station components in a string or text format.

At **130**, the two-dimensional barcode can be provided to the fuel dispenser display. In some implementations, the two-dimensional barcode can be transmitted from the processor of the at least one data processor, through the input/output device of the at least one data processor, and to the fuel dispenser display for depiction thereon. In some implementations, the two dimensional barcode can be provided to the fuel dispenser display after dispensation of fuel from the fuel dispenser has occurred, and the two dimensional barcode can include information characterizing the dispensation of fuel.

The two dimensional barcode, and other types of data characterizing various aspects of the fueling station transaction, can be transmitted between various components of the fueling station. For example, in some implementations, the two-dimensional barcode can be scanned by a camera of a mobile device of the fueling station customer, such as mobile device **240**. The mobile device, which can include memory and at least one data processor, can include an application that is configured to utilize the at least one data processor to recognize the two-dimensional barcode scanned by the camera and to discern the information encoded in the two-dimensional barcode.

The discerned information can be used by the processor to prepare a transaction data packet, which can be sent to a payment server, such as server **230**. The transaction data packet can include information characterizing the purchased fueling station items. In some implementations, the application can also provide a prompt for the user to provide their payment method (e.g., credit card, debit card, etc.). In some implementations, the payment method can be stored on the mobile device. In some implementations, the payment method can be scanned or otherwise entered by the user into the application prompt and included as part of the transaction data packet. The payment server can send the transaction data packet to the fueling station's bank, which can send payment and a transaction authorization to the fueling station that indicates that the transaction is complete. In some implementations, when the customer has ordered convenience store items as part of the purchase, the application can instruct the processor to generate, and provide to an interactive display of the mobile device, an authorization two-dimensional barcode that encodes the transaction authorization and the ordered convenience store items. When the authorization two-dimensional barcode is depicted on the display of the mobile device, the customer can present the authorization two-dimensional code to a two-dimensional barcode reader located within a convenience store at the fueling station to pick up the convenience store items. In some implementations, more than one authorization two-dimensional barcode can be determined and provided to the interactive display of the mobile device for use by the user in picking up portions of the purchased fueling station items at various locations at the fueling station.

FIG. **3** is a data flow diagram **300** illustrating the transfer of one or more of the types of data described herein between the system components illustrated in FIG. **2** and in accordance with some implementations of the current subject matter. Referring to FIGS. **2** and **3**, in some implementations, the two-dimensional barcode can encode information that characterizes, for example, the fueling station location, the fuel dispenser, and/or the fueling products (e.g., types/grades of fuel) available at the fuel dispenser. A user can, at **310**, acquire an image of the two-dimensional barcode from an interactive display of the fuel dispenser **210** using the camera on the user's mobile device **240**, and the camera can, in turn, provide the image to an image processor on the mobile device.

In some implementations, prior to the dispensation of fuel from the fuel dispenser, the customer can, instead of selecting their desired products on the interactive display of the fuel dispenser, select their desired products via the application on their mobile device. Similar to the functionality described above, a user can acquire an image of a two-dimensional barcode from a fuel dispenser using the camera on the user's mobile device and provide the image to an image processor on the mobile device. The image processor can decode the information encoded in the two-dimensional barcode and provide the decoded information to the application for further processing by the application during a fueling transaction. For example, in some implementations, wherein the decoded information characterizes the fueling

station, the fuel dispenser, and the fueling products available at the fuel dispenser, the application can generate a graphical representation of the fueling products and provide the graphical representation to the interactive display of the mobile device. As such, the application can depict a fueling station item on an interactive display of the mobile device. Similar to the functionality above, the fueling station item can characterize the various products and services available for selection by a user at a fueling station, such as a type/grade/amount of fuel, food, beverage, automotive supplies, car wash products, and the like. The user can select the fueling station item by interacting with the interactive display of the mobile device. In some implementations, the application can provide an interface for the user to provide a desired sale amount of fuel and to total any additional fueling station items with the desired sale amount to create a pre-authorization amount. The application can also provide a prompt for the user to provide their payment method (e.g., credit card, debit card, etc.). In some implementations, the payment method can be stored on the mobile device. In some implementations, the payment method can be scanned or otherwise entered by the user into the application prompt.

The mobile device **240** can then provide, at **320**, via communication components of the mobile device (e.g., Wi-Fi transceiver, cellular transceiver, etc.) in response to an instruction from the user to purchase the fueling product from the fuel dispenser, information characterizing the fueling product selection, the fuel dispenser, the fueling station, and any payment information associated with the user previously stored on the mobile device (such as credit/debit card information) to a transaction server (such as **230**) in operable communication with the mobile device **240**. The transaction server can generate a pre-authorization inquiry that includes a pre-authorization amount of money and provide the pre-authorization inquiry to a payment server of a merchant associated with the user's payment information that is also in operable communication with the transaction server **230**. The payment server can determine whether a bank account (or line of credit, if the payment information includes credit card information) associated with the payment information has funds available for payment of the fueling transaction.

If the payment server determines that the bank account (or line of credit, if applicable) has sufficient funds for payment for the fueling transaction, based on the pre-authorization amount of money, the payment server can generate and provide an authorization instruction to the transaction server that contains information characterizing an instruction to proceed with the fueling transaction in accordance with the pre-authorization amount of money. The transaction server **230** can, in response to receiving the authorization instruction, generate a fueling instruction characterizing a command to dispense fuel. The fueling instruction can include information characterizing the fuel dispenser, the fueling station, the pre-authorization amount of money, and the desired fueling product. The fueling instruction can be provided by the transaction server, at **330**, to a fueling station controller, such as fueling station controller **220**, at the fueling station. At **340**, the fueling station controller **220** can generate and provide a command to the fuel dispenser **210** to instruct the user to remove the fuel dispenser nozzle from the fuel dispenser and dispense the selected fuel via the nozzle in accordance with the fueling instruction. In some implementations, the transaction server can generate and provide the fueling instruction and the command directly to the fuel dispenser, bypassing the fueling station controller **220**.

Once the user has finished dispensing the fuel and replaced the nozzle on the fuel dispenser, the fuel dispenser generates and provides a transaction completion instruction to the transaction server. In some implementations, the transaction completion instruction can be provided to the transaction server via the forecourt controller. The transaction completion instruction can include such information as a quantity of fuel dispensed and a total sale amount. The transaction server can generate a payment settlement instruction containing a command to settle the payment for the fueling transaction and provide the payment settlement instruction to the payment server, which executes the payment settlement command. The transaction server can also generate a notification signifying that the transaction has been completed and provide the notification to the mobile device. The mobile device can display the notification to the user via the interactive display.

In some implementations, the application can provide instructions to a processor of the mobile device that can determine, based on the selected fueling station item (and thereby the selected product(s)/service(s)), an application two-dimensional barcode, which can be provided to the interactive display of the mobile device. Similar to the two-dimensional barcodes discussed above, the application two-dimensional barcode can encode information that characterizes the selected fueling station item. In some implementations, the processor of the mobile device can access the memory of the mobile device to retrieve and convert data characterizing the purchased products into the application two-dimensional barcode, which can be a graphical representation characterizing the selected products. For example, in some implementations, the processor of the mobile device can convert the first data packet into a binary-type code, which can then be graphically represented (e.g., white portion for "0", black portion for "1"). In some implementations, the processor of the mobile device can convert selected fueling station item into a quick reference code.

A user can then present the application two-dimensional barcode, as depicted on the interactive display of the mobile device, to a two-dimensional barcode reader disposed on the fuel dispenser. The two-dimensional barcode reader can read the application two-dimensional barcode and transmit the application two-dimensional barcode to the at least one data processor of the fuel dispenser. The at least one data processor of the fuel dispenser can decode the application two-dimensional barcode to determine the products (e.g., type/grade/amount of fuel) characterized by the selected fueling station item. The at least one data processor can activate various functions of the fuel dispenser, such as the dispensation of the purchased type/grade/amount of fuel, based on the selected fueling station item determined from the application two-dimensional barcode, such that the user may receive their selected products.

As mentioned above, in some implementations, the selected products can include convenience store items, such as food, beverage, automotive supplies, and the like, available for pickup at the convenience store of the fueling station. When the selected products include these items (and the application two-dimensional barcode encodes information characterizing the selected products in the manner described above), the user can present the application two-dimensional barcode to a two-dimensional barcode reader located within the convenience store, which can similarly read the barcode and transmit the barcode to at least one data processor of a convenience store register. The at least one data processor of the convenience store register can decode

the application two-dimensional barcode to determine the selected products and authorize the pickup of these items by the user.

The application can also include several capabilities that facilitate the functionality described herein. For example, in some implementations, the application can provide a depiction, to the interactive display of the mobile device, that indicates to the user the locations of nearby fueling stations and/or convenience stores. In some implementations, the application can provide, to the interactive display of the mobile device, a graphical depiction of the pumps at a fueling station that can indicate the types/grades of fuel available at each pump. The application can also provide a depiction, to the interactive display of the mobile device, that indicates available marketing and promotional offers that are applicable to products and/or services available at a fueling station and/or convenience store that located nearby, as identified by the application. In some implementations, the application can provide the depiction of the marketing and promotional offers specific to a particular fueling station in response to detecting, via the determined location of the mobile device, that the user has arrived at that fueling station. In some implementations, the application can retrieve coupons for the products and/or services, in two-dimensional barcode format, that are stored in the memory of the mobile device, and the application can provide a two-dimensional barcode characterizing the coupon to the interactive display of the mobile device, which can then be presented by the user to the fuel dispenser two-dimensional barcode reader and/or the convenience store register two-dimensional barcode reader for redemption by the user in a fueling station transaction. In some implementations, data characterizing the coupon can be encoded into the application two-dimensional barcodes described herein, such that, for example, the user can redeem the coupon when the two-dimensional barcodes are presented to the fuel dispenser two-dimensional barcode reader and/or the convenience store register two-dimensional barcode reader in accordance with the functionality described herein.

In some implementations, the application can include an input dialog configured to receive promotion and/or discount codes that permit the user to take advantage of reduced-price products and/or services. In some implementations, the application can also receive voice commands from a user and determine the products selected for purchase based on the voice commands. In some implementations, the application can transmit, via the communication interfaces of the mobile device, information about the fueling station items to other mobile device users. In some implementations, the authorization two-dimensional barcodes described herein can be forwarded to other mobile device users to thereby enable individuals other than the original purchaser to obtain the purchased fueling station items. In some implementations, the application can display the two-dimensional barcodes described herein on accessories operably coupled to the mobile device (e.g., smart watches etc.).

In some implementations, a static two-dimensional barcode can be displayed on an exterior surface of the fuel dispenser (e.g., a fuel dispenser electronics compartment or a fuel dispenser pump compartment). Similar to the two-dimensional barcode described above, the static two-dimensional barcode can encode information that characterizes, for example, the fueling station location, the fuel dispenser, and/or the fueling products (e.g., types/grades of fuel) available at the fuel dispenser. A user can acquire an image of the static two-dimensional barcode using the camera on the user's mobile device, and the camera can, in turn, provide the image to an image processor on the mobile device.

Similar to the functionality described above, the image processor can decode the information encoded in the static two-dimensional barcode and provide the decoded information to the application for further processing by the application during a fueling transaction. For example, in some implementations, wherein the decoded information characterizes the fueling station, the fuel dispenser, and the fueling products available at the fuel dispenser, the application can generate a graphical representation of the fueling products and provide the graphical representation to the interactive display of the mobile device. The user can then select the graphical representation corresponding to the desired fueling product via the interactive display. The application can then provide, via communication components of the mobile device (e.g., Wi-Fi transceiver, cellular transceiver, etc.) in response to an instruction from the user to purchase the fueling product from the fuel dispenser, information characterizing the fueling product selection, the fuel dispenser, the fueling station, and any payment information associated with the user previously stored on the mobile device (such as credit/debit card information) to a transaction server in operable communication with the mobile device. The transaction server can generate a pre-authorization inquiry that includes a pre-authorization amount of money and provide the pre-authorization inquiry to a payment server of a merchant associated with the user's payment information. The payment server can determine whether a bank account (or line of credit, if the payment information includes credit card information) associated with the payment information has funds available for payment of the fueling transaction.

If the payment server determines that the bank account (or line of credit, if applicable) has sufficient funds for payment for the fueling transaction, based on the pre-authorization amount of money, the payment server can generate and provide an authorization instruction to the transaction server that contains information characterizing an instruction to proceed with the fueling transaction in accordance with the pre-authorization amount of money. The transaction server can, in response to receiving the authorization instruction, generate a fueling instruction characterizing a command to dispense fuel. The fueling instruction can include information characterizing the fuel dispenser, the fueling station, the pre-authorization amount of money, and the desired fueling product. The fueling instruction can be provided by the transaction server to a forecourt controller at the fueling station, which can generate and provide a command to the fuel dispenser to instruct the user to remove the fuel dispenser nozzle from the fuel dispenser and dispense the selected fuel via the nozzle in accordance with the fueling instruction. In some implementations, the transaction server can generate and provide the fueling instruction and the command directly to the fuel dispenser, bypassing the forecourt controller.

Once the user has finished dispensing the fuel and replaced the nozzle on the fuel dispenser, the fuel dispenser generates and provides a transaction completion instruction to the transaction server. In some implementations, the transaction completion instruction can be provided to the transaction server via the forecourt controller. The transaction completion instruction can include such information as a quantity of fuel dispensed and a total sale amount. The transaction server can generate a payment settlement instruction containing a command to settle the payment for the fueling transaction and provide the payment settlement instruction to the payment server, which executes the pay-

ment settlement command. The transaction server can also generate a notification signifying that the transaction has been completed and provide the notification to the mobile device. The mobile device can display the notification to the user via the interactive display.

FIGS. **4**A and **4**B illustrate one embodiment of a fuel dispenser **400** that can be used in some implementations of the current subject matter, and FIG. **5** illustrates components of the fuel dispenser. In general, the fuel dispenser **400** includes an electronics compartment **402** and a pump compartment **404**. The pump compartment **404** 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 **404** 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 **404** is isolated from the electronics compartment **402** within the fuel dispenser **400** 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 **404** to the electronics compartment **302** and instead flows from the pump compartment **404** through hoses **406** to nozzles **408** for dispensing. As will be appreciated by a person skilled in the art, the nozzles **408** are each configured to dispense fuel from the fuel dispenser **400** as pumped therefrom by the pump.

The electronics compartment **402** houses electronics for facilitating payment for fuel and for facilitating the dispensing of the fuel. For example, the electronics compartment **402** can include a fuel controller **419** that, at least in some implementations, includes a data processor, memory, and storage forming part of at least one computing system. The fuel controller **419** is configured to control dispensing of the fuel from the pump compartment **404**. The electronics compartment **402** also includes a payment terminal **405** 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 via a forecourt controller, and deliver fueling instructions to the fuel controller **419** to dispense fuel. The payment terminal **405** 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.

The payment terminal **405** can be configured to facilitate communication between a user and the fuel controller **419**, and can include an interactive display **420** and an information module **410**. The information module **410** can, at least in some implementations include a data processor, memory, and storage, forming part of at least one computing system. The payment terminal **405** can also include one or more wired communication modules **416** and/or wireless communication modules **418** and a control module **412** that, at least in some implementations includes a data processor, memory, and storage, forming part of at least one computing system. The communication modules **416**, **418** can function to allow data to be transmitted to and from various components within the payment terminal **405** via wired and/or wireless communication, respectively. For example, the communication modules **416**, **418** can be configured to transmit and receive signals that can characterize, e.g., payment information, user identification information, and/or information regarding a desired fuel selection, via wired and/or wireless communications, respectively. The wireless communication module **418** can include, e.g., a transceiver for communicating via Bluetooth protocol, 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 **416**, **418** 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 interactive display **420**, which can be, or can include, a touchscreen. The interactive display **420** can be operably coupled to the control module **412** which can be used to control, dynamically rearrange, and/or update a graphical user interface (GUI) rendered on the display **420**. The display **420** can be configured to show information (e.g., media content, fuel selection options, payment information, user identification information, etc.) 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, etc.) thereon, and can deliver data characterizing the input to the control module **412** to be processed. Some examples of information that the display **420** 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 device 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.

To facilitate payment, the information module **410** 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 **412**. For example, the information module **310** can include a barcode and/or QR code scanner, and/or a NFC contactless card reader for receiving payment information and/or user identification information.

In some embodiments, the information module **410** can include an image sensor 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 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.

As shown in FIG. **5**, the information module **410** can be operably coupled to the wired communication module **416** and/or the wireless communication module **418**. The wired and wireless communication modules **416**, **418** can allow the information module **410** 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 **410** via the wired and/or wireless communication modules **416**, **418**. Although the wireless communication module **418** is shown to be located within the payment terminal, the wireless communication module **418**

can be located elsewhere on, within, or in the vicinity of, the fuel dispenser **400**. For example, the wireless communication module **418** can be mounted on top of the fuel dispenser, which can facilitate retrofitting the wireless communication module **418** to existing fuel dispensers and/or facilitate repair, upgrade, or other maintenance of the communication module **418**, as described in U.S. patent application Ser. No. 15/182,201 filed on Jun. 14, 2016 and entitled "Methods and Devices for Fuel Dispenser Electronic Communication."

The subject matter described herein can provide several advantages. By using the functionality and components described above, a customer can complete a fueling station transaction without having to provide credit card payment information to a fuel dispenser or a convenience store at the fueling station, which can eliminate the risk of theft of the customer's credit card information via such devices as credit card skimmers. The functionality described herein also provides for improved transaction speed as compared to conventional payment methods.

One or more aspects or features of the subject matter described herein can be realized in digital electronic circuitry, integrated circuitry, specially designed application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs) computer hardware, firmware, software, and/or combinations thereof. These various aspects or features can include implementation in one or more computer programs that are executable and/or interpretable on a programmable system including at least one programmable processor, which can be special or general purpose, coupled to receive data and instructions from, and to transmit data and instructions to, a storage system, at least one input device, and at least one output device. The programmable system or computing system may include clients and servers. A client and server are generally remote from each other and typically interact through a communication network. The relationship of client and server arises by virtue of computer programs running on the respective computers and having a client-server relationship to each other.

These computer programs, which can also be referred to as programs, software, software applications, applications, components, or code, include machine instructions for a programmable processor, and can be implemented in a high-level procedural language, an object-oriented programming language, a functional programming language, a logical programming language, and/or in assembly/machine language. As used herein, the term "machine-readable medium" refers to any computer program product, apparatus and/or device, such as for example magnetic discs, optical disks, memory, and Programmable Logic Devices (PLDs), used to provide machine instructions and/or data to a programmable processor, including a machine-readable medium that receives machine instructions as a machine-readable signal. The term "machine-readable signal" refers to any signal used to provide machine instructions and/or data to a programmable processor. The machine-readable medium can store such machine instructions non-transitorily, such as for example as would a non-transient solid-state memory or a magnetic hard drive or any equivalent storage medium. The machine-readable medium can alternatively or additionally store such machine instructions in a transient manner, such as for example as would a processor cache or other random access memory associated with one or more physical processor cores.

To provide for interaction with a user, one or more aspects or features of the subject matter described herein can be implemented on a computer having a display device, such as for example a cathode ray tube (CRT) or a liquid crystal display (LCD) or a light emitting diode (LED) monitor for displaying information to the user and a keyboard and a pointing device, such as for example a mouse or a trackball, by which the user may 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, such as for example visual feedback, auditory feedback, or tactile feedback; and input from the user may be received in any form, including, but not limited to, acoustic, speech, or tactile input. Other possible input devices include, but are not limited to, touch screens or other touch-sensitive devices such as single or multi-point resistive or capacitive trackpads, voice recognition hardware and software, optical scanners, optical pointers, digital image capture devices and associated interpretation software, and the like.

One skilled in the art will appreciate further features and advantages of the invention based on the above-described embodiments. Accordingly, the invention 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 herein by reference in their entirety.

What is claimed is:

**1**. A method comprising:

displaying instructions on an interactive display of a fuel dispenser, the instructions indicating to a user to remove a fuel dispenser nozzle from the fuel dispenser;

receiving, at the fuel dispenser, a selection of a first graphical object characterizing an amount of fuel to be dispensed from the fuel dispenser, wherein the first graphical object is presented on the interactive display;

determining, by a data processor communicatively coupled to the fuel dispenser, a first instance of a second graphical object characterizing a two-dimensional barcode, wherein the two-dimensional barcode includes information characterizing the selected amount of fuel;

causing, by the data processor, the first instance of the second graphical object characterizing the two-dimensional barcode to be displayed on the interactive display of the fuel dispenser;

determining, by the data processor, a dispensing instruction characterizing a command to pump the selected amount of the fuel from a fuel reservoir, the dispensing instruction being based at least in part on the first graphical object characterizing the amount of fuel and on an instruction received from an end user device, the instruction characterizing an authorization of the amount of fuel selected by the user from a second instance of the second graphical object displayed on the end user device, the second instance of the second graphical object characterizing the two-dimensional barcode displayed in the first instance of the second graphical object displayed on the interactive display of the fuel dispenser and acquired by the end user device; and

causing, by the data processor, a pump of the fuel dispenser to dispense the amount of the fuel through the fuel dispenser nozzle based on the received dispensing instruction.

**2**. The method of claim **1**, wherein a server generates the dispensing instruction and transmits the dispensing instruction to the fuel dispenser.

**3**. The method of claim **2**, wherein the server transmits the dispensing instruction to the fuel dispenser via a fueling

station controller in operable communication with each of the server and the fuel dispenser.

**4**. The method of claim **2**, wherein the end user device transmits the instruction characterizing the authorization of the amount of fuel to the server, and wherein the server generates the dispensing instruction based on the instruction received from the end user device.

**5**. The method of claim **1**, wherein the end user device is a mobile device, and wherein the first instance of the second graphical object is acquired by a camera of the mobile device.

**6**. The method of claim **1**, wherein the end user device generates the dispensing instruction and provides the dispensing instruction to the fuel dispenser.

**7**. The method of claim **6**, wherein the dispensing instruction is encoded in a second two-dimensional barcode generated by the end user device, and wherein the end user device provides the dispensing instruction to the fuel dispenser by depicting the second two-dimensional barcode on a display of the end user device that is acquired by a two-dimensional barcode reader of the fuel dispenser.

**8**. A system comprising:

at least one data processor; and

memory storing instructions configured to cause the at least one data processor to perform operations comprising:

displaying instructions on an interactive display of a fuel dispenser, the instructions indicating to a user to remove a fuel dispenser nozzle from the fuel dispenser;

receiving, at the fuel dispenser, a selection of a first graphical object characterizing an amount of fuel to be dispensed from the fuel dispenser, wherein the first graphical object is presented on the interactive display,

determining, by a data processor communicatively coupled to the fuel dispenser, a first instance of a second graphical object characterizing a two dimensional barcode, wherein the two-dimensional barcode includes information characterizing the selected amount of fuel,

causing, by the data processor, the first instance of the second graphical object characterizing the two-dimensional barcode to be displayed on the interactive display of the fuel dispenser;

determining, by the data processor, a dispensing instruction characterizing a command to pump the selected amount of the fuel from a fuel reservoir, the dispensing instruction being based at least in part on the first graphical object characterizing the amount and on an instruction received from an end user device, the instructions characterizing an authorization of the amount of fuel selected by the user from a second instance of the second graphical object displayed on the end user device, the second instance of the second graphical object characterizing the two-dimensional barcode displayed in the first instance of the second graphical object displayed on the interactive display of the fuel dispenser and acquired by the end user device; and

causing, by the data processor, a pump of the fuel dispenser to dispense the amount of the fuel through the fuel dispenser nozzle based on the received dispensing instruction.

**9**. The system of claim **8**, wherein a server generates the dispensing instruction and transmits the dispensing instruction to the fuel dispenser.

**10**. The system of claim **9**, wherein the server transmits the dispensing instruction to the fuel dispenser via a fueling station controller in operable communication with each of the server and the fuel dispenser.

**11**. The system of claim **9**, wherein the end user device transmits the instruction characterizing the authorization of the amount of fuel to the server, and wherein the server generates the dispensing instruction based on the instruction received from the end user device.

**12**. The system of claim **8**, wherein the end user device is a mobile device, and wherein the first instance of the second graphical object is acquired by a camera of the end user device.

**13**. The system of claim **8**, wherein the end user device generates the dispensing instruction and provides the dispensing instruction to the fuel dispenser.

**14**. The system of claim **13**, wherein the dispensing instruction is encoded in a second two-dimensional barcode generated by the end user device, and wherein the end user device provides the dispensing instruction to the fuel dispenser by depicting the second two-dimensional barcode on a display of the end user device for acquisition by a two-dimensional barcode reader disposed on the fuel dispenser.

**15**. A method, comprising:

displaying instructions on an interactive display of a fuel dispenser, the instructions indicating to a user to remove a fuel dispenser nozzle from the fuel dispenser;

receiving, at the fuel dispenser, a selection of a first graphical object characterizing an amount of a fuel available for purchase from the fuel dispenser, wherein the first graphical object is presented on the interactive display,

determining, by a data processor communicatively coupled to the fuel dispenser, a first instance of a second graphical object characterizing a two-dimensional barcode, wherein the two-dimensional barcode includes information characterizing the selected amount of fuel,

causing, by the data processor, the first instance of the second graphical object characterizing the two-dimensional barcode to be displayed on the interactive display of the fuel dispenser;

determining, by the data processor, a dispensing instruction based on the selected first graphical object characterizing the amount of fuel and on an instruction received from an end user device, the instruction characterizing an authorization of the amount of fuel selected by the user from a second instance of the second graphical object displayed on the end user device, the second instance of the second graphical object characterizing the two-dimensional barcode displayed in the first instance of the second graphical object displayed on the interactive display of the fuel dispenser and acquired by the end user device; and

causing, by the data processor, the dispensing instruction to be transmitted to the fuel dispenser so as to instruct the fuel dispenser to begin dispensing the amount of the fuel through the fuel dispenser nozzle.

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