Drinkify – Soda Dispenser

Capstone Final Report

DRINKIFY

Team Members: Hussein Al-Ansari, Jack Michie, Moeez Chaudhry

Student Numbers: 400395232, 400336515, 400264977

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Professor: Dr. Tom Wanyama

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Declaration: We hereby declare that this report represents our own work and has not been plagiarized in any form. All sources used have been properly cited

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Abstract

The Drinkify project presents a compact, modular, and affordable beverage dispensing system designed for homes and small businesses. The system integrates syrup pumps, carbonation control, and a dispensing head, all managed through an Arduino based control system. Key design features include user friendly operation and a compact housing suitable for practical use.

Over the course of the project, our team has successfully implemented a modified version of the SodaStream based carbonator, a 1L seltzer storage tank, relay controlled 12 V valves and pumps for syrup, seltzer and water and a 3D printed static mixer which is used for syrup and seltzer blending. The final prototype carbonates water, then transfers it to its storage, after that it dispenses a mixed drink on command using a button.

Challenges faced were threaded leaks, check valve and initial pump priming needed, inconsistent actuator movement causing inconsistent CO2 injection as well as high current draw. These were addressed with Teflon tape, physical reinforcement for the actuator, and an upgraded 12 V 20A power supply. Future work involves implementing a more accurate valve for injecting carbonation, sensors for smart control, building full modular housing that include user interface controls, and developing advanced features such as an HMI dashboard and IoT connectivity. All of these enhancements, combined with ongoing testing and optimization, will ensure Drinkify's success.

Summary

This report presented the complete development of the Drinkify prototype, an automated and cost-effective soda dispensing system designed for home and small-business use. The project began with an evaluation of the limitations of existing commercial dispensers and household carbonation systems, highlighting the need for an affordable, compact, and user friendly alternative. A review of industrial beverage systems and relevant fluid handling technologies informed the selection of components such as peristaltic pumps, diaphragm pumps, solenoid valves, food grade fittings, and a modified SodaStream carbonator. These findings shaped the conceptual design and established the technical foundation for the system architecture.

The implementation phase detailed the mechanical, electrical, and control subsystems that make up the final Drinkify prototype. The system successfully automates water filling, carbonation, pressure-based transfer to storage, and syrup-seltzer mixing using an Arduino-controlled sequence. Key achievements included modifying a SodaStream bottle with a bulkhead fitting for automated inlet and outlet flow, developing an actuator-controlled carbonation mechanism, implementing relay-based switching for all pumps and valves, and tuning the dispensing ratio using voltage-regulated pump control. The process flow and Arduino logic were structured around a timed sequence approach, enabling reliable operation despite the absence of sensors.

The project also addressed numerous engineering challenges, including leaks, pump priming issues, actuator alignment problems, pressure equalization effects, and electrical noise from the Arduino startup behavior. Each issue was resolved through iterative testing and targeted redesigns, resulting in a stable and functional prototype. Through this debugging process, the team improved both mechanical reliability and control consistency.

Overall, Drinkify demonstrates that a low-cost, modular soda dispenser can be built using accessible components while still delivering automated carbonation and beverage mixing. Although the prototype does not yet include advanced features such as active cooling, closed-loop sensing, or an HMI interface, it successfully validates the core concept of an automated soda dispensing system. The conclusions from this report show that further enhancements such as flow sensors, temperature control, integrated housing, and IoT connectivity would greatly improve performance and move Drinkify closer to a deployable product. The work completed in this term establishes a strong foundation for future development and demonstrates the technical feasibility of the system.

Introduction

The Drinkify project aims to create a cost-effective alternative to industry standard commercial soda dispensers. While existing competitors such as Coca-Cola with their Freestyle machines offer a wide variety of beverage options, and are designed for large commercial scales, they are much more expensive, often costing over $20,000. With our Drinkify project we are attempting to deliver a more accessible and affordable solution that can be used in small businesses or home environments while maintaining comparable beverage quality and user convenience.

The drink dispensing system contains several interconnected modules: a carbonation system, a seltzer storage tank, a syrup and seltzer mixing unit, and a dispensing mechanism. These subsystems are managed through Arduino-based control logic, which automates the sequence of filling, carbonating, mixing, and dispensing.

From a user perspective, the final Drinkify system will be intuitive to operate. Once fully completed, the user will be able to activate a switch which will then manage the dispensing process, activating the syrup and seltzer pumps to create a mix at the specified ratio, then dispensing the drink through the outlet to the user, while automatically maintaining the reserve of carbonated water.

This user-friendly approach, combined with affordable hardware components, enables Drinkify to provide the essential features of professional soda dispensers at a fraction of the cost.

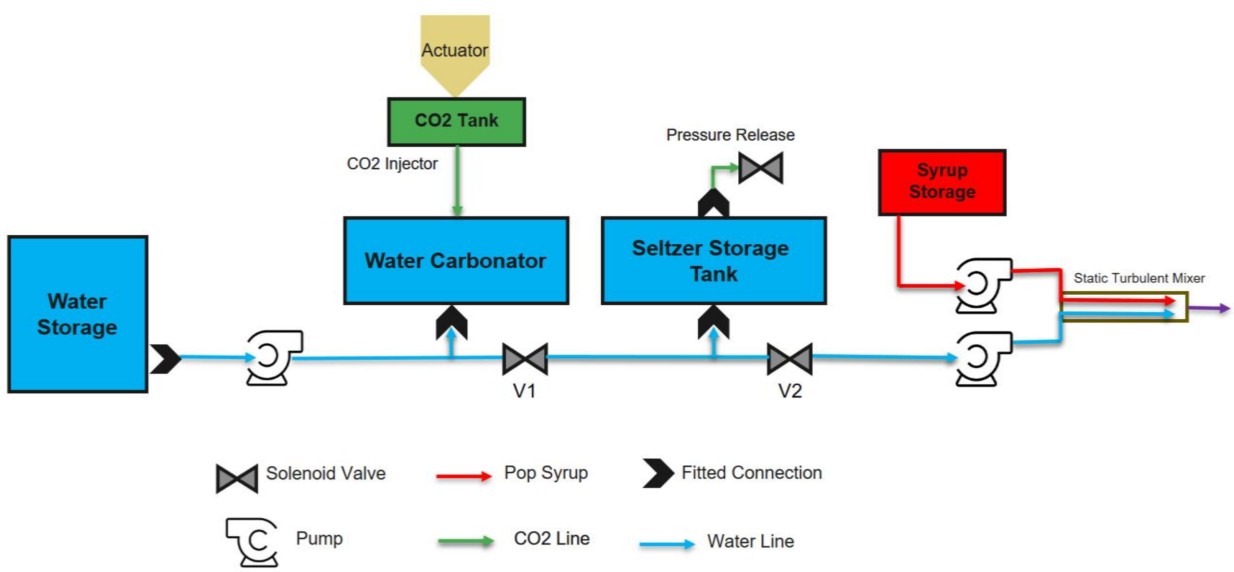

Figure 1 – Overall System Concept Diagram

Project Background / Literature Review

The beverage dispensing industry is primarily driven by large-scale, high-cost systems designed for commercial use. Machines such as Coca-Cola's Freestyle dispensers employ advanced micro-dosing pumps, RFID-enabled syrup cartridges, integrated refrigeration, and sophisticated digital control systems. Although these designs deliver exceptional accuracy, beverage variety, and strong brand control, their cost, physical footprint, and maintenance requirements make them impractical for small businesses or residential users.

Simpler home carbonation systems, such as SodaStream, have made carbonation more accessible to consumers but still rely heavily on manual interaction. The user must manually inject CO_2, control the carbonation level by "feel," and mix syrup and water separately. These systems do not provide automated portion control or integrated mixing, and they struggle to maintain optimal carbonation levels once the beverage is stored for any length of time. This gap between fully industrial machines and simple household devices motivates solutions that combine automation, precise dosing, and better CO_2 retention in a compact format.

Literature on fluid handling in food and beverage applications emphasizes the importance of accurate liquid metering and flow control to maintain drink consistency and carbonation. Peristaltic pumps are widely favoured for syrup dispensing because the fluid only contacts the inside of the flexible tubing. This prevents contamination of the pump mechanism, simplifies cleaning, and makes peristaltic pumps particularly suitable for high-viscosity, sugar-based syrups that could otherwise foul internal pump components. Their ability to deliver repeatable volumetric doses at low flow rates makes them a common choice wherever precise flavour ratios are required.

For water and carbonated water movement, diaphragm pumps are frequently used. They are capable of generating higher pressures and handling gas–liquid mixtures better than many other low-cost pump types. Their sealed, self-priming design allows reliable operation with intermittent duty cycles, which is important in carbonation cycles where water is repeatedly moved into and out of a pressurized vessel. This combination of durability, pressure capability, and cost effectiveness makes diaphragm pumps well suited for the water or seltzer side of small beverage systems.

Cooling and temperature management are also noted in literature as important factors in carbonation performance. Carbonated beverages retain CO2 more effectively at lower temperatures. While sophisticated commercial systems often use refrigeration or PID controlled cooling modules, small scale systems such as Drinkify rely on simpler methods. For Drinkify, ice was stored in the water during testing to maintain lower temperatures and improve carbonation stability without requiring a dedicated cooling subsystem.

Industry guidelines for beverage equipment emphasize the need for materials that are safe for food contact. Tubing, fittings, and seals must be constructed from food grade polymers or stainless steel to prevent contamination and preserve beverage quality. This informed the selection of polypropylene push to connect fittings and appropriate beverage grade tubing in the Drinkify system. These materials provide durability and safety while remaining affordable and easy to integrate into the prototype.

Project Implementation

The initial design from 4TR1, while very similar to the final architecture, was much more ambitious in scope. Previously, the project envisioned a fully integrated system with TEC-based active cooling around the seltzer tank, a PID control loop to maintain 4 °C, a touchscreen or HMI interface, and IoT connectivity for cloud-based inventory monitoring and remote control. The design also assumed full sensor-based feedback (level sensors, flowmeters, and temperature probes) to drive closed-loop control for carbonation, mixing ratios, and storage conditions.

In 4TR3, the core concept and major subsystems remained the same (SodaStream-based carbonator, 1L seltzer storage tank, peristaltic syrup pump, diaphragm seltzer pump, and Arduino-based control), but the implementation was refined to match realistic constraints in time, budget, and complexity. Instead of implementing TEC cooling and PID temperature control, the final prototype used ice to keep the water cold during testing, allowing the team to focus on reliably automating carbonation and dispensing first. Likewise, advanced features such as an HMI, IoT connectivity, and full flow/level sensing were moved to "future work" so that the limited development time could be spent on building the actual process and debugging the mechanical and electrical hardware.

Some changes to the water/seltzer lines were made to once tested in practice to reduce amount of pressure buildup to improve the flow of seltzer. Modification designs to the bottle including the carefully sealed bulkhead fittings were not fully specified in the earlier design. On the dispensing side, the theoretical 5:1 water-to-syrup ratio from 4TR1 was preserved, but in 4TR3 it was implemented through voltage regulators controlling the flow rate of both pumps before combining at a static mixer.

Bottle Modifications

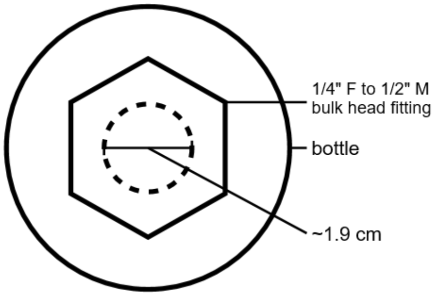

Figure 2 - Bulkhead Fitting Hole Layout for Carbonator Bottle

Figure 3 - Installed Bulkhead Connection on Modified Carbonator Bottle

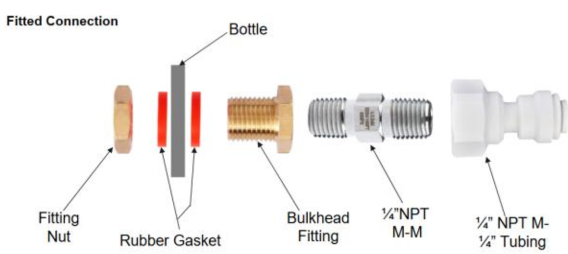

Figure 4 - View of Bulkhead Fitting Assembly with Gaskets & Push to Connect Adapter

The SodaStream bottle required modifications to support automated filling and draining, since the original design does not include any ports for water input or seltzer transfer. A hole was drilled into the bottle using a step drill bit, and a bulkhead fitting was installed to create a secure, pressure resistant pass through connection. Rubber gaskets on both sides of the bottle wall ensured an airtight and watertight seal during carbonation. A threaded adapter and push to connect fitting were then attached to interface with the fluid tubing in the system.

This modification allowed water to be pumped into the carbonation tank and carbonated water to flow out into the storage tank through controlled valve operation. Without this bulkhead assembly, the bottle could only function as a manual carbonation chamber, and the Drinkify system would not be able to automate the carbonation and transfer process.

Carbonation System

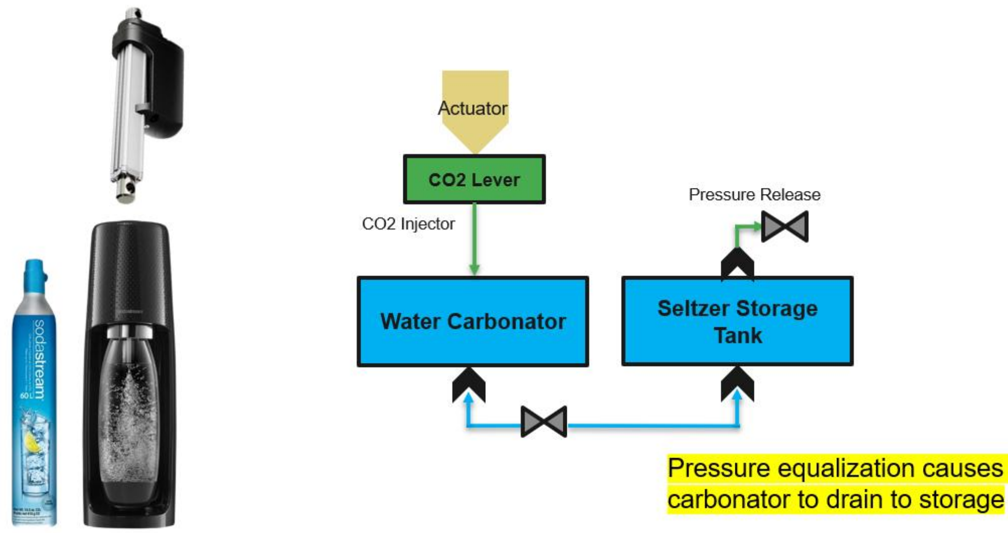

Figure 5 - Carbonator Design

Carbonation was one of the most important and challenging aspects of the Drinkify design. Commercial carbonation systems typically use specialized pressurized vessels, electronically controlled regulators, and high-cost metering assemblies that maintain precise CO_2 injection. These systems were far beyond the budget and complexity requirements of the Drinkify prototype.

To achieve effective carbonation while remaining inexpensive and safe, a SodaStream bottle and carbonation head were selected as the base carbonator. SodaStream devices are designed to safely prevent over pressurizing using a built-in safety relief valve, and they provide a reliable mechanical seal. However, a standard SodaStream requires manual operation, meaning the user must physically press the lever to inject CO_2. This manual mechanism could not support automated carbonation cycles.

A linear actuator was used to automate the manual process of pushing the lever down for carbonation. This allowed the Arduino to perform repeated carbonation cycles with consistent timings of the actuator extending to press down the SodaStream lever. The actuator movement direction can be controlled through an H bridge logic circuit, and the press and release durations were calibrated through testing to achieve adequate levels of carbonation.

Water is pumped into the carbonator during the filling stage, and once carbonation is complete, pressure equalization allows the carbonated water to drain into the seltzer storage tank. A solenoid valve on the top of the storage tank ensures that the seltzer storage tank remains at a lower pressure level than the carbonator to increase the flow of the carbonated water from the carbonator into storage.

This approach provided a simple and cost effective carbonation subsystem that delivered consistent carbonated water without the need for industrial equipment. The combination of the SodaStream carbonator, automated actuator motion, inlet and outlet routing, and passive pressure equalization created an automated carbonation cycle that aligned with the affordability goals of the Drinkify project.

Syrup Mixing

The syrup pump flow is controlled using a voltage regulator which allows the syrup rate to tuned to match the seltzer flow. A 3d printed static mixer (6mm diameter insert) is placed in the line to create turbulent flow. This allows for thorough mixing of syrup and carbonated water before dispensing.

Figure 6 - 3D Printed Static Mixer

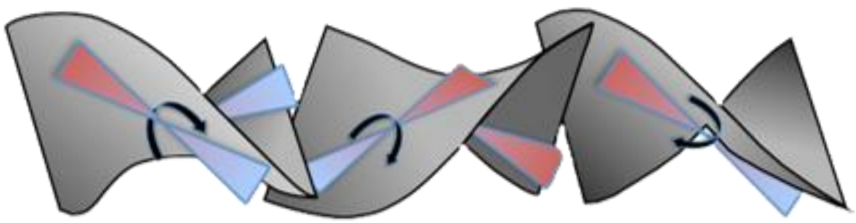

Figure 7 - Turbulent Flow causing Radial Mixing

Electrical Wiring

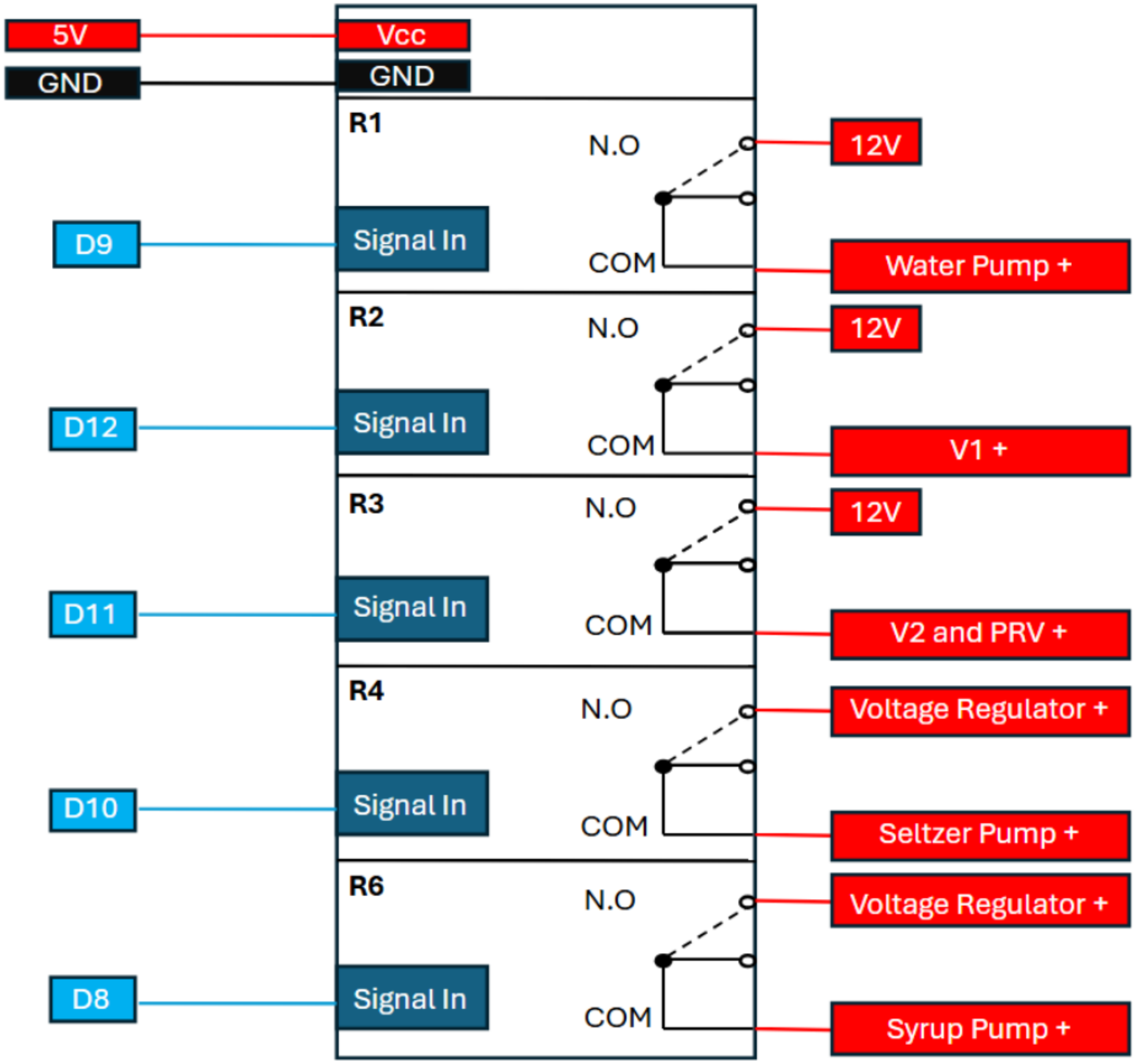

Figure 8 - Relay Wiring

As shown in figure 8 relays were used in our Drinkify system to safely interface high-power 12V pumps with the low voltage 5V Arduino controller. Since the pumps required more current than the Arduino can supply directly, relays acted as electrically operated switches that allowed the Arduino to control these components without being exposed to high voltage or current. By sending a small control signal to the relay coil, the Arduino can toggle the pump circuits on or off. This solution ensures electrical and system reliability while allowing the use of 12V components.

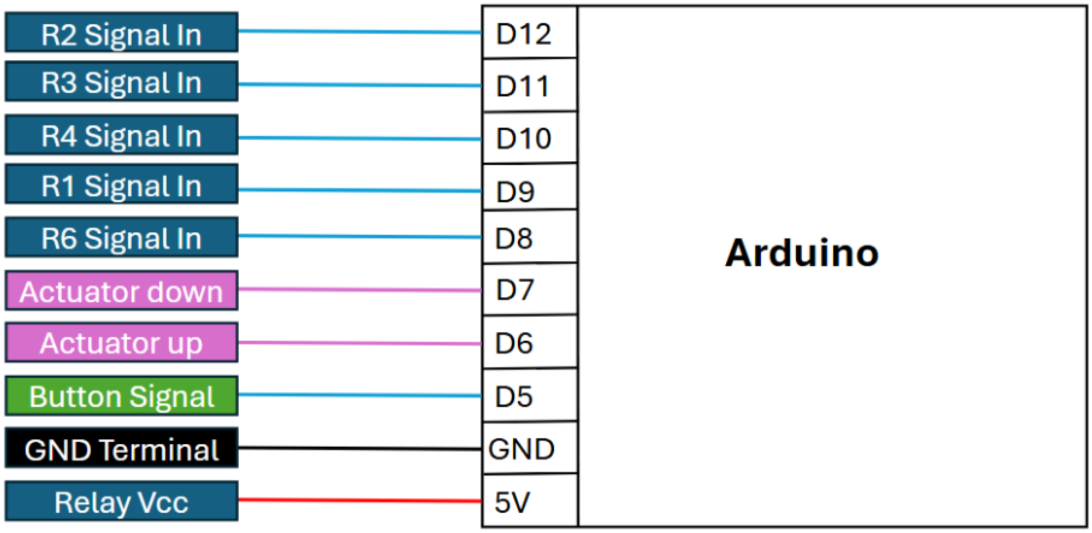

Figure 9 - Arduino Connections

Figure 9 shows the Arduino pin mapping used in the final prototype. Digital pins D8-12 provide signal lines to the relay modules, D6-D7 drive the actuator up/down through the H-bridge, D5 reads the front panel button, and the relay board shares the Arduino's 5V and GND rails for logic power and common reference.

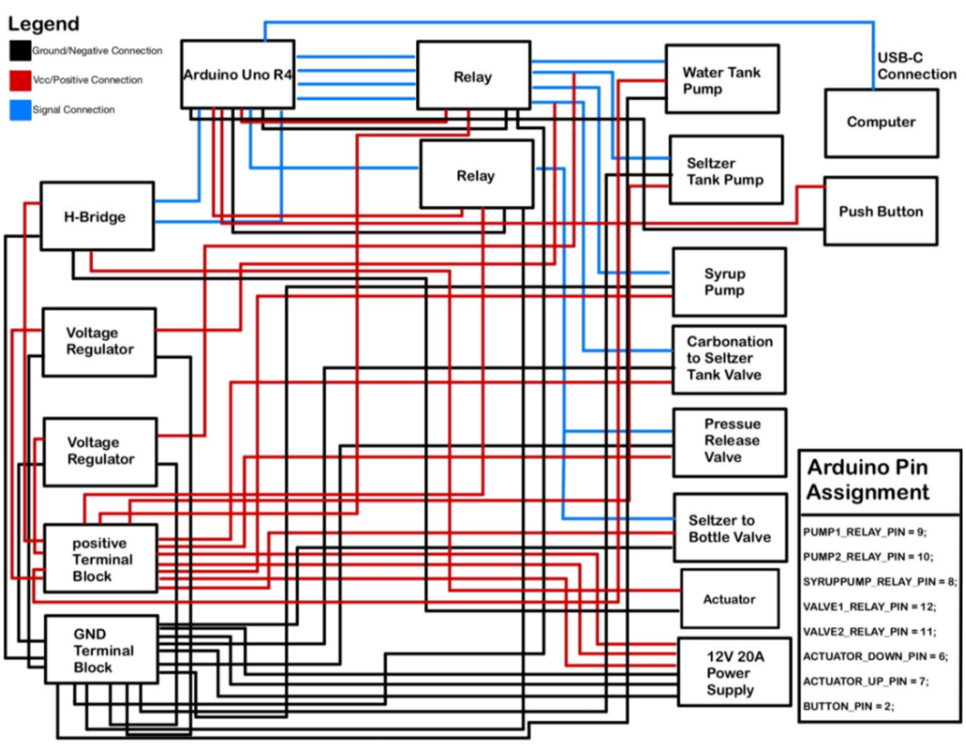

Figure 10 – Full Wiring Diagram

Process Flow and Coding

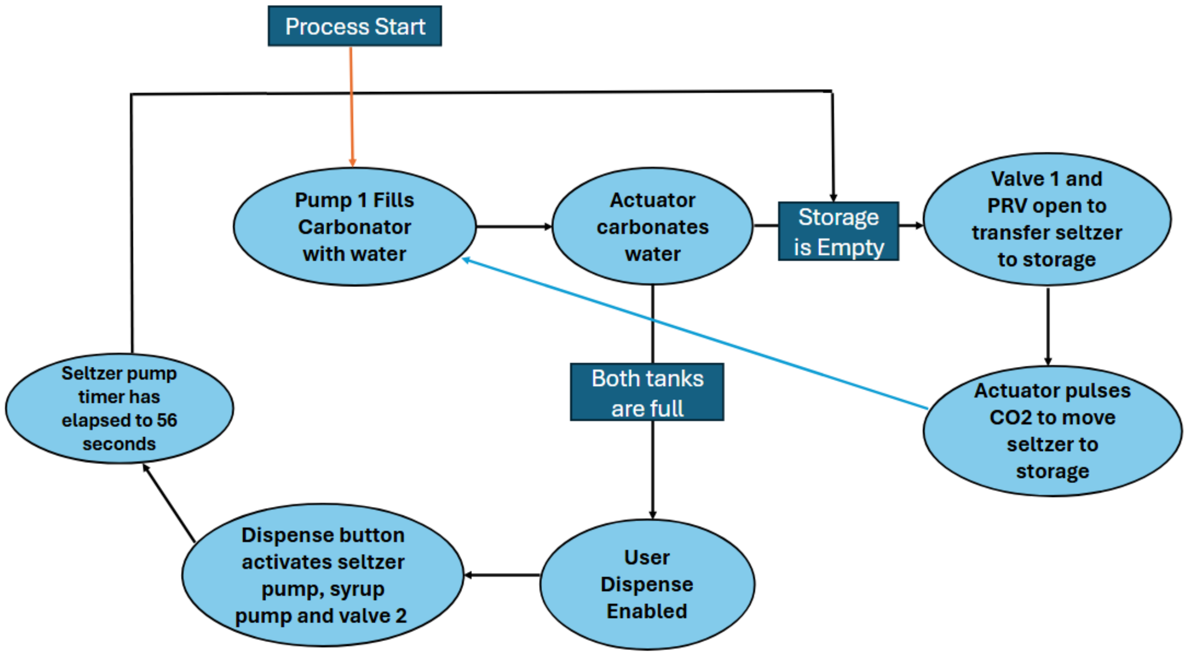

Figure 11 – Process Flow Diagram

The Drinkify system operates as a sequential process controlled entirely by the Arduino Uno R4. The overall workflow is represented in the process flow diagram and follows a repeatable sequence that manages water filling, carbonation, seltzer storage, and user dispensing. Because the prototype does not contain any level sensors, the system relies on carefully designed timing routines and actuator movement cycles to ensure consistent operation.

1. Process Initialization

When the system starts, the Arduino initializes all relay outputs, the H bridge actuator pins, and internal timers. In the prototype, the system is assumed to be empty on power up. The process immediately transitions into water filling and carbonation.

2. Water Filling Stage

Pump one is activated to fill the carbonation tank with a measured volume of water. Since no flowmeter or level switch is used, this is performed through a timer. The timer duration is determined experimentally based on the diaphragm pump flow rate. Once the required time has elapsed, the Arduino proceeds to the carbonation phase.

3. Carbonation Stage

The linear actuator is extended to press the SodaStream carbonation lever. This motion injects CO_2 into the carbonator. The actuator then retracts and is pulsed several times to maintain consistent pressure within the chamber. Timing values for actuator press duration, retraction, and pulsing were established through multiple tests to produce repeatable carbonation.

4. Transfer to Seltzer Storage Tank

Since the system is empty upon start up, valve one and the pressure relief valve are opened by energizing their relay channel. This allows the carbonated water to drain into the storage bottle. The actuator performs pulsed downward motions to push CO_2 into the system which forces seltzer into the storage tank. After a fixed timed interval the valve is closed and the system returns to the filling stage until the required storage volume is achieved.

Once the system has completed a predetermined number of fill and transfer cycles, both the carbonator and the storage tank are considered full and the system transitions to user mode.

5. User Dispense Mode

When both tanks are full, the Arduino enables the dispensing sequence. The user may press the momentary push button to request a drink. The button is read through a digital input pin.

When the button is pressed:

- The seltzer pump activates to move carbonated water from seltzer tank
- Valve two opens to allow flow through the mixer
- The peristaltic syrup pump activates at a regulated voltage to achieve a five to one seltzer to syrup ratio

If the elapsed pump timer reaches 56 seconds, the Arduino transfers the carbonated water from the carbonation tank into the seltzer tank and determines that the carbonation tank needs refilling and transitions out of user mode to begin a new carbonation cycle.

Design Evaluation and Criteria (Pairwise Comparison Chart)

The pairwise comparison chart was used to determine which design criteria were most important for guiding the Drinkify system. The five criteria evaluated were cost effectiveness, size efficiency, intuitive user experience, modular and scalable design, and maintainability. By comparing each criterion against the others, the chart helped establish a clear priority order for the project.

Cost effectiveness received the highest score, reflecting the need to create an affordable alternative to commercial soda dispensers. Size efficiency ranked second, since the system had to fit comfortably in small business or home environments. User experience, modularity, and maintainability each scored equally, showing that while they are important, they were secondary considerations in comparison to cost and space constraints.

The results of the PCC chart directly influenced the design direction. They justified the use of low-cost components such as an Arduino controller, diaphragm pumps, relay modules, and a modified SodaStream carbonator, while also supporting a compact plywood mounted structure. Overall, the PCC ensured that the final concept aligned with the most critical project requirements and remained practical within the scope of the capstone.

Criteria	Cost Effectiveness	Size Efficiency	Intuitive User Experie nce	Modular & Scalable Design	Maintainability	Total
Cost Effectiveness	*	1	1	1	1	4
Size Efficiency	0	*	1	1	1	3
Intuitive User Experience	0	0	*	0.5	0.5	1
Modular & Scalable Design	0	0	0.5	*	0.5	1
Maintainability	0	0	0.5	0.5	*	1

Figure 12 - Pairwise Comparison Chart (PCC)

Component List

Electrical and Control Components

- Arduino Uno R4
- Two ELEGOO four channel five volt relay modules
- Redrex 12V 20A Power Supply
- Two LM2596 adjustable DC to DC voltage regulators
- L298N dual H bridge motor driver
- Momentary push button switch 12V 20A
- MYFULLY DC 12V Linear Actuator
- Terminal blocks for power and ground distribution
- 16 AWG Electrical Wires
- 20 AWG Electrical Wires

Fluid Handling Components

- Two Spires 12V diaphragm pumps
- High flow peristaltic pump 12V four 400ml/minute
- Three DIGITEN twelve volt normally closed solenoid valves
- One way check valves
- Food grade polypropylene push to connect fittings
- 3/8'' Quick Connect Tube Fitting
- 1/4'' to 3/8'' Tube Push fit Quick Connect Tube Pipe Fitting
- 1/4'' Food grade flexible tubing
- 3/8'' Food grade flexible tubing

Carbonation and Storage Components

- Modified SodaStream bottle with inlet and outlet ports
- CO_2 cylinder with regulator
- 1L Seltzer storage bottle

• 5L Water Storage Tank

• Relief line and overflow collection bottle

• Bulkhead Fitting

Mechanical Components

• Plywood mounting boards

• Adjustable metal table legs

• Brackets, screws, Zip ties, and general mounting hardware

• 3D printed static mixer

• 3D Printed press fitted lever attachment

• Stainless Steel Hose Clamps

Component Selection

Component selection for the Drinkify prototype was guided by four major criteria: cost effectiveness, reliability, safety, and compatibility with the required level of automation. Each part was chosen based on performance characteristics that aligned with the functional needs of the carbonation, pumping, mixing, electrical control, and dispensing subsystems.

Our overall system design shown in figure 1, combines all previously mentioned components and concepts. The process begins at the water inlet, where water is directed into the improvised water carbonator using a 12V pump controlled by a 5V relay. When the actuator is activated and pressed the lever, CO_2 is injected from into the tank to carbonate the water. Once carbonated, the now seltzer is drained using pressure equalization into a 1L storage tank, where it is ideally kept at a constant 4°C. Once the program determines the storage tank is empty, it is refilled with a new batch of seltzer. Once a user triggers the activation switch the system pulls carbonated water and syrup from their respective storage tanks using a peristaltic pump for syrup and diaphragm pump for seltzer each operated on variable voltage amounts from the voltage regulator to control flowrate, which are activated by an Arduino controlled 5V relay.

Discussion

Our project aims to address the lack of accessible soda dispensers for personal and small-business use. Existing machines, such as the Coca-Cola Freestyle, are designed for high-volume, commercial environments, making the initial investment very steep. We are developing a cost-efficient alternative that can be used on smaller scales without compromising quality or functionality.

From a practicality standpoint, the final Drinkify prototype demonstrates that a modular carbonated drink system can be built using off-the-shelf components and an Arduino-based control strategy. When user activates the button, the system automatically carbonates the water in a modified SodaStream bottle. Then it transfers it into a 1 L seltzer storage tank and is ready to dispense. When dispensing, the system mixes the syrup and seltzer drink using a static mixer. The use of affordable parts such as the pumps, solenoid valves, relay and a linear actuator, make the system easy to recreate for at home use or small businesses. The biggest concern now is long term durability, especially regarding the CO_2 containment and seals that are used. Since we do not have long term testing results as well as the absence of an integrated cooling system. Another issue is that the system relies on time-based control rather than a closed loop flow and level feedback.

There are many alternate implementations that could used for a more industrial version of Drinkify. For the control side, using a PLC could replace the Arduino, providinng more robust I/O, built in safety diagnostics, and easier integration with HMI and SCADA systems. In addition, a Raspberry Pi could be added for advanced data logging, tweaking recipes, or even a GUI. This could be done while still using microcontroller level hardware for real time tasks. For the fluid side, using a purpose built industrial carbonator or even a pressurized mixing tank can replace the SodaStream mechanism. This would allow for higher pressures, better carbonation retention and be able to operate to commercial specifications. A gravity-fed design with elevated tanks could reduce the number of pumps but would sacrifice flexibility in layout and fine control over flow rate and ratio.

The current Arduino-based Drinkify prototype offers simplicity and low cost, which is ideal for prototyping and small, low-volume applications. Compared to PLC-based systems, it has limitations in noise immunity, data processing, and real-time determinism, but it is easy to program and modify. Likewise, the SodaStream-based carbonation approach is inexpensive and familiar to users but was not originally intended for continuous, automated operation, so its long-term reliability is lower than that of industrial carbonators. Using flowmeters and level sensors would be a lot more precise than using the time-based control strategy. However, this would increase complexity and cost. These decisions were made intentionally to prioritize an affordable and accessible system which provides educational value for this stage of development.

Over the term, the team has incrementally improved the practicality of the system. The carbonation subsystem was built and tested to reliably inject CO_2 using the actuator and H-bridge, and its ability to retain CO_2 and prevent leaks was validated through repeated trials. Issues such as solenoid valve backflow, check-valve priming, and non-food-safe fittings were resolved through the addition of one-way valves, system priming procedures, and certified polypropylene connectors. Mechanical instability of the actuator was addressed by redesigning the press-fit attachment and reinforcing the mount to deliver consistent lever strokes. On the control side, the final code implements automatic batch handling (auto transfer and refill after a defined pour time), manual serial overrides for testing, and an emergency stop routine that moves the actuator to a safe position and shuts down all outputs.

Overall, the Drinkify prototype is a compact, semi modular soda dispenser that is technically feasible for small scale use. Currently it does not match the cooling performance or capabilities of commercial equipment, but it successfully proves the core concept of automated carbonation and dispensing using low cost components. Future improvements can focus on this foundation by adding closed loop sensing, integrated cooling and more robust mechanical design. By adding a higher-level user interface, it can move the system closer to real world deployment.

Problems and Solutions

Throughout the development of the Drinkify prototype, several mechanical, electrical, and fluid related challenges emerged. Each issue required iterative testing and corrective action to ensure reliable carbonation, fluid transfer, and dispensing. The following summarizes the key problems encountered and the solutions implemented.

1. Pump Priming Difficulties

The diaphragm pumps required initial priming before they could begin drawing water or seltzer through the lines. Without priming, the pumps would run dry and fail to generate suction.

Solution:
The lines were manually primed during setup, and check valves were added to help retain water in the tubing after each cycle. This reduced the amount of priming required and improved consistency.

2. Threaded Leaks in the Carbonator Fittings

During early testing, the threaded bulkhead connections on the SodaStream bottle allowed small leaks when the carbonator was pressurized.

Solution:
Teflon tape was applied to all threaded connections. This sealing method prevented CO2 and water leakage and ensured the bottle could safely handle carbonation pressure.

3. High Pressure Leaks in Tubing Connections

At higher carbonation pressures, small leaks formed at tubing joints and fittings, especially where flexible tubing connected to rigid components.

Solution:
Multiple layers of electrical tape and hose clamps were added to reinforce these joints. This created a more secure seal and prevented pressure loss during actuator cycles.

4. Actuator Control Issues Using the H Bridge

Early attempts to control the linear actuator revealed inconsistent extension and retraction due to incorrect wiring and unclear motor direction control.

Solution:
The L298N H bridge was wired correctly to the actuator motor, and the Arduino code was updated to generate proper forward and reverse signals. This allowed precise control of the carbonation lever motion.

5. Calibration of System Timing

Because the system does not contain level sensors or flow sensors, accurate timing was critical. Through testing, the team observed that the storage tank emptied exactly at fifty six seconds of pump operation.

Solution:
This timing value was programmed into the Arduino logic. It became the basis for determining when the storage tank was empty and when a new carbonation cycle was required.

6. Pressure Equalization Causing Carbonator to Drain Unexpectedly

When carbonation was complete, pressure equalization sometimes caused the carbonator to drain too quickly into the storage tank.

Solution:

A top mounted valve was added to the seltzer storage tank. This valve allowed air to escape to atmosphere when required, reducing pressure buildup and allowing controlled draining.

7. Excessive Pressure Equalization Leading to Overflow

At times, the pressure in the system equalized too quickly and forced water out of the top of the storage tank.

Solution:
An overflow bottle was installed at the top vent. This captured excess water safely and prevented liquid from escaping into the environment during pressure spikes.

8. Arduino Pin Thirteen Output Pulsing on Startup

Pin thirteen on the Arduino Uno R4 is internally tied to the onboard LED and pulses during startup. This caused unintended activation of whichever relay was assigned to that pin.

Solution:
Pin thirteen was completely removed from use in the final code. All relay channels were reassigned to safe digital pins that remain low during boot.

9. Actuator Pressing Angle and Force Issues

The actuator did not initially align with the SodaStream carbonation lever and could not consistently press downward with enough force.

Solution:
A 3D printed press fit lever extension was designed and installed. This attachment properly aligned the actuator motion with the lever and allowed reliable carbonation cycles.

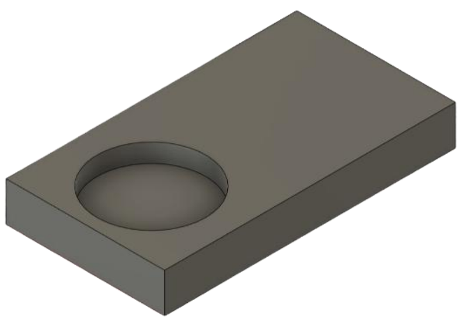

Figure 13 - 3D Printed Press Fitted Lever Attachment

Conclusion and Future Work

Conclusion

The Drinkify project designed and created an affordable soda dispensing system that is catered for homes and small businesses. As an alternative to the large and expensive commercial dispensers. The core concept was successfully demonstrated in the final prototype. By modifying a SodaStream carbonator alongside a dedicated seltzer storage tank with pumps, the dispenser is able to automatically carbonate water. Using an Arduino based control system, the system after carbonating, transfers to the storage tank and then dispenses a mixed syrup seltzer drink using a static mixer.

Over the term, the team has progressed from 4TR1 proposal to a fully functioning prototype. The system combines mechanical, electrical and control subsystems on a single platform. Notable achievements are developing a reliable linear actuator mechanism for CO2 injection, tuning all the carbonation and transfer sequence in the software and using relay based control for all 12 V loads. The team addressed practical issues such as leaks, backflow and non food safe fittings. Although the prototype created does not have all the originally planned features such as active cooling, PID temperature control and an HMI. It does meet the primary objective of demonstrating a functional, low cost automated soda dispenser built with accessible components.

Future Work

There are many directions for future improvement. From a control perspective, the time-based approach that is used to track the seltzer usage could be upgraded to a closed loop control that uses flowmeters and level sensors in both the carbonation and storage tanks. This would greatly improve the accuracy, lower the dependence on fix timing assumptions and allow for automatic detection of errors like partial fills and leaks. Also, adding pressure and temperature sensors would allow for safer operation and overall more consistent carbonation levels.

Another area of importance for future work is thermal management. By implementing a dedicated cooling system such as a thermoelectric (TEC) module with PID control would allow for the system to maintain 4 degrees Celsius and significantly improve carbonation stability. This would be a drastic improvement over the ice based method used during testing. On the user interface side, the system can be improved with a small touchscreen or HMI to allow the user to select flavours, display status, and show maintenance prompts.

Integration with an IoT platform can provide usage statistics, CO_2 and syrup inventory tracking.

Finally, there are mechanical refinements and further testing that needs to be done before any real world deployment. These includes designing a fully enclosed housing, improving the cable and tubing management for serviceability. By upgrading the structural components for repeated use and validating the durability of pumps and valves. Future iterations should assess compliance with relevant food and beverage equipment standards. These enhancements would move Drinkify from a successful proof of concept to a deployable system for daily use.

References & Appendices

Appendices:

References (APA):

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