Smart Bar
Project Proposal
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1 ABSTRACT

1.1 Purpose

The purpose of this project is to create a robotic bartending system that accurately monitors users to ensure their safety. In society today, high tech systems that allow users to complete tasks more efficiently are becoming increasingly common with the evolution of modern technology. These systems typically require some kind of user input to allow the system to function correctly, but what happens if user input becomes impaired? Warning labels advise against operating equipment while impaired, but what if the equipment directly causes impairment? Technically, the system would function correctly because it operated as designed, but the outcome may not be the originally intended result. This is an important safety issue that appears to be overlooked in the design process of robotic bartending systems. If it is unsafe to operate heavy machinery while intoxicated because of potential injury, it is also unsafe to use a machine that dispenses drinks, which can be harmful in large quantities.

1.2 Objective

Our objective is to design a robotic bartending system with a regulation system that uses identity verification to ensure the correct person, who is not too intoxicated, will be receiving the drink. This robot will monitor users in detail using a combination of identity recognition, BAC detection, and user limitations to support a safe drinking environment. Interfacing with the system will be done mainly through a mobile application, allowing for easy ordering and constant access to personal drinking statistics. The system will be designed for minimal interaction between the user and robotic system to safeguard the user from operating machinery while intoxicated.

2 PROJECT OVERVIEW

2.1 System Overview

Identity Detection

- Fingerprint Recognition

BAC Detection

- Breathalyzer
User I/O System
- Mobile Application
- Touch Screen

Network System
- Wireless communication
- Data update from server

Gravity Dispensing System
- Dispenses liquor
- High accuracy
- Solenoid valve flow control
- Liquid level sensors monitor liquid height
- Valve time calculated from sensor input

Pneumatic Dispensing System
- Dispenses water, soda, and juice
- Solenoid valve flow control
- Uses box and bag syrups

Mobile Device
- Easily order drinks and view statistics
- Main interface of system
- Stores individual user data
- Connected through server

Server System
- Web server
- Stores Drink Library
- Store All Data

2.2 Features Overview

Cut-Off System
- Drink pouring will require breathalyzer and facial recognition
- Recent undigested drinks taken into consideration with breathalyzer result
• Water recommendations
• Previous collected user data used to attempt to predict effects of next drink (i.e. 200 pound heavyweight can have another, 100 pound lightweight cannot)
• Customized warnings configured by user

Identification System
• Fingerprint scanner to login to system (through server)

Mobile Application
• Add drinks to the queue
• Display information and statistics
• Allow user to customize personal settings
• Communication with server to allow users to view history and other data

Server Data Analysis
• BAC data gathered could be used to model individual body reaction to alcohol
• Next day feedback could update drinking warnings automatically
3 BLOCK DIAGRAM
4 DISPENSING SYSTEM DESIGN

4.1 Gravity Powered Bottle System

The bottle system for this project will be gravity powered because it is both inexpensive and simple. The issue with a gravity powered dispensing system is that the flow rate out the container is directly related to the height of the liquid. As liquid exits the container, the weight of the water above the valve decreases, thus reducing the flow rate. This becomes a problem when attempting to dispense a precise amount of liquid, as is the case in this project. By adding a sensor to measure the height of the liquid, this change in flow rate can be calculated by the controller and the valve timing can be adjusted accordingly. Another issue faced by this system is balancing the pressure; as liquid exits the container, the pressure inside the container drops. When the pressure drops, the flow rate decreases and eventually stops until air is able to force its way back into the container. If only one valve is used, a very inconsistent flow rate is achieved because air forces itself back into the container through the valve sporadically. This can be avoided completely by using a secondary valve at the top of the container which opens at exactly the same time as the lower valve to let air in and balance the pressure.

Advantage vs. Using Pumps:

- The cost of the system is much lower
- Can be used with carbonated liquids
- System is very simple - easy to replace things, easy to debug
- Containers are closed at all times other than during pouring - fresh

Disadvantages vs. Using Pumps

- Flow rate is not constant
- Containers must be higher than the dispensing location
- Specific containers must be used instead of the bottles

4.2 Pneumatic Dispensing System

Working with a gravity feed system alone would become a problem when it comes to dispensing soda and juice. Soda bottles loose carbonation quickly after being opened and most juices require refrigeration. Our solution to this problem is to implement an electronically controlled and gas powered dispensing system similar to a fountain drink
dispenser. A carbonator with a CO2 tank can instantly carbonate water to be mixed with syrup to make soda on the spot. The soda dispensed will always be fresh so long as the temperature is controlled properly. We will use a large aluminum block with hollow channels for the water to run though allows for instant cooling. This is possible when the block is submerged in ice water because of the high thermal conductivity of aluminum. Juice dispensed will also be immediately cold, and the syrups do not have to be refrigerated.

4.3 Protection Features

There are a lot of problems with ensuring that the drink poured by the robot ends up in the right hands. People will always be trying to beat the system by having a friend order the drink for them, or use the breathalyzer. These will need to be addressed as they are discovered, but some can be avoided. Identity verification while using the breathalyzer can be used to confirm the correct user. If the total number of drinks a user could order were limited, users would not want to give them away. Users would then get a "drink allowance" of a certain number of drinks per hour to remain at appropriate level. As we develop the robot we will discover ways to beat the system and attempt to protect against them.

5 CONTROL SYSTEM DESIGN

5.1 Actuator Control System

In order to open and close the valves in the dispensing system, and determine which liquid and the quantity being dispensed, a microcontroller needs to interface with these systems to supply power where necessary. All commands, and drink orders eventually need to be converted into simple mechanical motions to pour the drink. Any errors or problems that occur from the actuators will be sent back to the main controller to make sure the appropriate action is taken.

5.2 Power System

All the systems need to be powered off a single power supply, via a wall outlet. The power supply will need to be regulated to several different power rails, including but not limited to the mechanical actuators, sensors, and microcontrollers.
5.3 Sensors

The robot will need the following to identify and interact with users:

- Gas Sensor
- Liquid Level Sensors
- Fingerprint Scanner

The camera will be used for facial recognition and must be a high enough resolution to accurately identify a user. The microphone will receive voice commands from the user. Gas sensors change resistance when in the presence of different concentrations of gases and can be calibrated to detect BAC. The fingerprint scanner will be an additional form of identity verification, allowing users to log in easily. Liquid level sensors will be used to monitor the height of the liquid in the containers. Several options will be considered including light sensors, weight sensors, and ultrasonic sensors to determine the liquid levels. This information must be sent to the actuator controller to control the liquid dispensing.

5.4 BAC Measuring and Cut-Off System

It is important that the user who is ordering the drink is actually in the condition to have another. Drink pouring will first require the user to test his Blood Alcohol Content via a Breathalyzer. A BAC sensor will be implemented to read convert the physical value into a value the controller will use to determine if the user may have another drink. Even if the user has not reached the limit to be cut off, the system will give the user notifications and warnings not to drink too much via the touch screen interface.

5.5 System Controller and Touch Screen User Interface

Once the drink has been ordered over the Mobile Application, information must be sent to a main controller to prepare for drink dispensing. After receiving the order the controller must display on a screen to prompt the user to confirm their identity, and allow for BAC detection via a touch screen. The touch screen will guide the customer through a series of steps, and after the user has been confirmed, and allowed to order another drink, the appropriate commands for the drink will be sent to the actuator control system.

5.6 Identity Detection

One of Smart Bar’s key feature hinges on the ability to confirm that the person picking up the drink is the same who ordered it. The identity recognition will be implemented via facial recognition.
5.7 Microcontroller Requirements

The microcontroller must be able to meet the following requirements to interface with the system:

- USB Port
- Sufficient GPIO
- High processing power
- Non-volatile memory
- UART

6 SOFTWARE DESIGN

6.1 BAC Measuring and Cut-Off System

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6.2 Mobile Application

The majority of the interfacing to the robot will be done through a mobile application. This allows users to order drinks easily and access all of their drinking data (total number of drinks, last recorded BAC, etc.) at any time. Drinks are added to the robot’s queue as they are ordered, and poured upon identity verification. Another advantage is that intoxicated users won’t have to use a single small interface, which could easily get spilled on. Depending on the microcontroller, the data management and communication could be either done through a server or directly by the robot. The mobile applications can also double as a way to manually control the robot to dispense the liquids or override someone trying to purchase a drink.
6.3 Server/Data Management

The robot will connect to a server system through Wi-Fi to manage data storage. The server will be used to communicate with the mobile application, which will free up the robots' processor to perform other tasks.

7 DIVISION OF LABOR

BRENDAN - Electrical Pneumatics System, Gravity Flow System
ELOY - Embedded Microprocessor Integration, Web Developer
LAUREN - Electric/Power Systems, Mobile Applications
MOLLY - Sensor Systems, Container Design
TYLER - Physical UI, Communications
MICHAEL - Software Design, Structure Design