Project Proposal CITS5506: Internet of Things
To be submitted by 11:59 pm on Thursday, 31 August 2023

1. **Name of Project:**

   Smart Saline/IV Bag Monitoring and Alert System.

2. **Group Number, Names and Student Numbers of team members:**

Group # 19	
Adharsh Sundaram Soudakar	23796349
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3. **Why ……. Why do you want to do this project? What benefit will your project bring?**

   Hospital attendants' jobs are very demanding. They must assist patients with their everyday needs. This tough job requires a lot of energy and concentration that is crucial to a zero-error work environment. A mistake in the medical field could be minor or severe, depending on the case. Our idea, Smart Saline/IV bag Monitoring and Alert System, could help the hospital attendants reduce their workload by potentially eliminating their duty to continuously monitor or check in regular intervals the Saline/IV bags. Also, the time spent checking could be used for other duties which could improve patient care. Furthermore, this importantly eliminates the risk of an empty IV bag which could result in patients' discomfort.

   The Smart Saline/IV Bag Monitoring and Alert System project brings numerous benefits to healthcare settings and patients:

   Patient Safety: Detects IV bag anomalies like leaks and empty bags, that could disrupt the fluid flow through the catheter into the patient, causing blood pool around the catheter, enhancing patient safety.

   Real-time Alerts: Provides instant alerts to healthcare staff, ensuring quick response to issues.

   Error Reduction: Manual checks of IV bags can introduce human errors. This can be minimized, leading to more accurate therapy.

   Resource Efficiency: As the IV bag is continuously monitored, IV fluid wastage (leaks for example) can be detected thereby optimizing resource utilization and saving costs.

   Workflow Improvement: Frees up healthcare providers' time from manual checks for better patient care. This could potentially improve the attendant’s mental.

Remote Monitoring: Possible remote monitoring, useful for home-based or remote treatments.

Patient Satisfaction: Builds patient trust and satisfaction through continuous monitoring.

Professional Support: Assists healthcare providers with reliable information for better care.

Innovation: Highlights innovation in healthcare technology for improved healthcare and patient outcomes.

4. **What ……What is the problem you will solve? What benefit will your solution bring? What is its impact (How big will the impact for example in terms of numbers of people, financial etc.?)**

The Smart Saline/IV Bag Monitoring and Alert System aims to address several critical challenges in healthcare settings:

Problem to Solve:

Patient Safety Risk: Current manual IV bag monitoring processes can lead to overlooked issues like leaks or empty bags, risking patient safety.

Resource Inefficiency: Wastage of IV fluids due to undetected leaks or empty bags results in unnecessary costs and resource inefficiency.

Workflow Inefficiency: Healthcare providers spend valuable time on manual checks that could be better utilized for patient care.

Benefits and Impact:

Enhanced Patient Safety: By promptly detecting anomalies and alerting healthcare providers, the system significantly reduces the risk of adverse events and improves patient safety.

Cost Savings: Prevention of IV fluid wastage translates into substantial cost savings for healthcare facilities, making resource utilization more efficient.

Efficient Workflow: Automated monitoring liberates healthcare providers from manual checks, allowing them to dedicate more time to patient care and other critical tasks.

Data-Driven Insights: The system's data collection and analysis provide insights that empower informed decisions, optimizing IV fluid management strategies.

Patient Satisfaction: Continuous monitoring instils patient confidence and satisfaction, contributing to better overall healthcare experiences.

Potential Impact: The impact of the Smart Saline/IV Bag Monitoring and Alert System could be significant, affecting multiple aspects:

Patient Safety: Potentially prevents complications for countless patients receiving IV therapy.

Financial Savings: Reduces costs related to IV fluid wastage and enhances resource utilization in healthcare facilities.

Workflow Efficiency: Frees up healthcare providers' time, which collectively could translate into increased patient care capacity.

Innovation Influence: Sets a precedent for integrating technology in healthcare, encouraging further innovation in the field.

The exact quantitative impact depends on several factors like system adoption rate, the size of healthcare facilities using the system, and the prevalence of IV therapy cases.

However, its potential to improve patient safety, optimize resources, and streamline workflows suggests a substantial positive impact on both patient outcomes and operational efficiency.

5. How ……. How you will do it. Explain your methodology (step by step process).

Step1. Identifying and procuring the required materials and tools:

The initial step would be to identify the sensors, apps, modules, and tools required to build the prototype. We have done research through various modes such as websites, forums, published papers etc. The identification part is done, as this is a crucial step to complete this proposal.

Step 2. Design of the prototype:

Next step would be to understand how each components work and build a circuit design that is optimal and efficient. This requires understanding the specifications of each component and how the components communicate with each other, the connection type etc. Once the circuit design is complete, the structure/ design of the prototype should be decided.

Step 3. Build the prototype’s circuit and frame:

After finalising the design, we proceed to build (connect) the circuit and the structure that holds it. Before connecting the components, we will test the components individually to ensure that they work as intended. On the side, we will build the skeleton/frame that holds all the parts (the circuit, IV bag, etc.) together. This step does not produce the final prototype as before fixing all the parts to the skeleton, we

will test the parts individually and connected as well (Fixing the parts to the skeleton would only be done after integrating all the parts together and testing them against the ground truth, this involves the software side as well).

Step 4. Adding Relevant Libraries to Arduino IDE and write the required code:

The sensors chosen may require certain libraries that will ease our work (for e.g., calibrating the sensor). For example, one our sensor, load cell, which will be used to measure the weight of the IV bag, requires an ADC/amplifier (HX711). This amplifier and the load cell require calibration, but this is readily available as libraries. Once we have identified the libraries and added them, we will work on the code, which will be the backbone of the prototype's functionality.

Step 5. Upload the Code and test the circuit:

Having written the code, the next step would be to upload the code to Arduino and testing the functionality of the circuit, whether it works as it should under different cases. Once this step is achieved, we will integrate the parts of the prototype together and complete the physical side of things.

Step 6: Create a Mobile App for notifications:

Completing the physical side of the prototype, we will work on creating a mobile app that will work on the data transmitted by the prototype and perform some analysis which will help the user to take appropriate actions. This also involves notifying the user of any emergency.

Step 7. Connecting with Mobile App:

Following the mobile app creation will be establishing a connection between the prototype and the device that runs the mobile app so that the data transmitted is received by the mobile device, readily available for the app to work on it. If this step is successfully completed, it means that the complete prototype has been built.

Step 8. Testing:

Finally, one of the most important steps, testing the prototype. This will involve various conditions, places, and scenarios. Completing this step denotes the end of the project.

6. What will be the functionality of your software?

Device Connection**:** The app can connect to the IoT devices and provide configuration options so that users can connect to the correct device.

Real Time Monitoring of Drip Information**:** The app should provide real time drip information. The information should include details such as the volume of fluid, patients' names, the kind of fluid etc.

Percentage Consumed Display**:** The app should calculate and display the percentage of IV fluid consumed, allowing users (nurses) to assess consumption of fluid.

IV Bag's Information Display**:** The app can record different patients' IV bags and display relevant information. This might require the input or identification of patient information and their IV bags.

Alert Function: The app should have an alert system to inform nurses when the fluid of IV bag is at a low level. Alerts can be delivered through notifications.

Data storage**:** The app can keep a history of IV bags. It can help healthcare providers review patients' drip history.

7. Hardware required (Each group has $50 budget for the items (not including costs of Raspberry Pi, Arduino, Breadboards, LCD, and sensors available in Arduino kits). Due to existing circumstances, you should choose items from Jaycar and Altronics.

S.No	Items Description	Available at UWA (Y/N)	Cost	Web address	Delivery Time
01	Arduino UNO R3	Y	-	https://www.altronics.com.au/p/z6240-funduino-uno-r3-compatible-development-board/	-
02	Strain Gauge Load Cell 5kg	N	18	https://www.auselectronicsdirect.com.au/5kg-load-cell-weight-sensor-module-for-electronic?gclid=Cj0KCQjwi7GnBhDXARIsAFLvH4m4a62I0p0rr577Xm_gjRdCve9_kwBW75X3VuBQFhnwA3QYLXUZwrIaAmHOEALw_wcB	5-7 Business Days

03	Load cell ADC HX711	N	13	https://www.auselectronicsdirect.com.au/load-cell-amplifier-module-hx711-for-arduino-proje	5-7 Business Days
04	ESP8266 Mini Wi-Fi Breakout Module	Y	-	https://www.altronics.com.au/p/z6360-esp8266-esp01-mini-wifi-breakout-module/	-
05	16 x 2 LCD Display	Y	-	https://core-electronics.com.au/assembled-standard-lcd-16x2-extras-white-on-blue.html	-
06	Bread Board	Y	-	https://core-electronics.com.au/solderless-breadboard-830-tie-point-zy-102.html	-
07	Sofa leg	N	4.98	https://www.bunnings.com.au/adoored-150mm-pine-round-furniture-leg_p0225589	Available in Bunnings, (East Victoria Park)
08	Miscellaneous (Bolts, Nuts, Screws...)	N	10	-	Available in Bunnings (East Victoria Park)

8. An initial Distribution of Work among students by mutual discussion (You can change this distribution during the project, as per strengths of the members)

Name of Student	Work Assigned
Adharsh Sundaram Soudakar	Circuit Design and Hardware Construction
Warren Wang	Hardware Construction and Testing
Yuxiao Shi	Circuit/App Coding
Zhiyang Cai	Circuit/App Coding

9. References (What research you have done while choosing this project).

References through papers/publications:

[1] R. Su, Z. Cai, X. Wei, and W. Wang," Design of an Intelligent Intravenous Infusion Monitoring System Based on IoT," Journal of Sensors, vol. 2018, Article ID 3961016, 7 pages, 2018.https://doi.org/10.1155/2018/3961016.

[2] M. Abdelhafez, A. Elsheikh, S. Khalil, and W. I. Khedr," A Novel Real-time Intravenous Infusion Monitoring System for Hospitalized Patients," Journal of Medical Systems, vol. 42, no. 8, pp. 141-149, 2018.

[3] K. Kumari and P. Kumar," IoT Based IV Drip Monitoring and Alerting System," International Journal of Innovative Research in Science, Engineering and Technology, vol. 8, no. 1, pp. 143-146, 2019.
[4] P. Kumar, P. Kumar, R. Gupta, and A. Mittal," Smart IV Drip Monitoring System Using IoT," International Journal of Engineering Technology, vol. 7, no. 2.26, pp. 33-37, 2018.

[5] J. A. Su´arez-Canedo, L. Casal-Garc´ıa, J. R. Casar-Corredera, J. C.´Alvarez-Santos, and J. R. P´erez-Blanco," Smart Intravenous Drip Control System with Automatic Notification," Journal of Medical Systems, vol. 42, no. 10, pp.1-11, 2018.

[6] Y. Qiu, Y. Yao, and D. Lin," Design and Implementation of an Intravenous Drip Monitoring System Based on RFID," Journal of Medical Systems, vol. 40, no. 11, pp. 237-243, 2016.

Links:

https://www.electronicwings.com/users/SyedAshhad/projects/2343/design-of-iot-based-iv-bag-monitoring-system

https://youtu.be/XmAJm2F2zG8?si=XOKf3BWXU7KBRYJq