



MEDIHELP

ADAPTIVE, SMART, GRAVITY BASED INFUSION PUMP MONITOR

TEAM MEDIHELP
UNIVERSITY OF MORATUWA



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ADAPTIVE SMART GRAVITY BASED INFUSION PUMP

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WHY ?

Key Problems Identified:

Manual Flow Rates:

Deviations cause overdose/underdose risks, especially critical for chemotherapy.

No External Display:

Patients cannot monitor Flow, and staff must constantly check manually.

Patient Self-Adjustment:

Some patients dangerously self-adjust flows, particularly for chemotherapy.

Expensive Regulators:

Advanced pumps are expensive and rare in Sri Lanka, limiting access.



Our proposed solution effectively addresses these issues identified during a field visit to Apeksha Hospital in Maharagama on 12th August 2025, conducted under the guidance of Dr. Ranjith Mahilal, Medical Officer – Oncology



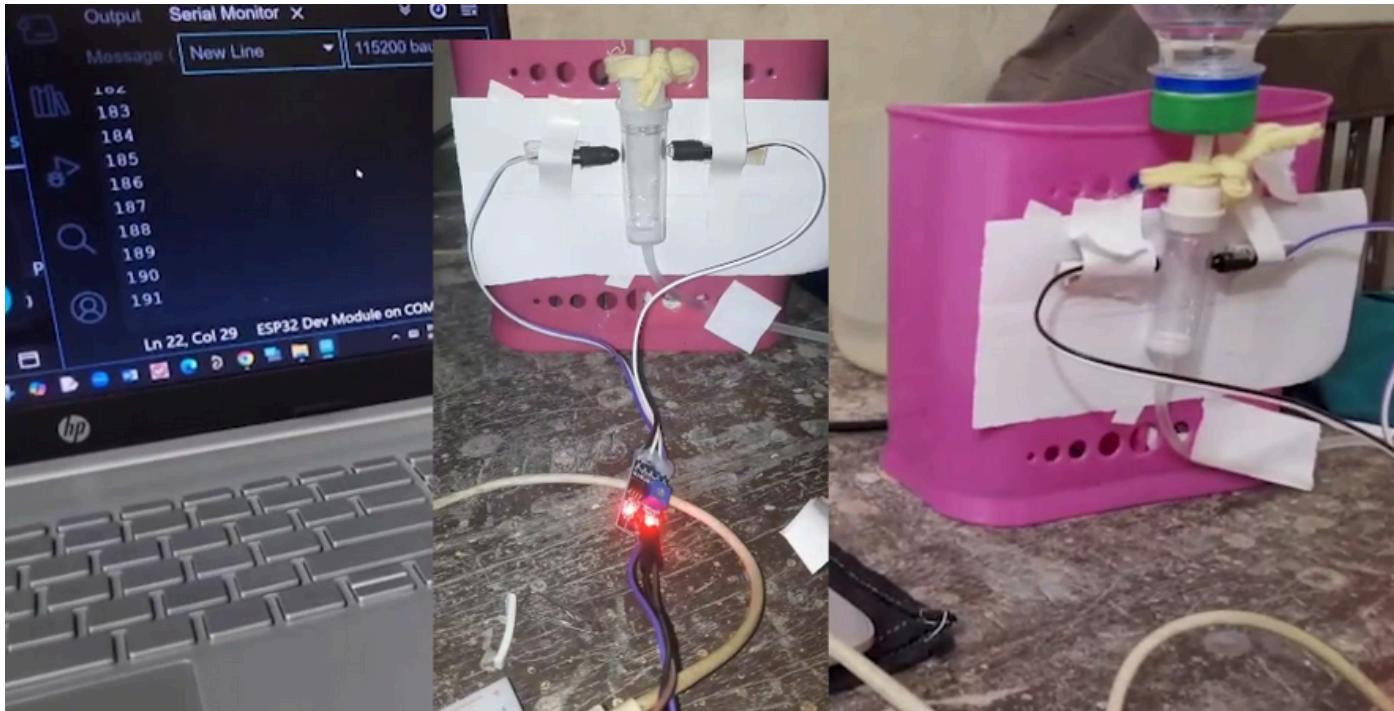


WE ADDRESS A SERIOUS ISSUE IN HEALTHCARE!

As identified **during a field visit to Apeksha Hospital in Maharagama on 12th August 2025**, conducted under the guidance of Dr. Ranjith Abeywardhana, Medical Officer – Oncology,

for a ward of 25 beds, only 3 advanced infusion pumps are available where other 22 beds are making use of simple gravity based infusion pumps!

IR Method



Capacitive Method

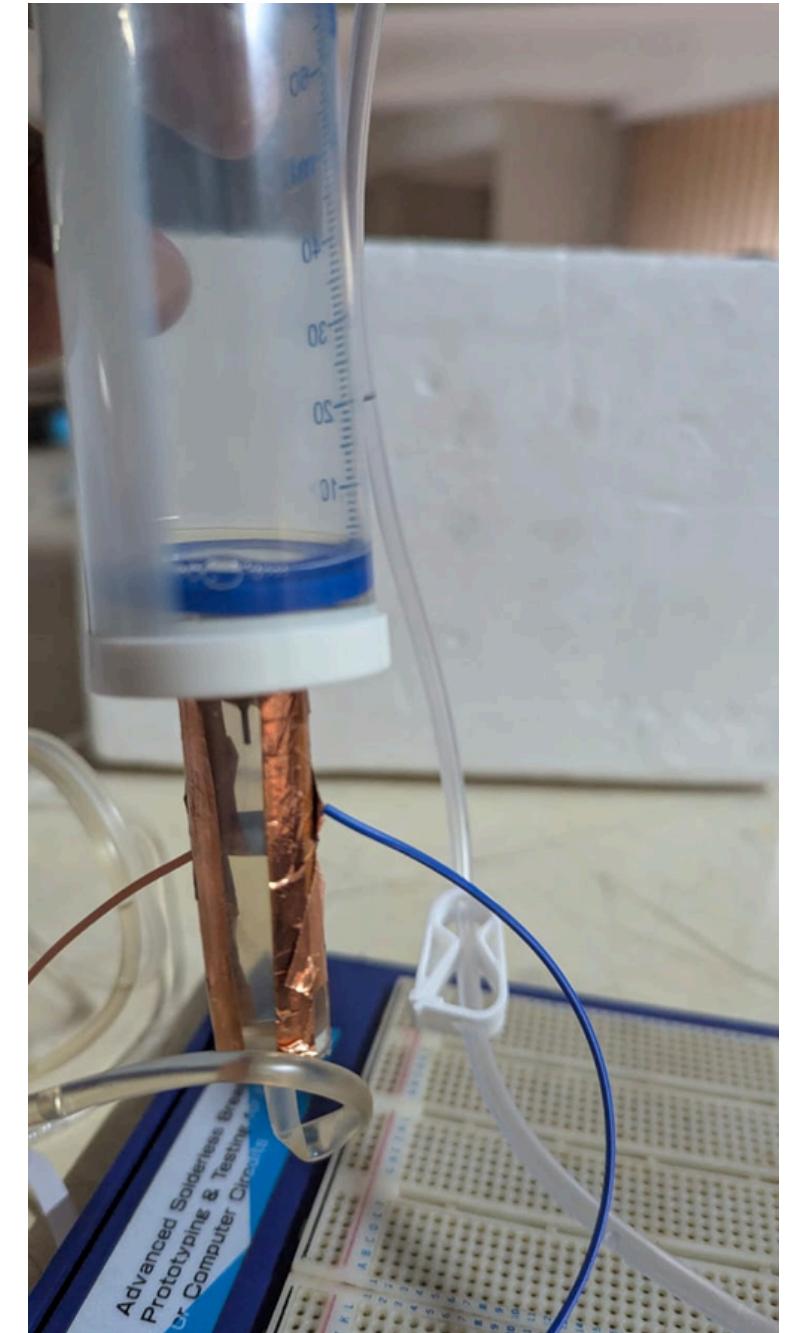
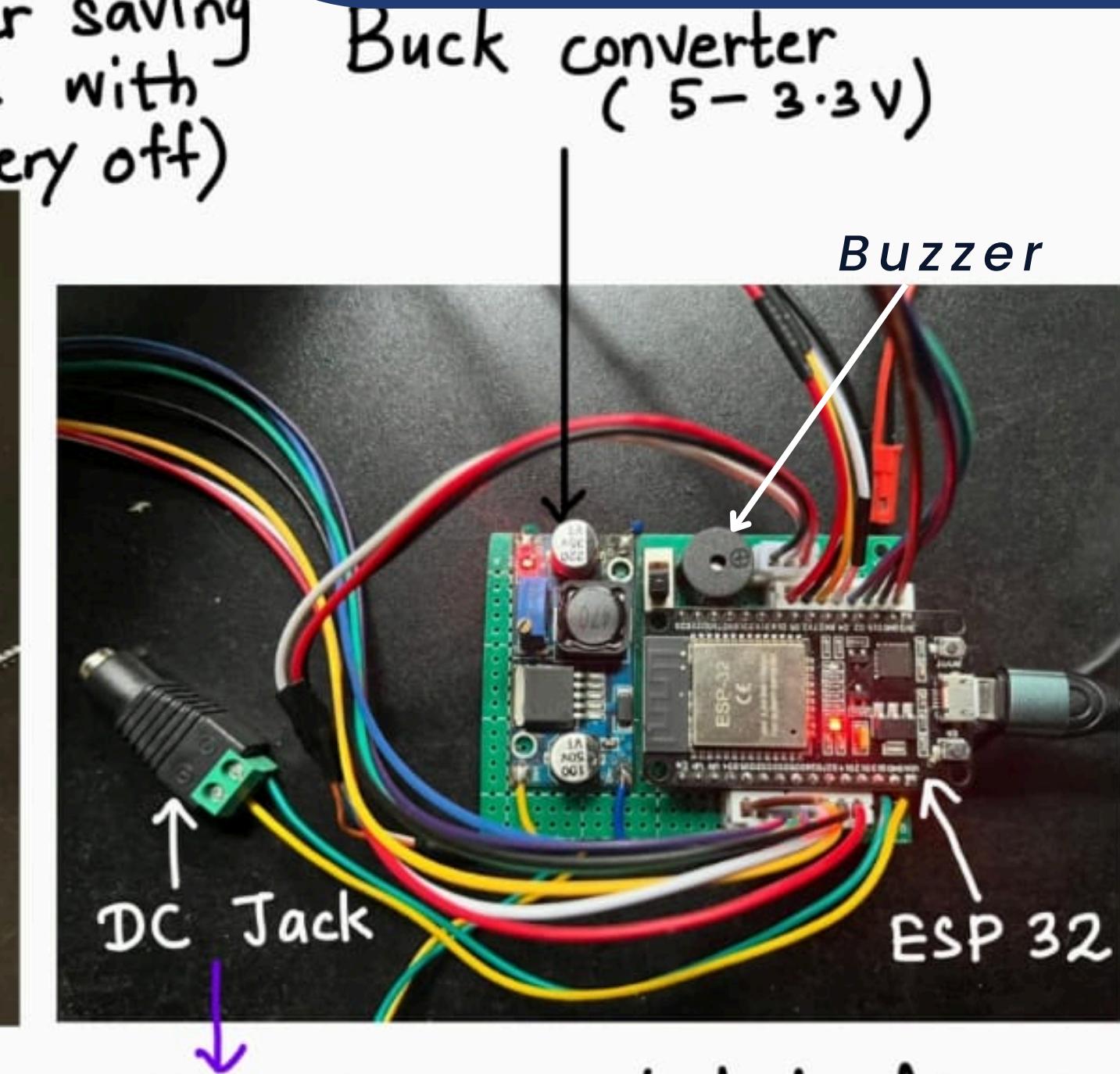
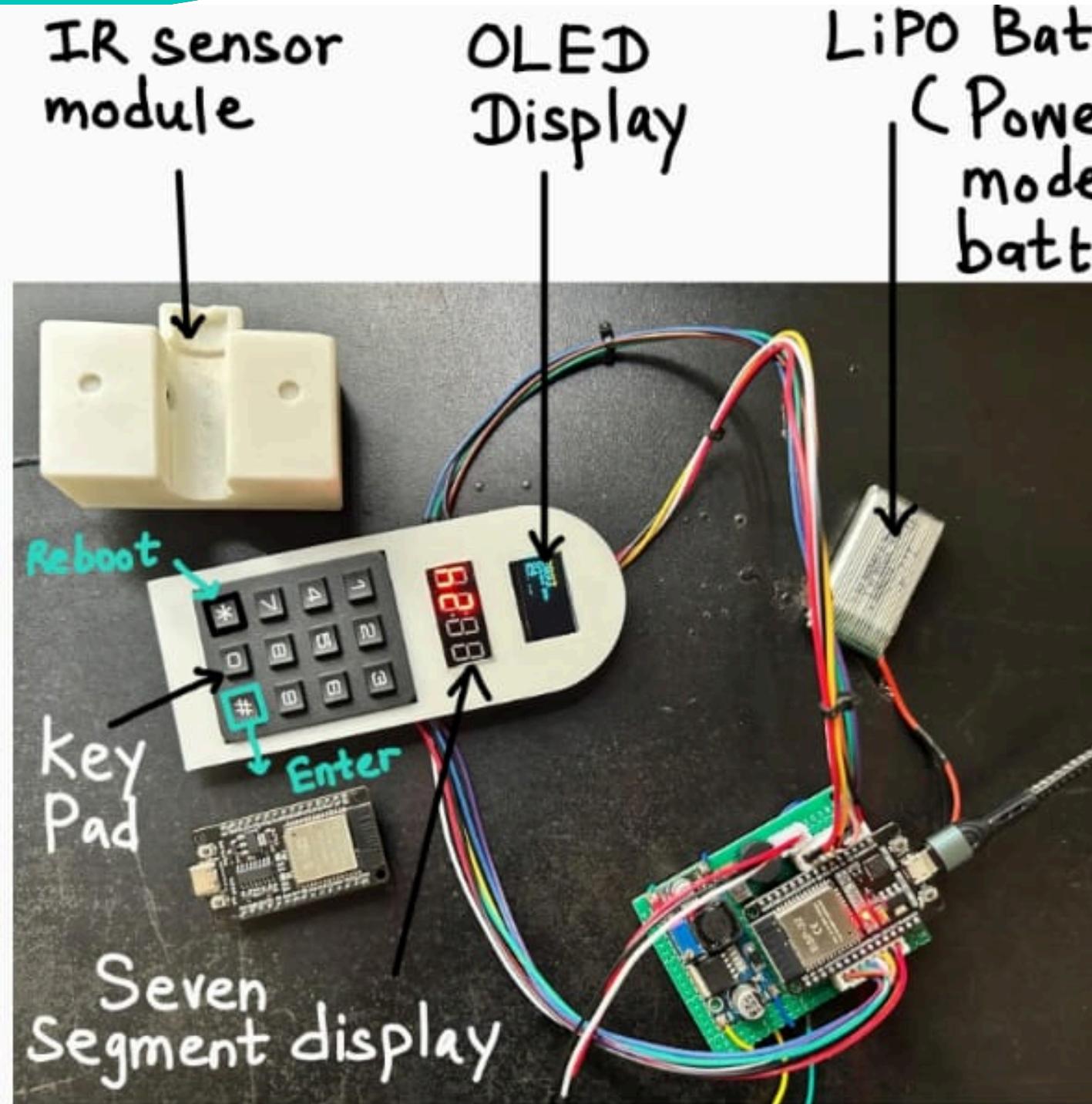


Image processing Method

Circuit Design and Product Dissection

Component Selection



Directly connected to Ac power
to 5v DC adapter



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Component	Role in the Product
ESP32	The brain of the system. Processes signals from the IR sensor, calculates drop rate, displays results, and connects with mobile/IoT systems.
Buzzer	Acts as an alarm. Alerts staff immediately when the drip rate deviates from the expected value.
Num Pad	Allows medical staff to input the desired drip rate (drops/min) for each patient.
Display	Shows the real-time drip rate in drops/min and mL, making it doctor-friendly and patient-friendly.
TP4056	Manages battery charging with built-in overcharge protection, ensuring safe and reliable backup power.
DC Jack	Provides AC power connection for continuous operation in the ward.
3D Printing	Creates the protective enclosure. Designed to be easily opened for sensor inspection, cleaning, and maintenance.
IR Sensor	Detects each IV fluid drop when it interrupts the light beam, enabling accurate real-time drop counting.

Technical Overview

Tools	Platform / Service	Technologies & Protocols
ESP32 DevKit (hardware)	On-device MCU (ESP32)	Arduino
TP4056 module, Li-ion battery	Power subsystem	Battery charge/protection, AC/DC adapter input
IR emitter & receiver pair	Sensor subsystem	Photointerrupt detection, analog/digital input
OLED / LCD	Local UI	I ² C/SPI display drivers
Buzzer, NumPad, Magnets, Wires, PCB	Mechanical & electrical components	GPIO, debouncing, and mechanical mounting
3D printer (Prusa/Creatality)	Enclosure prototyping	Fusion
Development IDEs: PlatformIO / Arduino / ESP-IDF	Firmware dev	C/C++ with JSON serialization
Mobile app: Flutter	Mobile platform (Android/iOS)	JSON over MQTT/REST;
Testing tools: Multimeter, Oscilloscope, Postman, Android emulator	Lab & QA	Automated unit tests, integration tests
PCB fabrication: JLCPCB	Altium	Gerbers, pick-and-place files

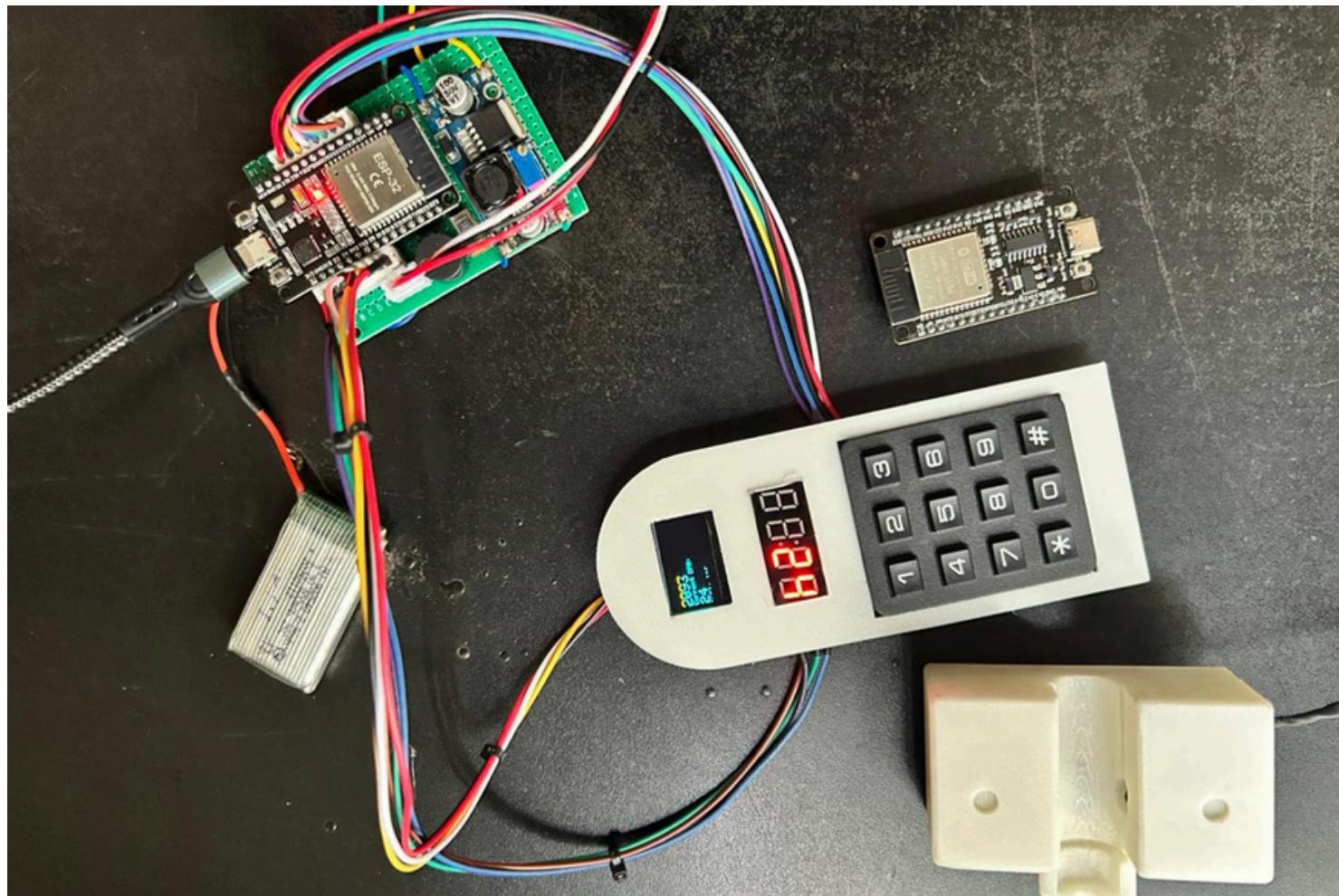
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ADAPTIVE SMART GRAVITY BASED INFUSION PUMP

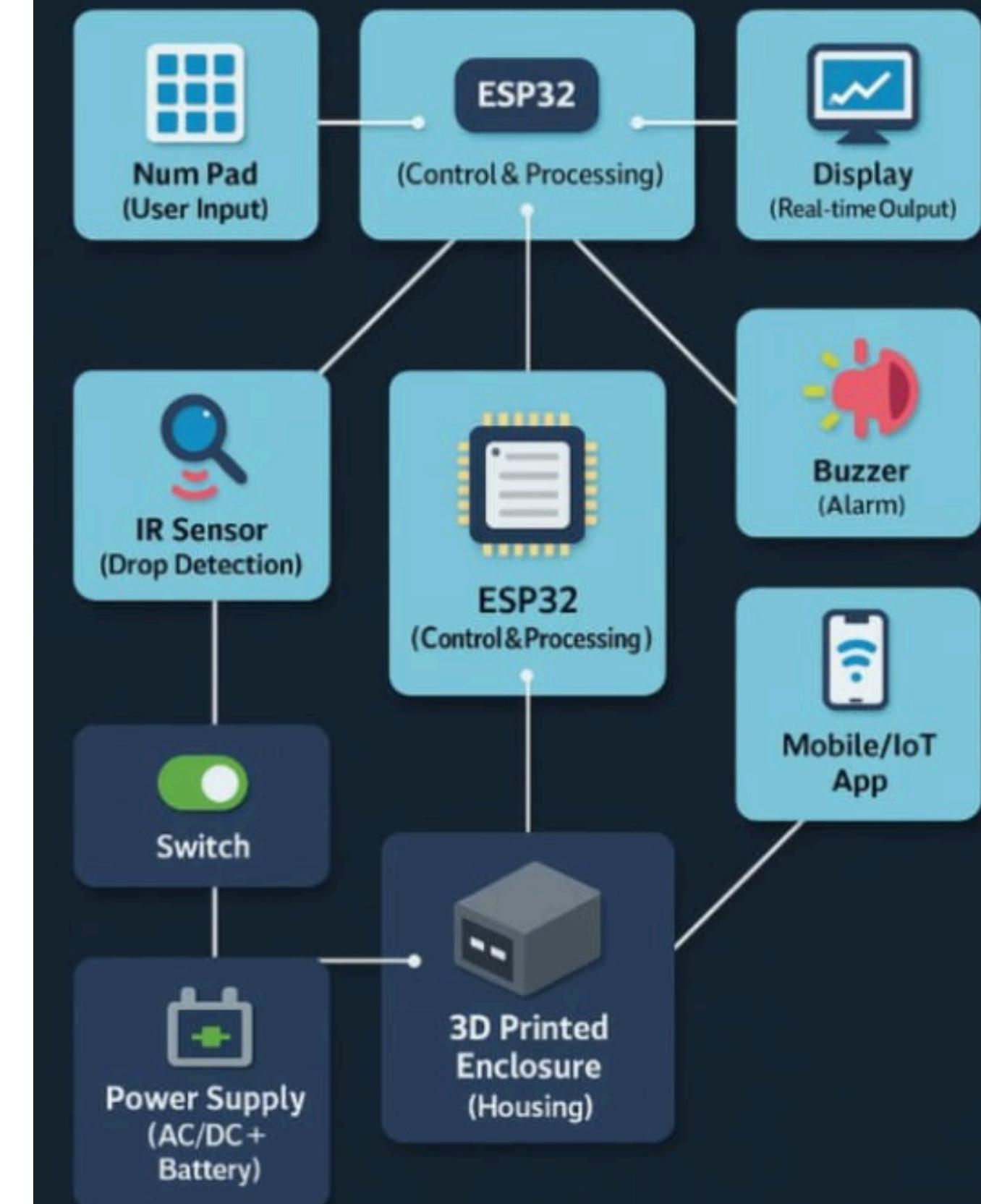


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Funcional block diagram



Product Functional Architecture Flow Diagram



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UI/UX Design and IOT Integration

The image shows a screenshot of the InfuCare software interface, which includes a login screen, a dashboard, and several registration modules.

Login Screen: The leftmost window shows the InfuCare login page. It features a logo, the text "InfuCare IV Fluid Regulator System", and fields for "Username" (oshu_vp) and "Password". A "Login" button is at the bottom, and a note "Authorized personnel only" is at the very bottom.

Dashboard: The central window displays the InfuCare dashboard. At the top, there are links for "Registration", "Manage", "Device Monitor", "All Devices", "Patient History", and "Administration". A user profile for "Oshadha Perera" is shown, along with a "Logout" button. Below these are three summary cards: "Total Devices" (2 Registered devices), "Total Patients" (4 In database), and "Total Beds" (3 Registered beds). At the bottom of the dashboard, there are three buttons: "Register Device" (Add new monitoring device), "Register Patient" (Add new patient information), and "Register Bed" (Add new bed/ward).

Device Registration: The bottom-left window shows the "Device Registration" module. It has a "Device Monitoring" section with a table and a "Monitoring" section with a table.

Patient Registration: The bottom-middle window shows the "Patient Registration" module. It has a "Patient Monitoring" section with a table and a "Monitoring" section with a table.

Bed Registration: The bottom-right window shows the "Bed Registration" module. It has a "Bed Monitoring" section with a table and a "Monitoring" section with a table.

Footer: The bottom right corner of the dashboard shows a purple sidebar with the InfuCare logo and the text "Loading InfuCare..." followed by five dots.

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localhost:3000/register/patient localhost:3000/administration localhost:3000/monitor localhost:3000/history

InfuCare - IV Fluid Monitor InfuCare - IV Fluid Monitor InfuCare - IV Fluid Monitor InfuCare - IV Fluid Monitor

Patient Registration

Full Name *: Oshadha Perera

NIC Number *:

Phone Number:

Date of Birth: mm/dd/yyyy

Gender: Select Gender

Address:

Create Device Assignment

Device *: Select Device

Patient *: Select Patient

Bed *: Select Bed

Expected Drop Rate (drops per minute) *:

Diagnosis:

Real-Time Device Monitor

Select Active Assignment: oshadha perera - ESP32_005 - Bed BED_01

Tip: Type patient name or device number to search

Patient Information

Name: oshadha perera
NIC: 200326111972
Bed: BED_01
Ward: ICU
Diagnosis: cancer

Current Status

Normal

Expected Rate: 17 drops/min

Current Rate: 17 drops/min

Drop Rate History Chart

Upali - 200384100283

Tip: Type patient name or NIC to search

Drops per Minute vs Time

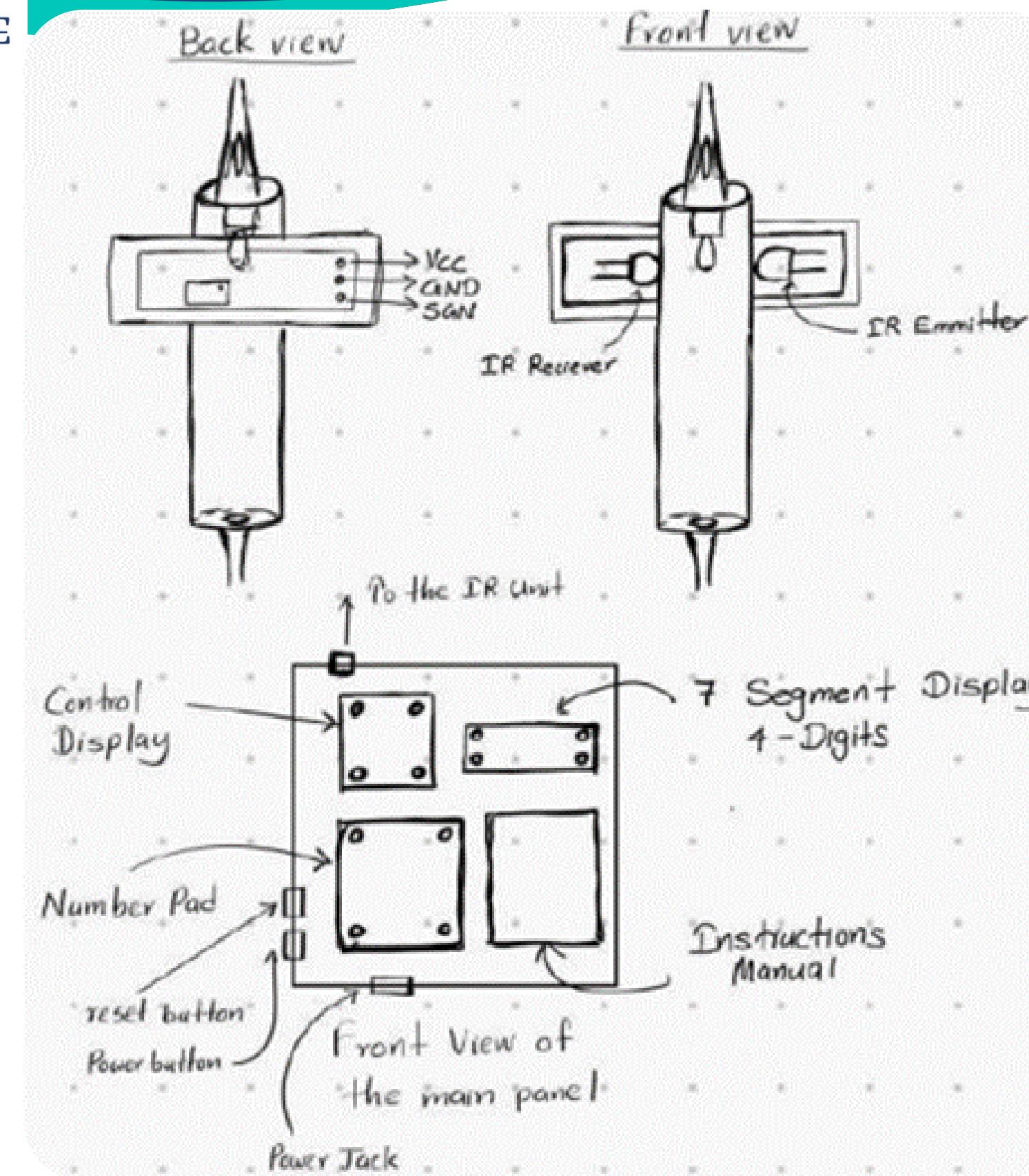
11/25/2025, 9:46:53 AM
Expected: 12 drops/min
Actual: 57.84826 drops/min
Deviation: 45.85 drops/min
Critical

DATE & TIME **EXPECTED RATE** **ACTUAL RATE** **DEVIATION** **STATUS**

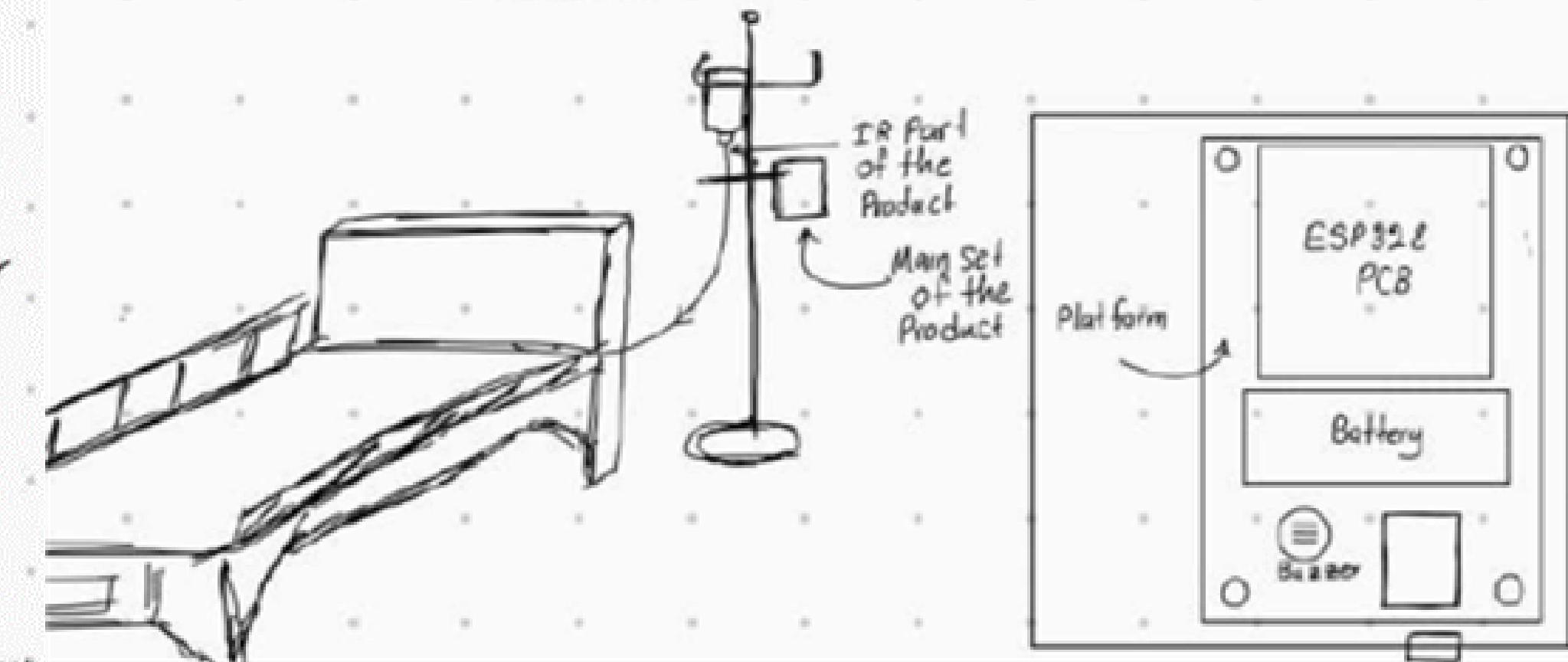
DATE & TIME	EXPECTED RATE	ACTUAL RATE	DEVIATION	STATUS
11/25/2025, 10:29:23 AM	557 drops/min	210.4078 drops/min	346.59 drops/min	Critical
11/25/2025, 9:49:19 AM	557 drops/min	116.6938 drops/min	440.31 drops/min	Critical
11/25/2025, 9:47:47 AM	12 drops/min	159.679 drops/min	147.68 drops/min	Critical
11/25/2025, 9:47:43 AM	12 drops/min	159.679 drops/min	147.68 drops/min	Critical
11/25/2025, 9:47:37 AM	12 drops/min	159.679 drops/min	147.68 drops/min	Critical
11/25/2025, 9:47:33 AM	12 drops/min	159.679 drops/min	147.68 drops/min	Critical
11/25/2025, 9:47:27 AM	12 drops/min	170.3347 drops/min	158.33 drops/min	Critical
11/25/2025, 9:47:23 AM	12 drops/min	2.338062 drops/min	9.66 drops/min	Critical
11/25/2025, 9:47:17 AM	12 drops/min	57.84826 drops/min	45.85 drops/min	Critical

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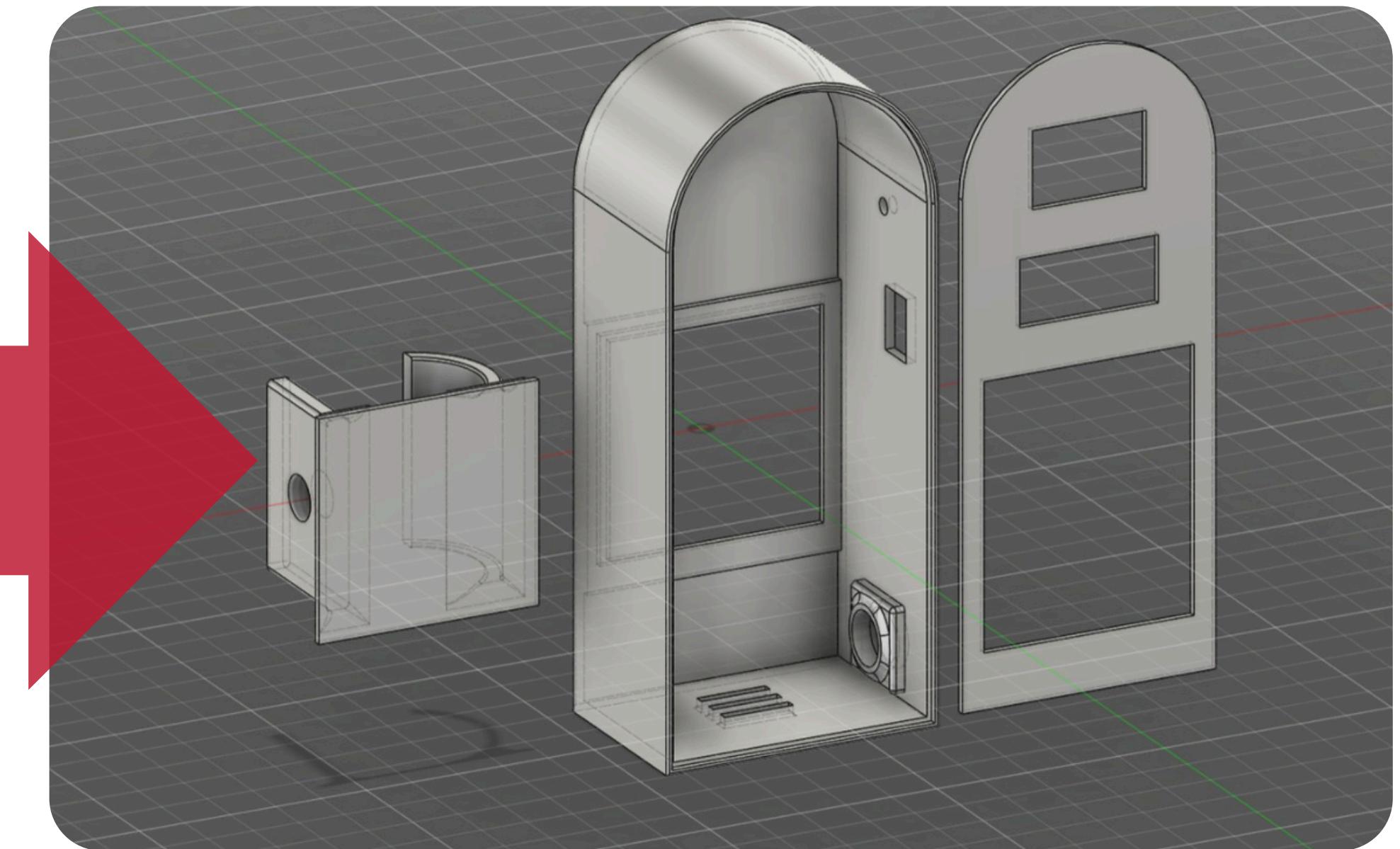
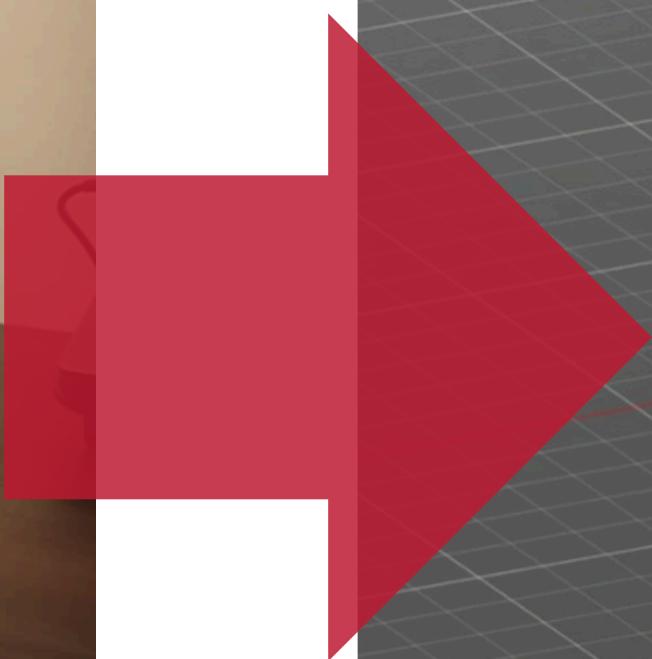
Sketch





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Enclosure Design



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Demonstration

1. Power **on** the device.
 2. Enter the **required medicine volume**.
 3. Set the **duration** that we want to pass the medicine.
 4. **Adjust the IV set** until the displayed drop rate (DPM) matches the required value.
 - After displaying the target DPM, the device will **remain silent for 5 minutes** to allow the nurse sufficient time to set the drip rate (no alarms during this period)
5. Alarm Indication Protocol:
- If the drop rate deviates from the set value:
 - Ignore deviations for the **first 5 seconds (no alarm)**.
 - If deviation persists beyond 5 seconds, activate an **alert alarm for 3 seconds**.
 - After the alert, the device **waits silently to observe if the drop rate corrects itself**.
 - If the deviation continues for 10 seconds, the device activates a **continuous alarm until the drop rate is corrected**.



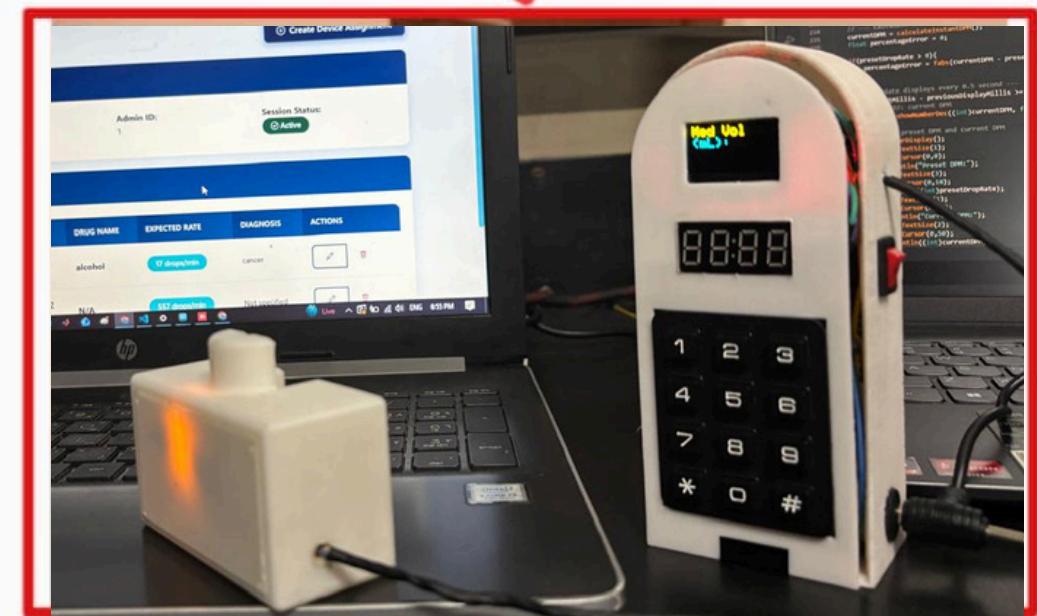
UNIQUENESS OF INFUCARE MVP

Simple Gravity
Based pump



External display ✗
Rate Deviation alarm ✗
Affordability ✓
Reliability ✗
IOT Monitoring ✗

Infucare
(MVP)



External display ✓
Rate Deviation alarm ✓
Unit Cost < Rs. 10000
Affordability ✓
Reliability ✓
IOT Monitoring ✓

Advanced Infusion
Pumps



External display ✓
Rate Deviation alarm ✓
Unit cost > Rs. 20000
Affordability ✗
Reliability ✓
IOT Monitoring ✗



UNIQUENESS OF INFUCARE MVP

Simple Gravity
Based pump



External display ✗

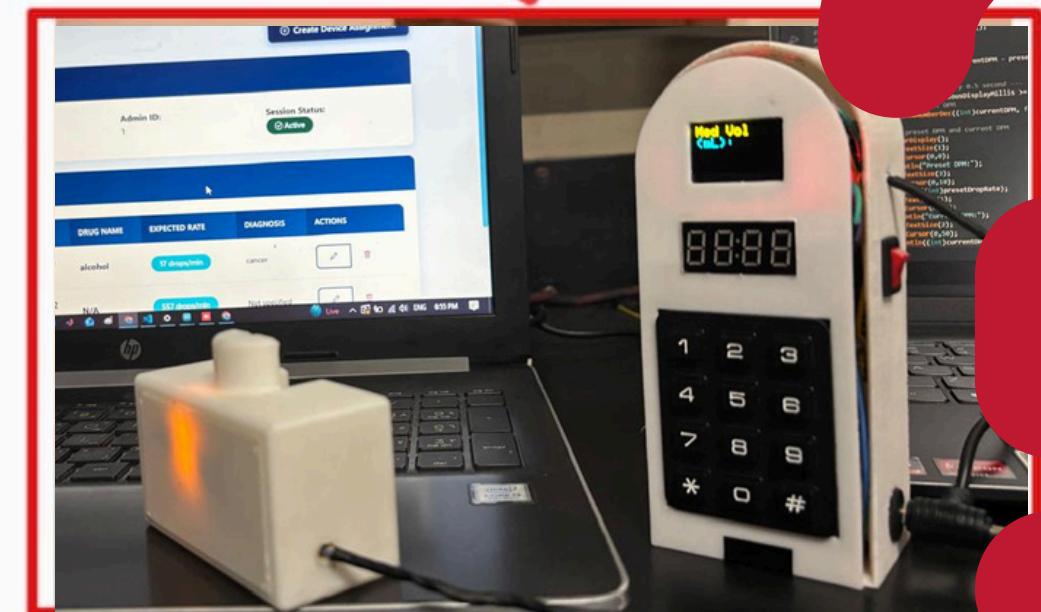
Rate Deviation alarm ✗

Affordability ✗

Reliability

IOT

Infucare
(MVP)



External display ✓

Rate Deviation alarm ✓

Unit Cost < Rs. 10000

Advanced Infusion
Pumps



External display ✓

Unit cost > Rs. 200000

What features cause the Rs. 190 000 difference per unit?

Does low-cost reduce the efficiency of Infucare?

INFUCARE UNBEATABLE COST ADVANTAGE

	INFUCARE INFUSION PUMP	ADVANCED INFUSION PUMPS																								
IMPLEMENTATION COST PER UNIT	<p>Cost Per Unit (Bulk Production) +100 Units</p> <table border="1"> <thead> <tr> <th>Expenses</th><th>Amount per Item</th></tr> </thead> <tbody> <tr> <td>Component Cost (30-50% decrement)- 40% off</td><td>4790 x 0.60</td></tr> <tr> <td>Batch 3D printing (+100)</td><td>800-1400</td></tr> <tr> <td>PCB Print (+100)</td><td>300 - 600</td></tr> <tr> <td>Manufacturing and Assembly cost (+100) (soldering, wiring etc.)</td><td>400- 600</td></tr> <tr> <td>Packaging and Logistics (Box, Cushioning, labelling etc.)</td><td>300 -500</td></tr> <tr> <td>Cost per unit</td><td>5324</td></tr> <tr> <td>Software Implementation - One time Software Licence Fee</td><td>1500</td></tr> <tr> <td>Marketing Sales & Operational overhead (10-20%) - 15%</td><td>5324 x 0.15</td></tr> <tr> <td>Profit Margin (15-40%) - 20% Profit</td><td>(5324 + 799) x 0.2</td></tr> <tr> <td>Estimated Total Price per unit</td><td>8850</td></tr> <tr> <td colspan="2">TOTAL UNIT PRICE = Rs. 8850 .00</td></tr> </tbody> </table>	Expenses	Amount per Item	Component Cost (30-50% decrement)- 40% off	4790 x 0.60	Batch 3D printing (+100)	800-1400	PCB Print (+100)	300 - 600	Manufacturing and Assembly cost (+100) (soldering, wiring etc.)	400- 600	Packaging and Logistics (Box, Cushioning, labelling etc.)	300 -500	Cost per unit	5324	Software Implementation - One time Software Licence Fee	1500	Marketing Sales & Operational overhead (10-20%) - 15%	5324 x 0.15	Profit Margin (15-40%) - 20% Profit	(5324 + 799) x 0.2	Estimated Total Price per unit	8850	TOTAL UNIT PRICE = Rs. 8850 .00		<p>Greater than Rs. 200000.00</p> <p>NOT AFFORDABLE !</p>
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IMPLEMENTATION COST PER WARD OF 25 BEDS	<p>Rs. 8850 x 25 = Rs. 221 250.00</p> <p>Savings by implementing Infucare over advanced pumps: 55.75 %</p>	<p>Rs. 200000 x 25 = Rs. 5000000.00</p>																								

DOUBLE COST EFFICIENCY FOR INVESTORS!!



INFUCARE GO-TO-MARKET STRATEGY

1. Regulatory Approval Pathway

STEP 1

Submitting documents to obtain the **ethical clearance from the University Ethics Review Committee, University of Moratuwa** (<https://uom.lk/uerc>) to perform initial clinical trials.

STEP 2

Submitting documents to obtain the **clearance from the National Medicines Regulatory Authority (NMRA)**, the responsible body for the regulation and control of registration, licensing, manufacture, importation and all other aspects pertaining to medical devices in Sri Lanka to further continue clinical trials.

FDA Class II
non-invasive and thus require to perform as expected and will not cause injury or harm to their users
Low-moderate risk device
Classification systems for notified medical devices in India (www.icac.in)



INFUCARE GO-TO-MARKET STRATEGY

2. strategic partnerships with hospitals and local manufacturers to accelerate regulatory approval and market entry.

Landscape of the Market	Market segmentation	Target market	Nature of competitors
<p>In Sri Lanka, IV therapy is one of the most common treatments used in hospitals. Almost every type of patient depends on IV fluids, from cancer patients to those in ICUs and after surgery. But proper IV fluid regulators are very limited. For example, at Apeksha Hospital, which is the main cancer hospital, there are only about four infusion pumps available for more than forty beds in a ward. In rural hospitals, many patients are treated only with simple gravity-based IV sets that are not accurate.</p> <p>This shows a big gap between the need and the available solutions. With the number of patients increasing every year due to cancer, heart disease, diabetes, and surgeries, the demand for a reliable but low-cost regulator will keep growing.</p>	<p>From the hospital side, there are three main levels: large national hospitals like Colombo and Kandy that handle thousands of patients, regional hospitals that serve smaller cities, and rural hospitals where facilities are very basic. From the economic side, private hospitals can afford expensive devices, but government hospitals, which treat the largest number of patients, cannot.</p> <p>This means that even though private hospitals are able to buy costly infusion pumps, the real need is in government and rural hospitals where patients depend only on basic IV sets.</p>	<p>The main target is government hospitals because they have the highest patient load and the biggest need. They struggle the most with having too few regulators and too many patients. The second target is private hospitals. The third important target is rural hospitals that do not have improved IV regulators at all. Introducing even a basic affordable system will make a big difference in safety for patients and reduce stress on staff who are already overloaded.</p>	<p>Advanced IV fluid regulation systems are not affordable to the local hospital system.</p> <p>At the moment, no one is providing a low-cost but reliable IV regulator made for the Sri Lankan context. This creates a clear space in the market that our solution can fill.</p>



In future developments, the system will be enhanced by enabling ESP32-to-ESP32 communication within each hospital ward. This will allow the creation of a **local LED indicator network connecting all infusion setups in the ward**. Each bed will have a dedicated LED indicator that reflects the current drip status – normal, deviating, or alarm – in real time.

This offline communication model will ensure that the monitoring and alert **functions remain fully operational even if internet connectivity fails, making the system highly suitable for rural hospitals and low-resource environments** where reliable internet access cannot be guaranteed.

References

- [1] O. Hoffman and O. Bacon, “Infusion Pumps,” in Making Healthcare Safer III: A Critical Analysis of Existing and Emerging Patient Safety Practices, K. K. Hall, S. Shoemaker-Hunt, L. Hoffman, et al., Eds. Rockville, MD, USA: Agency for Healthcare Research and Quality (US), Mar. 2020. [Online]. Available: <https://www.ncbi.nlm.nih.gov/books/NBK555506/>
- [2] B. Jung, K. S. Seo, S. J. Kwon, K. Lee, S. Hong, H. Seo, G. Y. Kim, G. M. Park, J. Jeong, and S. Seo, “Efficacy evaluation of syringe pump developed for continuous drug infusion,” *J. Dent. Anesth. Pain Med.*, vol. 16, no. 4, pp. 303–307, Dec. 2016. doi: 10.17245/jdapm.2016.16.4.303. PMID: 28879319; PMCID: PMC5564196. [Online]. Available: <https://pmc.ncbi.nlm.nih.gov/articles/PMC5564196/>

INFUCARE GO-TO-MARKET STRATEGY

THANK YOU
Q & A



INFUCARE

More Lives. Less Cost.