Automated Stomach Fluid Transfer for GI Complications

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Design Goal and Motivation

Pancreatic cancer patients and others with GI Complications lack a connection between their stomach and intestine. They use an auxiliary system of 2 tubes for feeding into the intestine (Jejunal Tube) and extracting stomach acids (Gastrostomy Tube).

At consistent intervals, patients must extract stomach acids using a syringe and reinfuse these through their intestinal tube.

This can be a **time-consuming process** and requires patients to **smell** and **look at foul stomach fluids**, which leads to **patient non-compliance** that can significantly **worsen patient outcomes.**

Our **goal** was to **improve patient outcomes by developing a fully automated system with minimal user interaction, promoting ease of use and compliance.**

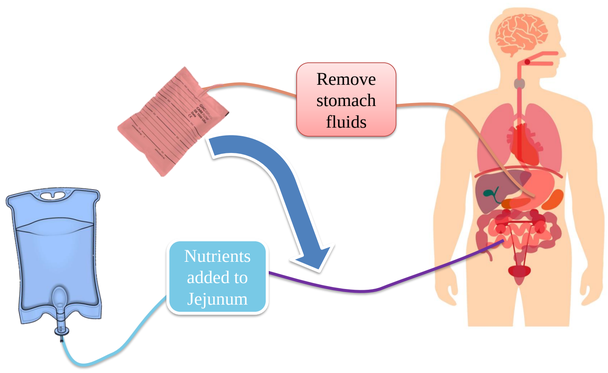

Fig 1. Current Jejunal Transfer System
Current System uses a syringe to transfer stomach fluids to the Jejunal tube (Blue Arrow). The designed system will automatically complete this transfer.

Design Solution

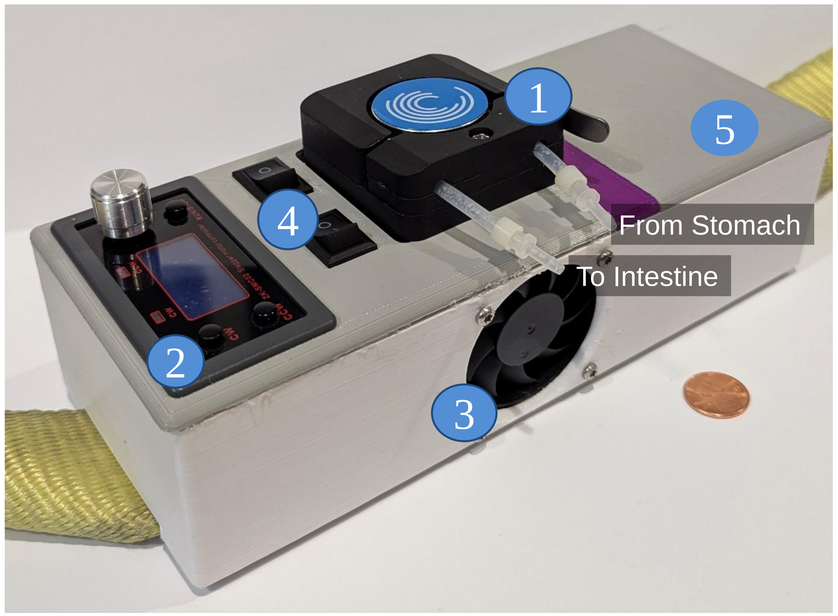

Fig 2. Completed Design Solution of the Automated Jejunal Transfer System

Key Design Components

1. Peristaltic Pump: Operates at 12–24V, delivers up to 140 ml/min flow, fits 2–3 mm I.D. tubing, and includes a stepper motor harness for precise control.
2. Stepper Motor Driver (5-30V, 4A): Powers and controls stepper motors, setting speed, direction, and movement.
3. Cooling Fan (12V): Maintains optimal system temperatures
4. System Switches: One main switch controls the entire system, and a separate switch powers the 12V cooling fan.
5. 8 lithium-ion batteries in series (3.7V each)

Process of Operation

Healthcare Provider sets Customized Target Flow Rate → Patient turns on switches for the system → Patient presses Run on the controller → Stomach Fluids are quickly transported into the J-Tube

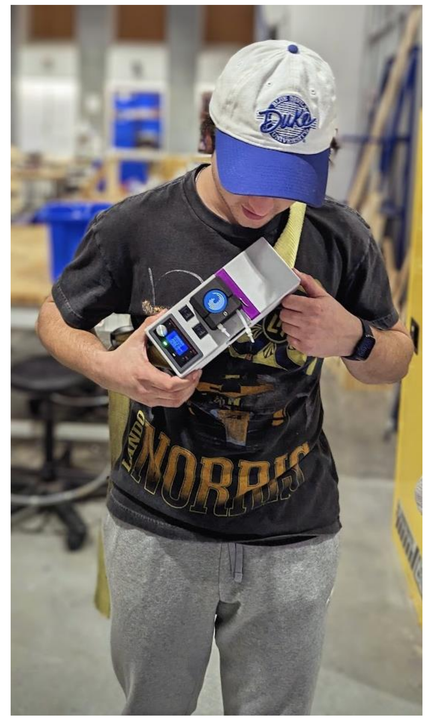

Fig 3. Wearable Prototype in Use

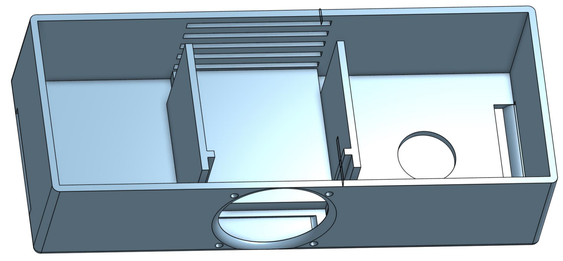

Fig 4. Housing 3d Model

Design Criteria and Testing

Design Criteria	Performance Criteria	Test	Result
Transport Nutrients	Flow Rate ≥ 15 ml/hr	Flow rates were tested under various speed settings, all consistently exceeding 15 mL/hr	**Pass** – Capable of flow rate ≥ 250 ml/hr
Combining Nutrients	Mix stomach fluids and nutrients from IV	Combining nutrients was demonstrated using food dye, visibly tracking the mixing process	**Pass** – Fluids mixed sufficiently
Smell	Odor cannot be detected within a minute of opening	A smell test using vanilla extract was conducted to demonstrate that the system contains odors effectively.	TBD
Sight	Stomach acids cannot easily be seen by the user	Tape was applied around the tubing to conceal the gastric contents	TBD
Durability	Last ≥ 6 Months	Measure the degradation in performance over 15 10 mL transfers	**Fail** – ± 3s in transfers after 5 trials, but component broke
Ease of Use	Activation takes ≤ 2 Steps	Count the # of steps needed for a patient to activate the system	**Pass** – 2 Steps
Weight	≤ 3 lbs (1.36 kg)	Weigh the full unit	**Pass** – 2:13.7 lbs (1.30 kg)

Conclusion and Future Plans

Current System:

- Uses a customizable pump to automate transfers of stomach fluids when activated
- Reduces the amount of time & effort needed for patients
- Portable for on-the-go use

Future Plans:

- Include pressure sensor to automatically actuate system when patients feel discomfort
- Create night-time and 24-hour modes for extended use
- Enhance system durability for long-term reliability

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